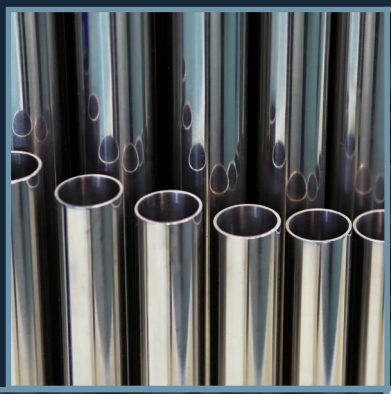
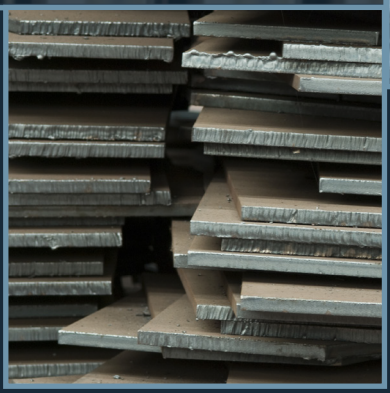




ASTM INTERNATIONAL
DS67D

# Handbook of Comparative World Steel Standards

5th Edition

John E. Bringas, Editor

ASTM AFNOR API ASME BSI CSA DIN EN GB ISO JIS SAE

ASTM INTERNATIONAL

John E. Bringas, Editor

# Handbook of Comparative World Steel Standards—5th Edition

ASTM Stock No. DS67D

ASTM International
100 Barr Harbor Drive
PO Box C700
West Conshohocken, PA 19428-2959

Printed in the U.S.A.

Library of Congress Cataloging-in-Publication Data
Names: Bringas, John E , 1953-
Title: Handbook of comparative world steel standards / John E Bringas, editor
Description: Fifth edition | West Conshohocken, PA : ASTM International, [2016] | "ASTM Stock No : DS67D " | Includes bibliographical references and index
Identifiers: LCCN 2015042235 | ISBN 9780803170773 (alk. paper)
Subjects: LCSH: Steel—Standards—Handbooks, manuals, etc | Steel alloys—Standards—Handbooks, manuals, etc
Classification: LCC TA472 .H25 2016 | DDC 620.1/70218 dc22 LC record available at http://lccn.loc.gov/2015042235

Copyright © 2016 ASTM International, West Conshohocken, PA All rights reserved This material may not be reproduced or copied, in whole or in part, in any printed, mechanical electronic, film, or other distribution and storage media, without the written consent of the publisher.

**Photocopy Rights**

Authorization to photocopy items for internal, personal, or educational classroom use, or the internal personal, or education classroom use of specific clients, is granted by the American Society for Testing and Materials (ASTM International) provided that the appropriate fee is paid to the Copyright Clearance Center, 222 Rosewood Drive, Danvers, MA 01923; Tel: 978-750-8400; online: http://www.copyright.com/

Mayfield, PA
March, 2016

# Table of Contents


Preface 1

Acknowledgments 3

Getting Started with This Book 5

1. Introduction to Comparing World Steel Standards 7

- Myth and Methodology When Comparing Steel Standards 8
- Comparative and Closest Match 8
- Organization 10
  - Definitions of Steel Terms 10
- Cautionary Note 12
- Questions Regarding the Rules of Comparison 12
- Noncomparable Steels 12
- Criteria for Comparing Steels 12
- List of Comparison Rules 13
- Brief Introduction to Steel Standards and Designation Systems 14
- ASTM Designation System 14
- ASTM Referenced Standards and Supplementary Requirements 15
- SAE Designation System and Related AISI Designation System 15
- UNS Designation System 16
- Canadian Standards Association (CSA) 16
- Introduction to European (EN) Standard Steel Designation System 16
- EN 10027 Standard Designation System for Steels 17
- Steel Names 17
- Numerical System 17
- Former National Standards Superseded by CEN Standards 17
- Indexes in this Handbook 17

2. Carbon and Alloy Steels for General Use 19

- 2.1 Chemical Composition of Carbon Steels for General Use 21
- 2.2 Chemical Composition of High Manganese Carbon Steels for General Use 34
- 2.3 Chemical Composition of Alloy Steels for General Use 36

2.3.1 Chromium (Cr) Steels 36
2.3.2 Chromium Molybdenum (Cr Mo) Steels 39
2.3.3 Chromium Nickel (Cr Ni) Steels 41
2.3.4 Nickel Chromium Molybdenum (Ni Cr Mo) Steels 42
2.3.5 Chromium Molybdenum Aluminum (Cr Mo Al) Steels 43
2.3.6 Boron (B) Steels 44
2.3.7 Chromium Vanadium (Cr V) Steels 45
3. Structural Steel Plates 47
3.1 Carbon Steels for Structural Steel Plates 51
3.1A Mechanical Properties of Carbon Steels for Structural Steel Plates 51
3.1B Chemical Composition of Carbon Steels for Structural Steel Plates 66
3.2 Alloy Steels for Structural Steel Plates 74
3.2.1A Mechanical Properties of High Strength Low Alloy Structural Steel Plates 74
3.2.1B Chemical Composition of High Strength Low Alloy Structural Steel Plates 80
3.2.2A Mechanical Properties of Alloy Steels for Structural Steel Plates 85
3.2.2B Chemical Composition of Alloy Steels for Structural Steel Plates 92
3.3 Structural Steels with Improved Atmospheric Corrosion Resistance 97
3.3A Mechanical Properties of Structural Steels with Improved Atmospheric Corrosion Resistance 97
3.3B Chemical Composition of Structural Steels with Improved Atmospheric Corrosion Resistance 103
4. Pressure Vessel Steel Plates 107
4.1 Carbon Steels for Pressure Vessel Plates 112
4.1A Mechanical Properties of Carbon Steels for Pressure Vessel Plates 112
4.1B Chemical Composition of Carbon Steels for Pressure Vessel Plates 120
4.2 Carbon Steels for Pressure Vessel Plates With Impact Testing Below 20°C 128
4.2A Mechanical Properties of Carbon Steels for Pressure Vessel Plates With Impact Testing Below 20°C 128
4.2B Chemical Composition of Carbon Steels for Pressure Vessel Plates With Impact Testing Below 20°C 131
4.3 ½Mo Alloy Steels for Pressure Vessel Plates 134
4.3A Chemical Composition of ½Mo Alloy Steels for Pressure Vessel Plates 134
4.3B Mechanical Properties of ½Mo Alloy Steels for Pressure Vessel Plates 138
4.4 Cr Mo Alloy Steels for Pressure Vessel Plates 140
4.4.1A Chemical Composition of ¾Cr ½Mo Alloy Steels for Pressure Vessel Plates 140
4.4.1B Mechanical Properties of ¾Cr ½Mo Alloy Steels for Pressure Vessel Plates 140
4.4.2A Chemical Composition of 1Cr ½Mo Alloy Steels for Pressure Vessel Plates 141
4.4.2B Mechanical Properties of 1Cr ½Mo Alloy Steels for Pressure Vessel Plates 141
4.4.3A Chemical Composition of 1¼Cr ½Mo Alloy Steels for Pressure Vessel Plates 142
4.4.3B Mechanical Properties of 1¼Cr ½Mo Alloy Steels for Pressure Vessel Plates 142
4.4.4A Chemical Composition of 2¼Cr 1Mo Alloy Steels for Pressure Vessel Plates 143

4.4.4B Mechanical Properties of 2¼Cr 1Mo Alloy Steels for Pressure Vessel Plates 143
4.4.5A Chemical Composition of 3Cr 1Mo Alloy Steels for Pressure Vessel Plates 144
4.4.5B Mechanical Properties of 3Cr 1Mo Alloy Steels for Pressure Vessel Plates 144
4.4.6A Chemical Composition of 5Cr ½Mo Alloy Steels for Pressure Vessel Plates 145
4.4.6B Mechanical Properties of 5Cr ½Mo Alloy Steels for Pressure Vessel Plates 145
4.4.7A Chemical Composition of 9Cr 1Mo Alloy Steels for Pressure Vessel Plates 146
4.4.7B Mechanical Properties of 9Cr 1Mo Alloy Steels for Pressure Vessel Plates 146
4.5 Ni Alloy Steels for Pressure Vessel Plates 147
4.5.1A Chemical Composition of ½Ni Alloy Steels for Pressure Vessel Plates 147
4.5.1B Mechanical Properties of ½Ni Alloy Steels for Pressure Vessel Plates 147
4.5.2A Chemical Composition of 1½Ni Alloy Steels for Pressure Vessel Plates 148
4.5.2B Mechanical Properties of 1½Ni Alloy Steels for Pressure Vessel Plates 148
4.5.3A Chemical Composition of 2¼Ni Alloy Steels for Pressure Vessel Plates 149
4.5.3B Mechanical Properties of 2¼Ni Alloy Steels for Pressure Vessel Plates 150
4.5.4A Chemical Composition of 3½Ni Alloy Steels for Pressure Vessel Plates 151
4.5.4B Mechanical Properties of 3½Ni Alloy Steels for Pressure Vessel Plates 152
4.5.5A Chemical Composition of 5Ni Alloy Steels for Pressure Vessel Plates 153
4.5.5B Mechanical Properties of 5Ni Alloy Steels for Pressure Vessel Plates 153
4.5.6A Chemical Composition of 9Ni Alloy Steels for Pressure Vessel Plates 153
4.5.6B Mechanical Properties of 9Ni Alloy Steels for Pressure Vessel Plates 154
4.6 Ni Mo Alloy Steels for Pressure Vessel Plates 155
4.6.1A Chemical Composition of ½Ni ½Mo Alloy Steels for Pressure Vessel Plates 155
4.6.1B Mechanical Properties of ½Ni ½Mo Alloy Steels for Pressure Vessel Plates 156
4.6.2A Chemical Composition of ¾Ni ½Mo Alloy Steels for Pressure Vessel Plates 157
4.6.2B Mechanical Properties of ¾Ni ½Mo Alloy Steels for Pressure Vessel Plates 158
4.7 Ferritic and Martensitic Stainless Steels for Pressure Vessel Plates 159
4.7A Chemical Composition of Ferritic and Martensitic Stainless Steels for Pressure Vessel Plates 159
4.7B Mechanical Properties of Ferritic and Martensitic Stainless Steels for Pressure Vessel Plates 162
4. Pressure Vessel Steel Plates (Continued)
4.8 Austenitic Stainless Steels for Pressure Vessel Plates 165
4.8A Chemical Composition of Austenitic Stainless Steels for Pressure Vessel Plates 165
4.8B Mechanical Properties of Austenitic Stainless Steels for Pressure Vessel Plates 171
4.9 Duplex (Ferritic Austenitic) Stainless Steels for Pressure Vessel Plates 185
4.9A Chemical Composition of Duplex (Ferritic Austenitic) Stainless Steels for Pressure Vessel Plates 185
4.9B Mechanical Properties of Duplex (Ferritic Austenitic) Stainless Steels for Pressure Vessel Plates 186
5. Steel Tubes and Pipes 189
5.1 Carbon Steel Tubes for General and Structural Applications 198

5.1A Mechanical Properties of Carbon Steel Tubes for General and Structural Applications 198
5.1B Chemical Composition of Carbon Steel Tubes for General and Structural Applications 213
5.2 Alloy Steel Tubes for General and Structural Applications 224
5.2A Chemical Composition of Alloy Steel Tubes for General and Structural Applications 224
5.2B Mechanical Properties of Alloy Steel Tubes for General and Structural Applications 225
5.3 Stainless Steel Tubes for General and Structural Applications 227
5.3.1A Chemical Composition of Ferritic and Martensitic Stainless Steel Tubes for General and Structural Applications 227
5.3.1B Mechanical Properties of Ferritic and Martensitic Stainless Steel Tubes for General and Structural Applications 228
5.3.2A Chemical Composition of Austenitic Stainless Steel Tubes for General and Structural Applications 232
5.3.2B Mechanical Properties of Austenitic Stainless Steel Tubes for General and Structural Applications 235
5.3.3A Chemical Composition of Duplex Stainless Steel Tubes and Pipes for General and Structural Applications 243
5.3.3B Mechanical Properties of Duplex Stainless Steel Tubes and Pipes for General and Structural Applications 244
5.4 Carbon Steel Tubes and Pipes for Low Temperature Service 246
5.4A Mechanical Properties of Carbon Steel Tubes and Pipes With Impact Testing Below 20°C 246
5.4B Chemical Composition of Carbon Steel Tubes and Pipes With Impact Testing Below 20°C 249
5.5 Alloy Steel Tubes and Pipes for Low-Temperature Service 251
5.5A Chemical Composition of Alloy Steel Tubes and Pipes for Low-Temperature Service 251
5.5B Mechanical Properties of Alloy Steel Tubes and Pipes for Low-Temperature Service 252
5.6 Carbon Steel Tubes and Pipes for Pressure Purposes 255
5.6A Mechanical Properties of Carbon Steel Tubes and Pipes for Pressure Purposes 255
5.6B Chemical Composition of Carbon Steel Tubes and Pipes for Pressure Purposes 258
5.7 Carbon Steel Tubes and Pipes for Pressure Purposes at High Temperatures 260
5.7A Mechanical Properties of Carbon Steel Tubes and Pipes for Pressure Purposes at High Temperatures 260
5.7B Chemical Composition of Carbon Steel Tubes and Pipes for Pressure Purposes at High Temperatures 264
5.8 Alloy Steel Tubes and Pipes for Pressure Purposes at High Temperatures 267
5.8.1A Chemical Composition of ¼Mo Alloy Steel Tubes and Pipes for Pressure Purposes at High Temperatures 267
5.8.1B Mechanical Properties of ¼Mo Alloy Steel Tubes and Pipes for Pressure Purposes at High Temperatures 267
5.8.2A Chemical Composition of ½Mo Alloy Steel Tubes and Pipes for Pressure Purposes at High Temperatures 268
5.8.2B Mechanical Properties of ½Mo Alloy Steel Tubes and Pipes for Pressure Purposes at High Temperatures 269

5.8.3A Chemical Composition of ½Cr ½Mo Alloy Steel Tubes and Pipes for Pressure Purposes at High Temperatures 271

5.8.3B Mechanical Properties of ½Cr ½Mo Alloy Steel Tubes and Pipes for Pressure Purposes at High Temperatures 272

5.8.4A Chemical Composition of ½Cr 1Mo Alloy Steel Tubes and Pipes for Pressure Purposes at High Temperatures 273

5.8.4B Mechanical Properties of ½Cr 1Mo Alloy Steel Tubes and Pipes for Pressure Purposes at High Temperatures 273

5.8.5A Chemical Composition of 1Cr ½Mo Alloy Steel Tubes and Pipes for Pressure Purposes at High Temperatures 274

5.8.5B Mechanical Properties of 1Cr ½Mo Alloy Steel Tubes and Pipes for Pressure Purposes at High Temperatures 275

5.8.6A Chemical Composition of 1¼Cr ½Mo Alloy Steel Tubes and Pipes for Pressure Purposes at High Temperatures 276

5.8.6B Mechanical Properties of 1¼Cr ½Mo Alloy Steel Tubes and Pipes for Pressure Purposes at High Temperatures 277

5.8.7A Chemical Composition of 2¼Cr 1Mo Alloy Steel Tubes and Pipes for Pressure Purposes at High Temperatures 278

5.8.7B Mechanical Properties of 2¼Cr 1Mo Alloy Steel Tubes and Pipes for Pressure Purposes at High Temperatures 279

5.8.8A Chemical Composition of 5Cr ½Mo Alloy Steel Tubes and Pipes for Pressure Purposes at High Temperatures 280

5.8.8B Mechanical Properties of 5Cr ½Mo Alloy Steel Tubes and Pipes for Pressure Purposes at High Temperatures 281

5.8.9A Chemical Composition of 9Cr 1Mo Alloy Steel Tubes and Pipes for Pressure Purposes at High Temperatures 283

5.8.9B Mechanical Properties of 9Cr 1Mo Alloy Steel Tubes and Pipes for Pressure Purposes at High Temperatures 284

5.9 Stainless Steel Tubes and Pipes for Pressure Purposes and High Temperatures 286

5.9.1A Chemical Composition of Ferritic and Martensitic Stainless Steel Tubes and Pipes for Pressure Purposes and High Temperatures 286

5.9.1B Mechanical Properties of Ferritic and Martensitic Stainless Steel Tubes and Pipes for Pressure Purposes and High Temperatures 287

5.9.2A Chemical Composition of Austenitic Stainless Steel Tubes and Pipes for Pressure Purposes and High Temperatures 288

5.9.2B Mechanical Properties of Austenitic Stainless Steel Tubes and Pipes for Pressure Purposes and High Temperatures 298

5.10 Line Pipe Steels 316

5.10.1A Mechanical Properties of Line Pipe Steels Without Notch Toughness Requirements 316

5.10.1B Chemical Composition of Line Pipe Steels Without Notch Toughness Requirements 318

5.10.2A Mechanical Properties of Line Pipe Steels With Notch Toughness Requirements 321

5.10.2B Chemical Composition of Line Pipe Steels With Notch Toughness Requirements 324

6. Steel Forgings 329

6.1 Carbon Steel Forgings 333
6.1.1A Mechanical Properties of Carbon Steel Forgings for General Use 333
6.1.1B Chemical Composition of Carbon Steel Forgings for General Use 339
6.1.2A Mechanical Properties of Carbon Steel Forgings for Piping, Pressure Vessel, and Components 341
6.1.2B Chemical Composition of Carbon Steel Forgings for Piping, Pressure Vessel and Components 344
6.2 Alloy Steel Forgings 347
6.2.1A Chemical Composition of 1¼Cr ¼Mo Alloy Steel Forgings for General Use 347
6.2.1B Mechanical Properties of 1¼Cr ¼Mo Alloy Steel Forgings for General Use 347
6.2.2 Alloy Steel Forgings for Piping, Pressure Vessel and Components 348
6.2.2.1A Chemical Composition of Mo Alloy Steel Forgings for Piping, Pressure Vessel and Components 348
6.2.2.1B Mechanical Properties of Mo Alloy Steel Forgings for Piping, Pressure Vessel and Components 348
6.2.2.2A Chemical Composition of ½Cr ½Mo Alloy Steel Forgings for Piping, Pressure Vessel and Components 349
6.2.2.2B Mechanical Properties of ½Cr ½Mo Alloy Steel Forgings for Piping, Pressure Vessel and Components 349
6.2.2.3A Chemical Composition of 1Cr ½Mo Alloy Steel Forgings for Piping, Pressure Vessel and Components 350
6.2.2.3B Mechanical Properties of 1Cr ½Mo Alloy Steel Forgings for Piping, Pressure Vessel and Components 350
6.2.2.4A Chemical Composition of 1¼Cr ½Mo Alloy Steel Forgings for Piping, Pressure Vessel and Components 351
6.2.2.4B Mechanical Properties of 1¼Cr ½Mo Alloy Steel Forgings for Piping, Pressure Vessel and Components 351
6.2.2.5A Chemical Composition of 2¼Cr 1Mo Alloy Steel Forgings for Piping, Pressure Vessel and Components 352
6.2.2.5B Mechanical Properties of 2¼Cr 1Mo Alloy Steel Forgings for Piping, Pressure Vessel and Components 353
6.2.2.6A Chemical Composition of 3Cr-1Mo Alloy Steel Forgings for Piping, Pressure Vessel and Components 354
6.2.2.6B Mechanical Properties of 3Cr-1Mo Alloy Steel Forgings for Piping, Pressure Vessel and Components 354
6.2.2.7A Chemical Composition of 5Cr ½Mo Alloy Steel Forgings for Piping, Pressure Vessel and Components 355
6.2.2.7B Mechanical Properties of 5Cr ½Mo Alloy Steel Forgings for Piping, Pressure Vessel and Components 356
6.2.2.8A Chemical Composition of 9Cr 1Mo Alloy Steel Forgings for Piping, Pressure Vessel and Components 356
6.2.2.8B Mechanical Properties of 9Cr 1Mo Alloy Steel Forgings for Piping, Pressure Vessel and Components 356

6.2.2.9A Chemical Composition of 11Cr ½Ni 1Mo Alloy Steel Forgings for Piping, Pressure Vessel and Components 357
6.2.2.9B Mechanical Properties of 11Cr ½Ni 1Mo Alloy Steel Forgings for Piping, Pressure Vessel and Components 357
6.2.2.10A Chemical Composition of Ni Alloy Steel Forgings for Piping, Pressure Vessel and Components 357
6.2.2.10B Mechanical Properties of Ni Alloy Steel Forgings for Piping, Pressure Vessel and Components 358
6.2.2.11A Chemical Composition of Ni-Mn Alloy Steel Forgings for Piping, Pressure Vessel and Components 359
6.2.2.11B Mechanical Properties of Ni-Mn Alloy Steel Forgings for Piping, Pressure Vessel and Components 359
6.2.2.12A Chemical Composition of ¾Ni ½Cr Mo Alloy Steel Forgings for Piping, Pressure Vessel and Components 361
6.2.2.12B Mechanical Properties of ¾Ni ½Cr Mo Alloy Steel Forgings for Piping, Pressure Vessel and Components 361
6.2.2.13A Chemical Composition of ¾Ni ½Mo Alloy Steel Forgings for Piping, Pressure Vessel and Components 362
6.2.2.13B Mechanical Properties of ¾Ni ½Mo Alloy Steel Forgings for Piping, Pressure Vessel and Components 362
6.2.2.14A Chemical Composition of 3¼Ni 1¾Cr ½Mo Alloy Steel Forgings for Piping, Pressure Vessel and Components 363
6.2.2.14B Mechanical Properties of 3¼Ni 1¾Cr ½Mo Alloy Steel Forgings for Piping, Pressure Vessel and Components 363
6.3 Stainless Steel Forgings 364
6.3.1A Chemical Composition of Martensitic Stainless Steel Forgings 364
6.3.1B Mechanical Properties of Martensitic Stainless Steel Forgings 365
6.3.2A Chemical Composition of Ferritic Stainless Steel Forgings 366
6.3.2B Mechanical Properties of Ferritic Stainless Steel Forgings 366
6.3.3A Chemical Composition of Austenitic Stainless Steel Forgings 367
6.3.3B Mechanical Properties of Austenitic Stainless Steel Forgings 373
6.3.4A Chemical Composition of Precipitation Hardening Stainless Steel Forgings 379
6.3.4B Mechanical Properties of Precipitation Hardening Stainless Steel Forgings 380
6.3.5A Chemical Composition of Duplex (Ferritic Austenitic) Stainless Steel Forgings 381
6.3.5B Mechanical Properties of Duplex (Ferritic Austenitic) Stainless Steel Forgings 383
7. Steel Castings 385
7.1 Cast Carbon Steels 389
7.1.1A Mechanical Properties of Cast Carbon Steel for General and Structural Applications 389
7.1.1B Chemical Composition of Cast Carbon Steel for General and Structural Applications 392
7.1.2A Mechanical Properties of Cast Carbon Steel for Pressure Purposes at High Temperatures 396

7.1.2B Chemical Composition of Cast Carbon Steel for Pressure Purposes at High Temperatures 397
7.1.3A Mechanical Properties of Cast Carbon Steel for Pressure Purposes at Low Temperatures 398
7.1.3B Chemical Composition of Cast Carbon Steel for Pressure Purposes at Low Temperatures 399
7.2 Cast Manganese Steels 400
7.2A Chemical Composition of Cast Manganese Steels 400
7.2B Mechanical Properties of Cast Manganese Steels 401
7.3 Cast Alloy Steels 402
7.3.1A Chemical Composition of Cast Alloy Steels for General and Structural Purposes 402
7.3.1B Mechanical Properties of Cast Alloy Steels for General and Structural Purposes 403
7.3.2A Chemical Composition of Cast Alloy Steels for Pressure Purposes at High Temperatures 406
7.3.2B Mechanical Properties of Cast Alloy Steels for Pressure Purposes at High Temperatures 407
7.3.3A Chemical Composition of Cast Alloy Steels for Pressure Purposes at Low Temperatures 409
7.3.3B Mechanical Properties of Cast Alloy Steels for Pressure Purposes at Low Temperatures 411
7.4 Cast Stainless Steels 413
7.4.1 Cast Stainless Steels for General and Corrosion Resistant Applications 413
7.4.1.1A Chemical Composition of Martensitic and Ferritic Stainless Steels for General and Corrosion Resistant Applications 413
7.4.1.1B Mechanical Properties of Martensitic and Ferritic Stainless Steels for General and Corrosion Resistant Applications 414
7.4.1.2A Chemical Composition of Austenitic Stainless Steels for General and Corrosion Resistant Applications 415
7.4.1.2B Mechanical Properties of Austenitic Stainless Steels for General and Corrosion Resistant Applications 417
7.4.2 Cast Stainless Steels for Pressure Purposes 419
7.4.2.1A Chemical Composition of Martensitic and Ferritic Stainless Steels for Pressure Purposes 419
7.4.2.1B Mechanical Properties of Martensitic and Ferritic Stainless Steels for Pressure Purposes 421
7.4.2.2A Chemical Composition of Austenitic Stainless Steels for Pressure Purposes 422
7.4.2.2B Mechanical Properties of Austenitic Stainless Steels for Pressure Purposes 424
7.5 Cast Heat Resistant Steels 426
7.5A Chemical Composition of Cast Heat Resistant Steels 426
7.5B Mechanical Properties of Cast Heat Resistant Steels 430
8. Wrought Stainless Steels 433
8.1 Stainless Steels: Plate, Sheet, and Strip 438
8.1.1A Chemical Composition of Martensitic Stainless Steels 438
8.1.1B Mechanical Properties of Martensitic Stainless Steels 440
8.1.2A Chemical Composition of Ferritic Stainless Steels 445
8.1.2B Mechanical Properties of Ferritic Stainless Steels 450
8.1.3A Chemical Composition of Austenitic Stainless Steels 458

8.1.3B Mechanical Properties of Austenitic Stainless Steels 473
8.1.4A Chemical Composition of Precipitation Hardening Stainless Steels 505
8.1.4B Mechanical Properties of Precipitation Hardening Stainless Steels 506
8.1.5A Chemical Composition of Duplex (Ferritic Austenitic) Stainless Steels 513
8.1.5B Mechanical Properties of Duplex (Ferritic Austenitic) Stainless Steels 515
8.2 Stainless Steels: Bar 519
8.2.1A Chemical Composition of Martensitic Stainless Steels 519
8.2.1B Mechanical Properties of Martensitic Stainless Steels 522
8.2.2A Chemical Composition of Ferritic Stainless Steels 534
8.2.2B Mechanical Properties of Ferritic Stainless Steels 536
8.2.3A Chemical Composition of Austenitic Stainless Steels 541
8.2.3B Mechanical Properties of Austenitic Stainless Steels 551
8.2.4A Chemical Composition of Precipitation Hardening Stainless Steels 593
8.2.4B Mechanical Properties of Precipitation Hardening Stainless Steels 594
8.2.5A Chemical Composition of Duplex Stainless Steels 600
8.2.5B Mechanical Properties of Duplex Stainless Steels 602
9. Steels for Special Use 607
9.1 Free-Machining Steels 611
9.1.1 Chemical Composition of Resulfurized Carbon Steels for Free Machining Applications 611
9.1.2 Chemical Composition of Rephosphorized and Resulfurized Carbon Steels for Free-Machining Applications 613
9.1.3 Chemical Composition of Resulfurized and Leaded Carbon Steels for Free Machining Applications 614
9.1.4 Chemical Composition of Rephosphorized, Resulfurized, and Leaded Carbon Steels for Free Machining Applications 614
9.1.5 Chemical Composition of Free-Machining Stainless Steels 615
9.2 Spring Steels 615
9.2.1 Chemical Composition of Cold Rolled Carbon Spring Steels 615
9.2.1.1 Chemical Composition of Cold Rolled Carbon Wire Spring Steels 615
9.2.1.2 Chemical Composition of Cold Rolled Carbon Strip Spring Steels 616
9.2.2 Chemical Composition of Hot Rolled Alloy Spring Steels 618
9.2.2.1 Chemical Composition of Hot Rolled Si Alloy Spring Steels 618
9.2.2.2 Chemical Composition of Hot Rolled Cr Alloy Spring Steels 618
9.2.2.3 Chemical Composition of Hot Rolled Cr Si Alloy Spring Steels 619
9.2.2.4 Chemical Composition of Hot Rolled Cr Mo Alloy Spring Steels 619
9.2.2.5 Chemical Composition of Hot Rolled Cr V Alloy Spring Steels 620
9.2.2.6 Chemical Composition of Hot Rolled Cr B Alloy Spring Steels 621

9.2.3 Chemical Composition of Stainless Spring Steels 621
9.3 Tool Steels 622
9.3.1 Chemical Composition of Carbon Tool Steels 622
9.3.2 Chemical Composition of High-Speed Tool Steels 623
9.3.2.1 Chemical Composition of Tungsten Type High Speed Tool Steels 623
9.3.2.2 Chemical Composition of Molybdenum Type High Speed Tool Steels 624
9.3.3 Chemical Composition of Cold Work Tool Steels 625
9.3.4 Chemical Composition of Hot Work Tool Steels 626
9.3.5 Chemical Composition of Special Purpose Tool Steels 627
9.4 Bearing Steels 628
9.4.1 Chemical Composition of Bearing Steels 628
Appendix 1 ASTM Ferrous Metal Standards 629
Appendix 2 Discontinued Ferrous Metal Standards 645
Appendix 3 JIS Steel and Related Standards 663
Appendix 4 EN Current Steel Standards 669
Appendix 5 EN ISO Current Steel Standards 677
Appendix 6 ISO Iron and Steel Product Standards 679
Appendix 7 ASTM A941 15 Standard Terminology Relating to Steel, Stainless Steel, Related Alloys, and Ferroalloys 687
Appendix 8 ASTM E527 12 Standard Practice for Numbering Metals and Alloys in the Unified Numbering System (UNS) 697
Appendix 9 SI Quick Reference Guide 705
Steel Grade/Name Index 711
UNS Number Index 773
Steel Number Index 781
Specification Designation Index 789

# Preface

This is the book I never wanted to write but always wanted to own. As a metallurgical engineer and long-time user of steel standards, author of the four CASTI Metals Data Books, and as a member of ASTM, ISO, and SAE steel standard committees, I knew all too well the many pitfalls and challenges of writing such a handbook. There were many steel standards from around the world that were new to me and that created many surprises, including the Chinese GB steel standards, which were translated into English by the metallurgical engineers of CASTI Publishing, Inc.

Comparing steel standards is not an exact science, so the biggest challenge in preparing such a book was deciding on the "rules of comparison." Of the similar books on the market today, none explain in detail why one steel is comparable to another. They simply appear together in a list of steels. I kept a daily diary to help construct a workable set of comparison rules that I could share with other users to assist them in understanding how and why one steel is comparable to another.

When writing the first edition of this book (DS67A), these rules changed from chapter to chapter while the book was being written. It was not until the last chapter and the appendix were completed that I was able to finalize the rules of comparison. In the end, a complete review of the book was performed, resulting in the reorganization of some chapters and the fine tuning of others. There were too many occasions when I thought the book was finished, only to have to change, add, or delete a rule that made yet another review of the book necessary.

My writing of this fifth edition (DS67D) was greatly assisted by using the ASTM Passport to Steel database. Without it, the handbook would be much smaller. The addition of data from Chinese GB and ASME steel standards has significantly improved this edition. With the use of the ASTM Passport to Steel database, many new comparable steels were also added to this edition.

I hope you enjoy using this handbook as much as I have. Tie a chain to it and anchor it to your desk because once others see it, you may never see the book again.

I am interested in your comments and suggestions for improving this handbook and encourage you to send your feedback directly to ASTM.

John E. Bringas, P.Eng.
President and Metallurgical Engineer
CASTI Publishing, Inc.

# Acknowledgments

The author gratefully acknowledges the assistance of Michael Ling, P.Eng., and Toan Huynh, P.Eng., whose work in compiling and organizing the data was of particular importance. A special acknowledgment is made to Yin Huang, Ph.D., who was the lead metallurgical engineering translator of the Chinese GB steel standards. Without his dedicated work, the GB data included here would not have maintained the high quality standard for which this handbook is known worldwide. The advice given by these individuals when difficult technical decisions had to be made is appreciated.

Several colleagues from ASTM, Society of Automotive Engineers (SAE), and International Standards Organization (ISO) committees were contacted for their input during the progress of this handbook, including ASTM committee members Ralph Davison, Frank Christensen, and John Mahaney; Günter Briefs and Baoshi Liu from the ISO; and Mel Head of the SAE. They added valuable insights into the history and technical aspects of the standards data found in this handbook.

The ASTM publishing staff, most notably John Pace, David Von Glahn, Kathy Dernoga, and Monica Siperko, were very supportive of my requests to obtain access to the hundreds of standards needed to write this handbook. Their patience and confidence in my ability to complete the work is appreciated. Thank you all.

The author also acknowledges the dedicated assistance of the Codes and Standards Training Institute (CASTI) staff who assisted in the research, entered data, and who updated the book with care and diligence.

A special thanks is extended to Information Handling Service (IHS) Engineering Products for permitting the use of their Engineering Resource Center (ERC).

One person could not have produced this handbook. It took a dedicated team of professionals. These acknowledgments cannot adequately express the author's sincere appreciation and gratitude for everyone's assistance. Without it, this handbook would never have been completed.

# Getting Started With This Book

The intent of this handbook is to allow the user to identify comparable steels that are found in standards from around the world and then to evaluate each complete standard on its own merit to ensure that the selected steel is suited for the intended application. This handbook is not designed to be the sole source of information for selecting a comparative steel and is not intended to be used as a replacement for steel standards. This handbook is one tool in the process of comparing steel standards from around the world.

Comparing steel standards is not an exact science, and there is no foolproof method. When you begin to use this handbook, you will quickly discover that there is no such thing as "equivalent" steel standards. The user must also be aware that not all steels have comparative counterparts. Before proceeding directly to the contents of this handbook, it is strongly recommended that you read Chapter 1, which includes a detailed explanation of the "rules of comparison" used in this handbook.

Because there was often insufficient space on one page to place both the chemical composition and mechanical properties tables, they were split into two separate tables. To assist the user in keeping track of which comparison criteria were used for a given steel, each table within a chapter was sequentially numbered and appended with either the letter A or B. Table numbers ending in the letter A designate that the table was the main criterion used for comparison; whereas table numbers ending with the letter B were "mirrored" from the A table.

Each group of steel data in the tables is separated by two types of horizontal lines: black and gray. Black lines separate groups of steels that are more closely comparable to each other; whereas gray lines separate steel data within a comparative group.

***Caution:*** The pages of this handbook are formatted to keep comparative groups together as much as possible. However, when a group of comparative steels extends to more than one page, a note is placed at the bottom of the page to indicate that the comparative group continues on the following page (i.e., "NOTE: This section continues on the next page").

Appendix 2 and Appendix 4 include lists of withdrawn and replaced standards that should always be checked when trying to find comparable steels. This handbook, unlike many others, includes the year date of each standard, which is critical when trying to identify the status of a standard.

Chapter

# 1

# *INTRODUCTION TO COMPARING WORLD STEEL STANDARDS*

### Myth and Methodology When Comparing Steel Standards

When comparing steel standards from different national and international standard development organizations (SDOs), there is no such thing as *equivalent* steel standards. At best, one may be able to group *comparable* steel standards together based on some defined set of rules, which has been done in this handbook. For example, ASTM A516/A516M Grade 70 is *comparable* to JIS G3118 symbol SGV 480 and to EN 10028-2 steel name P295GH, based on chemical compositions, mechanical properties, and application. Yet they are not *equivalent* because there are differences in all three standards. Comparing steel standards is not an exact science and cannot be made into a mathematical equation where two sides of an equation are equal to one another because there will always be differences among standards.

These differences may be significant to one user but not significant to another. Therefore, this handbook uses the term *comparative* to denote similar standards that have been compared to each other. Comparative is a relative word that is inevitably dependent upon the requirements of the end user, the one who is ultimately responsible for selecting the appropriate steel for a specific application.

There are some steel standards that are shared by multiple SDOs. For example, EN ISO 4957–Tool Steels is a standard that is shared within the European Committee for Standardization (CEN) and the International Standards Organization (ISO) systems. Consequently, the data are equivalent in both systems, but there is only one standard.

There are also different standards that share the same grades of steel. For example, ASTM A485 and ISO 683-17 share seven identical bearing steel grade chemical compositions, yet there are differences in grain size, hardenability, microstructure, hardness, inspection, testing, and in other details of both standards. As a result, the seven bearing steels within these two standards are not equivalent, but they are comparable.

### Comparative and Closest Match

There is also a difference between *comparative* and *closest match* when evaluating steel standards. While gathering the data for this handbook, it was difficult to decide whether to include data on a technically comparative basis or on a closest match basis as both have their merits and limitations. (See 70 % rule in EN 10020 on page 6 for a more detailed discussion.)

A technically comparative group of steels can assist the user with making a material selection based on technical merit. However, this may severely limit the number of steels that would be comparable. On the other hand, displaying the closest match data will usually increase the number of comparative steels for the user to consider but at the risk of widening the technical comparison criteria. Likewise, a strict technical comparison will provide more accurate results, but a closest match comparison will provide more data to assist the user in searching for similar steels.

There are many instances in the handbook where it would be a disservice to the reader not to include the closest match steels because there would be no comparisons otherwise. Because this broadens the technical comparison criteria, the user is warned that the data herein cannot substitute for education, experience, and sound engineering judgment after evaluating all of the specifications within each comparable standard.

In the end, there are no definitive rules that can be formulated to distinguish between *comparative* steels and *closest match* steels. Consequently, at the editor's discretion, both types of comparisons are used in this handbook. Table 1.1 is one example of the comparison process, with respect to technically comparative steels and closest match steels.

Table 1.1 lists the chemical compositions of four grades of cast alloy chromium-nickel-molybdenum (Cr-Ni-Mo) steels. If a strict technical comparison was made based on their chemical composition, none of these alloys would be comparable because their chemical compositions would differ; although there are similarities in their carbon (C), Cr, Mo, and Ni contents.

Table 1.2 shows how these four steels were divided into two separate comparative groups based on the differing Cr and Mo contents. The thin black line in Table 1.2 is the separator between the two comparative groups.

Displaying the two groups side by side also assists the user in seeing the differences and similarities among these four cast alloy steels.

**Table 1.1 List of Chemical Compositions of Cr-Ni-Mo Alloy Cast Steels Before Comparison**

| Specification | Designation | Steel No. | UNS No. | Weight, % max, Unless Otherwise Specified* | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASTM A958/ A958M-14 | SC 4330 | --- | J23259 | 0.28–0.33 | 0.60–0.90 | 0.30–0.60 | 0.035 | 0.040 | 0.70–0.90 | 1.65–2.00 | 0.20–0.30 | — |
| JIS G5111:1991 | SCNCrM 2 | --- | --- | 0.25–0.35 | 0.90–1.50 | 0.30–0.60 | 0.040 | 0.040 | 0.30–0.90 | 1.60–2.00 | 0.15–0.35 | — |
| EN 10293:2015 | G32NiCrMo8-5-4 | 1.6570 | --- | 0.28–0.35 | 0.60–1.00 | 0.60 | 0.020 | 0.015 | 1.00–1.40 | 1.60–2.10 | 0.30–0.50 | V 0.05 Cu 0.30 |
| ISO 14737:2003 | Grade G32NiCrMo8-5-4 | --- | --- | 0.28–0.35 | 0.60–1.00 | 0.60 | 0.020 | 0.015 | 1.00–1.40 | 1.60–2.10 | 0.30–0.50 | V 0.05 Cu 0.30 |

**Table 1.2 List of Chemical Compositions of Cr-Ni-Mo Cast Alloy Steels After Comparison**

| Specification | Designation | Steel No. | UNS No. | Weight, %, max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASTM A958/ A958M-14 | SC 4330 | --- | J23259 | 0.28–0.33 | 0.60–0.90 | 0.30–0.60 | 0.035 | 0.040 | 0.70–0.90 | 1.65–2.00 | 0.20–0.30 | --- |
| JIS G5111:1991 | SCNCrM 2 | --- | --- | 0.25-0.35 | 0.90-1.50 | 0.30-0.60 | 0.040 | 0.040 | 0.30-0.90 | 1.60-2.00 | 0.15-0.35 | --- |
| EN 10293:2015 | G32NiCrMo8-5-4 | 1.6570 | --- | 0.28–0.35 | 0.60–1.00 | 0.60 | 0.020 | 0.015 | 1.00–1.40 | 1.60–2.10 | 0.30–0.50 | V 0.05 Cu 0.30 |
| ISO 14737:2003 | Grade G32NiCrMo8-5-4 | --- | --- | 0.28–0.35 | 0.60–1.00 | 0.60 | 0.020 | 0.015 | 1.00–1.40 | 1.60–2.10 | 0.30–0.50 | V 0.05 Cu 0.30 |

A classic closest match example is shown in Table 1.3, where the four grades within EN 10085 are different; on this basis, they may not belong to this comparative group. However, the Cr-Al-Mo alloys in this group typically are used as nitriding steels, and the EN 10085 steels are the closest match for this group. Excluding them would be a disservice to the user because they belong to the same application family, and its inclusion in this group will direct the user to other similar nitriding alloys.

There are many opportunities to make technical errors that may lead to inappropriate steel comparisons. For example, there are many technical decisions to make when comparing stainless steels because finding identical chemical compositions within standards from different countries is not common. Table 1.4 shows a list of comparative Cr-Ni-Mo wrought austenitic stainless steels from the United States, Europe, China, Japan, and other international locations. Note the differences in the silicon (Si), Cr, Ni, and nitrogen (N). The U.S., Chinese, and Japanese chemical compositions are more closely matched, whereas the European and international (ISO) standards are identical. These differences may affect the corrosion resistance performance in many applications, such that the user must be very careful when selecting a comparative steel based solely on data in this handbook.

In summary, if strict technical comparison is made to this type of data, few relationships among the various grades of steel would be established, and the comparison would serve no purpose. By widening the technical comparison criteria to find the closest match steels, the user must understand that these steels are not equivalent and cannot be indiscriminately substituted without first reviewing the complete current standards and securing competent technical advice prior to any decision making.

To find a balance for comparison of steels by product form, use (application), mechanical properties, chemical compositions,

**Table 1.3 Chromium-Molybdenum-Aluminum (Cr-Mo-Al) Steels for Nitriding**

| Specification | Designation | UNS No. | Steel No. | Weight, %, max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASTM A355-89 (2012) | A | K24065 | --- | 0.38–0.43 | 0.50–0.70 | 0.15–0.35 | 0.035 | 0.040 | 1.40–1.80 | --- | 0.30–0.40 | Al 0.95–1.30 |
| EN 10085:2001 | 32CrAlMo7-10 | --- | 1.8505 | 0.28–0.35 | 0.40–0.70 | 0.40 | 0.025 | 0.035 | 1.50–1.80 | --- | 0.20–0.40 | Al 0.80–1.20 |
| | 34CrAlMo5-10 | --- | 1.8507 | 0.30–0.37 | 0.40–0.70 | 0.40 | 0.025 | 0.035 | 1.00–1.30 | --- | 0.15–0.25 | Al 0.80–1.20 |
| | 34CrAlNi7-10 | --- | 1.8550 | 0.30–0.37 | 0.40–0.70 | 0.40 | 0.025 | 0.035 | 1.50–1.80 | 0.85–1.15 | 0.15–0.25 | Al 0.80–1.20 |
| | 41CrAlMo7-10 | --- | 1.8509 | 0.38–0.45 | 0.40–0.70 | 0.40 | 0.025 | 0.035 | 1.50–1.80 | --- | 0.20–0.35 | Al 0.80–1.20 |
| GB/T 3077-1999 | Grade 38CrMoAl | --- | --- | 0.35–0.42 | 0.30–0.60 | 0.20–0.45 | 0.035 | 0.035 | 1.35–1.65 | 0.30 | 0.15–0.25 | Al 0.70–1.10; Cu 0.30 |
| GB/T 3078-94 | Grade 38CrMoAlA | --- | --- | 0.35–0.42 | 0.30–0.60 | 0.20–0.45 | 0.025 | 0.025 | 1.35–1.65 | 0.30 | 0.15–0.25 | Al 0.70–1.10; Cu 0.25 |
| ISO 683-10:1987 | 41 CrAlMo 7 4 | --- | --- | 0.38–0.45 | 0.50–0.80 | 0.50 | 0.030 | 0.035 | 1.50–1.80 | --- | 0.25–0.40 | Al 0.8–1.20 |
| JIS G4053:2008 | Symbol SACM 645 | --- | --- | 0.40–0.50 | 0.60 | 0.15–0.50 | 0.030 | 0.030 | 1.30–1.70 | 0.25 | 0.15–0.30 | Al 0.70–1.20; Cu 0.30 |

**Table 1.4 List of Comparative Cr-Ni-Mo Wrought Austenitic Stainless Steels**

| Specification | Designation | UNS No. | Steel No. | Weight, %, max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASME SA-240/SA-240M | Type 317L | S31703 | --- | 0.030 | 2.00 | 0.75 | 0.045 | 0.030 | 18.0–20.0 | 11.0–15.0 | 3.0–4.0 | N 0.10 |
| ASTM A240/A240M-15a | Type 317L | S31703 | --- | 0.030 | 2.00 | 0.75 | 0.045 | 0.030 | 18.0–20.0 | 11.0–15.0 | 3.0–4.0 | N 0.10 |
| EN 10028-7:2007 | X2CrNiMo18-15-4 | --- | 1.4438 | 0.030 | 2.00 | 1.00 | 0.045 | 0.015 | 17.5–19.5 | 13.0–16.0 | 3.0–4.0 | N 0.10 |
| EN 10088-2:2014 | X2CrNiMo18-15-4 | --- | 1.4438 | 0.030 | 2.00 | 1.00 | 0.045 | 0.015 | 17.5–19.5 | 13.0–16.0 | 3.0–4.0 | N 0.10 |
| GB 4237-92 | Grade 00Cr19Ni13Mo3 | --- | --- | 0.030 | 2.00 | 1.00 | 0.035 | 0.030 | 18.00–20.00 | 11.00–15.00 | 3.00–4.00 | --- |
| GB 4239-91 | Grade 00Cr19Ni13Mo3 | --- | --- | 0.030 | 2.00 | 1.00 | 0.035 | 0.030 | 18.00–20.00 | 11.00–15.00 | 3.00–4.00 | --- |
| ISO 9328-7:2004 | Grade X2CrNiMo18-15-4 | --- | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.015 | 17.5–19.5 | 13.0–16.0 | 3.00–4.0 | N 0.11 |
| JIS G 4304:2012 | Symbol SUS317L | --- | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 18.00–20.00 | 11.00–15.00 | 3.00–4.00 | --- |
| JIS G 4305:2012 | Symbol SUS317L | --- | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 18.00–20.00 | 11.00–15.00 | 3.00–4.00 | --- |
| SAE J405 JUN98 | Type 317L | S31703 | --- | 0.030 | 2.00 | 0.75 | 0.045 | 0.030 | 18.00–20.00 | 11.00–15.00 | 3.00–4.00 | N 0.10 |

related manufacturing processes (including heat treatment), and so forth, a methodology had to be put in place and rules had to be established. However, as much as methodology and rules were essential in preparing this handbook, there were many instances where they would not cover every variable and circumstance. Therefore, difficult comparison decisions—such as those described previously—had to be made. There were literally hundreds, if not more than a thousand, such decisions made in this handbook. In these cases, the closest match comparison decisions were made at the discretion of the editor.

### Organization

Two of the main variables in selecting a specific grade of steel are its intended application (use) and product form, which usually narrows the selection to a family of steels. Therefore, the remaining data chapters in this handbook were organized by product form and use, as follows.

| Chapter No. | Title |
|---|---|
| 2. | Carbon and Alloy Steels for General Use |
| 3. | Structural Steel Plates |
| 4. | Pressure Vessel Steel Plates |
| 5. | Steel Tubes and Pipes |
| 6. | Steel Forgings |
| 7. | Steel Castings |
| 8. | Wrought Stainless Steels |
| 9. | Steels for Special Use |

Although this list of chapter titles, at first glance, looks rather straightforward, there were difficult decisions regarding the steel comparisons within each chapter. For example, ASTM has 9 definitions for *pipe* and 22 definitions for *tube*, depending on the standard's subject matter and application (see *ASTM Dictionary of Engineering Science & Technology*, 10th edition). In contrast, ISO 2604, Steel Products for Pressure Purposes—Quality Requirements—Part II: Wrought Seamless Tubes, notes that "The word *tube* is synonymous with *pipe*."

Each standard is typically listed only in one chapter, but there are exceptions. For example, ASTM A240/A240M–15a, Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications, appears in more than one chapter due to its dual role for pressure vessel and general applications (i.e., Chapter 4—Pressure Vessel Steel Plates and Chapter 8—Wrought Stainless Steels). Similarly, the Japanese Industrial Standards (JIS) and Chinese (Guojia Biaozhun, or GB) stainless steel flat product standards were also included in Chapters 4 and 8.

#### *Definitions of Steel Terms*

It is common to find terminology standards for steels within most but not all standard development organizations (SDOs). These

standards are very useful when working with steel standards, particularly when interpreting specific terms. Table 1.5 contains a list of steel terminology standards.

It is important to note that these standards differ in the terms used to describe the different types of steel. The user of comparative steel standards data must take into account that each national SDO has their own set of terms and definitions for steels and related products and, in some cases, may have multiple definitions. For example, three different definitions for carbon steel can be found in ASTM standards A941-13b, A902-14, and F1789-14a.

A summary of the chemical element limits for ASTM A941-13b alloy steel and EN 10020:2000 non-alloy steel is shown in Table 1.6. Although the limits seem to be the same, it is important to note the 70 % rule in EN 10020, Paragraph 3.1.2, which states:

> Where for elements other than manganese a maximum value only is specified in the product standard or specification for the ladle analysis, a value of 70 % of this maximum value shall be taken for classification as set out in tables 1 and 2. For manganese see note *a* of table 1.

In some cases, this 70 % rule resulted in several steels being noncomparable. For example, EN 10028–3:2009, Flat Products Made of Steels for Pressure Purposes—Part 3: Weldable Fine Grain Steels, Normalized, contains steels with a nickel content of 0.50 % maximum (i.e., there is no minimum nickel requirement). Using the 70 % rule, this would define these steels to contain 0.35 % Ni, which is over the 0.30 % maximum limit for non-alloy steels (carbon steels), thereby making them alloy steels and thus becoming noncomparable with non-alloy steels.

ASTM A941-13b and EN 10020:2000 share the same definition for stainless steel, as follows.

> Stainless steel a steel that conforms to a specification that requires, by mass percent, a minimum chromium content of 10.5 or more, and a maximum carbon content of less than 1.20.

In this handbook, steels have been divided into three main categories:

1. Carbon Steels (Non Alloy Steels)
2. Alloy Steels
3. Stainless Steels

**Table 1.5 List of Steel Terminology Standards**

| | |
|---|---|
| ASTM A941-13b | Standard Terminology Relating to Steel, Stainless Steel, Related Alloys, and Ferroalloys |
| ASTM A644-14 | Standard Terminology Relating to Iron Castings |
| ASTM A751-14a | Standard Test Methods, Practices, and Terminology for Chemical Analysis of Steel Products |
| ASTM A902-15 | Standard Terminology Relating to Metallic Coated Steel Products |
| EN 10020:2000 | Definition and Classification of Grades of Steel |
| EN 10027-1:2005 | Designation systems for steels—Part 1: Steel names |
| EN 10052:1993 | Vocabulary of Heat Treatment Terms for Ferrous Products |
| EN 10079:2007 | Definition of Steel Products |
| EN 10169-1:2003 | Continuously Organic Coated (Coil Coated) Steel Flat Products—Part 1: General Information (Definitions, Materials, Tolerances, Test Methods) |
| EN 10266:2003 | Steel tubes, fittings and structural hollow sections—Symbols and definitions of terms for use in product standards |
| GB/T 13304-1991 | Steels—Classification |
| GB/T 15574-1995 | Steel products classification and definitions |
| GB/T 15575-1995 | Steel products standard designation |
| GB/T 341-1989 | Steel wire—Classification and vocabulary |
| JIS G 0201:2000 | Glossary of terms used in iron and steel (Heat treatment) |
| JIS G 0202:2013 | Glossary of terms used in iron and steel (Testing) |
| JIS G 0203:2009 | Glossary of terms used in iron and steel (Products and quality) |
| ISO 6929:1987 | Steel products—Definitions and classification |
| ISO 2532:1974 | Steel wire ropes—Vocabulary |
| ISO 3252:2000 | Powder metallurgy—Vocabulary |
| ISO 4885:1996 | Ferrous products—heat treatments—Vocabulary |
| ISO 8954-1:1990 | Ferroalloys—Vocabulary—Part 1: Materials |
| ISO 8954-2:1990 | Ferroalloys—Vocabulary—Part 2: Sampling and sample preparation |
| ISO 8954-3:1990 | Ferroalloys—Vocabulary—Part 3 Sieve analysis |
| ISO 17893:2004 | Steel wire ropes—Vocabulary, designation, and classification |

**Table 1.6 Limits for EN 10020:2000 and ASTMA 941-13b Between Carbon Steels/Non-Alloy Steel and Alloy Steela (% by mass)**

| Symbol | Name | EN 10020:2000b | ASTM A941-13b |
|---|---|---|---|
| Al | Aluminum | 0.30 | 0.30 |
| B | Boron | 0.0008 | 0.0008 |
| Bi | Bismuth | 0.10 | --- |
| Co | Cobalt | 0.30 | 0.30 |
| Cr | Chromium | 0.30 | 0.30 |
| Cu | Copper | 0.40 | 0.40 |
| La | Lanthanides | 0.10 | --- |
| Mn | Manganese | 1.65b | 1.65 |
| Mo | Molybdenum | 0.08 | 0.08 |
| Nb | Niobium | 0.06 | 0.06 |
| Ni | Nickel | 0.30 | 0.30 |
| Pb | Lead | 0.40 | 0.40 |
| Se | Selenium | 0.10 | --- |
| Si | Silicon | 0.60 | 0.60 |
| Te | Tellurium | 0.10 | --- |
| Ti | Titanium | 0.05 | 0.05 |
| V | Vanadium | 0.10 | 0.10 |
| W | Tungsten | 0.30 | 0.30 |
| Zr | Zirconium | 0.05 | 0.05 |
| | Other (except C, P, S, N) | 0.10 | 0.10 |

[a]Alloy steel when equal to or greater than the limit.

[b]Where manganese is specified only as a maximum, the limit value is 1.80 % and the 70 % rule does not apply (see 3.1.2 of EN 10020:2000).

ASTM A941-13b and EN 10020:2000 were used as guidelines in developing these categories. Where practical, these steel categories were further divided into subcategories based on their product form, intended application, service requirement, or other similar criteria.

### Cautionary Note

Many standard specifications include cautionary paragraphs that warn users about their responsibilities (e.g., see Paragraph 1.5 from ASTM A53/A53M-12, quoted here). Accordingly, it is the user's responsibility when comparing steel standards to perform an engineering review of each standard to ensure that it is suitable for their intended application.

> The following precautionary caveat pertains only to the test method portion, Sections 7, 8, 9, 13, 14, and 15 of this specification: This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory requirements prior to use.

### Questions Regarding the Rules of Comparison

When comparing two or more steel standards, the following questions must be asked:

1. Should mechanical properties or chemical composition be the main criteria? If mechanical properties are compared, which property should be the first criteria for comparison, that is, yield strength, tensile strength, elongation, impact strength, hardness, and so on? Once having selected a primary criterion, say tensile strength, should there be a secondary criterion for ranking the comparative steels within this group, for example, yield strength, hardness, and so on? When mechanical properties or chemical compositions vary with section thickness for a given steel grade, which section thickness data should be selected as the criteria for comparison? When two steels have the same minimum tensile strength values but have different yield strength values, are they no longer similar?
2. Should comparisons be based on the data's minimum values, maximum values, or average values of their minimum/maximum ranges? Should alloy steels and stainless steels be compared based on their mechanical properties when they generally are selected for use based on their alloying elements' abilities to provide satisfactory service in their intended applications?
3. Is it reasonable to compare steels based only on their chemical compositions, regardless of their product form? That is, should forging steels be compared to steel plates or tubes because they have similar chemical compositions, and is this type of comparative data useful in engineering practice?

### Noncomparable Steels

It is fundamental to understand that not all steels have comparative counterparts. Knowing that a steel is noncomparable can be just as important as knowing that there are comparative steels. Otherwise, valuable time could be wasted searching for something that does not exist.

### Criteria for Comparing Steels

The two major criteria for comparing steels in this type of handbook are mechanical properties and chemical compositions. For each given standard steel grade, there is typically only one chemical composition, which makes it ideal as a comparison criterion. However, there are several mechanical properties that can be used to compare standard steel grades and, to be consistent throughout a handbook of this type, only one property can be chosen. The decision was to use a steel's tensile strength as the second comparison criterion.

Having settled on chemical composition and tensile strength as the two main comparison criteria, the next step was to decide

when to apply one or the other, or both. Because carbon steels typically are selected based on mechanical properties, it was decided that tensile strength would be the first criterion used for comparing carbon steels. Likewise, because alloy steels and stainless steels generally are selected based on their chemistry, it was decided that chemical composition would be used to compare them. An exception to this methodology is made for the structural steels data in Chapter 3, where the tensile strength was used as the main comparison criterion for carbon and alloy steels. This exception was made because structural steels generally are selected based on their mechanical properties. Also in this same chapter, high-strength, low-alloy steels are treated as a subcategory to alloy steels, although ASTM A941 defines them separately.

Because there was insufficient space on a page to place both the chemical composition and mechanical properties tables, they were split into two separate tables. To assist the user in keeping track of the comparison criteria used for a given steel, each table within a chapter was sequentially numbered and appended with the letter A or B. Table numbers ending in the letter A designate that it was the main criterion used for comparison, whereas table numbers ending with the letter B were "mirrored" from the A tables. In this manner, the user must first consider the data in the A table, and then see how well the data in the B table match the steels that are being compared.

This is not a foolproof methodology of comparison. For example, ASTM A958 Grade SC 4330 has one chemical composition but has 13 different strength classes based on heat treatment (see Chapter 7). So just because two steel grades have comparative chemical compositions does not mean that they are comparable in mechanical properties and vice versa. Using data found in this handbook is only one step in finding suitable comparable steel for the intended application.

With this basic methodology in place, the following is a list of the comparison rules that were established to produce this handbook.

### List of Comparison Rules

1. The first criterion of order for carbon (non alloy) steels is based on tensile strength, followed by yield strength; that is, if two steels have the same tensile strength, then they are placed in ascending order by yield strength, and if yield strength is not required, it is placed at the top of the order.
2. Typically, comparative groups are made for every 50 MPa (50 $N/mm^2$ or 7.25 ksi) in tensile strength (that is, a black line divides comparative groups every 50 Mpa [50 $N/mm^2$ or 7.25 ksi]). When an abundance of data is available, this limit may be reduced to improve the comparison accuracy.
3. Mechanical property subcategories, such as steels with impact testing below 20°C ( 4°F), are used to further narrow the comparison process.
4. If a carbon steel's tensile strength varies with section thickness, the tensile strength of the lowest section thickness will be used as the governing comparison factor. There is no technical reason for choosing the lowest section thickness; it is just that one had to be chosen.
5. If a carbon steel standard does not contain mechanical properties, such as those found in Chapter 2, Carbon and Alloy Steels for General Use, then the steels will be compared based on their carbon content.
6. The major criterion for alloy steel and stainless steel comparisons is chemical composition. Once these steels are placed in a comparative group by chemical composition, they are then arranged in ascending order within these groups by their tensile strength. Where possible, subcategories of alloy and stainless steel groups are made to further narrow the comparison process.
7. Chemical compositions listed are the heat analysis requirements in the standards (also called ladle or cast analysis). Product analyses are not listed.
8. The chemical composition and mechanical properties data for the same steel grades are typically not listed on the same page due to space limitations. Consequently, as a means of keeping the data consistent between these two sets of tables, each table is numbered, and each table number ends with either the letter A or B.
9. Each set of steel data in the tables is divided by two types of horizontal lines: black and gray. Black lines separate groups of steels that are more closely comparable to each other, whereas gray lines separate steel data within a comparative group. This does not mean that steels outside of these groups cannot be compared because these horizontal lines are dependent upon all of the comparison rules in this list and can be subjective at times. **Caution**: Do not confuse the thinner dividing black line within a table with the thicker black rule that borders the table. To assist in this regard, the pages were formatted to keep comparative groups together as much as practicable. However, when a group of comparative steels appears on more than one page, a note is placed at the bottom of the page to indicate that the comparative group continues on the following page ("Note: This group continues on the next page"). Likewise, when a specification within a group of comparative steels cannot fit onto just one page, a note is placed at the bottom of the page to indicate that the specification within the comparative group continues on the following page ("Note: This specification continues on the next page within the same group").
10. Steel data in standards are not always mandatory. Some data are listed as typical values or informative values or are found in supplementary requirements. This type of data is still very useful and has been included in this handbook whenever possible. This type of data is identified with an explanatory note that appears in the list of standards at the beginning of the related chapter.
11. Some standards included multiple requirements for impact testing, such as differing test temperatures or requirements for subsize specimens.

12. Where space permitted, as much data as possible were included. However, there are occasions when the phrase "see standard for impact test data" was used to indicate that more data could be found in the standard.
13. The phrase "see standard for impact test data" was also used when the standard did not specify a test temperature but did specify an absorbed energy value.
14. Impact testing values listed in the tables are typically for full-size specimens and for the minimum average result at the testing temperature but do not include the minimum individual test piece requirement, if any.
15. For the purpose of this handbook, phrases found in standards such as "may be applied if necessary" or "may be applied by agreement between the purchaser and supplier" or "the manufacturer may find it necessary to" or "when specified" or "may be added if necessary" are not a part of the comparison process.
16. Data from footnotes in the chemical composition and mechanical properties tables of steel standards were considered during the comparison process but were not always reported in the handbook due to lack of space in the tables or because they represented technical issues that were too complex to be represented in a tabular format. In these cases, the note "see standard" was used.
17. The same heat treatment terms used in each standard are listed at the beginning of each chapter. Abbreviations in the tables were made based on the terms used in the standards. A concerted effort was made to make the abbreviations consistent from chapter to chapter, although there are exceptions because each heat treatment abbreviation must be referred to in the list of heat treatment terms at the beginning of each chapter. There are many instances when the heat treatment requirements within a standard became very cumbersome to include in a small cell within a table. Consequently, the phrase "see standard" is used to direct the user to the standard to read all of the heat treatment details involved.
18. A determined effort was made to enter the data in this handbook in a manner identical to that listed in the related standard, including the use of niobium (Nb) or columbium (Cb). It should be noted that even within the same SDO, data were not always entered in the same manner from standard to standard; for example, TP304 versus TP 304, where a space between the letter P and the number 3 is listed in the data.

### Brief Introduction to Steel Standards and Designation Systems

In the world of standardization, metals were at the forefront at the turn of the twentieth century. In 1895, the International Association for Testing Materials (IATM) held their first conference in Zurich and the standardization of metals began. The IATM encouraged members to form national chapters and, on June 16, 1898, 70 IATM members met in Philadelphia to form the American section of the International Association for Testing Materials, which in 1898 became the American Society for Testing Materials (ASTM).

By reviewing some examples of the more prominent metals' designation systems, a direction is offered to assist those who use metal standards as a part of their work or study. This section is not all-inclusive. The amount of information on this topic could easily make up a complete book.

#### ASTM Designation System

ASTM's designation system for metals consists of a letter (A for ferrous materials) followed by an arbitrary sequentially assigned number. These designations often apply to specific products; for example, A822 is applicable to seamless cold-drawn carbon steel tubing for hydraulic system service. Metric ASTM standards have a suffix letter M.

Examples of the ASTM ferrous metal designation system, describing its use of specification numbers and letters, are as follows:

ASTM A334/A334M-04a (2010), Grade 1—Pressure Vessel Plates, Alloy Steel and High-Strength Low-Alloy Steel, Quenched-and-Tempered:

- A describes a ferrous metal but does not subclassify it as cast iron, carbon steel, alloy steel, tool steel, or stainless steel.
- *334* is a sequential number without any relationship to the metal's properties.
- M indicates that the standard A334M is written in rationalized SI units (the "M" comes from the word "metric"); hence, together A334/A334M includes both inch pound and SI units.
- 04 indicates the year of adoption or last revision and a letter *a* following the year indicates the second revision of the standard in 2004.
- *(*2010*)*, a number in parentheses, indicates the year of last reapproval.
- Grade 1 indicates the type of steel.

In the steel industry, the terms *grade*, *type*, and *class* generally are defined as follows. *Grade* is used to describe chemical composition; *type* is used to define deoxidation practice; and *class* is used to indicate other characteristics such as strength level or surface finish. However, within ASTM standards, these terms were adapted for use to identify a particular metal within a metal standard and are used without any "strict" definition but essentially mean the same thing, although some loose rules do exist, as follows.

ASTM A106/A106M-14 Grade A, Grade B, Grade C—Seamless Carbon Steel Pipe for High-Temperature Service:

- Typically an increase in alphabet (such as the letters A, B, C) results in higher tensile or yield strength steels and, if it is an unalloyed carbon steel, an increase in carbon content.
- In this case: Grade A: 0.25 % C (max.), 48 ksi tensile strength (min.); Grade B: 0.30 % C (max.), 60 ksi tensile strength (min.); Grade C: 0.35 % C (max.), 70 ksi tensile strength (min.)

ASTM A276/A276M-15, Type 304, 316, 410—Stainless Steel Bars and Shapes:

- Types 304, 316, 410, and others are based on the SAE designation system for stainless steels (see SAE and former American Iron and Steel Institute [AISI] description that follows).

Another use of ASTM grade designators is found in pipe, tube, and forging products, where the first letter "P" refers to pipe, "T" refers to tube, "TP" may refer to tube or pipe, and "F" refers to forging. Examples are found in the following ASTM specifications:

- ASTM A335/A335M-15, Grade P22, Seamless Ferritic Alloy-Steel Pipe for High-Temperature Service
- ASTM A213/A213M-15a, Grade T22, Seamless Ferritic and Austenitic Alloy-Steel Boiler, Superheater, and Heat-Exchanger Tubes
- ASTM A312/A312M 15, Grade TP304, Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes
- ASTM A336/A336M-10a, Grade F91, Alloy Steel Forgings for Pressure and High-Temperature Parts

### ASTM Referenced Standards and Supplementary Requirements

ASTM standards contain a "referenced documents" section, which lists other ASTM standards that are referenced in the text and that either become a part of the original standard or its supplementary requirements. Supplementary requirements are listed at the end of the ASTM standards and do not apply unless specified in the purchase order—that is, they are optional.

### SAE Designation System and Related AISI Designation System

For many years, certain grades of carbon and alloy steels have been designated by a four-digit AISI/SAE numbering system that identified the grades according to standard chemical compositions. Because the AISI does not write material specifications, the relationship between AISI and grade designations has been discontinued. Beginning with the 1995 edition of the Iron and Steel Society (ISS) Strip Steel Manual, the four-digit designations are referred to solely as SAE designations.

The SAE system uses a basic four-digit system to designate the chemical composition of carbon and alloy steels. Throughout the system, the last two digits give the carbon content in hundredths of a percent. Carbon steels are designated 10XX. For example, a carbon steel containing 0.45 % carbon is designated 1045 in this system.

Resulfurized carbon steels are designated within the series 11XX, resulfurized and rephosphorized carbon steels within 12XX, and steels having manganese contents between 0.9 % and 1.5 % but no other alloying elements are designated 15XX. Composition ranges for manganese and silicon and maximum percentages for sulfur and phosphorus are also specified.

For alloy steels, the first two digits of the SAE system describe the major alloying elements present in the material, the first digit giving the alloy group. For example the 43XX series of steels contain 1.65–2.00 % Ni, 0.50–0.80 % Cr, and 0.20–0.30 % Mo, along with composition ranges for manganese and silicon and the maximums for sulfur and phosphorus.

Additional letters added between the second and third digits include "B" when boron is added (between 0.0005 % and 0.003 %) for enhanced hardenability and "L" when lead is added (between 0.15 % and 0.35 %) for enhanced machinability. The prefix "M" is used to designate merchant quality steel (the least restrictive quality descriptor for hot-rolled steel bars used in noncritical parts of structures and machinery). The prefix "E" (electric-furnace steel) and the suffix "H" (hardenability requirements) are mainly

**Table 1.7 Types and Identifying Elements in Standard SAE Carbon and Alloy Steels**

| Carbon Steels | Description |
|---|---|
| 10XX | Non-resulfurized, 1.00 manganese maximum |
| 11XX | Resulfurized |
| 12XX | Rephosphorized and resulfurized |
| 15XX | Non-resulfurized, over 1.00 manganese maximum |
| **Alloy Steels** | **Description** |
| 13XX | 1.75 manganese |
| 40XX | 0.20 or 0.25 molybdenum or 0.25 molybdenum and 0.042 sulfur |
| 41XX | 0.50, 0.80, or 0.95 chromium and 0.12, 0.20, or 0.30 molybdenum |
| 43XX | 1.83 nickel, 0.50 to 0.80 chromium, and 0.25 molybdenum |
| 46XX | 0.85 or 1.83 nickel and 0.20 or 0.25 molybdenum |
| 47XX | 1.05 nickel, 0.45 chromium, 0.20 or 0.35 molybdenum |
| 48XX | 3.50 nickel and 0.25 molybdenum |
| 51XX | 0.80, 0.88, 0.93, 0.95, or 1.00 chromium |
| 51XXX | 1.03 chromium |
| 52XXX | 1.45 chromium |
| 61XX | 0.60 or 0.95 chromium and 0.13 or 0.15 vanadium minimum |
| 86XX | 0.55 nickel, 0.50 chromium, and 0.20 molybdenum |
| 87XX | 0.55 nickel, 0.50 chromium, and 0.25 molybdenum |
| 88XX | 0.55 nickel, 0.50 chromium, and 0.35 molybdenum |
| 92XX | 2.00 silicon or 1.40 silicon and 0.70 chromium |
| 50BXX | 0.28 or 0.50 chromium |
| 51BXX | 0.80 chromium |
| 81BXX | 0.30 nickel, 0.45 chromium, and 0.12 molybdenum |
| 94BXX | 0.45 nickel, 0.40 chromium, and 0.12 molybdenum |

applicable to alloy steels. The full series of classification groups is shown in Table 1.7.

### UNS Designation System

The Unified Numbering System (UNS) is an alphanumeric designation system consisting of a letter followed by five numbers. This system represents only the chemical composition for an individual metal or alloy and is not a metal standard or specification. For the most part, existing systems such as the SAE designations were incorporated into the UNS so that some familiarity was given to the system where possible.

For example, the UNS prefix letter for carbon and alloy steels is "G," and the first four digits are the SAE designation; for example, SAE 1040 is UNS G10400. The intermediate letters "B" and "L" of the SAE system are replaced by making the fifth digit of the UNS designation 1 and 4, respectively, while the prefix letter "E" for electric furnace steels is designated in the UNS system by making the fifth digit "6." The SAE steels, which have a hardenability requirement indicated by the suffix letter "H," are designated by the Hxxxxx series in the UNS system. Carbon and alloy steels not referred to in the SAE system are categorized under the prefix letter "K."

Where possible, the first letter in the system denotes the metal group; for instance, "S" designates stainless steels. Of the five digits of the UNS designation for stainless steels, the first three are the SAE alloy classification; for example, S304XX. The final two digits are equivalent to the various modifications represented by suffix letters in the SAE system as given in the list of suffixes in Table 1.7. The UNS designations for ferrous metals and alloys are described in Table 1.8.

### Canadian Standards Association (CSA)

The Canadian Standards Association (CSA) has established metal standards for structural steels (CSA G40.20/40.21), pipeline steels (CSA Z245.1), corrugated steel pipe (G401), wire products (CSA G4, G12, G30.x, G279.2, G387), sprayed metal coatings (G189), and welding consumables (CSA W48.x).

Most CSA material standards use SI units, although some are available in both SI and Imperial units (for example, CSA G40.20/G40.21-04). When a CSA standard designation is followed by the letter "M," it uses SI units, and if the letter "M" is not present, it may use both units or use only Imperial units. The type of measurement units adopted in CSA standards are specific industry driven, with some industries moving faster toward the exclusive use of SI units than others, and thus the reason for these differences.

As far as practicable, rationalization with relevant ISO standards has been achieved in CSA G4, Steel Wire Rope for General Purpose and for Mine Hoisting and for Mine Haulage. Similarly, the 2005 edition of CSA Z245.1, Steel Line Pipe, references requirements for ISO 1027:1998 (E) on radiographic image indicators for nondestructive testing: principles and identification, as well as ISO 5579:1998 on nondestructive testing—radiographic examination of metallic materials by X- and gamma rays—basic rules.

### Introduction to European (EN) Standard Steel Designation System

The Comité Européen de Normalisation (CEN, the European Committee for Standardization) was founded in 1961 by the national standards bodies in the European Economic Community and European Free Trade Association (EFTA) countries. The CEN is a system of formal processes to produce standards, shared principally among:

- Thirty national members and the representative expertise they assemble from each country; these members vote for and implement European Standards (EN).
- Seven associate members and four affiliates.
- The CEN Management Centre, Brussels.

The CEN works closely with the European Committee for Electrotechnical Standardization (CENELEC), the European

**Table 1.8 UNS Designations for Ferrous Metals and Alloys**

| UNS Descriptor | Ferrous Metals |
|---|---|
| Dxxxxx | Specified mechanical properties of steels |
| Fxxxxx | Cast irons |
| Gxxxxx | SAE and former AISI carbon and alloy steels (except tool steels) |
| Hxxxxx | AISI H-steels |
| Jxxxxx | Cast steels |
| Kxxxxx | Miscellaneous steels and ferrous alloys |
| Sxxxxx | Heat and corrosion-resistant (stainless) steels |
| Txxxxx | Tool steels |
| **UNS Descriptor** | **Welding Filler Metals** |
| Wxxxxx | Welding filler metals, covered and tubular electrodes classified by weld deposit composition |

Telecommunications Standards Institute (ETSI), and the ISO. It also has close liaisons with European trade and professional organizations.

The principal task of CEN is to prepare and issue European standards (EN), defined as a set of technical specifications established and approved in collaboration with the parties concerned in the various member countries of CEN. They are established on the principle of consensus and are adopted by the votes of weighted majority. Adopted standards must be implemented in their entirety as national standards by each member country regardless of the way in which the national member voted, and any conflicting national standards must be withdrawn.

The identification of European standards in each member country begins with the reference letters of the country's national standards body—for example, BS for the British Standards Institution (BSI) in the United Kingdom; DIN for the German Institute for Standardization (Deutsches Institut für Normung); NF for the French national organization for standardization (Association Française de Normalisation, or AFNOR). It is followed by the initials EN and a sequential number of up to five digits. For example, BS EN 10025, DIN EN 10025, or NF EN 10025 are all the same EN standard, which is available in English, French, and German.

An EN standard may contain one document, or it may be made up of several parts. For example, EN 10028 Parts 1 through 7, where each part specifies a particular characteristic of the steel product, may not include the word *part* in the designation but rather it is replaced with a hyphen (e.g., EN 10028-1, etc.), meaning Part 1. The prefix "pr" preceding the EN designation identifies the document as a draft standard that has not yet been approved, (e.g., prEN 10088-1, etc.).

### EN 10027 Standard Designation System for Steels

The CEN designation system for steels is standardized in EN 10027, which is published in two parts:

- Part 1—Steel Names
- Part 2—Numerical System

The steel name is a combination of letters and numbers as described by EN 10027-1. Within this system, steel names are classified into two groups. The system is similar in some respects to, but is not identical with, that outlined in an ISO technical report (ISO TS 4949:2003—Steel names based on letter symbols).

### Steel Names

Steel Names Group 1, within EN 10027-1, refers to steels that are designated according to their application and mechanical or physical properties. These have names that are comprised of one or more letters related to the application, followed by a number related to properties. For example, the name for structural steels begins with the letter S, line pipe steels begin with the letter L, rail steels begin with the letter R, and steels for pressure purposes begin with the letter P, such as EN 10028-3 Steel Name P275NH.

Steel Names Group 2 is used for steels that are designated according to their chemical composition and are further divided into four subgroups, depending on alloy content. Examples of these Group 2 steel names are:

- EN 10222 2 Steel Name 13CrMo4 5
- EN 10250 4 Steel Name X2CrNi18 9

### Numerical System

EN 10027-2 describes the system used for assigning steel numbers, which are complementary to the steel names described earlier. These consist of a fixed set of digits and hence are more suitable than the name for data processing purposes. The steel numbers are in the form 1.XXXX, where the "1" refers to steel. The first two digits following the "1" represent the steel group number. Examples of steel numbers are as follows:

- EN 10222 2 Steel Name 13CrMo4 5, Steel Number 1.7335
- EN 10250 4 Steel Name X2CrNi18 9, Steel Number 1.4307

### Former National Standards Superseded by CEN Standards

An increasing number of national European and UK standards are being withdrawn and superseded by EN standards. This transition, from old to new standards, has made it increasingly difficult to compare the superseded national standards with current standards from other nations outside of Europe and the UK, let alone to compare them to the new EN standards. For example, if you are looking up a former national standard such as DIN 17441, it has been superseded by EN 10028-7:2007.

Superseded national standards may be replaced by more than one new EN standard, and some may have been partially replaced. So, a superseded national standard could be replaced by 2, 3, 4, or more new EN standards, or it may be only partially replaced by these new EN standards.

### Indexes in this Handbook

One of the easiest ways of using this handbook is to refer to one of the four indexes. If a user is looking for a comparable steel, then the information can be found in at least one of the indexes, which are built around the steel designation systems described previously, namely:

- Steel Grade/Name Index
- UNS Number Index
- Steel Number Index
- Specification Designation Index

Chapter

# 2

# *CARBON AND ALLOY STEELS FOR GENERAL USE*

### ASME Standard

| | |
|---|---|
| ASME SA-29/SA-29M | Steel Bars, Carbon and Alloy, Hot-Wrought, General Requirements for |

### ASTM Standards

| | |
|---|---|
| ASTM A29/A29M-12e1 | General Requirements for Steel Bars, Carbon and Alloy, Hot-Wrought |
| ASTM A322-13 | Steel Bars, Alloy, Standard Grades |
| ASTM A355-89 (2012) | Steel Bars, Alloys, for Nitriding |
| ASTM A576-90b (2012) | Steel Bars, Carbon, Hot-Wrought, Special Quality |

### EN Standards

| | |
|---|---|
| EN 10083-2:2006 | Steels for quenching and tempering – Part 2: Technical delivery conditions for non alloy steels |
| EN 10083-3:2006 C1:2008 | Steels for quenching and tempering – Part 3: Technical delivery conditions for alloy steels |
| EN 10084:2008 | Case hardening steels – Technical delivery conditions |
| EN 10085:2001 | Nitriding steels – Technical delivery conditions |
| EN 10250-2:1999 C1:2000 | Open die steel forgings for general engineering purposes – Part 2: Non-alloy quality and special steels |
| EN 10263-3:2001 C1:2001 | Steel rod, bars and wire for cold heading and cold extrusion – Part 3: Technical delivery conditions for case hardening steels |
| EN 10263-4:2001 C2:2003 | Steel rod, bars and wire for cold heading and cold extrusion – Part 4: Technical delivery conditions for steels for quenching and tempering |
| EN 10269:2013 | Steels and nickel alloys for fasteners with specified elevated and/or low temperature properties |

### ISO Standards

| | |
|---|---|
| ISO 683-1:1987 | Heat-Treatable Steels, Alloy Steels and Free-Cutting Steels – Part 1: Direct-Hardening Unalloyed and Low-Alloyed Wrought Steel in Form of Different Black Products |
| ISO 683-10:1987 | Heat-Treatable Steels, Alloy Steels and Free-Cutting Steels – Part 10: Wrought Nitriding Steels |
| ISO 683-11:1987 | Heat-Treatable Steels, Alloy Steels and Free-Cutting Steels – Part 11: Wrought Case-Hardening Steels |

### EN ISO Standards

| | |
|---|---|
| EN ISO 16120-2:2011 | Non-alloy steel wire rod for conversion to wire – Part 2: Specific requirements for general-purpose wire rod |
| EN ISO 16120-4:2011 | Non-alloy steel wire rod for conversion to wire – Part 4: Specific requirements for wire rod for special applications |

### GB Standards

| | |
|---|---|
| GB/T 699-1999 | Quality Carbon Structural Steels |
| GB 715-89 | Hot-Rolled Round Carbon Steel Bars for Standard Parts |
| GB/T 3077-1999 | Alloy Structure Steels |
| GB/T 3078-94 | Technical Requirements for Quality Structural Steel Cold Drawn Bars |
| GB 5216-85 | Technical Requirements for Structural Steel with Specified Hardenability Bands |
| GB 13791-92 | Cold Drawn Special Shaped Steel Bar |

### JIS Standards

| | |
|---|---|
| JIS G 4051:2009 | Carbon steels for machine structural use |
| JIS G 4053:2008 | Low-alloyed steels for machine structural use |
| JIS G 7105:2000 | Heat-treatable steels, alloy steels and free-cutting steels – Part 18: Bright products of unalloyed and low alloy steels |

### SAE Standards

| | |
|---|---|
| SAE J403 JUN14 | Chemical Compositions of SAE Carbon Steels (Long Products Only) |
| SAE J404 JAN09 | Chemical Compositions of SAE Alloy Steels (Hot Rolled and Cold Finished Bars Only) |

**2.1 Chemical Composition of Carbon Steels for General Use**

| Specification | Designation | UNS No. | Steel No. | Weight, %max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASME SA-29/SA-29M | Grade 1005 | G10050 | --- | 0.06 | 0.35 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| ASTM A29/A29M-12e1 | Grade 1005 | G10050 | --- | 0.06 | 0.35 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| EN ISO 16120-2:2011 | C4D | --- | 1.0300 | 0.06 | 0.30-0.60 | 0.30 | 0.035 | 0.035 | 0.20 | 0.25 | 0.05 | Al 0.01; Cu 0.30 |
| EN ISO 16120-4:2011 | C3D2 | --- | 1.1110 | 0.05 | 0.30-0.50 | 0.30 | 0.020 | 0.025 | 0.10 | 0.10 | 0.05 | Al 0.01; Cu 0.15; N 0.007; (Cu+Ni+Cr) 0.30; (Cu+Sn) 0.15 |
| SAE J403 JUN14 | Grade 1005 | G10050 | --- | 0.06 | 0.35 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| ASME SA-29/SA-29M | Grade 1006 | G10060 | --- | 0.08 | 0.25-0.40 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| ASTM A29/A29M-12e1 | Grade 1006 | G10060 | --- | 0.08 | 0.25-0.40 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| EN ISO 16120-2:2011 | C7D | --- | 1.0313 | 0.05-0.09 | 0.30-0.60 | 0.30 | 0.035 | 0.035 | 0.20 | 0.25 | 0.05 | Al 0.01; Cu 0.30 |
| EN ISO 16120-4:2011 | C5D2 | --- | 1.1111 | 0.07 | 0.30-0.50 | 0.30 | 0.020 | 0.025 | 0.10 | 0.10 | 0.05 | Al 0.01; Cu 0.15; N 0.007; (Cu+Ni+Cr) 0.30; (Cu+Sn) 0.15 |
| SAE J403 JUN14 | Grade 1006 | G10060 | --- | 0.08 | 0.25-0.40 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| ASME SA-29/SA-29M | Grade 1008 | G10080 | --- | 0.10 | 0.30-0.50 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| ASTM A29/A29M-12e1 | Grade 1008 | G10080 | --- | 0.10 | 0.30-0.50 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| ASTM A576-90b (2012) | Grade 1008 | G10080 | --- | 0.10 | 0.30-0.50 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| EN ISO 16120-2:2011 | C9D | --- | 1.0304 | 0.10 | 0.30-0.60 | 0.30 | 0.035 | 0.035 | 0.20 | 0.25 | 0.05 | Al 0.01; Cu 0.30 |
| EN ISO 16120-4:2011 | C8D2 | --- | 1.1113 | 0.06-0.10 | 0.30-0.50 | 0.30 | 0.020 | 0.025 | 0.10 | 0.10 | 0.05 | Al 0.01; Cu 0.15; N 0.007; (Cu+Ni+Cr) 0.30; (Cu+Sn) 0.15 |
| GB/T 699-1999 | Grade 08 | --- | --- | 0.05-0.11 | 0.35-0.65 | 0.17-0.37 | --- | --- | 0.10 | 0.30 | --- | Cu 0.25 |
| | Grade 08F | --- | --- | 0.05-0.11 | 0.25-0.50 | 0.03 | --- | --- | 0.10 | 0.30 | --- | Cu 0.25 |
| SAE J403 JUN14 | Grade 1008 | G10080 | --- | 0.10 | 0.30-0.50 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| ASME SA-29/SA-29M | Grade 1010 | G10100 | --- | 0.08-0.13 | 0.30-0.60 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| ASTM A29/A29M-12e1 | Grade 1010 | G10100 | --- | 0.08-0.13 | 0.30-0.60 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| ASTM A576-90b (2012) | Grade 1010 | G10100 | --- | 0.08-0.13 | 0.30-0.60 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| EN 10084:2008 | C10E | --- | 1.1121 | 0.07-0.13 | 0.30-0.60 | 0.40 | 0.035 | 0.035 | --- | --- | --- | --- |
| | C10R | --- | 1.1207 | 0.07-0.13 | 0.30-0.60 | 0.40 | 0.035 | 0.020-0.040 | --- | --- | --- | --- |
| EN ISO 16120-2:2011 | C10D | --- | 1.0310 | 0.08-0.13 | 0.30-0.60 | 0.30 | 0.035 | 0.035 | 0.20 | 0.25 | 0.05 | Al 0.01; Cu 0.30 |
| EN ISO 16120-4:2011 | C10D2 | --- | 1.1114 | 0.08-0.12 | 0.30-0.50 | 0.30 | 0.020 | 0.025 | 0.10 | 0.10 | 0.05 | Al 0.01; Cu 0.15; N 0.007; (Cu+Ni+Cr) 0.30; (Cu+Sn) 0.15 |
| GB 13791-92 | Grade 10 | --- | --- | 0.07-0.13 | 0.35-0.65 | 0.17-0.37 | --- | --- | 0.15 | 0.30 | --- | Cu 0.25 |
| GB/T 3078-94 | Grade 10 | --- | --- | 0.07-0.13 | 0.35-0.65 | 0.17-0.37 | --- | --- | 0.15 | 0.30 | --- | Cu 0.25 |
| | Grade 10F | --- | --- | 0.07-0.13 | 0.50 | 0.03 | 0.035 | 0.035 | --- | --- | --- | --- |
| GB/T 699-1999 | Grade 10 | --- | --- | 0.07-0.13 | 0.35-0.65 | 0.17-0.37 | --- | --- | 0.15 | 0.30 | --- | Cu 0.25 |
| | Grade 10F | --- | --- | 0.07-0.13 | 0.25-0.50 | 0.07 | --- | --- | 0.15 | 0.30 | --- | Cu 0.25 |
| ISO 683-11:1987 | Type C 10 | --- | --- | 0.07-0.13 | 0.30-0.60 | 0.15-0.40 | 0.035 | 0.035 | --- | --- | --- | --- |
| JIS G 4051:2009 | Symbol S10C | --- | --- | 0.08-0.13 | 0.30-0.60 | 0.15-0.35 | 0.030 | 0.035 | 0.20 | 0.20 | --- | Cu 0.30; (Ni+Cr) 0.35 |
| | Symbol S09CK | --- | --- | 0.07-0.12 | 0.30-0.60 | 0.10-0.35 | 0.025 | 0.025 | 0.20 | 0.20 | --- | Cu 0.25; (Ni+Cr) 0.30 |
| SAE J403 JUN14 | Grade 1010 | G10100 | --- | 0.08-0.13 | 0.30-0.60 | --- | 0.040 | 0.050 | --- | --- | --- | --- |

**2.1 Chemical Composition of Carbon Steels for General Use (Continued)**

| Specification | Designation | UNS No. | Steel No. | Weight, %max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASME SA-29/SA-29M | Grade 1012 | G10120 | --- | 0.10-0.15 | 0.30-0.60 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| ASTM A29/A29M-12e1 | Grade 1012 | G10120 | --- | 0.10-0.15 | 0.30-0.60 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| ASTM A576-90b (2012) | Grade 1012 | G10120 | --- | 0.10-0.15 | 0.30-0.60 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| EN ISO 16120-2:2011 | C12D | --- | 1.0311 | 0.10-0.15 | 0.30-0.60 | 0.30 | 0.035 | 0.035 | 0.20 | 0.25 | 0.05 | Al 0.01; Cu 0.30 |
| EN ISO 16120-4:2011 | C12D2 | --- | 1.1124 | 0.10-0.15 | 0.30-0.50 | 0.30 | 0.020 | 0.025 | 0.10 | 0.10 | 0.05 | Al 0.01; Cu 0.15; N 0.007; (Cu+Ni+Cr) 0.30; (Cu+Sn) 0.15 |
| GB 715-89 | Grade BL2 | --- | --- | 0.09-0.15 | 0.25-0.55 | 0.07 | 0.040 | 0.040 | --- | --- | --- | --- |
| JIS G 4051:2009 | Symbol S12C | --- | --- | 0.10-0.15 | 0.30-0.60 | 0.15-0.35 | 0.030 | 0.035 | 0.20 | 0.20 | --- | Cu 0.30; (Ni+Cr) 0.35 |
| SAE J403 JUN14 | Grade 1012 | G10120 | --- | 0.10-0.15 | 0.30-0.60 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| ASME SA-29/SA-29M | Grade 1015 | G10150 | --- | 0.13-0.18 | 0.30-0.60 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| | Grade 1016 | G10160 | --- | 0.13-0.18 | 0.60-0.90 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| ASTM A29/A29M-12e1 | Grade 1015 | G10150 | --- | 0.13-0.18 | 0.30-0.60 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| | Grade 1016 | G10160 | --- | 0.13-0.18 | 0.60-0.90 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| ASTM A576-90b (2012) | Grade 1015 | G10150 | --- | 0.13-0.18 | 0.30-0.60 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| | Grade 1016 | G10160 | --- | 0.13-0.18 | 0.60-0.90 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| EN 10084:2008 | C15R | --- | 1.1140 | 0.12-0.18 | 0.30-0.60 | 0.40 | 0.035 | 0.020-0.040 | --- | --- | --- | --- |
| | C15E | --- | 1.1141 | 0.12-0.18 | 0.30-0.60 | 0.40 | 0.035 | 0.035 | --- | --- | --- | --- |
| | C16E | --- | 1.1148 | 0.12-0.18 | 0.60-0.90 | 0.40 | 0.035 | 0.035 | --- | --- | --- | --- |
| | C16R | --- | 1.1208 | 0.12-0.18 | 0.60-0.90 | 0.40 | 0.035 | 0.020-0.040 | --- | --- | --- | --- |
| EN ISO 16120-2:2011 | C15D | --- | 1.0413 | 0.12-0.17 | 0.30-0.60 | 0.30 | 0.035 | 0.035 | 0.20 | 0.25 | 0.05 | Al 0.01; Cu 0.30 |
| EN ISO 16120-4:2011 | C15D2 | --- | 1.1126 | 0.13-0.17 | 0.30-0.50 | 0.30 | 0.020 | 0.025 | 0.10 | 0.10 | 0.05 | Al 0.01; Cu 0.15; N 0.007; (Cu+Ni+Cr) 0.30; (Cu+Sn) 0.15 |
| GB/T 699-1999 | Grade 15 | --- | --- | 0.12-0.18 | 0.35-0.65 | 0.17-0.37 | --- | --- | 0.25 | 0.30 | --- | Cu 0.25 |
| | Grade 15F | --- | --- | 0.12-0.18 | 0.25-0.50 | 0.07 | --- | --- | 0.25 | 0.30 | --- | Cu 0.25 |
| | Grade 15Mn | --- | --- | 0.12-0.18 | 0.70-1.00 | 0.17-0.37 | --- | --- | 0.25 | 0.30 | --- | Cu 0.25 |
| GB/T 3078-94 | Grade 15 | --- | --- | 0.12-0.18 | 0.35-0.65 | 0.17-0.37 | --- | --- | 0.25 | 0.30 | --- | Cu 0.25 |
| | Grade 15F | --- | --- | 0.12-0.18 | 0.50 | 0.07 | 0.035 | 0.035 | --- | --- | --- | --- |
| | Grade 15Mn | --- | --- | 0.12-0.18 | 0.70-1.00 | 0.17-0.37 | --- | --- | 0.25 | 0.30 | --- | Cu 0.25 |
| GB 13791-92 | Grade 15 | --- | --- | 0.12-0.18 | 0.35-0.65 | 0.17-0.37 | --- | --- | 0.25 | 0.30 | --- | Cu 0.25 |
| ISO 683-11:1987 | Type C 16 M2 | --- | --- | 0.12-0.18 | 0.60-0.90 | 0.15-0.40 | 0.035 | 0.020-0.040 | --- | --- | --- | --- |
| | Type C 16 E4 | --- | --- | 0.12-0.18 | 0.60-0.90 | 0.15-0.40 | 0.035 | 0.035 | --- | --- | --- | --- |
| | Type C 15 M2 | --- | --- | 0.12-0.18 | 0.30-0.60 | 0.15-0.40 | 0.035 | 0.020-0.040 | --- | --- | --- | --- |
| | Type C 15 E4 | --- | --- | 0.12-0.18 | 0.30-0.60 | 0.15-0.40 | 0.035 | 0.035 | --- | --- | --- | --- |
| JIS G 4051:2009 | Symbol S15C | --- | --- | 0.13-0.18 | 0.30-0.60 | 0.15-0.35 | 0.030 | 0.035 | 0.20 | 0.20 | --- | Cu 0.30; (Ni+Cr) 0.35 |
| | Symbol S15CK | --- | --- | 0.13-0.18 | 0.30-0.60 | 0.15-0.35 | 0.025 | 0.025 | 0.20 | 0.20 | --- | Cu 0.25; (Ni+Cr) 0.30 |
| SAE J403 JUN14 | Grade 1015 | G10150 | --- | 0.13-0.18 | 0.30-0.60 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| | Grade 1016 | G10160 | --- | 0.13-0.18 | 0.60-0.90 | --- | 0.040 | 0.050 | --- | --- | --- | --- |

**2.1 Chemical Composition of Carbon Steels for General Use (Continued)**

| Specification | Designation | UNS No. | Steel No. | Weight, %max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASME SA-29/SA-29M | Grade 1017 | G10170 | --- | 0.15-0.20 | 0.30-0.60 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| | Grade 1018 | G10180 | --- | 0.15-0.20 | 0.60-0.90 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| | Grade 1019 | G10190 | --- | 0.15-0.20 | 0.70-1.00 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| ASTM A29/A29M-12e1 | Grade 1017 | G10170 | --- | 0.15-0.20 | 0.30-0.60 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| | Grade 1018 | G10180 | --- | 0.15-0.20 | 0.60-0.90 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| | Grade 1019 | G10190 | --- | 0.15-0.20 | 0.70-1.00 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| ASTM A576-90b (2012) | Grade 1017 | G10170 | --- | 0.15-0.20 | 0.30-0.60 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| | Grade 1018 | G10180 | --- | 0.15-0.20 | 0.60-0.90 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| | Grade 1019 | G10190 | --- | 0.15-0.20 | 0.70-1.00 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| EN ISO 16120-2:2011 | C18D | --- | 1.0416 | 0.15-0.20 | 0.30-0.60 | 0.30 | 0.035 | 0.035 | 0.20 | 0.25 | 0.05 | Al 0.01; Cu 0.30 |
| EN ISO 16120-4:2011 | C18D2 | --- | 1.1129 | 0.16-0.20 | 0.30-0.50 | 0.30 | 0.020 | 0.025 | 0.10 | 0.10 | 0.05 | Al 0.01; Cu 0.15; N 0.007; (Cu+Ni+Cr) 0.30; (Cu+Sn) 0.15 |
| JIS G 4051:2009 | Symbol S17C | --- | --- | 0.15-0.20 | 0.30-0.60 | 0.15-0.35 | 0.030 | 0.035 | 0.20 | 0.20 | --- | Cu 0.30; (Ni+Cr) 0.35 |
| SAE J403 JUN14 | Grade 1017 | G10170 | --- | 0.15-0.20 | 0.30-0.60 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| | Grade 1018 | G10180 | --- | 0.15-0.20 | 0.60-0.90 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| ASME SA-29/SA-29M | Grade 1020 | G10200 | --- | 0.18-0.23 | 0.30-0.60 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| | Grade 1021 | G10210 | --- | 0.18-0.23 | 0.60-0.90 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| | Grade 1022 | G10220 | --- | 0.18-0.23 | 0.70-1.00 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| ASTM A29/A29M-12e1 | Grade 1020 | G10200 | --- | 0.18-0.23 | 0.30-0.60 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| | Grade 1021 | G10210 | --- | 0.18-0.23 | 0.60-0.90 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| | Grade 1022 | G10220 | --- | 0.18-0.23 | 0.70-1.00 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| ASTM A576-90b (2012) | Grade 1020 | G10200 | --- | 0.18-0.23 | 0.30-0.60 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| | Grade 1021 | G10210 | --- | 0.18-0.23 | 0.60-0.90 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| | Grade 1022 | G10220 | --- | 0.18-0.23 | 0.70-1.00 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| EN 10083-2:2006 | C22R | --- | 1.1149 | 0.17-0.24 | 0.40-0.70 | 0.40 | 0.030 | 0.020-0.040 | 0.40 | 0.40 | 0.10 | (Cr+Mo+Ni) 0.63 |
| | C22E | --- | 1.1151 | 0.17-0.24 | 0.40-0.70 | 0.40 | 0.030 | 0.035 | 0.40 | 0.40 | 0.10 | (Cr+Mo+Ni) 0.63 |
| EN 10250-2:1999 C1:2000 | C22 | --- | 1.0402 | 0.17-0.24 | 0.40-0.70 | 0.40 | 0.045 | 0.045 | 0.40 | 0.40 | 0.10 | (Cr+Mo+Ni) 0.63 |
| EN ISO 16120-2:2011 | C20D | --- | 1.0414 | 0.18-0.23 | 0.30-0.60 | 0.30 | 0.035 | 0.035 | 0.20 | 0.25 | 0.05 | Al 0.01; Cu 0.30 |
| EN ISO 16120-4:2011 | C20D2 | --- | 1.1137 | 0.18-0.23 | 0.30-0.50 | 0.30 | 0.020 | 0.025 | 0.10 | 0.10 | 0.05 | Al 0.01; Cu 0.15; N 0.007; (Cu+Ni+Cr) 0.30; (Cu+Sn) 0.15 |
| GB/T 699-1999 | Grade 20 | --- | --- | 0.17-0.23 | 0.35-0.65 | 0.17-0.37 | --- | --- | 0.25 | 0.30 | --- | Cu 0.25 |
| | Grade 20Mn | --- | --- | 0.17-0.23 | 0.70-1.00 | 0.17-0.37 | --- | --- | 0.25 | 0.30 | --- | Cu 0.25 |
| GB 715-89 | Grade BL3 | --- | --- | 0.14-0.22 | 0.30-0.60 | 0.07 | 0.040 | 0.040 | --- | --- | --- | --- |
| GB/T 3078-94 | Grade 20 | --- | --- | 0.17-0.23 | 0.35-0.65 | 0.17-0.37 | --- | --- | 0.25 | 0.30 | --- | Cu 0.25 |
| | Grade 20F | --- | --- | 0.17-0.24 | 0.50 | 0.07 | 0.035 | 0.035 | --- | --- | --- | --- |
| | Grade 20Mn | --- | --- | 0.17-0.23 | 0.70-1.00 | 0.17-0.37 | --- | --- | 0.25 | 0.30 | --- | Cu 0.25 |
| GB 13791-92 | Grade 20 | --- | --- | 0.17-0.23 | 0.35-0.65 | 0.17-0.37 | --- | --- | 0.25 | 0.30 | --- | Cu 0.25 |

Note: This section continued on next page

**2.1 Chemical Composition of Carbon Steels for General Use (Continued)**

| Specification | Designation | UNS No. | Steel No. | Weight, %max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| JIS G 4051:2009 | Symbol S20C | --- | --- | 0.18-0.23 | 0.30-0.60 | 0.15-0.35 | 0.030 | 0.035 | 0.20 | 0.20 | --- | Cu 0.30; (Ni+Cr) 0.35 |
| | Symbol S20CK | --- | --- | 0.18-0.23 | 0.30-0.60 | 0.15-0.35 | 0.025 | 0.025 | 0.20 | 0.20 | --- | Cu 0.25; (Ni+Cr) 0.30 |
| SAE J403 JUN14 | Grade 1020 | G10200 | --- | 0.18-0.23 | 0.30-0.60 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| | Grade 1021 | G10210 | --- | 0.18-0.23 | 0.60-0.90 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| | Grade 1022 | G10220 | --- | 0.18-0.23 | 0.70-1.00 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| ASME SA-29/SA-29M | Grade 1023 | G10230 | --- | 0.20-0.25 | 0.30-0.60 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| ASTM A29/A29M-12e1 | Grade 1023 | G10230 | --- | 0.20-0.25 | 0.30-0.60 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| ASTM A576-90b (2012) | Grade 1023 | G10230 | --- | 0.20-0.25 | 0.30-0.60 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| JIS G 4051:2009 | Symbol S22C | --- | --- | 0.20-0.25 | 0.30-0.60 | 0.15-0.35 | 0.030 | 0.035 | 0.20 | 0.20 | --- | Cu 0.30; (Ni+Cr) 0.35 |
| SAE J403 JUN14 | Grade 1023 | G10230 | --- | 0.20-0.25 | 0.30-0.60 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| ASME SA-29/SA-29M | Grade 1025 | G10250 | --- | 0.22-0.28 | 0.30-0.60 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| | Grade 1026 | G10260 | --- | 0.22-0.28 | 0.60-0.90 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| ASTM A29/A29M-12e1 | Grade 1025 | G10250 | --- | 0.22-0.28 | 0.30-0.60 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| | Grade 1026 | G10260 | --- | 0.22-0.28 | 0.60-0.90 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| ASTM A576-90b (2012) | Grade 1025 | G10250 | --- | 0.22-0.28 | 0.30-0.60 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| | Grade 1026 | G10260 | --- | 0.22-0.28 | 0.60-0.90 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| EN ISO 16120-2:2011 | C26D | --- | 1.0415 | 0.24-0.29 | 0.50-0.80 | 0.10-0.30 | 0.030 | 0.030 | 0.20 | 0.25 | 0.05 | Al 0.01; Cu 0.30 |
| EN ISO 16120-4:2011 | C26D2 | --- | 1.1139 | 0.24-0.29 | 0.50-0.70 | 0.10-0.30 | 0.020 | 0.025 | 0.10 | 0.10 | 0.03 | Al 0.01; Cu 0.15; N 0.007; (Cu+Ni+Cr) 0.30; (Cu+Sn) 0.15 |
| GB 13791-92 | Grade 25 | --- | --- | 0.22-0.29 | 0.50-0.80 | 0.17-0.37 | --- | --- | 0.25 | 0.30 | --- | Cu 0.25 |
| GB/T 3078-94 | Grade 25 | --- | --- | 0.22-0.29 | 0.50-0.80 | 0.17-0.37 | --- | --- | 0.25 | 0.30 | --- | Cu 0.25 |
| | Grade 25Mn | --- | --- | 0.22-0.29 | 0.70-1.00 | 0.17-0.37 | --- | --- | 0.25 | 0.30 | --- | Cu 0.25 |
| GB/T 699-1999 | Grade 25 | --- | --- | 0.22-0.29 | 0.50-0.80 | 0.17-0.37 | --- | --- | 0.25 | 0.30 | --- | Cu 0.25 |
| | Grade 25Mn | --- | --- | 0.22-0.29 | 0.70-1.00 | 0.17-0.37 | --- | --- | 0.25 | 0.30 | --- | Cu 0.25 |
| ISO 683-1:1987 | Grade C 25 | --- | --- | 0.22-0.29 | 0.40-0.70 | 0.10-0.40 | 0.045 | 0.045 | --- | --- | --- | --- |
| | Grade C 25 E4 | --- | --- | 0.22-0.29 | 0.40-0.70 | 0.10-0.40 | 0.035 | 0.035 | --- | --- | --- | --- |
| | Grade C 25 M2 | --- | --- | 0.22-0.29 | 0.40-0.70 | 0.10-0.40 | 0.035 | 0.020-0.040 | --- | --- | --- | --- |
| JIS G 4051:2009 | Symbol S25C | --- | --- | 0.22-0.28 | 0.30-0.60 | 0.15-0.35 | 0.030 | 0.035 | 0.20 | 0.20 | --- | Cu 0.30; (Ni+Cr) 0.35 |
| SAE J403 JUN14 | Grade 1025 | G10250 | --- | 0.22-0.28 | 0.30-0.60 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| | Grade 1026 | G10260 | --- | 0.22-0.28 | 0.60-0.90 | --- | 0.040 | 0.050 | --- | --- | --- | --- |

**2.1 Chemical Composition of Carbon Steels for General Use (Continued)**

| Specification | Designation | UNS No. | Steel No. | Weight, %max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASME SA-29/SA-29M | Grade 1029 | G10290 | --- | 0.25-0.31 | 0.60-0.90 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| ASTM A29/A29M-12e1 | Grade 1029 | G10290 | --- | 0.25-0.31 | 0.60-0.90 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| ASTM A576-90b (2012) | Grade 1029 | G10290 | --- | 0.25-0.31 | 0.60-0.90 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| JIS G 4051:2009 | Symbol S28C | --- | --- | 0.25-0.31 | 0.60-0.90 | 0.15-0.35 | 0.030 | 0.035 | 0.20 | 0.20 | --- | Cu: 0.30; (Ni+Cr) 0.35 |
| SAE J403 JUN14 | Grade 1029 | G10290 | --- | 0.25-0.31 | 0.60-0.90 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| ASME SA-29/SA-29M | Grade 1030 | G10300 | --- | 0.28-0.34 | 0.60-0.90 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| ASTM A29/A29M-12e1 | Grade 1030 | G10300 | --- | 0.28-0.34 | 0.60-0.90 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| ASTM A576-90b (2012) | Grade 1030 | G10300 | --- | 0.28-0.34 | 0.60-0.90 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| GB 13791-92 | Grade 30 | --- | --- | 0.27-0.34 | 0.50-0.80 | 0.17-0.37 | --- | --- | 0.25 | 0.30 | --- | Cu 0.25 |
| GB/T 3078-94 | Grade 30 | --- | --- | 0.27-0.34 | 0.60 | 0.20 | 0.035 | 0.035 | --- | --- | --- | --- |
| | Grade 30Mn | --- | --- | 0.27-0.34 | 0.70-1.00 | 0.17-0.37 | --- | --- | 0.25 | 0.30 | --- | Cu 0.25 |
| GB/T 699-1999 | Grade 30 | --- | --- | 0.27-0.34 | 0.50-0.80 | 0.17-0.37 | --- | --- | 0.25 | 0.30 | --- | Cu 0.25 |
| | Grade 30Mn | --- | --- | 0.27-0.34 | 0.70-1.00 | 0.17-0.37 | --- | --- | 0.25 | 0.30 | --- | Cu 0.25 |
| ISO 683-1:1987 | Grade C 30 | --- | --- | 0.27-0.34 | 0.50-0.80 | 0.10-0.40 | 0.045 | 0.045 | --- | --- | --- | --- |
| | Grade C 30 E4 | --- | --- | 0.27-0.34 | 0.50-0.80 | 0.10-0.40 | 0.035 | 0.035 | --- | --- | --- | --- |
| | Grade C 30 M2 | --- | --- | 0.27-0.34 | 0.50-0.80 | 0.10-0.40 | 0.035 | 0.020-0.040 | --- | --- | --- | --- |
| JIS G 4051:2009 | Symbol S30C | --- | --- | 0.27-0.33 | 0.60-0.90 | 0.15-0.35 | 0.030 | 0.035 | 0.20 | 0.20 | --- | Cu 0.30; (Ni+Cr) 0.35 |
| SAE J403 JUN14 | Grade 1030 | G10300 | --- | 0.28-0.34 | 0.60-0.90 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| EN ISO 16120-2:2011 | C32D | --- | 1.0530 | 0.30-0.35 | 0.50-0.80 | 0.10-0.30 | 0.030 | 0.030 | 0.20 | 0.25 | 0.05 | Al 0.01; Cu 0.30 |
| EN ISO 16120-4:2011 | C32D2 | --- | 1.1143 | 0.30-0.34 | 0.50-0.70 | 0.10-0.30 | 0.020 | 0.025 | 0.10 | 0.10 | 0.03 | Al 0.01; Cu 0.15; N 0.007; (Cu+Ni+Cr) 0.30; (Cu+Sn) 0.15 |
| JIS G 4051:2009 | Symbol S33C | --- | --- | 0.30-0.36 | 0.60-0.90 | 0.15-0.35 | 0.030 | 0.035 | 0.20 | 0.20 | --- | Cu 0.30; (Ni+Cr) 0.35 |

**2.1 Chemical Composition of Carbon Steels for General Use (Continued)**

| Specification | Designation | UNS No. | Steel No. | Weight, %max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASME SA-29/SA-29M | Grade 1034 | G10340 | --- | 0.32-0.38 | 0.50-0.80 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| | Grade 1035 | G10350 | --- | 0.32-0.38 | 0.60-0.90 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| | Grade 1037 | G10370 | --- | 0.32-0.38 | 0.70-1.00 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| ASTM A29/A29M-12e1 | Grade 1034 | G10340 | --- | 0.32-0.38 | 0.50-0.80 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| | Grade 1035 | G10350 | --- | 0.32-0.38 | 0.60-0.90 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| | Grade 1037 | G10370 | --- | 0.32-0.38 | 0.70-1.00 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| ASTM A576-90b (2012) | Grade 1035 | G10350 | --- | 0.32-0.38 | 0.60-0.90 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| | Grade 1037 | G10370 | --- | 0.32-0.38 | 0.70-1.00 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| EN 10083-2:2006 | C35R | --- | 1.1180 | 0.32-0.39 | 0.50-0.80 | 0.40 | 0.030 | 0.020-0.040 | 0.40 | 0.40 | 0.10 | (Cr+Mo+Ni) 0.63 |
| | C35E | --- | 1.1181 | 0.32-0.39 | 0.50-0.80 | 0.40 | 0.030 | 0.035 | 0.40 | 0.40 | 0.10 | (Cr+Mo+Ni) 0.63 |
| | C35 | --- | 1.0501 | 0.32-0.39 | 0.50-0.80 | 0.40 | 0.045 | 0.045 | 0.40 | 0.40 | 0.10 | (Cr+Mo+Ni) 0.63 |
| EN ISO 16120-4:2011 | C36D2 | --- | 1.1145 | 0.34-0.38 | 0.50-0.70 | 0.10-0.30 | 0.020 | 0.025 | 0.10 | 0.10 | 0.03 | Al 0.01; Cu 0.15; N 0.007; (Cu+Ni+Cr) 0.30; (Cu+Sn) 0.15 |
| GB/T 699-1999 | Grade 35 | --- | --- | 0.32-0.39 | 0.50-0.80 | 0.17-0.37 | --- | --- | 0.25 | 0.30 | --- | Cu 0.25 |
| | Grade 35Mn | --- | --- | 0.32-0.39 | 0.70-1.00 | 0.17-0.37 | --- | --- | 0.25 | 0.30 | --- | Cu 0.25 |
| GB/T 3078-94 | Grade 35 | --- | --- | 0.32-0.39 | 0.60 | 0.20 | 0.035 | 0.035 | --- | --- | --- | --- |
| | Grade 35Mn | --- | --- | 0.32-0.39 | 0.70-1.00 | 0.17-0.37 | --- | --- | 0.25 | 0.30 | --- | Cu 0.25 |
| GB 13791-92 | Grade 35 | --- | --- | 0.32-0.39 | 0.50-0.80 | 0.17-0.37 | --- | --- | 0.25 | 0.30 | --- | Cu 0.25 |
| ISO 683-1:1987 | Grade C 35 | --- | --- | 0.32-0.39 | 0.50-0.80 | 0.10-0.40 | 0.045 | 0.045 | --- | --- | --- | --- |
| | Grade C 35 E4 | --- | --- | 0.32-0.39 | 0.50-0.80 | 0.10-0.40 | 0.035 | 0.035 | --- | --- | --- | --- |
| | Grade C 35 M2 | --- | --- | 0.32-0.39 | 0.50-0.80 | 0.10-0.40 | 0.035 | 0.020-0.040 | --- | --- | --- | --- |
| JIS G 4051:2009 | Symbol S35C | --- | --- | 0.32-0.38 | 0.60-0.90 | 0.15-0.35 | 0.030 | 0.035 | 0.20 | 0.20 | --- | Cu 0.30; (Ni+Cr) 0.35 |
| SAE J403 JUN14 | Grade 1035 | G10350 | --- | 0.32-0.38 | 0.60-0.90 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| ASME SA-29/SA-29M | Grade 1038 | G10380 | --- | 0.35-0.42 | 0.60-0.90 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| ASTM A29/A29M-12e1 | Grade 1038 | G10380 | --- | 0.35-0.42 | 0.60-0.90 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| ASTM A576-90b (2012) | Grade 1038 | G10380 | --- | 0.35-0.42 | 0.60-0.90 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| EN ISO 16120-2:2011 | C38D | --- | 1.0516 | 0.35-0.40 | 0.50-0.80 | 0.10-0.30 | 0.030 | 0.030 | 0.20 | 0.25 | 0.05 | Al 0.01; Cu 0.30 |
| EN ISO 16120-4:2011 | C38D2 | --- | 1.1150 | 0.36-0.40 | 0.50-0.70 | 0.10-0.30 | 0.020 | 0.025 | 0.10 | 0.10 | 0.03 | Al 0.01; Cu 0.15; N 0.007; (Cu+Ni+Cr) 0.30; (Cu+Sn) 0.15 |
| JIS G 4051:2009 | Symbol S38C | --- | --- | 0.35-0.41 | 0.60-0.90 | 0.15-0.35 | 0.030 | 0.035 | 0.20 | 0.20 | --- | Cu 0.30; (Ni+Cr) 0.35 |
| SAE J403 JUN14 | Grade 1038 | G10380 | --- | 0.35-0.42 | 0.60-0.90 | --- | 0.040 | 0.050 | --- | --- | --- | --- |

**2.1 Chemical Composition of Carbon Steels for General Use (Continued)**

| Specification | Designation | UNS No. | Steel No. | Weight, %max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASME SA-29/SA-29M | Grade 1039 | G10390 | --- | 0.37-0.44 | 0.70-1.00 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| | Grade 1040 | G10400 | --- | 0.37-0.44 | 0.60-0.90 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| ASTM A29/A29M-12e1 | Grade 1039 | G10390 | --- | 0.37-0.44 | 0.70-1.00 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| | Grade 1040 | G10400 | --- | 0.37-0.44 | 0.60-0.90 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| ASTM A576-90b (2012) | Grade 1039 | G10390 | --- | 0.37-0.44 | 0.70-1.00 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| | Grade 1040 | G10400 | --- | 0.37-0.44 | 0.60-0.90 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| EN 10083-2:2006 | C40E | --- | 1.1186 | 0.37-0.44 | 0.50-0.80 | 0.40 | 0.030 | 0.035 | 0.40 | 0.40 | 0.10 | (Cr+Mo+Ni) 0.63 |
| | C40R | --- | 1.1189 | 0.37-0.44 | 0.50-0.80 | 0.40 | 0.030 | 0.020-0.040 | 0.40 | 0.40 | 0.10 | (Cr+Mo+Ni) 0.63 |
| | C40 | --- | 1.0511 | 0.37-0.44 | 0.50-0.80 | 0.40 | 0.045 | 0.045 | 0.40 | 0.40 | 0.10 | (Cr+Mo+Ni) 0.63 |
| EN ISO 16120-4:2011 | C40D2 | -- | 1.1153 | 0.38-0.42 | 0.50-0.70 | 0.10-0.30 | 0.020 | 0.025 | 0.10 | 0.10 | 0.03 | Al 0.01; Cu 0.15; N 0.007; (Cu+Ni+Cr) 0.30; (Cu+Sn) 0.15 |
| GB 13791-92 | Grade 40 | --- | --- | 0.37-0.44 | 0.50-0.80 | 0.17-0.37 | --- | --- | 0.25 | 0.30 | --- | Cu 0.25 |
| GB/T 3078-94 | Grade 40 | --- | --- | 0.37-0.44 | 0.60 | 0.20 | 0.035 | 0.035 | --- | --- | --- | --- |
| | Grade 40Mn | --- | --- | 0.37-0.44 | 0.70-1.00 | 0.17-0.37 | --- | --- | 0.25 | 0.30 | --- | Cu 0.25 |
| GB/T 699-1999 | Grade 40 | --- | --- | 0.37-0.44 | 0.50-0.80 | 0.17-0.37 | --- | --- | 0.25 | 0.30 | --- | Cu 0.25 |
| | Grade 40Mn | --- | --- | 0.37-0.44 | 0.70-1.00 | 0.17-0.37 | --- | --- | 0.25 | 0.30 | --- | Cu 0.25 |
| ISO 683-1:1987 | Grade C 40 | --- | --- | 0.37-0.44 | 0.50-0.80 | 0.10-0.40 | 0.045 | 0.045 | --- | --- | --- | --- |
| | Grade C 40 E4 | --- | --- | 0.37-0.44 | 0.50-0.80 | 0.10-0.40 | 0.035 | 0.035 | --- | --- | --- | --- |
| | Grade C 40 M2 | --- | --- | 0.37-0.44 | 0.50-0.80 | 0.10-0.40 | 0.035 | 0.020-0.040 | --- | --- | --- | --- |
| JIS G 4051:2009 | Symbol S40C | --- | --- | 0.37-0.43 | 0.60-0.90 | 0.15-0.35 | 0.030 | 0.035 | 0.20 | 0.20 | --- | Cu 0.30; (Ni+Cr) 0.35 |
| SAE J403 JUN14 | Grade 1039 | G10390 | --- | 0.37-0.44 | 0.70-1.00 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| | Grade 1040 | G10400 | --- | 0.37-0.44 | 0.60-0.90 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| ASME SA-29/SA-29M | Grade 1042 | G10420 | --- | 0.40-0.47 | 0.60-0.90 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| | Grade 1043 | G10430 | --- | 0.40-0.47 | 0.70-1.00 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| ASTM A29/A29M-12e1 | Grade 1042 | G10420 | --- | 0.40-0.47 | 0.60-0.90 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| | Grade 1043 | G10430 | --- | 0.40-0.47 | 0.70-1.00 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| ASTM A576-90b (2012) | Grade 1042 | G10420 | --- | 0.40-0.47 | 0.60-0.90 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| | Grade 1043 | G10430 | --- | 0.40-0.47 | 0.70-1.00 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| EN ISO 16120-2:2011 | C42D | --- | 1.0541 | 0.40-0.45 | 0.50-0.80 | 0.10-0.30 | 0.030 | 0.030 | 0.20 | 0.25 | 0.05 | Al 0.01; Cu 0.30 |
| EN ISO 16120-4:2011 | C42D2 | --- | 1.1154 | 0.40-0.44 | 0.50-0.70 | 0.10-0.30 | 0.020 | 0.025 | 0.10 | 0.10 | 0.03 | Al 0.01; Cu 0.15; N 0.007; (Cu+Ni+Cr) 0.30; (Cu+Sn) 0.15 |
| JIS G 4051:2009 | Symbol S43C | --- | --- | 0.40-0.46 | 0.60-0.90 | 0.15-0.35 | 0.030 | 0.035 | 0.20 | 0.20 | --- | Cu 0.30; (Ni+Cr) 0.35 |
| SAE J403 JUN14 | Grade 1042 | G10420 | --- | 0.40-0.47 | 0.60-0.90 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| | Grade 1043 | G10430 | --- | 0.40-0.47 | 0.70-1.00 | --- | 0.040 | 0.050 | --- | --- | --- | --- |

**2.1 Chemical Composition of Carbon Steels for General Use (Continued)**

| Specification | Designation | UNS No. | Steel No. | Weight, %max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASME SA-29/SA-29M | Grade 1044 | G10440 | --- | 0.43-0.50 | 0.30-0.60 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| | Grade 1045 | G10450 | --- | 0.43-0.50 | 0.60-0.90 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| | Grade 1046 | G10460 | --- | 0.43-0.50 | 0.70-1.00 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| ASTM A29/A29M-12e1 | Grade 1044 | G10440 | --- | 0.43-0.50 | 0.30-0.60 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| | Grade 1045 | G10450 | --- | 0.43-0.50 | 0.60-0.90 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| | Grade 1046 | G10460 | --- | 0.43-0.50 | 0.70-1.00 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| ASTM A576-90b (2012) | Grade 1044 | G10440 | --- | 0.43-0.50 | 0.30-0.60 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| | Grade 1045 | G10450 | --- | 0.43-0.50 | 0.60-0.90 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| | Grade 1046 | G10460 | --- | 0.43-0.50 | 0.70-1.00 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| EN 10083-2:2006 | C45E | --- | 1.1191 | 0.42-0.50 | 0.50-0.80 | 0.40 | 0.030 | 0.035 | 0.40 | 0.40 | 0.10 | (Cr+Mo+Ni) 0.63 |
| | C45R | --- | 1.1201 | 0.42-0.50 | 0.50-0.80 | 0.40 | 0.030 | 0.020-0.040 | 0.40 | 0.40 | 0.10 | (Cr+Mo+Ni) 0.63 |
| | C45 | --- | 1.0503 | 0.42-0.50 | 0.50-0.80 | 0.40 | 0.045 | 0.045 | 0.40 | 0.40 | 0.10 | (Cr+Mo+Ni) 0.63 |
| EN ISO 16120-2:2011 | C48D | --- | 1.0517 | 0.45-0.50 | 0.50-0.80 | 0.10-0.30 | 0.030 | 0.030 | 0.15 | 0.20 | 0.05 | Al 0.01; Cu 0.25; (Cu+Sn) 0.25 |
| EN ISO 16120-4:2011 | C46D2 | --- | 1.1162 | 0.44-0.48 | 0.50-0.70 | 0.10-0.30 | 0.020 | 0.025 | 0.10 | 0.10 | 0.03 | Al 0.01; Cu 0.15; N 0.007; (Cu+Ni+Cr) 0.30; (Cu+Sn) 0.15 |
| | C48D2 | --- | 1.1164 | 0.46-0.50 | 0.50-0.70 | 0.10-0.30 | 0.020 | 0.025 | 0.10 | 0.10 | 0.03 | Al 0.01; Cu 0.15; N 0.007; (Cu+Ni+Cr) 0.30; (Cu+Sn) 0.15 |
| GB 13791-92 | Grade 45 | --- | --- | 0.42-0.50 | 0.50-0.80 | 0.17-0.37 | --- | --- | 0.25 | 0.30 | --- | Cu 0.25 |
| GB/T 699-1999 | Grade 45 | --- | --- | 0.42-0.50 | 0.50-0.80 | 0.17-0.37 | --- | --- | 0.25 | 0.30 | --- | Cu 0.25 |
| | Grade 45Mn | --- | --- | 0.42-0.50 | 0.70-1.00 | 0.17-0.37 | --- | --- | 0.25 | 0.30 | --- | Cu 0.25 |
| GB/T 3078-94 | Grade 45 | --- | --- | 0.42-0.49 | 0.60 | 0.20 | 0.035 | 0.035 | --- | --- | --- | --- |
| | Grade 45Mn | --- | --- | 0.42-0.50 | 0.70-1.00 | 0.17-0.37 | --- | --- | 0.25 | 0.30 | --- | Cu 0.25 |
| ISO 683-1:1987 | Grade C 45 | --- | --- | 0.42-0.50 | 0.50-0.80 | 0.10-0.40 | 0.045 | 0.045 | --- | --- | --- | --- |
| | Grade C 45 E4 | --- | --- | 0.42-0.50 | 0.50-0.80 | 0.10-0.40 | 0.035 | 0.035 | --- | --- | --- | --- |
| | Grade C 45 M2 | --- | --- | 0.42-0.50 | 0.50-0.80 | 0.10-0.40 | 0.035 | 0.020-0.040 | --- | --- | --- | --- |
| JIS G 4051:2009 | Symbol S45C | --- | --- | 0.42-0.48 | 0.60-0.90 | 0.15-0.35 | 0.030 | 0.035 | 0.20 | 0.20 | --- | Cu 0.30; (Ni+Cr) 0.35 |
| | Symbol S48C | --- | --- | 0.45-0.51 | 0.60-0.90 | 0.15-0.35 | 0.030 | 0.035 | 0.20 | 0.20 | --- | Cu 0.30; (Ni+Cr) 0.35 |
| SAE J403 JUN14 | Grade 1044 | G10440 | --- | 0.43-0.50 | 0.30-0.60 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| | Grade 1045 | G10450 | --- | 0.43-0.50 | 0.60-0.90 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| | Grade 1046 | G10460 | --- | 0.43-0.50 | 0.70-1.00 | --- | 0.040 | 0.050 | --- | --- | --- | --- |

**2.1 Chemical Composition of Carbon Steels for General Use (Continued)**

| Specification | Designation | UNS No. | Steel No. | Weight, %max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASME SA-29/SA-29M | Grade 1049 | G10490 | --- | 0.46-0.53 | 0.60-0.90 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| | Grade 1050 | G10500 | --- | 0.48-0.55 | 0.60-0.90 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| | Grade 1053 | G10530 | --- | 0.48-0.55 | 0.70-1.00 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| ASTM A29/A29M-12e1 | Grade 1049 | G10490 | --- | 0.46-0.53 | 0.60-0.90 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| | Grade 1050 | G10500 | --- | 0.48-0.55 | 0.60-0.90 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| | Grade 1053 | G10530 | --- | 0.48-0.55 | 0.70-1.00 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| ASTM A576-90b (2012) | Grade 1049 | G10490 | --- | 0.46-0.53 | 0.60-0.90 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| | Grade 1050 | G10500 | --- | 0.48-0.55 | 0.60-0.90 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| | Grade 1053 | G10530 | --- | 0.48-0.55 | 0.70-1.00 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| EN 10083-2:2006 | C50E | --- | 1.1206 | 0.47-0.55 | 0.60-0.90 | 0.40 | 0.030 | 0.035 | 0.40 | 0.40 | 0.10 | (Cr+Mo+Ni) 0.63 |
| | C50R | --- | 1.1241 | 0.47-0.55 | 0.60-0.90 | 0.40 | 0.030 | 0.020-0.040 | 0.40 | 0.40 | 0.10 | (Cr+Mo+Ni) 0.63 |
| EN ISO 16120-2:2011 | C50D | --- | 1.0586 | 0.48-0.53 | 0.50-0.80 | 0.10-0.30 | 0.030 | 0.030 | 0.15 | 0.20 | 0.05 | Al 0.01; Cu 0.25; (Cu+Sn) 0.25 |
| EN ISO 16120-4:2011 | C50D2 | --- | 1.1171 | 0.48-0.52 | 0.50-0.70 | 0.10-0.30 | 0.020 | 0.025 | 0.10 | 0.10 | 0.03 | Al 0.01; Cu 0.15; N 0.007; (Cu+Ni+Cr) 0.30; (Cu+Sn) 0.15 |
| GB 13791-92 | Grade 50 | --- | --- | 0.47-0.55 | 0.50-0.80 | 0.17-0.37 | --- | --- | 0.25 | 0.30 | --- | Cu 0.25 |
| | Grade 50Mn | --- | --- | 0.48-0.56 | 0.70-1.00 | 0.17-0.37 | --- | --- | 0.25 | 0.30 | --- | Cu 0.25 |
| GB/T 3078-94 | Grade 50 | --- | --- | 0.47-0.55 | 0.50-0.80 | 0.17-0.37 | --- | --- | 0.25 | 0.30 | --- | Cu 0.25 |
| | Grade 50Mn | --- | --- | 0.48-0.56 | 0.70-1.00 | 0.17-0.37 | --- | --- | 0.25 | 0.30 | --- | Cu 0.25 |
| GB/T 699-1999 | Grade 50 | --- | --- | 0.47-0.55 | 0.50-0.80 | 0.17-0.37 | --- | --- | 0.25 | 0.30 | --- | Cu 0.25 |
| | Grade 50Mn | --- | --- | 0.48-0.56 | 0.70-1.00 | 0.17-0.37 | --- | --- | 0.25 | 0.30 | --- | Cu 0.25 |
| ISO 683-1:1987 | Grade C 50 | --- | --- | 0.47-0.55 | 0.60-0.90 | 0.10-0.40 | 0.045 | 0.045 | --- | --- | --- | --- |
| | Grade C 50 E4 | --- | --- | 0.47-0.55 | 0.60-0.90 | 0.10-0.40 | 0.035 | 0.035 | --- | --- | --- | --- |
| | Grade C 50 M2 | --- | --- | 0.47-0.55 | 0.60-0.90 | 0.10-0.40 | 0.035 | 0.020-0.040 | --- | --- | --- | --- |
| JIS G 4051:2009 | Symbol S50C | --- | --- | 0.47-0.53 | 0.60-0.90 | 0.15-0.35 | 0.030 | 0.035 | 0.20 | 0.20 | --- | Cu 0.30; (Ni+Cr) 0.35 |
| SAE J403 JUN14 | Grade 1049 | G10490 | --- | 0.46-0.53 | 0.60-0.90 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| | Grade 1050 | G10500 | --- | 0.48-0.55 | 0.60-0.90 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| | Grade 1053 | G10530 | --- | 0.48-0.55 | 0.70-1.00 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| EN ISO 16120-2:2011 | C52D | --- | 1.0588 | 0.50-0.55 | 0.50 | 0.80 | 0.030 | 0.030 | 0.15 | 0.20 | 0.05 | Al 0.01; Cu 0.25; (Cu+Sn) 0.25 |
| EN ISO 16120-4:2011 | C52D2 | --- | 1.1202 | 0.50-0.54 | 0.50-0.70 | 0.10-0.30 | 0.020 | 0.025 | 0.10 | 0.10 | 0.03 | Al 0.01; Cu 0.15; N 0.007; (Cu+Ni+Cr) 0.30; (Cu+Sn) 0.15 |
| JIS G 4051:2009 | Symbol S53C | --- | --- | 0.50-0.56 | 0.60-0.90 | 0.15-0.35 | 0.030 | 0.035 | 0.20 | 0.20 | --- | Cu 0.30; (Ni+Cr) 0.35 |

**2.1 Chemical Composition of Carbon Steels for General Use (Continued)**

| Specification | Designation | UNS No. | Steel No. | Weight, %max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASME SA-29/SA-29M | Grade 1055 | G10550 | --- | 0.50-0.60 | 0.60-0.90 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| ASTM A29/A29M-12e1 | Grade 1055 | G10550 | --- | 0.50-0.60 | 0.60-0.90 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| ASTM A576-90b (2012) | Grade 1055 | G10550 | --- | 0.50-0.60 | 0.60-0.90 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| EN 10083-2:2006 | C55E | --- | 1.1203 | 0.52-0.60 | 0.60-0.90 | 0.40 | 0.030 | 0.035 | 0.40 | 0.40 | 0.10 | (Cr+Mo+Ni) 0.63 |
| | C55R | --- | 1.1209 | 0.52-0.60 | 0.60-0.90 | 0.40 | 0.030 | 0.020-0.040 | 0.40 | 0.40 | 0.10 | (Cr+Mo+Ni) 0.63 |
| | C55 | --- | 1.0535 | 0.52-0.60 | 0.60-0.90 | 0.40 | 0.045 | 0.045 | 0.40 | 0.40 | 0.10 | (Cr+Mo+Ni) 0.63 |
| EN ISO 16120-2:2011 | C56D | --- | 1.0518 | 0.53-0.58 | 0.50-0.80 | 0.10-0.30 | 0.030 | 0.030 | 0.15 | 0.20 | 0.05 | Al 0.01; Cu 0.25; (Cu+Sn) 0.25 |
| EN ISO 16120-4:2011 | C56D2 | --- | 1.1220 | 0.54-0.58 | 0.50-0.70 | 0.10-0.30 | 0.020 | 0.025 | 0.10 | 0.10 | 0.03 | Al 0.01; Cu 0.15; N 0.007; (Cu+Ni+Cr) 0.30; (Cu+Sn) 0.15 |
| GB/T 3078-94 | Grade 55 | --- | --- | 0.52-0.60 | 0.50-0.80 | 0.17-0.37 | --- | --- | 0.25 | 0.30 | --- | Cu 0.25 |
| GB/T 699-1999 | Grade 55 | --- | --- | 0.52-0.60 | 0.50-0.80 | 0.17-0.37 | --- | --- | 0.25 | 0.30 | --- | Cu 0.25 |
| ISO 683-1:1987 | Grade C 55 | --- | --- | 0.52-0.60 | 0.60-0.90 | 0.10-0.40 | 0.045 | 0.045 | --- | --- | --- | --- |
| | Grade C 55 E4 | --- | --- | 0.52-0.60 | 0.60-0.90 | 0.10-0.40 | 0.035 | 0.035 | --- | --- | --- | --- |
| | Grade C 55 M2 | --- | --- | 0.52-0.60 | 0.60-0.90 | 0.10-0.40 | 0.035 | 0.020-0.040 | --- | --- | --- | --- |
| JIS G 4051:2009 | Symbol S55C | --- | --- | 0.52-0.58 | 0.60-0.90 | 0.15-0.35 | 0.030 | 0.035 | 0.20 | 0.20 | --- | Cu 0.30; (Ni+Cr) 0.35 |
| SAE J403 JUN14 | Grade 1055 | G10550 | --- | 0.50-0.60 | 0.60-0.90 | --- | 0.040 | 0.050 | --- | --- | --- | --- |

**2.1 Chemical Composition of Carbon Steels for General Use (Continued)**

| Specification | Designation | UNS No. | Steel No. | Weight, %max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASME SA-29/SA-29M | Grade 1059 | G10590 | --- | 0.55-0.65 | 0.50-0.80 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| | Grade 1060 | G10600 | --- | 0.55-0.65 | 0.60-0.90 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| ASTM A29/A29M-12e1 | Grade 1059 | G10590 | --- | 0.55-0.65 | 0.50-0.80 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| | Grade 1060 | G10600 | --- | 0.55-0.65 | 0.60-0.90 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| ASTM A576-90b (2012) | Grade 1060 | G10600 | --- | 0.55-0.65 | 0.60-0.90 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| EN 10083-2:2006 | C60E | --- | 1.1221 | 0.57-0.65 | 0.60-0.90 | 0.40 | 0.030 | 0.035 | 0.40 | 0.40 | 0.10 | (Cr+Mo+Ni) 0.63 |
| | C60R | --- | 1.1223 | 0.57-0.65 | 0.60-0.90 | 0.40 | 0.030 | 0.020-0.040 | 0.40 | 0.40 | 0.10 | (Cr+Mo+Ni) 0.63 |
| | C60 | --- | 1.0601 | 0.57-0.65 | 0.60-0.90 | 0.40 | 0.045 | 0.045 | 0.40 | 0.40 | 0.10 | (Cr+Mo+Ni) 0.63 |
| EN ISO 16120-2:2011 | C58D | --- | 1.0609 | 0.55-0.60 | 0.50-0.80 | 0.10-0.30 | 0.030 | 0.030 | 0.15 | 0.20 | 0.05 | Al 0.01; Cu 0.25; (Cu+Sn) 0.25 |
| | C60D | --- | 1.0610 | 0.58-0.63 | 0.50-0.80 | 0.10-0.30 | 0.030 | 0.030 | 0.15 | 0.20 | 0.05 | Al 0.01; Cu 0.25; (Cu+Sn) 0.25 |
| EN ISO 16120-4:2011 | C58D2 | --- | 1.1212 | 0.56-0.60 | 0.50-0.70 | 0.10-0.30 | 0.020 | 0.025 | 0.10 | 0.10 | 0.03 | Al 0.01; Cu 0.15; N 0.007; (Cu+Ni+Cr) 0.30; (Cu+Sn) 0.15 |
| | C60D2 | --- | 1.1228 | 0.58-0.62 | 0.50-0.70 | 0.10-0.30 | 0.020 | 0.025 | 0.10 | 0.10 | 0.03 | Al 0.01; Cu 0.15; N 0.007; (Cu+Ni+Cr) 0.30; (Cu+Sn) 0.15 |
| GB 13791-92 | Grade 60 | --- | --- | 0.57-0.65 | 0.50-0.80 | 0.17-0.37 | --- | --- | 0.25 | 0.30 | --- | Cu 0.25 |
| GB/T 3078-94 | Grade 60 | --- | --- | 0.57-0.65 | 0.50-0.80 | 0.17-0.37 | --- | --- | 0.25 | 0.30 | --- | Cu 0.25 |
| | Grade 60Mn | --- | --- | 0.57-0.65 | 0.70-1.00 | 0.17-0.37 | --- | --- | 0.25 | 0.30 | --- | Cu 0.25 |
| GB/T 699-1999 | Grade 60 | --- | --- | 0.57-0.65 | 0.50-0.80 | 0.17-0.37 | --- | --- | 0.25 | 0.30 | --- | Cu 0.25 |
| | Grade 60Mn | --- | --- | 0.57-0.65 | 0.70-1.00 | 0.17-0.37 | --- | --- | 0.25 | 0.30 | --- | Cu 0.25 |
| ISO 683-1:1987 | Grade C 60 | --- | --- | 0.57-0.65 | 0.60-0.90 | 0.10-0.40 | 0.045 | 0.045 | --- | --- | --- | --- |
| | Grade C 60 E4 | --- | --- | 0.57-0.65 | 0.60-0.90 | 0.10-0.40 | 0.035 | 0.035 | --- | --- | --- | --- |
| | Grade C 60 M2 | --- | --- | 0.57-0.65 | 0.60-0.90 | 0.10-0.40 | 0.035 | 0.020-0.040 | --- | --- | --- | --- |
| JIS G 4051:2009 | Symbol S58C | --- | --- | 0.55-0.61 | 0.60-0.90 | 0.15-0.35 | 0.030 | 0.035 | 0.20 | 0.20 | --- | Cu 0.30; (Ni+Cr) 0.35 |
| SAE J403 JUN14 | Grade 1060 | G10600 | --- | 0.55-0.65 | 0.60-0.90 | --- | 0.040 | 0.050 | --- | --- | --- | --- |

**2.1 Chemical Composition of Carbon Steels for General Use (Continued)**

| Specification | Designation | UNS No. | Steel No. | Weight, %max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASME SA-29/SA-29M | Grade 1064 | G10640 | --- | 0.60-0.70 | 0.50-0.80 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| | Grade 1065 | G10650 | --- | 0.60-0.70 | 0.60-0.90 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| ASTM A29/A29M-12e1 | Grade 1064 | G10640 | --- | 0.60-0.70 | 0.50-0.80 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| | Grade 1065 | G10650 | --- | 0.60-0.70 | 0.60-0.90 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| EN ISO 16120-2:2011 | C62D | --- | 1.0611 | 0.60-0.65 | 0.50-0.80 | 0.10-0.30 | 0.030 | 0.030 | 0.15 | 0.20 | 0.05 | Al 0.01; Cu 0.25; (Cu+Sn) 0.25 |
| | C66D | --- | 1.0612 | 0.63-0.68 | 0.50-0.80 | 0.10-0.30 | 0.030 | 0.030 | 0.15 | 0.20 | 0.05 | Al 0.01; Cu 0.25; (Cu+Sn) 0.25 |
| | C68D | --- | 1.0613 | 0.65-0.70 | 0.50-0.80 | 0.10-0.30 | 0.030 | 0.030 | 0.15 | 0.20 | 0.05 | Al 0.01; Cu 0.25; (Cu+Sn) 0.25 |
| EN ISO 16120-4:2011 | C62D2 | --- | 1.1222 | 0.60-0.64 | 0.50-0.70 | 0.10-0.30 | 0.020 | 0.025 | 0.10 | 0.10 | 0.03 | Al 0.01; Cu 0.15; N 0.007; (Cu+Ni+Cr) 0.30; (Cu+Sn) 0.15 |
| | C68D2 | --- | 1.1232 | 0.66-0.70 | 0.50-0.70 | 0.10-0.30 | 0.020 | 0.025 | 0.10 | 0.10 | 0.03 | Al 0.01; Cu 0.15; N 0.007; (Cu+Ni+Cr) 0.30; (Cu+Sn) 0.15 |
| | C66D2 | --- | 1.1236 | 0.64-0.68 | 0.50-0.70 | 0.10-0.30 | 0.020 | 0.025 | 0.10 | 0.10 | 0.03 | Al 0.01; Cu 0.15; N 0.007; (Cu+Ni+Cr) 0.30; (Cu+Sn) 0.15 |
| GB/T 3078-94 | Grade 65 | --- | --- | 0.62-0.70 | 0.50-0.80 | 0.17-0.37 | --- | --- | 0.25 | 0.30 | --- | Cu 0.25 |
| | Grade 65Mn | --- | --- | 0.62-0.70 | 0.90-1.20 | 0.17-0.37 | --- | --- | 0.25 | 0.30 | --- | Cu 0.25 |
| GB/T 699-1999 | Grade 65 | --- | --- | 0.62-0.70 | 0.50-0.80 | 0.17-0.37 | --- | --- | 0.25 | 0.30 | --- | Cu 0.25 |
| | Grade 65Mn | --- | --- | 0.62-0.70 | 0.90-1.20 | 0.17-0.37 | --- | --- | 0.25 | 0.30 | --- | Cu 0.25 |
| SAE J403 JUN14 | Grade 1065 | G10650 | --- | 0.60-0.70 | 0.60-0.90 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| ASME SA-29/SA-29M | Grade 1069 | G10690 | --- | 0.65-0.75 | 0.40-0.70 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| | Grade 1070 | G10700 | --- | 0.65-0.75 | 0.60-0.90 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| | Grade 1071 | --- | --- | 0.65-0.70 | 0.75-1.05 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| ASTM A29/A29M-12e1 | Grade 1069 | G10690 | --- | 0.65-0.75 | 0.40-0.70 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| | Grade 1070 | G10700 | --- | 0.65-0.75 | 0.60-0.90 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| | Grade 1071 | --- | --- | 0.65-0.70 | 0.75-1.05 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| ASTM A576-90b (2012) | Grade 1070 | G10700 | --- | 0.65-0.75 | 0.60-0.90 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| EN ISO 16120-2:2011 | C70D | --- | 1.0615 | 0.68-0.73 | 0.50-0.80 | 0.10-0.30 | 0.030 | 0.030 | 0.15 | 0.20 | 0.05 | Al 0.01; Cu 0.25; (Cu+Sn) 0.25 |
| | C72D | --- | 1.0617 | 0.70-0.75 | 0.50-0.80 | 0.10-0.30 | 0.030 | 0.030 | 0.15 | 0.20 | 0.05 | Al 0.01; Cu 0.25; (Cu+Sn) 0.25 |
| EN ISO 16120-4:2011 | C72D2 | --- | 1.1242 | 0.70-0.74 | 0.50-0.70 | 0.10-0.30 | 0.020 | 0.025 | 0.10 | 0.10 | 0.03 | Al 0.01; Cu 0.15; N 0.007; (Cu+Ni+Cr) 0.30; (Cu+Sn) 0.15 |
| | C70D2 | --- | 1.1251 | 0.68-0.72 | 0.50-0.70 | 0.10-0.30 | 0.020 | 0.025 | 0.10 | 0.10 | 0.03 | Al 0.01; Cu 0.15; N 0.007; (Cu+Ni+Cr) 0.30; (Cu+Sn) 0.15 |
| GB/T 699-1999 | Grade 70 | --- | --- | 0.67-0.75 | 0.50-0.80 | 0.17-0.37 | --- | --- | 0.25 | 0.30 | --- | Cu 0.25 |
| | Grade 70Mn | --- | --- | 0.67-0.75 | 0.90-1.20 | 0.17-0.37 | --- | --- | 0.25 | 0.30 | --- | Cu 0.25 |
| SAE J403 JUN14 | Grade 1070 | G10700 | --- | 0.65-0.75 | 0.60-0.90 | --- | 0.040 | 0.050 | --- | --- | --- | --- |

**2.1 Chemical Composition of Carbon Steels for General Use (Continued)**

| Specification | Designation | UNS No. | Steel No. | Weight, %max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASME SA-29/SA-29M | Grade 1074 | G10740 | --- | 0.70-0.80 | 0.50-0.80 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| | Grade 1075 | G10750 | --- | 0.70-0.80 | 0.40-0.70 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| ASTM A29/A29M-12e1 | Grade 1074 | G10740 | --- | 0.70-0.80 | 0.50-0.80 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| | Grade 1075 | G10750 | --- | 0.70-0.80 | 0.40-0.70 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| EN ISO 16120-2:2011 | C76D | --- | 1.0614 | 0.73-0.78 | 0.50-0.80 | 0.10-0.30 | 0.030 | 0.030 | 0.15 | 0.20 | 0.05 | Al 0.01; Cu 0.25; (Cu+Sn) 0.25 |
| | C78D | --- | 1.0620 | 0.75-0.80 | 0.50-0.80 | 0.10-0.30 | 0.030 | 0.030 | 0.15 | 0.20 | 0.05 | Al 0.01; Cu 0.25; (Cu+Sn) 0.25 |
| EN ISO 16120-4:2011 | C78D2 | --- | 1.1252 | 0.76-0.80 | 0.50-0.70 | 0.10-0.30 | 0.020 | 0.025 | 0.10 | 0.10 | 0.03 | Al 0.01; Cu 0.15; N 0.007; (Cu+Ni+Cr) 0.30; (Cu+Sn) 0.15 |
| | C76D2 | --- | 1.1253 | 0.74-0.78 | 0.50-0.70 | 0.10-0.30 | 0.020 | 0.025 | 0.10 | 0.10 | 0.03 | Al 0.01; Cu 0.15; N 0.007; (Cu+Ni+Cr) 0.30; (Cu+Sn) 0.15 |
| GB/T 699-1999 | Grade 75 | --- | --- | 0.72-0.80 | 0.50-0.80 | 0.17-0.37 | --- | --- | 0.25 | 0.30 | --- | Cu 0.25 |
| SAE J403 JUN14 | Grade 1074 | G10740 | --- | 0.70-0.80 | 0.50-0.80 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| | Grade 1075 | G10750 | --- | 0.70-0.80 | 0.40-0.70 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| ASME SA-29/SA-29M | Grade 1078 | G10780 | --- | 0.72-0.85 | 0.30-0.60 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| ASTM A29/A29M-12e1 | Grade 1078 | G10780 | --- | 0.72-0.85 | 0.30-0.60 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| ASTM A576-90b (2012) | Grade 1078 | G10780 | --- | 0.72-0.85 | 0.30-0.60 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| EN ISO 16120-2:2011 | C80D | --- | 1.0622 | 0.78-0.83 | 0.50-0.80 | 0.10-0.30 | 0.030 | 0.030 | 0.15 | 0.20 | 0.05 | Al 0.01; Cu 0.25; (Cu+Sn) 0.25 |
| | C82D | --- | 1.0626 | 0.80-0.85 | 0.50-0.80 | 0.10-0.30 | 0.030 | 0.030 | 0.15 | 0.20 | 0.05 | Al 0.01; Cu 0.25; (Cu+Sn) 0.25 |
| EN ISO 16120-4:2011 | C80D2 | --- | 1.1255 | 0.78-0.82 | 0.50-0.70 | 0.10-0.30 | 0.020 | 0.025 | 0.10 | 0.10 | 0.03 | Al 0.01; Cu 0.15; N 0.007; (Cu+Ni+Cr) 0.30; (Cu+Sn) 0.15 |
| | C82D2 | --- | 1.1262 | 0.80-0.84 | 0.50-0.70 | 0.10-0.30 | 0.020 | 0.025 | 0.10 | 0.10 | 0.03 | Al 0.01; Cu 0.15; N 0.007; (Cu+Ni+Cr) 0.30; (Cu+Sn) 0.15 |
| GB/T 699-1999 | Grade 80 | --- | --- | 0.77-0.85 | 0.50-0.80 | 0.17-0.37 | --- | --- | 0.25 | 0.30 | --- | Cu 0.25 |
| SAE J403 JUN14 | Grade 1078 | G10780 | --- | 0.72-0.85 | 0.30-0.60 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| ASME SA-29/SA-29M | Grade 1080 | G10800 | --- | 0.75-0.88 | 0.60-0.90 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| ASTM A29/A29M-12e1 | Grade 1080 | G10800 | --- | 0.75-0.88 | 0.60-0.90 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| ASTM A576-90b (2012) | Grade 1080 | G10800 | --- | 0.75-0.88 | 0.60-0.90 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| EN ISO 16120-2:2011 | C86D | --- | 1.0616 | 0.83-0.88 | 0.50-0.80 | 0.10-0.30 | 0.030 | 0.030 | 0.15 | 0.20 | 0.05 | Al 0.01; Cu 0.25; (Cu+Sn) 0.25 |
| EN ISO 16120-4:2011 | C86D2 | --- | 1.1265 | 0.84-0.88 | 0.50-0.70 | 0.10-0.30 | 0.020 | 0.025 | 0.10 | 0.10 | 0.03 | Al 0.01; Cu 0.15; N 0.007; (Cu+Ni+Cr) 0.30; (Cu+Sn) 0.15 |
| SAE J403 JUN14 | Grade 1080 | G10800 | --- | 0.75-0.88 | 0.60-0.90 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| ASME SA-29/SA-29M | Grade 1084 | G10840 | --- | 0.80-0.93 | 0.60-0.90 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| | Grade 1086 | G10860 | --- | 0.80-0.93 | 0.30-0.50 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| ASTM A29/A29M-12e1 | Grade 1084 | G10840 | --- | 0.80-0.93 | 0.60-0.90 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| | Grade 1086 | G10860 | --- | 0.80-0.93 | 0.30-0.50 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| ASTM A576-90b (2012) | Grade 1084 | G10840 | --- | 0.80-0.93 | 0.60-0.90 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| EN ISO 16120-2:2011 | C88D | --- | 1.0628 | 0.85-0.90 | 0.50-0.80 | 0.10-0.30 | 0.030 | 0.030 | 0.15 | 0.20 | 0.05 | Al 0.01; Cu 0.25; (Cu+Sn) 0.25 |
| EN ISO 16120-4:2011 | C88D2 | --- | 1.0628 | 0.86-0.90 | 0.50-0.70 | 0.10-0.30 | 0.020 | 0.025 | 0.10 | 0.10 | 0.03 | Al 0.01; Cu 0.15; N 0.007; (Cu+Ni+Cr) 0.30; (Cu+Sn) 0.15 |
| GB/T 699-1999 | Grade 85 | --- | --- | 0.82-0.90 | 0.50-0.80 | 0.17-0.37 | --- | --- | 0.25 | 0.30 | --- | Cu 0.25 |
| SAE J403 JUN14 | Grade 1084 | G10840 | --- | 0.80-0.93 | 0.60-0.90 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| | Grade 1086 | G10860 | --- | 0.80-0.93 | 0.30-0.50 | --- | 0.040 | 0.050 | --- | --- | --- | --- |

**2.1 Chemical Composition of Carbon Steels for General Use (Continued)**

| Specification | Designation | UNS No. | Steel No. | Weight, %max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASME SA-29/SA-29M | Grade 1090 | G10900 | --- | 0.85-0.98 | 0.60-0.90 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| ASTM A29/A29M-12e1 | Grade 1090 | G10900 | --- | 0.85-0.98 | 0.60-0.90 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| ASTM A576-90b (2012) | Grade 1090 | G10900 | --- | 0.85-0.98 | 0.60-0.90 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| EN ISO 16120-2:2011 | C92D | --- | 1.0618 | 0.90-0.95 | 0.50-0.80 | 0.10-0.30 | 0.030 | 0.030 | 0.15 | 0.20 | 0.05 | Al 0.01; Cu 0.25; (Cu+Sn) 0.25 |
| EN ISO 16120-4:2011 | C92D2 | --- | 1.1282 | 0.90-0.94 | 0.50-0.70 | 0.10-0.30 | 0.020 | 0.025 | 0.10 | 0.10 | 0.03 | Al 0.01; Cu 0.15; N 0.007; (Cu+Ni+Cr) 0.30; (Cu+Sn) 0.15 |
| SAE J403 JUN14 | Grade 1090 | G10900 | --- | 0.85-0.98 | 0.60-0.90 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| ASME SA-29/SA-29M | Grade 1095 | G10950 | --- | 0.90-1.03 | 0.30-0.50 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| ASTM A29/A29M-12e1 | Grade 1095 | G10950 | --- | 0.90-1.03 | 0.30-0.50 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| ASTM A576-90b (2012) | Grade 1095 | G10950 | --- | 0.90-1.03 | 0.30-0.50 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| EN ISO 16120-4:2011 | C98D2 | --- | 1.1283 | 0.96-1.00 | 0.50-0.70 | 0.10-0.30 | 0.020 | 0.025 | 0.10 | 0.10 | 0.03 | Al 0.01; Cu 0.15; N 0.007; (Cu+Ni+Cr) 0.30; (Cu+Sn) 0.15 |
| SAE J403 JUN14 | Grade 1095 | G10950 | --- | 0.90-1.03 | 0.30-0.50 | --- | 0.040 | 0.050 | --- | --- | --- | --- |

**2.2 Chemical Composition of High Manganese Carbon Steels for General Use**

| Specification | Designation | UNS No. | Steel No. | Weight, %max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASME SA-29/SA-29M | Grade 1522 | G15220 | --- | 0.18-0.24 | 1.10-1.40 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| ASTM A29/A29M-12e1 | Grade 1522 | G15220 | --- | 0.18-0.24 | 1.10-1.40 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| | Grade 1524 | G15240 | --- | 0.19-0.25 | 1.35-1.65 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| ASTM A576-90b (2012) | Grade 1522 | G15220 | --- | 0.18-0.24 | 1.10-1.40 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| | Grade 1524 | G15240 | --- | 0.19-0.25 | 1.35-1.65 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| GB/T 3077-1999 | Grade 20Mn2 | --- | --- | 0.17-0.24 | 1.40-1.80 | 0.17-0.37 | 0.035 | 0.035 | 0.30 | 0.30 | 0.15 | Cu 0.30 |
| GB/T 3078-94 | Grade 20Mn2 | --- | --- | 0.17-0.24 | 1.40-1.80 | 0.17-0.37 | 0.035 | 0.035 | 0.30 | 0.30 | 0.15 | Cu 0.30 |
| ISO 683-1:1987 | Grade 22 Mn 6 | --- | --- | 0.19-0.26 | 1.30-1.65 | 0.10-0.40 | 0.035 | 0.035 | --- | --- | --- | --- |
| JIS G 4053:2008 | Symbol SMn420 | --- | --- | 0.17-0.23 | 1.20-1.50 | 0.15-0.35 | 0.030 | 0.030 | 0.35 | 0.25 | --- | Cu 0.30 |
| | Symbol SMnC420 | --- | --- | 0.17-0.23 | 1.20-1.50 | 0.15-0.35 | 0.030 | 0.030 | 0.35-0.70 | 0.25 | --- | Cu 0.30 |
| SAE J403 JUN14 | Grade 1522 | G15220 | --- | 0.18-0.24 | 1.10-1.40 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| | Grade 1524 | G15240 | --- | 0.19-0.25 | 1.35-1.65 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| EN 10083-2:2006 | 28Mn6 | --- | 1.1170 | 0.25-0.32 | 1.30-1.65 | 0.40 | 0.030 | 0.035 | 0.40 | 0.40 | 0.10 | (Cr+Mo+Ni) 0.63 |
| GB/T 3077-1999 | Grade 30Mn2 | --- | --- | 0.27-0.34 | 1.40-1.80 | 0.17-0.37 | 0.035 | 0.035 | 0.30 | 0.30 | 0.15 | Cu 0.30 |
| ISO 683-1:1987 | Grade 28 Mn 6 | --- | --- | 0.25-0.32 | 1.30-1.65 | 0.10-0.40 | 0.035 | 0.035 | --- | --- | --- | --- |
| ASME SA-29/SA-29M | Grade 1536 | G15360 | --- | 0.30-0.37 | 1.20-1.50 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| ASTM A29/A29M-12e1 | Grade 1536 | G15360 | --- | 0.30-0.37 | 1.20-1.50 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| ASTM A576-90b (2012) | Grade 1536 | G15360 | --- | 0.30-0.37 | 1.20-1.50 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| GB/T 3077-1999 | Grade 35Mn2 | --- | --- | 0.32-0.39 | 1.40-1.80 | 0.17-0.37 | 0.035 | 0.035 | 0.30 | 0.30 | 0.15 | Cu 0.30 |
| GB/T 3078-94 | Grade 35Mn2 | --- | --- | 0.32-0.39 | 1.40-1.80 | 0.17-0.37 | 0.035 | 0.035 | 0.30 | 0.30 | 0.15 | Cu 0.30 |
| JIS G 4053:2008 | Symbol SMn433 | --- | --- | 0.30-0.36 | 1.20-1.50 | 0.15-0.35 | 0.030 | 0.030 | 0.35 | 0.25 | --- | Cu 0.30 |
| SAE J403 JUN14 | Grade 1536 | G15360 | --- | 0.30-0.37 | 1.20-1.50 | --- | 0.040 | 0.050 | --- | --- | --- | --- |

**2.2 Chemical Composition of High Manganese Carbon Steels for General Use (Continued)**

| Specification | Designation | UNS No. | Steel No. | Weight, %max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASME SA-29/SA-29M | Grade 1541 | G15410 | --- | 0.36-0.44 | 1.35-1.65 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| ASTM A29/A29M-12e1 | Grade 1541 | G15410 | --- | 0.36-0.44 | 1.35-1.65 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| ASTM A576-90b (2012) | Grade 1541 | G15410 | --- | 0.36-0.44 | 1.35-1.65 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| GB/T 3077-1999 | Grade 40Mn2 | --- | --- | 0.37-0.44 | 1.40-1.80 | 0.17-0.37 | 0.035 | 0.035 | 0.30 | 0.30 | 0.15 | Cu 0.30 |
| GB/T 3078-94 | Grade 40Mn2 | --- | --- | 0.37-0.44 | 1.40-1.80 | 0.17-0.37 | 0.035 | 0.035 | 0.30 | 0.30 | 0.15 | Cu 0.30 |
| ISO 683-1:1987 | Grade 36 Mn 6 | --- | --- | 0.33-0.40 | 1.30-1.65 | 0.10-0.40 | 0.035 | 0.035 | --- | --- | --- | --- |
| JIS G 4053:2008 | Symbol SMn438 | --- | --- | 0.35-0.41 | 1.35-1.65 | 0.15-0.35 | 0.030 | 0.030 | 0.35 | 0.25 | --- | Cu 0.30 |
| SAE J403 JUN14 | Grade 1541 | G15410 | --- | 0.36-0.44 | 1.35-1.65 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| ISO 683-1:1987 | Grade 42 Mn 6 | --- | --- | 0.39-0.46 | 1.30-1.65 | 0.10-0.40 | 0.035 | 0.035 | --- | --- | --- | --- |
| JIS G 4053:2008 | Symbol SMn443 | --- | --- | 0.40-0.46 | 1.35-1.65 | 0.15-0.35 | 0.030 | 0.030 | 0.35 | 0.25 | --- | Cu 0.30 |
| ASTM A29/A29M-12e1 | Grade 1547 | G15470 | --- | 0.43-0.51 | 1.35-1.65 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| ASTM A576-90b (2012) | Grade 1547 | G15470 | --- | 0.43-0.51 | 1.35-1.65 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| GB/T 3077-1999 | Grade 45Mn2 | --- | --- | 0.42-0.49 | 1.40-1.80 | 0.17-0.37 | 0.035 | 0.035 | 0.30 | 0.30 | 0.15 | Cu 0.30 |
| GB/T 3078-94 | Grade 45Mn2 | --- | --- | 0.42-0.49 | 1.40-1.80 | 0.17-0.37 | 0.035 | 0.035 | 0.30 | 0.30 | 0.15 | Cu 0.30 |
| SAE J403 JUN14 | Grade 1547 | G15470 | --- | 0.43-0.51 | 1.35-1.65 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| ASTM A29/A29M-12e1 | Grade 1552 | G15520 | --- | 0.47-0.55 | 1.20-1.50 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| ASTM A576-90b (2012) | Grade 1552 | G15520 | --- | 0.47-0.55 | 1.20-1.50 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| GB/T 3077-1999 | Grade 50Mn2 | --- | --- | 0.47-0.55 | 1.40-1.80 | 0.17-0.37 | 0.035 | 0.035 | 0.30 | 0.30 | 0.15 | Cu 0.30 |
| GB/T 3078-94 | Grade 50Mn2 | --- | --- | 0.47-0.55 | 1.40-1.80 | 0.17-0.37 | 0.035 | 0.035 | 0.30 | 0.30 | 0.15 | Cu 0.30 |
| SAE J403 JUN14 | Grade 1552 | G15520 | --- | 0.47-0.55 | 1.20-1.50 | --- | 0.040 | 0.050 | --- | --- | --- | --- |

## 2.3 Chemical Composition of Alloy Steels for General Use

### 2.3.1 Chromium (Cr) Steels

| Specification | Designation | UNS No. | Steel No. | Weight, %max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| EN 10084:2008 | 17CrS3 | --- | 1.7014 | 0.14-0.20 | 0.60-0.90 | 0.40 | 0.025 | 0.020-0.040 | 0.70-1.00 | --- | --- | --- |
| | 17Cr3 | --- | 1.7016 | 0.14-0.20 | 0.60-0.90 | 0.40 | 0.025 | 0.035 | 0.70-1.00 | --- | --- | --- |
| GB/T 3077-1999 | Grade 15Cr | --- | --- | 0.12-0.18 | 0.40-0.70 | 0.17-0.37 | 0.035 | 0.035 | 0.70-1.00 | 0.30 | 0.15 | Cu 0.30 |
| | Grade 15CrA | --- | --- | 0.12-0.17 | 0.40-0.70 | 0.17-0.37 | 0.025 | 0.025 | 0.70-1.00 | 0.30 | 0.10 | Cu 0.25 |
| GB/T 3078-94 | Grade 15CrA | --- | --- | 0.12-0.17 | 0.40-0.70 | 0.17-0.37 | 0.025 | 0.025 | 0.70-1.00 | 0.30 | 0.10 | Cu 0.25 |
| JIS G 4053:2008 | Symbol SCr415 | --- | --- | 0.13-0.18 | 0.60-0.90 | 0.15-0.35 | 0.030 | 0.030 | 0.90-1.20 | 0.25 | --- | Cu 0.30 |
| ASME SA-29/SA-29M | Grade 5120 | G51200 | --- | 0.17-0.22 | 0.70-0.90 | 0.15-0.35 | 0.035 | 0.040 | 0.70-0.90 | --- | --- | --- |
| ASTM A29/A29M-12e1 | Grade 5120 | G51200 | --- | 0.17-0.22 | 0.70-0.90 | 0.15-0.35 | 0.035 | 0.040 | 0.70-0.90 | --- | --- | --- |
| ASTM A322-13 | Grade 5120 | G51200 | --- | 0.17-0.22 | 0.70-0.90 | 0.15-0.35 | 0.035 | 0.040 | 0.70-0.90 | --- | --- | --- |
| GB 13791-92 | Grade 20Cr | --- | --- | 0.18-0.24 | 0.50-0.80 | 0.17-0.37 | 0.035 | 0.035 | 0.70-1.00 | 0.30 | 0.15 | Cu 0.30 |
| GB 5216-85 | Grade 20CrH | --- | --- | 0.17-0.23 | 0.50-0.85 | 0.17-0.37 | 0.035 | 0.035 | 0.70-1.10 | 0.30 | --- | Cu 0.30 |
| GB/T 3077-1999 | Grade 20Cr | --- | --- | 0.18-0.24 | 0.50-0.80 | 0.17-0.37 | 0.035 | 0.035 | 0.70-1.00 | 0.30 | 0.15 | Cu 0.30 |
| GB/T 3078-94 | Grade 20Cr | --- | --- | 0.18-0.24 | 0.50-0.80 | 0.17-0.37 | 0.035 | 0.035 | 0.70-1.00 | 0.30 | 0.15 | Cu 0.30 |
| ISO 683-11:1987 | Type 20 CrS 4 | --- | --- | 0.17-0.23 | 0.60-0.90 | 0.15-0.40 | 0.035 | 0.020-0.040 | 0.90-1.20 | --- | --- | --- |
| | Type 20 Cr 4 | --- | --- | 0.17-0.23 | 0.60-0.90 | 0.15-0.40 | 0.035 | 0.035 | 0.90-1.20 | --- | --- | --- |
| JIS G 4053:2008 | Symbol SCr420 | --- | --- | 0.18-0.23 | 0.60-0.90 | 0.15-0.35 | 0.030 | 0.030 | 0.90-1.20 | 0.25 | --- | Cu 0.30 |
| SAE J404 JAN09 | Grade 5120 | G51200 | --- | 0.17-0.22 | 0.70-0.90 | 0.15-0.35 | 0.030 | 0.040 | 0.70-0.90 | 0.25 | 0.06 | Cu 0.35 |
| ASME SA-29/SA-29M | Grade 5130 | G51300 | --- | 0.28-0.33 | 0.70-0.90 | 0.15-0.35 | 0.035 | 0.040 | 0.80-1.10 | --- | --- | --- |
| ASTM A29/A29M-12e1 | Grade 5130 | G51300 | --- | 0.28-0.33 | 0.70-0.90 | 0.15-0.35 | 0.035 | 0.040 | 0.80-1.10 | --- | --- | --- |
| ASTM A322-13 | Grade 5130 | G51300 | --- | 0.28-0.33 | 0.70-0.90 | 0.15-0.35 | 0.035 | 0.040 | 0.80-1.10 | --- | --- | --- |
| EN 10084:2008 | 28Cr4 | --- | 1.7030 | 0.24-0.31 | 0.60-0.90 | 0.40 | 0.025 | 0.035 | 0.90-1.20 | --- | --- | --- |
| | 28CrS4 | --- | 1.7036 | 0.24-0.31 | 0.60-0.90 | 0.40 | 0.025 | 0.020-0.040 | 0.90-1.20 | --- | --- | --- |
| GB/T 3077-1999 | Grade 30Cr | --- | --- | 0.27-0.34 | 0.50-0.80 | 0.17-0.37 | 0.035 | 0.035 | 0.80-1.10 | 0.30 | 0.15 | Cu 0.30 |
| GB/T 3078-94 | Grade 30Cr | --- | --- | 0.27-0.34 | 0.50-0.80 | 0.17-0.37 | 0.035 | 0.035 | 0.80-1.10 | 0.30 | 0.15 | Cu 0.30 |
| JIS G 4053:2008 | Symbol SCr430 | --- | --- | 0.28-0.33 | 0.60-0.90 | 0.15-0.35 | 0.030 | 0.030 | 0.90-1.20 | 0.25 | --- | Cu 0.30 |
| SAE J404 JAN09 | Grade 5130 | G51300 | --- | 0.28-0.33 | 0.70-0.90 | 0.15-0.35 | 0.030 | 0.040 | 0.80-1.10 | 0.25 | 0.06 | Cu 0.35 |

**2.3 Chemical Composition of Alloy Steels for General Use (Continued)**

**2.3.1 Chromium (Cr) Steels (Continued)**

| Specification | Designation | UNS No. | Steel No. | Weight, %max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASME SA-29/SA-29M | Grade 5132 | G51320 | --- | 0.30-0.35 | 0.60-0.80 | 0.15-0.35 | 0.035 | 0.040 | 0.75-1.00 | --- | --- | --- |
| ASTM A29/A29M-12e1 | Grade 5132 | G51320 | --- | 0.30-0.35 | 0.60-0.80 | 0.15-0.35 | 0.035 | 0.040 | 0.75-1.00 | --- | --- | --- |
| ASTM A322-13 | Grade 5132 | G51320 | --- | 0.30-0.35 | 0.60-0.80 | 0.15-0.35 | 0.035 | 0.040 | 0.75-1.00 | --- | --- | --- |
| EN 10083-3:2006 C1:2008 | 34Cr4 | --- | 1.7033 | 0.30-0.37 | 0.60-0.90 | 0.40 | 0.025 | 0.035 | 0.90-1.20 | --- | --- | --- |
| | 34CrS4 | --- | 1.7037 | 0.30-0.37 | 0.60-0.90 | 0.40 | 0.025 | 0.020-0.040 | 0.90-1.20 | --- | --- | --- |
| ISO 683-1:1987 | Grade 34 Cr 4 | --- | --- | 0.30-0.37 | 0.60-0.90 | 0.10-0.40 | 0.035 | 0.035 | 0.90-1.20 | --- | --- | --- |
| | Grade 34 CrS 4 | --- | --- | 0.30-0.37 | 0.60-0.90 | 0.10-0.40 | 0.035 | 0.020-0.040 | 0.90-1.20 | --- | --- | --- |
| SAE J404 JAN09 | Grade 5132 | G51320 | --- | 0.30-0.35 | 0.60-0.80 | 0.15-0.35 | 0.030 | 0.040 | 0.75-1.00 | 0.25 | 0.06 | Cu 0.35 |
| ASME SA-29/SA-29M | Grade 5135 | G51350 | --- | 0.33-0.38 | 0.60-0.80 | 0.15-0.35 | 0.035 | 0.040 | 0.80-1.05 | --- | --- | --- |
| ASTM A29/A29M-12e1 | Grade 5135 | G51350 | --- | 0.33-0.38 | 0.60-0.80 | 0.15-0.35 | 0.035 | 0.040 | 0.80-1.05 | --- | --- | --- |
| ASTM A322-13 | Grade 5135 | G51350 | --- | 0.33-0.38 | 0.60-0.80 | 0.15-0.35 | 0.035 | 0.040 | 0.80-1.05 | --- | --- | --- |
| EN 10083-3:2006 C1:2008 | 37Cr4 | --- | 1.7034 | 0.34-0.41 | 0.60-0.90 | 0.40 | 0.025 | 0.035 | 0.90-1.20 | --- | --- | --- |
| | 37CrS4 | --- | 1.7038 | 0.34-0.41 | 0.60-0.90 | 0.40 | 0.025 | 0.020-0.040 | 0.90-1.20 | --- | --- | --- |
| GB/T 3077-1999 | Grade 35Cr | --- | --- | 0.32-0.39 | 0.50-0.80 | 0.17-0.37 | 0.035 | 0.035 | 0.80-1.10 | 0.30 | 0.15 | Cu 0.30 |
| GB/T 3078-94 | Grade 35Cr | --- | --- | 0.32-0.39 | 0.50-0.80 | 0.17-0.37 | 0.035 | 0.035 | 0.80-1.10 | 0.30 | 0.15 | Cu 0.30 |
| ISO 683-1:1987 | Grade 37 Cr 4 | --- | --- | 0.34-0.41 | 0.60-0.90 | 0.10-0.40 | 0.035 | 0.035 | 0.90-1.20 | --- | --- | --- |
| | Grade 37 CrS 4 | --- | --- | 0.34-0.41 | 0.60-0.90 | 0.10-0.40 | 0.035 | 0.020-0.040 | 0.90-1.20 | --- | --- | --- |
| JIS G 4053:2008 | Symbol SCr435 | --- | --- | 0.33-0.38 | 0.60-0.90 | 0.15-0.35 | 0.030 | 0.030 | 0.90-1.20 | 0.25 | --- | Cu 0.30 |
| ASME SA-29/SA-29M | Grade 5140 | G51400 | --- | 0.38-0.43 | 0.70-0.90 | 0.15-0.35 | 0.035 | 0.040 | 0.70-0.90 | --- | --- | --- |
| ASTM A29/A29M-12e1 | Grade 5140 | G51400 | --- | 0.38-0.43 | 0.70-0.90 | 0.15-0.35 | 0.035 | 0.040 | 0.70-0.90 | --- | --- | --- |
| ASTM A322-13 | Grade 5140 | G51400 | --- | 0.38-0.43 | 0.70-0.90 | 0.15-0.35 | 0.035 | 0.040 | 0.70-0.90 | --- | --- | --- |
| EN 10083-3:2006 C1:2008 | 41Cr4 | --- | 1.7035 | 0.38-0.45 | 0.60-0.90 | 0.40 | 0.025 | 0.035 | 0.90-1.20 | --- | --- | --- |
| | 41CrS4 | --- | 1.7039 | 0.38-0.45 | 0.60-0.90 | 0.40 | 0.025 | 0.020-0.040 | 0.90-1.20 | --- | --- | --- |
| GB/T 3077-1999 | Grade 40Cr | --- | --- | 0.37-0.44 | 0.50-0.80 | 0.17-0.37 | 0.035 | 0.035 | 0.80-1.10 | 0.30 | 0.15 | Cu 0.30 |
| GB/T 3078-94 | Grade 40Cr | --- | --- | 0.34-0.42 | 0.50-0.80 | 0.20 | 0.035 | 0.035 | 0.80-1.10 | --- | --- | --- |
| GB 5216-85 | Grade 40CrH | --- | --- | 0.37-0.44 | 0.50-0.85 | 0.17-0.37 | 0.035 | 0.035 | 0.70-1.10 | 0.30 | --- | Cu 0.30 |
| GB 13791-92 | Grade 40Cr | --- | --- | 0.37-0.44 | 0.50-0.80 | 0.17-0.37 | 0.035 | 0.035 | 0.80-1.10 | 0.30 | 0.15 | Cu 0.30 |
| ISO 683-1:1987 | Grade 41 Cr 4 | --- | --- | 0.38-0.45 | 0.60-0.90 | 0.10-0.40 | 0.035 | 0.035 | 0.90-1.20 | --- | --- | --- |
| | Grade 41 CrS 4 | --- | --- | 0.38-0.45 | 0.60-0.90 | 0.10-0.40 | 0.035 | 0.020-0.040 | 0.90-1.20 | --- | --- | --- |
| JIS G 4053:2008 | Symbol SCr440 | --- | --- | 0.38-0.43 | 0.60-0.90 | 0.15-0.35 | 0.030 | 0.030 | 0.90-1.20 | 0.25 | --- | Cu 0.30 |
| SAE J404 JAN09 | Grade 5140 | G51400 | --- | 0.38-0.43 | 0.70-0.90 | 0.15-0.35 | 0.030 | 0.040 | 0.70-0.90 | 0.25 | 0.06 | Cu 0.35 |

**2.3 Chemical Composition of Alloy Steels for General Use (Continued)**

**2.3.1 Chromium (Cr) Steels (Continued)**

| Specification | Designation | UNS No. | Steel No. | Weight, %max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASME SA-29/SA-29M | Grade 5145 | G51450 | --- | 0.43-0.48 | 0.70-0.90 | 0.15-0.35 | 0.035 | 0.040 | 0.70-0.90 | --- | --- | --- |
| ASTM A29/A29M-12e1 | Grade 5145 | G51450 | --- | 0.43-0.48 | 0.70-0.90 | 0.15-0.35 | 0.035 | 0.040 | 0.70-0.90 | --- | --- | --- |
| GB 5216-85 | Grade 45CrH | --- | --- | 0.42-0.49 | 0.50-0.85 | 0.17-0.37 | 0.035 | 0.035 | 0.70-1.10 | 0.30 | --- | Cu 0.30 |
| GB/T 3077-1999 | Grade 45Cr | --- | --- | 0.42-0.49 | 0.50-0.80 | 0.17-0.37 | 0.035 | 0.035 | 0.80-1.10 | 0.30 | 0.15 | Cu 0.30 |
| GB/T 3078-94 | Grade 45Cr | --- | --- | 0.42-0.49 | 0.50-0.80 | 0.17-0.37 | 0.035 | 0.035 | 0.80-1.10 | 0.30 | 0.15 | Cu 0.30 |
| JIS G 4053:2008 | Symbol SCr445 | --- | --- | 0.43-0.48 | 0.60-0.90 | 0.15-0.35 | 0.030 | 0.030 | 0.90-1.20 | 0.25 | --- | Cu 0.30 |
| ASTM A29/A29M-12e1 | Grade 5150 | G51500 | --- | 0.48-0.53 | 0.70-0.90 | 0.15-0.35 | 0.035 | 0.040 | 0.70-0.90 | --- | --- | --- |
| ASTM A322-13 | Grade 5150 | G51500 | --- | 0.48-0.53 | 0.70-0.90 | 0.15-0.35 | 0.035 | 0.040 | 0.70-0.90 | --- | --- | --- |
| GB/T 3077-1999 | Grade 50Cr | --- | --- | 0.47-0.54 | 0.50-0.80 | 0.17-0.37 | 0.035 | 0.035 | 0.80-1.10 | 0.30 | 0.15 | Cu 0.30 |
| SAE J404 JAN09 | Grade 5150 | G51500 | --- | 0.48-0.53 | 0.70-0.90 | 0.15-0.35 | 0.030 | 0.040 | 0.70-0.90 | 0.25 | 0.06 | Cu 0.35 |

**2.3 Chemical Composition of Alloy Steels for General Use (Continued)**

**2.3.2 Chromium-Molybdenum (Cr-Mo) Steels**

| Specification | Designation | UNS No. | Steel No. | Weight, %max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASME SA-29/SA-29M | Grade 4118 | G41180 | --- | 0.18-0.23 | 0.70-0.90 | 0.15-0.35 | 0.035 | 0.040 | 0.40-0.60 | --- | 0.08-0.15 | --- |
| | Grade 4120 | G41200 | --- | 0.18-0.23 | 0.90-1.20 | 0.15-0.35 | 0.035 | 0.040 | 0.40-0.60 | --- | 0.13-0.20 | --- |
| | Grade 4121 | G41210 | --- | 0.18-0.23 | 0.75-1.00 | 0.15-0.35 | 0.035 | 0.040 | 0.45-0.65 | --- | 0.20-0.30 | --- |
| ASTM A29/A29M-12e1 | Grade 4118 | G41180 | --- | 0.18-0.23 | 0.70-0.90 | 0.15-0.35 | 0.035 | 0.040 | 0.40-0.60 | --- | 0.08-0.15 | --- |
| | Grade 4120 | G41200 | --- | 0.18-0.23 | 0.90-1.20 | 0.15-0.35 | 0.035 | 0.040 | 0.40-0.60 | --- | 0.13-0.20 | --- |
| | Grade 4121 | G41210 | --- | 0.18-0.23 | 0.75-1.00 | 0.15-0.35 | 0.035 | 0.040 | 0.45-0.65 | --- | 0.20-0.30 | --- |
| ASTM A322-13 | Grade 4118 | G41180 | --- | 0.18-0.23 | 0.70-0.90 | 0.15-0.35 | 0.035 | 0.040 | 0.40-0.60 | --- | 0.08-0.15 | --- |
| | Grade 4120 | G41200 | --- | 0.18-0.23 | 0.90-1.20 | 0.15-0.35 | 0.035 | 0.040 | 0.40-0.60 | --- | 0.13-0.20 | --- |
| | Grade 4121 | G41210 | --- | 0.18-0.23 | 0.75- 1.00 | 0.15-0.35 | 0.035 | 0.040 | 0.45-0.65 | --- | 0.20-0.30 | --- |
| EN 10084:2008 | 18CrMo4 | --- | 1.7243 | 0.15-0.21 | 0.60-0.90 | 0.40 | 0.025 | 0.035 | 0.90-1.20 | --- | 0.15-0.25 | --- |
| | 18CrMoS4 | --- | 1.7244 | 0.15-0.21 | 0.60-0.90 | 0.40 | 0.025 | 0.020-0.040 | 0.90-1.20 | --- | 0.15-0.25 | --- |
| | 20MoCrS3 | --- | 1.7319 | 0.17-0.23 | 0.60-0.90 | 0.40 | 0.025 | 0.020-0.040 | 0.40-0.70 | --- | 0.30-0.40 | --- |
| | 20MoCr3 | --- | 1.7320 | 0.17-0.23 | 0.60-0.90 | 0.40 | 0.025 | 0.035 | 0.40-0.70 | --- | 0.30-0.40 | --- |
| | 20MoCr4 | --- | 1.7321 | 0.17-0.23 | 0.70-1.00 | 0.40 | 0.025 | 0.035 | 0.30-0.60 | --- | 0.40-0.50 | --- |
| | 20MoCrS4 | --- | 1.7323 | 0.17-0.23 | 0.70-1.00 | 0.40 | 0.025 | 0.020-0.040 | 0.30-0.60 | --- | 0.40-0.50 | --- |
| | 22CrMoS3-5 | --- | 1.7333 | 0.19-0.24 | 0.70-1.00 | 0.40 | 0.025 | 0.020-0.040 | 0.70-1.00 | --- | 0.40-0.50 | --- |
| GB/T 3077-1999 | Grade 20CrMnMo | --- | --- | 0.17-0.23 | 0.90-1.20 | 0.17-0.37 | 0.035 | 0.035 | 1.10-1.40 | 0.30 | 0.20-0.30 | Cu 0.30 |
| | Grade 20CrMo | --- | --- | 0.17-0.24 | 0.40-0.70 | 0.17-0.37 | 0.035 | 0.035 | 0.80-1.10 | 0.30 | 0.15-0.25 | Cu 0.30 |
| GB/T 3078-94 | Grade 20CrMnMo | --- | --- | 0.17-0.23 | 0.90-1.20 | 0.17-0.37 | 0.035 | 0.035 | 1.10-1.40 | 0.30 | 0.20-0.30 | Cu 0.30 |
| | Grade 20CrMo | --- | --- | 0.17-0.24 | 0.40-0.70 | 0.17-0.37 | 0.035 | 0.035 | 0.80-1.10 | 0.30 | 0.15-0.25 | Cu 0.30 |
| GB 5216-85 | Grade 20CrMnMoH | --- | --- | 0.17-0.23 | 0.85-1.20 | 0.17-0.37 | 0.035 | 0.035 | 1.05-1.40 | 0.30 | 0.20-0.30 | Cu 0.30 |
| GB 13791-92 | Grade 20CrMo(A) | --- | --- | 0.17-0.24 | 0.40-0.70 | 0.17-0.37 | 0.025 | 0.025 | 0.80-1.10 | 0.30 | 0.15-0.25 | Cu 0.25 |
| ISO 683-11:1987 | Type 18 CrMo 4 | --- | --- | 0.15-0.21 | 0.60-0.90 | 0.15-0.40 | 0.035 | 0.035 | 0.90-1.20 | --- | 0.15-0.25 | --- |
| | Type 18 CrMoS 4 | --- | --- | 0.15-0.21 | 0.60-0.90 | 0.15-0.40 | 0.035 | 0.020-0.040 | 0.90-1.20 | --- | 0.15-0.25 | --- |
| JIS G 4053:2008 | Symbol SCM418 | --- | --- | 0.16-0.21 | 0.60-0.90 | 0.15-0.35 | 0.030 | 0.030 | 0.90-1.20 | 0.25 | 0.15-0.25 | Cu 0.30 |
| | Symbol SCM420 | --- | --- | 0.18-0.23 | 0.60-0.90 | 0.15-0.35 | 0.030 | 0.030 | 0.90-1.20 | 0.25 | 0.15-0.25 | Cu 0.30 |
| | Symbol SCM421 | --- | --- | 0.17-0.23 | 0.70-1.00 | 0.15-0.35 | 0.030 | 0.030 | 0.90-1.20 | 0.25 | 0.15-0.25 | Cu 0.30 |
| | Symbol SCM822 | --- | --- | 0.20-0.25 | 0.60-0.90 | 0.15-0.35 | 0.030 | 0.030 | 0.90-1.20 | 0.25 | 0.35-0.45 | Cu 0.30 |
| SAE J404 JAN09 | Grade 4118 | G41180 | --- | 0.18-0.23 | 0.70-0.90 | 0.15-0.35 | 0.030 | 0.040 | 0.40-0.60 | 0.25 | 0.08-0.15 | Cu 0.35 |
| | Grade 4120 | G41200 | --- | 0.18-0.23 | 0.90-1.20 | 0.15-0.35 | 0.030 | 0.040 | 0.40-0.60 | 0.25 | 0.13-0.20 | Cu 0.35 |

**2.3 Chemical Composition of Alloy Steels for General Use (Continued)**

**2.3.2 Chromium-Molybdenum (Cr-Mo) Steels (Continued)**

| Specification | Designation | UNS No. | Steel No. | Weight, %max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASME SA-29/SA-29M | Grade 4130 | G41300 | --- | 0.28-0.33 | 0.40-0.60 | 0.15-0.35 | 0.035 | 0.040 | 0.80-1.10 | --- | 0.15-0.25 | --- |
| ASTM A29/A29M-12e1 | Grade 4130 | G41300 | --- | 0.28-0.33 | 0.40-0.60 | 0.15-0.35 | 0.035 | 0.040 | 0.80-1.10 | --- | 0.15-0.25 | --- |
| ASTM A322-13 | Grade 4130 | G41300 | --- | 0.28-0.33 | 0.40-0.60 | 0.15-0.35 | 0.035 | 0.040 | 0.80-1.10 | --- | 0.15-0.25 | --- |
| EN 10083-3:2006 C1:2008 | 25CrMoS4 | --- | 1.7213 | 0.22-0.29 | 0.60-0.90 | 0.40 | 0.025 | 0.020-0.040 | 0.90-1.20 | --- | 0.15-0.30 | --- |
| | 25CrMo4 | --- | 1.7218 | 0.22-0.29 | 0.60-0.90 | 0.40 | 0.025 | 0.035 | 0.90-1.20 | --- | 0.15-0.30 | --- |
| GB/T 3077-1999 | Grade 30CrMo | --- | --- | 0.26-0.34 | 0.40-0.70 | 0.17-0.37 | 0.035 | 0.035 | 0.80-1.10 | 0.30 | 0.15-0.25 | Cu 0.30 |
| | Grade 30CrMoA | --- | --- | 0.26-0.33 | 0.40-0.70 | 0.17-0.37 | 0.025 | 0.025 | 0.80-1.10 | 0.30 | 0.15-0.25 | Cu 0.25 |
| GB/T 3078-94 | Grade 30CrMo | --- | --- | 0.26-0.34 | 0.40-0.70 | 0.17-0.37 | 0.035 | 0.035 | 0.80-1.10 | 0.30 | 0.15-0.25 | Cu 0.30 |
| ISO 683-1:1987 | Grade 25 CrMo 4 | --- | --- | 0.22-0.29 | 0.60-0.90 | 0.10-0.40 | 0.035 | 0.035 | 0.90-1.20 | --- | 0.15-0.30 | --- |
| | Grade 25 CrMoS 4 | --- | --- | 0.22-0.29 | 0.60-0.90 | 0.10-0.40 | 0.035 | 0.020-0.040 | 0.90-1.20 | --- | 0.15-0.30 | --- |
| JIS G 4053:2008 | Symbol SCM425 | --- | --- | 0.23-0.28 | 0.60-0.90 | 0.15-0.35 | 0.030 | 0.030 | 0.90-1.20 | 0.25 | 0.15-0.30 | Cu 0.30 |
| | Symbol SCM430 | --- | --- | 0.28-0.33 | 0.60-0.90 | 0.15-0.35 | 0.030 | 0.030 | 0.90-1.20 | 0.25 | 0.15-0.30 | Cu 0.30 |
| | Symbol SCM432 | --- | --- | 0.27-0.37 | 0.30-0.60 | 0.15-0.35 | 0.030 | 0.030 | 1.00-1.50 | 0.25 | 0.15-0.30 | Cu 0.30 |
| SAE J404 JAN09 | Grade 4130 | G41300 | --- | 0.28-0.33 | 0.40-0.60 | 0.15-0.35 | 0.030 | 0.040 | 0.80-1.10 | 0.25 | 0.15-0.25 | Cu 0.35 |
| ASME SA-29/SA-29M | Grade 4137 | G41370 | --- | 0.35-0.40 | 0.70-0.90 | 0.15-0.35 | 0.035 | 0.040 | 0.80-1.10 | --- | 0.15-0.25 | --- |
| ASTM A29/A29M-12e1 | Grade 4137 | G41370 | --- | 0.35-0.40 | 0.70-0.90 | 0.15-0.35 | 0.035 | 0.040 | 0.80-1.10 | --- | 0.15-0.25 | --- |
| ASTM A322-13 | Grade 4137 | G41370 | --- | 0.35-0.40 | 0.70-0.90 | 0.15-0.35 | 0.035 | 0.040 | 0.80-1.10 | --- | 0.15-0.25 | --- |
| EN 10083-3:2006 C1:2008 | 34CrMo4 | --- | 1.7220 | 0.30-0.37 | 0.60-0.90 | 0.40 | 0.025 | 0.035 | 0.90-1.20 | --- | 0.15-0.30 | --- |
| | 34CrMoS4 | --- | 1.7226 | 0.30-0.37 | 0.60-0.90 | 0.40 | 0.025 | 0.020-0.040 | 0.90-1.20 | --- | 0.15-0.30 | --- |
| GB 13791-92 | Grade 35CrMo(A) | --- | --- | 0.32-0.40 | 0.40-0.70 | 0.17-0.37 | 0.025 | 0.025 | 0.80-1.10 | 0.30 | 0.15-0.25 | Cu 0.25 |
| GB/T 3077-1999 | Grade 35CrMo | --- | --- | 0.32-0.40 | 0.40-0.70 | 0.17-0.37 | 0.035 | 0.035 | 0.80-1.10 | 0.30 | 0.15-0.25 | Cu 0.30 |
| GB/T 3078-94 | Grade 35CrMo | --- | --- | 0.32-0.40 | 0.40-0.70 | 0.17-0.37 | 0.035 | 0.035 | 0.80-1.10 | 0.30 | 0.15-0.25 | Cu 0.30 |
| ISO 683-1:1987 | Grade 34 CrMo 4 | --- | --- | 0.30-0.37 | 0.60-0.90 | 0.10-0.40 | 0.035 | 0.035 | 0.90-1.20 | --- | 0.15-0.30 | --- |
| | Grade 34 CrMoS 4 | --- | --- | 0.30-0.37 | 0.60-0.90 | 0.10-0.40 | 0.035 | 0.020-0.040 | 0.90-1.20 | --- | 0.15-0.30 | --- |
| JIS G 4053:2008 | Symbol SCM435 | --- | --- | 0.33-0.38 | 0.60-0.90 | 0.15-0.35 | 0.030 | 0.030 | 0.90-1.20 | 0.25 | 0.15-0.30 | Cu 0.30 |
| SAE J404 JAN09 | Grade 4137 | G41370 | --- | 0.35-0.40 | 0.70-0.90 | 0.15-0.35 | 0.030 | 0.040 | 0.80-1.10 | 0.25 | 0.15-0.25 | Cu 0.35 |

**2.3 Chemical Composition of Alloy Steels for General Use (Continued)**

**2.3.2 Chromium-Molybdenum (Cr-Mo) Steels (Continued)**

| Specification | Designation | UNS No. | Steel No. | Weight, %max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASME SA-29/SA-29M | Grade 4140 | G41400 | --- | 0.38-0.43 | 0.75-1.00 | 0.15-0.35 | 0.035 | 0.040 | 0.80-1.10 | --- | 0.15-0.25 | --- |
| ASTM A29/A29M-12e1 | Grade 4140 | G41400 | --- | 0.38-0.43 | 0.75-1.00 | 0.15-0.35 | 0.035 | 0.040 | 0.80-1.10 | --- | 0.15-0.25 | --- |
| ASTM A322-13 | Grade 4140 | G41400 | --- | 0.38-0.43 | 0.75-1.00 | 0.15-0.35 | 0.035 | 0.040 | 0.80-1.10 | --- | 0.15-0.25 | --- |
| EN 10083-3:2006 C1:2008 | 42CrMo4 | --- | 1.7225 | 0.38-0.45 | 0.60-0.90 | 0.40 | 0.025 | 0.035 | 0.90-1.20 | --- | 0.15-0.30 | --- |
| | 42CrMoS4 | --- | 1.7227 | 0.38-0.45 | 0.60-0.90 | 0.40 | 0.025 | 0.020-0.040 | 0.90-1.20 | --- | 0.15-0.30 | --- |
| GB/T 3077-1999 | Grade 42CrMo | --- | --- | 0.38-0.45 | 0.50-0.80 | 0.17-0.37 | 0.035 | 0.035 | 0.90-1.20 | 0.30 | 0.15-0.25 | Cu 0.30 |
| GB/T 3078-94 | Grade 42CrMo | --- | --- | 0.38-0.45 | 0.50-0.80 | 0.17-0.37 | 0.035 | 0.035 | 0.90-1.20 | 0.30 | 0.15-0.25 | Cu 0.30 |
| ISO 683-1:1987 | Grade 42 CrMo 4 | --- | --- | 0.38-0.45 | 0.60-0.90 | 0.10-0.40 | 0.035 | 0.035 | 0.90-1.20 | --- | 0.15-0.30 | --- |
| | Grade 42 CrMoS 4 | --- | --- | 0.38-0.45 | 0.60-0.90 | 0.10-0.40 | 0.035 | 0.020-0.040 | 0.90-1.20 | --- | 0.15-0.30 | --- |
| JIS G 4053:2008 | Symbol SCM440 | --- | --- | 0.38-0.43 | 0.60-0.90 | 0.15-0.35 | 0.030 | 0.030 | 0.90-1.20 | 0.25 | 0.15-0.30 | Cu 0.30 |
| SAE J404 JAN09 | Grade 4140 | G41400 | --- | 0.38-0.43 | 0.75-1.00 | 0.15-0.35 | 0.030 | 0.040 | 0.80-1.10 | 0.25 | 0.15-0.25 | Cu 0.35 |
| ASME SA-29/SA-29M | Grade 4145 | G41450 | --- | 0.43-0.48 | 0.75-1.00 | 0.15-0.35 | 0.035 | 0.040 | 0.80-1.10 | --- | 0.15-0.25 | --- |
| ASTM A29/A29M-12e1 | Grade 4145 | G41450 | --- | 0.43-0.48 | 0.75-1.00 | 0.15-0.35 | 0.035 | 0.040 | 0.80-1.10 | --- | 0.15-0.25 | --- |
| ASTM A322-13 | Grade 4145 | G41450 | --- | 0.43-0.48 | 0.75-1.00 | 0.15-0.35 | 0.035 | 0.040 | 0.80-1.10 | --- | 0.15-0.25 | --- |
| JIS G 4053:2008 | Symbol SCM445 | --- | --- | 0.43-0.48 | 0.60-0.90 | 0.15-0.35 | 0.030 | 0.030 | 0.90-1.20 | 0.25 | 0.15-0.30 | Cu 0.30 |
| SAE J404 JAN09 | Grade 4145 | G41450 | --- | 0.43-0.48 | 0.75-1.00 | 0.15-0.35 | 0.030 | 0.040 | 0.80-1.10 | 0.25 | 0.15-0.25 | Cu 0.35 |
| ASME SA-29/SA-29M | Grade 4150 | G41500 | --- | 0.48-0.53 | 0.75-1.00 | 0.15-0.35 | 0.035 | 0.040 | 0.80-1.10 | --- | 0.15-0.25 | --- |
| ASTM A29/A29M-12e1 | Grade 4150 | G41500 | --- | 0.48-0.53 | 0.75-1.00 | 0.15-0.35 | 0.035 | 0.040 | 0.80-1.10 | --- | 0.15-0.25 | --- |
| ASTM A322-13 | Grade 4150 | G41500 | --- | 0.48-0.53 | 0.75-1.00 | 0.15-0.35 | 0.035 | 0.040 | 0.80-1.10 | --- | 0.15-0.25 | --- |
| EN 10083-3:2006 C1:2008 | 50CrMo4 | --- | 1.7228 | 0.46-0.54 | 0.50-0.80 | 0.40 | 0.025 | 0.035 | 0.90-1.20 | --- | 0.15-0.30 | --- |
| ISO 683-1:1987 | Grade 50 CrMo 4 | --- | --- | 0.46-0.54 | 0.50-0.80 | 0.10-0.40 | 0.035 | 0.035 | 0.90-1.20 | --- | 0.15-0.30 | --- |
| JIS G 7105:2000 | Type 50CrMo4 | --- | --- | 0.46-0.54 | 0.50-0.80 | 0.10-0.40 | 0.035 | 0.035 | 0.90-1.20 | --- | 0.15-0.30 | --- |
| SAE J404 JAN09 | Grade 4150 | G41500 | --- | 0.48-0.53 | 0.75-1.00 | 0.15-0.35 | 0.030 | 0.040 | 0.80-1.10 | 0.25 | 0.15-0.25 | Cu 0.35 |

**2.3.3 Chromium-Nickel (Cr-Ni) Steels**

| Specification | Designation | UNS No. | Steel No. | Weight, %max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| EN 10084:2008 | 15NiCr13 | --- | 1.5752 | 0.14-0.20 | 0.40-0.70 | 0.40 | 0.025 | 0.035 | 0.60-0.90 | 3.00-3.50 | --- | --- |
| GB/T 3077-1999 | Grade 12CrNi3 | --- | --- | 0.10-0.17 | 0.30-0.60 | 0.17-0.37 | 0.035 | 0.035 | 0.60-0.90 | 2.75-3.15 | --- | --- |
| ISO 683-11:1987 | Type 15 NiCr 13 | --- | --- | 0.12-0.18 | 0.35-0.65 | 0.15-0.40 | 0.035 | 0.035 | 0.60-0.90 | 3.00-3.50 | --- | --- |
| JIS G 4053:2008 | Symbol SNC815 | --- | --- | 0.12-0.18 | 0.35-0.65 | 0.15-0.35 | 0.030 | 0.030 | 0.60-1.00 | 3.00-3.50 | --- | Cu 0.30 |
| GB/T 3077-1999 | Grade 30CrNi3 | --- | --- | 0.27-0.33 | 0.30-0.60 | 0.17-0.37 | --- | --- | 0.60-0.90 | 2.75-3.15 | --- | --- |
| JIS G 4053:2008 | Symbol SNC631 | --- | --- | 0.27-0.35 | 0.35-0.65 | 0.15-0.35 | 0.030 | 0.030 | 0.60-1.00 | 2.50-3.00 | --- | Cu 0.30 |

**2.3 Chemical Composition of Alloy Steels for General Use (Continued)**

**2.3.4 Nickel-Chromium-Molybdenum (Ni-Cr-Mo) Steels**

| Specification | Designation | UNS No. | Steel No. | Weight, %max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ISO 683-11:1987 | Type 17 NiCrMo 6 | --- | --- | 0.14-0.20 | 0.60-0.90 | 0.15-0.40 | 0.035 | 0.035 | 0.80-1.10 | 1.20-1.60 | 0.15-0.25 | --- |
| JIS G 4053:2008 | Symbol SNCM415 | --- | --- | 0.12-0.18 | 0.40-0.70 | 0.15-0.35 | 0.030 | 0.030 | 0.40-0.60 | 1.60-2.00 | 0.15-0.30 | Cu 0.30 |
| ASME SA-29/SA-29M | Grade 4320 | G43200 | --- | 0.17-0.22 | 0.45-0.65 | 0.15-0.35 | 0.035 | 0.040 | 0.40-0.60 | 1.65-2.00 | 0.20-0.30 | --- |
| ASTM A29/A29M-12e1 | Grade 4320 | G43200 | --- | 0.17-0.22 | 0.45-0.65 | 0.15-0.35 | 0.035 | 0.040 | 0.40-0.60 | 1.65-2.00 | 0.20-0.30 | --- |
| ASTM A322-13 | Grade 4320 | G43200 | --- | 0.17-0.22 | 0.45-0.65 | 0.15-0.35 | 0.035 | 0.040 | 0.40-0.60 | 1.65-2.00 | 0.20-0.30 | --- |
| EN 10084:2008 | 20NiCrMoS6-4 | --- | 1.6571 | 0.16-0.23 | 0.50-0.90 | 0.40 | 0.025 | 0.020-0.040 | 0.60-0.90 | 1.40-1.70 | 0.25-0.35 | --- |
| GB/T 3077-1999 | Grade 20CrNiMo | --- | --- | 0.17-0.23 | 0.60-0.95 | 0.17-0.37 | 0.035 | 0.035 | 0.40-0.70 | 0.35-0.75 | 0.20-0.30 | --- |
| JIS G 4053:2008 | Symbol SNCM420 | --- | --- | 0.17-0.23 | 0.40-0.70 | 0.15-0.35 | 0.030 | 0.030 | 0.40-0.60 | 1.60-2.00 | 0.15-0.30 | Cu 0.30 |
| SAE J404 JAN09 | Grade 4320 | G43200 | --- | 0.17-0.22 | 0.45-0.65 | 0.15-0.35 | 0.030 | 0.040 | 0.40-0.60 | 1.65-2.00 | 0.20-0.30 | Cu 0.35 |
| ASME SA-29/SA-29M | Grade 4340 | G43400 | --- | 0.38-0.43 | 0.60-0.80 | 0.15-0.35 | 0.035 | 0.040 | 0.70-0.90 | 1.65-2.00 | 0.20-0.30 | --- |
| | Grade E4340 | G43406 | --- | 0.38-0.43 | 0.65-0.85 | 0.15-0.35 | 0.025 | 0.025 | 0.70-0.90 | 1.65-2.00 | 0.20-0.30 | --- |
| ASTM A29/A29M-12e1 | Grade 4340 | G43400 | --- | 0.38-0.43 | 0.60-0.80 | 0.15-0.35 | 0.035 | 0.040 | 0.70-0.90 | 1.65-2.00 | 0.20-0.30 | --- |
| | Grade E4340 | G43406 | --- | 0.38-0.43 | 0.65-0.85 | 0.15-0.35 | 0.025 | 0.025 | 0.70-0.90 | 1.65-2.00 | 0.20-0.30 | --- |
| ASTM A322-13 | Grade 4340 | G43400 | --- | 0.38-0.43 | 0.60-0.80 | 0.15-0.35 | 0.035 | 0.040 | 0.70-0.90 | 1.65-2.00 | 0.20-0.30 | --- |
| | Grade E4340 | G43406 | --- | 0.38-0.43 | 0.65-0.85 | 0.15-0.35 | 0.025 | 0.025 | 0.70-0.90 | 1.65-2.00 | 0.20-0.30 | --- |
| GB/T 3077-1999 | Grade 40CrNiMoA | --- | --- | 0.37-0.44 | 0.50-0.80 | 0.17-0.37 | 0.025 | 0.025 | 0.60-0.90 | 1.25-1.65 | 0.15-0.25 | Cu 0.25 |
| GB/T 3078-94 | Grade 40CrNiMoA | --- | --- | 0.37-0.44 | 0.50-0.80 | 0.17-0.37 | 0.025 | 0.025 | 0.60-0.90 | 1.25-1.65 | 0.15-0.25 | Cu 0.25 |
| JIS G 4053:2008 | Symbol SNCM439 | --- | --- | 0.36-0.43 | 0.60-0.90 | 0.15-0.35 | 0.030 | 0.030 | 0.60-1.00 | 1.60-2.00 | 0.15-0.30 | Cu 0.30 |
| SAE J404 JAN09 | Grade 4340 | G43400 | --- | 0.38-0.43 | 0.60-0.80 | 0.15-0.35 | 0.030 | 0.040 | 0.70-0.90 | 1.65-2.00 | 0.20-0.30 | Cu 0.35 |
| | Grade E4340 | G43406 | --- | 0.38-0.43 | 0.65-0.85 | 0.15-0.35 | 0.025 | 0.025 | 0.70-0.90 | 1.65-2.00 | 0.20-0.30 | Cu 0.35 |
| ASME SA-29/SA-29M | Grade 8620 | G86200 | --- | 0.18-0.23 | 0.70-0.90 | 0.15-0.35 | 0.035 | 0.040 | 0.40-0.60 | 0.40-0.70 | 0.15-0.25 | --- |
| ASTM A29/A29M-12e1 | Grade 8620 | G86200 | --- | 0.18-0.23 | 0.70-0.90 | 0.15-0.35 | 0.035 | 0.040 | 0.40-0.60 | 0.40-0.70 | 0.15-0.25 | --- |
| ASTM A322-13 | Grade 8620 | G86200 | --- | 0.18-0.23 | 0.70-0.90 | 0.15-0.35 | 0.035 | 0.04 | 0.40-0.60 | 0.40-0.70 | 0.15-0.25 | --- |
| EN 10084:2008 | 20NiCrMo2-2 | --- | 1.6523 | 0.17-0.23 | 0.65-0.95 | 0.40 | 0.025 | 0.035 | 0.35-0.70 | 0.40-0.70 | 0.15-0.25 | --- |
| | 20NiCrMoS2-2 | --- | 1.6526 | 0.17-0.23 | 0.65-0.95 | 0.40 | 0.025 | 0.020-0.040 | 0.35-0.70 | 0.40-0.70 | 0.15-0.25 | --- |
| GB 5216-85 | Grade 20CrNiMoH | --- | --- | 0.17-0.23 | 0.60-0.95 | 0.17-0.37 | 0.035 | 0.035 | 0.35-0.65 | 0.35-0.75 | 0.15-0.25 | Cu 0.30 |
| ISO 683-11:1987 | Type 20 NiCrMo 2 | --- | --- | 0.17-0.23 | 0.65-0.95 | 0.15-0.4 | 0.035 | 0.035 | 0.30-0.65 | 0.40-0.70 | 0.15-0.25 | --- |
| | Type 20 NiCrMoS 2 | --- | --- | 0.17-0.23 | 0.65-0.95 | 0.15-0.4 | 0.035 | 0.020-0.040 | 0.30-0.65 | 0.40-0.70 | 0.15-0.25 | --- |
| JIS G 4053:2008 | Symbol SNCM220 | --- | --- | 0.17-0.23 | 0.60-0.90 | 0.15-0.35 | 0.030 | 0.030 | 0.40-0.60 | 0.40-0.70 | 0.15-0.25 | Cu 0.30 |
| SAE J404 JAN09 | Grade 8620 | G86200 | --- | 0.18-0.23 | 0.70-0.90 | 0.15-0.35 | 0.030 | 0.040 | 0.40-0.60 | 0.40-0.70 | 0.15-0.25 | Cu 0.35 |

**2.3 Chemical Composition of Alloy Steels for General Use (Continued)**

**2.3.4 Nickel-Chromium-Molybdenum (Ni-Cr-Mo) Steels (Continued)**

| Specification | Designation | UNS No. | Steel No. | Weight, %max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASME SA-29/SA-29M | Grade 8640 | G86400 | --- | 0.38-0.43 | 0.75-1.00 | 0.15-0.35 | 0.035 | 0.040 | 0.40-0.60 | 0.40-0.70 | 0.15-0.25 | --- |
| ASTM A29/A29M-12e1 | Grade 8640 | G86400 | --- | 0.38-0.43 | 0.75-1.00 | 0.15-0.35 | 0.035 | 0.040 | 0.40-0.60 | 0.40-0.70 | 0.15-0.25 | --- |
| ASTM A322-13 | Grade 8640 | G86400 | --- | 0.38-0.43 | 0.75-1.00 | 0.15-0.35 | 0.035 | 0.040 | 0.40-0.60 | 0.40-0.70 | 0.15-0.25 | --- |
| ISO 683-1:1987 | Grade 41 CrNiMo 2 | --- | --- | 0.37-0.44 | 0.70-1.00 | 0.10-0.40 | 0.035 | 0.035 | 0.40-0.60 | 0.40-0.70 | 0.15-0.30 | --- |
| | Grade 41 CrNiMoS 2 | --- | --- | 0.37-0.44 | 0.70-1.00 | 0.10-0.40 | 0.035 | 0.020-0.040 | 0.40-0.60 | 0.40-0.70 | 0.15-0.30 | --- |
| JIS G 4053:2008 | Symbol SNCM240 | --- | --- | 0.38-0.43 | 0.70-1.00 | 0.15-0.35 | 0.030 | 0.030 | 0.40-0.60 | 0.40-0.70 | 0.15-0.30 | Cu 0.30 |
| SAE J404 JAN09 | Grade 8640 | G86400 | --- | 0.38-0.43 | 0.75-1.00 | 0.15-0.35 | 0.030 | 0.040 | 0.40-0.60 | 0.40-0.70 | 0.15-0.25 | Cu 0.35 |
| ASME SA-29/SA-29M | Grade E9310 | G93106 | --- | 0.08-0.13 | 0.45-0.65 | 0.15-0.30 | 0.025 | 0.025 | 1.00-1.40 | 3.00-3.50 | 0.08-0.15 | --- |
| ASTM A29/A29M-12e1 | Grade E9310 | G93106 | --- | 0.08-0.13 | 0.45-0.65 | 0.15-0.30 | 0.025 | 0.025 | 1.00-1.40 | 3.00-3.50 | 0.08-0.15 | --- |
| EN 10084:2008 | 14NiCrMo13-4 | --- | 1.6657 | 0.11-0.17 | 0.30-0.60 | 0.40 | 0.025 | 0.035 | 0.80-1.10 | 3.00-3.50 | 0.20-0.30 | --- |

**2.3.5 Chromium-Molybdenum-Aluminum (Cr-Mo-Al) Steels**

| Specification | Designation | UNS No. | Steel No. | Weight, %max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASTM A355-89 (2012) | Class A | K24065 | --- | 0.38-0.43 | 0.50-0.70 | 0.15-0.35 | 0.035 | 0.040 | 1.40-1.80 | --- | 0.30-0.40 | Al 0.95-1.30 |
| EN 10085:2001 | 32CrAlMo7-10 | --- | 1.8505 | 0.28-0.35 | 0.40-0.70 | 0.40 | 0.025 | 0.035 | 1.50-1.80 | --- | 0.20-0.40 | Al 0.80-1.20 |
| | 34CrAlMo5-10 | --- | 1.8507 | 0.30-0.37 | 0.40-0.70 | 0.40 | 0.025 | 0.035 | 1.00-1.30 | --- | 0.15-0.25 | Al 0.80-1.20 |
| | 41CrAlMo7-10 | --- | 1.8509 | 0.38-0.45 | 0.40-0.70 | 0.40 | 0.025 | 0.035 | 1.50-1.80 | --- | 0.20-0.35 | Al 0.80-1.20 |
| | 34CrAlNi7-10 | --- | 1.8550 | 0.30-0.37 | 0.40-0.70 | 0.40 | 0.025 | 0.035 | 1.50-1.80 | 0.85-1.15 | 0.15-0.25 | Al 0.80-1.20 |
| GB/T 3077-1999 | Grade 38CrMoAl | --- | --- | 0.35-0.42 | 0.30-0.60 | 0.20-0.45 | 0.035 | 0.035 | 1.35-1.65 | 0.30 | 0.15-0.25 | Al 0.70-1.10; Cu 0.30 |
| GB/T 3078-94 | Grade 38CrMoAlA | --- | --- | 0.35-0.42 | 0.30-0.60 | 0.20-0.45 | 0.025 | 0.025 | 1.35-1.65 | 0.30 | 0.15-0.25 | Al 0.70-1.10; Cu 0.25 |
| ISO 683-10:1987 | Type 41 CrAlMo 74 | --- | --- | 0.38-0.45 | 0.50-0.80 | 0.50 | 0.030 | 0.035 | 1.50-1.80 | --- | 0.15-0.30 | Al 0.8-1.20 |
| JIS G 4053:2008 | Symbol SACM645 | --- | --- | 0.40-0.50 | 0.60 | 0.15-0.50 | 0.030 | 0.030 | 1.30-1.70 | 0.25 | 0.15-0.30 | Al 0.70-1.20; Cu 0.30 |

**2.3 Chemical Composition of Alloy Steels for General Use (Continued)**

**2.3.6 Boron (B) Steels**

| Specification | Designation | UNS No. | Steel No. | Weight, %max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASTM A29/A29M-12e1 | Grade 10B18 | G10181 | --- | 0.15-0.20 | 0.60-0.90 | --- | 0.040 | 0.050 | --- | --- | --- | B 0.0005-0.003 |
| EN 10263-3:2001 C1:2001 | Grade 18B2 | --- | 1.5503 | 0.16-0.20 | 0.60-0.80 | 0.30 | 0.025 | 0.025 | --- | --- | --- | B 0.0008-0.005; Cu 0.25 |
| EN 10263-4:2001 C2:2003 | Grade 17B2 | --- | 1.5502 | 0.15-0.20 | 0.60-0.90 | 0.30 | 0.025 | 0.025 | 0.30 | --- | --- | B 0.0008-0.005; Cu 0.25 |
| SAE J403 JUN14 | Grade 10B18 | G10181 | --- | 0.15-0.20 | 0.60-0.90 | --- | 0.040 | 0.050 | --- | -- | --- | B 0.0005-0.003 |
| ASTM A29/A29M-12e1 | Grade 10B23 | G10231 | --- | 0.20-0.25 | 0.30-0.60 | --- | 0.040 | 0.050 | --- | --- | --- | B 0.0005-0.003 |
| EN 10263-4:2001 C2:2003 | Grade 23B2 | --- | 1.5508 | 0.20-0.25 | 0.60-0.90 | 0.30 | 0.025 | 0.025 | 0.30 | --- | --- | B 0.0008-0.005; Cu 0.25 |
| SAE J403 JUN14 | Grade 10B23 | G10231 | --- | 0.20-0.25 | 0.30-0.60 | --- | 0.040 | 0.050 | --- | --- | --- | B 0.0005-0.003 |
| ASTM A29/A29M-12e1 | Grade 10B29 | G10291 | --- | 0.25-0.31 | 0.60-0.90 | --- | 0.040 | 0.050 | --- | --- | --- | B 0.0005-0.003 |
| EN 10263-4:2001 C2:2003 | Grade 28B2 | --- | 1.5510 | 0.25-0.30 | 0.60-0.90 | 0.30 | 0.025 | 0.025 | 0.30 | --- | --- | B 0.0008-0.005; Cu 0.25 |
| SAE J403 JUN14 | Grade 10B29 | G10291 | --- | 0.25-0.31 | 0.60-0.90 | --- | 0.040 | 0.050 | --- | --- | --- | B 0.0005-0.003 |
| ASTM A29/A29M-12e1 | Grade 10B30 | G10301 | --- | 0.28-0.34 | 0.60-0.90 | --- | 0.040 | 0.050 | --- | --- | --- | B0.0005-0.003 |
| EN 10263-4:2001 C2:2003 | Grade 33B2 | --- | 1.5514 | 0.30-0.35 | 0.60-0.90 | 0.30 | 0.025 | 0.025 | 0.30 | --- | --- | B 0.0008-0.005; Cu 0.25 |
| SAE J403 JUN14 | Grade 10B30 | G10301 | --- | 0.28-0.34 | 0.60-0.90 | --- | 0.040 | 0.050 | --- | --- | --- | B0.0005-0.003 |
| ASTM A29/A29M-12e1 | Grade 10B38 | G10381 | --- | 0.35-0.42 | 0.60-0.90 | --- | 0.040 | 0.050 | --- | --- | --- | B 0.0005-0.003 |
| EN 10263-4:2001 C2:2003 | Grade 38B2 | --- | 1.5515 | 0.35-0.40 | 0.60-0.90 | 0.15-0.30 | 0.025 | 0.025 | 0.30 | --- | --- | B 0.0008-0.005; Cu 0.25 |
| EN 10269:2013 | Grade 35B2 | --- | 1.5511 | 0.32-0.39 | 0.50-0.80 | 0.40 | 0.030 | 0.015 | --- | --- | --- | B 0.0008-0.0050; Al 0.020 min. |
| SAE J403 JUN14 | Grade 10B38 | G10381 | --- | 0.35-0.42 | 0.60-0.90 | --- | 0.040 | 0.050 | --- | --- | --- | B 0.0005-0.003 |
| ASTM A29/A29M-12e1 | Grade 10B40 | G10401 | --- | 0.37-0.44 | 0.60-0.90 | --- | 0.040 | 0.050 | --- | --- | --- | B 0.0005-0.003 |
| GB/T 3077-1999 | Grade 40B | --- | --- | 0.37-0.44 | 0.60-0.90 | 0.17-0.37 | 0.035 | 0.035 | 0.30 | 0.30 | 0.15 | B 0.0005-0.0035; Cu 0.30 |
| GB/T 3078-94 | Grade 40B | --- | --- | 0.37-0.44 | 0.60-0.90 | 0.17-0.37 | 0.035 | 0.035 | 0.30 | 0.30 | 0.15 | B 0.0005-0.0035; Cu 0.30 |
| SAE J403 JUN14 | Grade 10B40 | G10401 | --- | 0.37-0.44 | 0.60-0.90 | --- | 0.040 | 0.050 | --- | --- | --- | B 0.0005-0.003 |
| ASTM A29/A29M-12e1 | Grade 10B45 | G10451 | --- | 0.43-0.50 | 0.60-0.90 | --- | 0.040 | 0.050 | --- | --- | --- | B 0.0005-0.003 |
| GB/T 3077-1999 | Grade 45B | --- | --- | 0.42-0.49 | 0.60-0.90 | 0.17-0.37 | 0.035 | 0.035 | 0.30 | 0.30 | 0.15 | B 0.0005-0.0035; Cu 0.30 |
| GB/T 3078-94 | Grade 45B | --- | --- | 0.42-0.49 | 0.60-0.90 | 0.17-0.37 | 0.035 | 0.035 | 0.30 | 0.30 | 0.15 | B 0.0005-0.0035; Cu 0.30 |
| SAE J403 JUN14 | Grade 10B45 | G10451 | --- | 0.43-0.50 | 0.60-0.90 | --- | 0.040 | 0.050 | --- | --- | --- | B 0.0005-0.003 |
| ASTM A29/A29M-12e1 | Grade 10B50 | G10501 | --- | 0.48-0.55 | 0.60-0.90 | --- | 0.040 | 0.050 | --- | --- | --- | B 0.0005-0.003 |
| GB 13791-92 | Grade 50B | --- | --- | 0.47-0.55 | 0.60-0.90 | 0.17-0.37 | 0.035 | 0.035 | 0.30 | 0.30 | 0.15 | B 0.0005-0.0035; Cu 0.30 |
| GB/T 3077-1999 | Grade 50B | --- | --- | 0.47-0.55 | 0.60-0.90 | 0.17-0.37 | 0.035 | 0.035 | 0.30 | 0.30 | 0.15 | B 0.0005-0.0035; Cu 0.30 |
| GB/T 3078-94 | Grade 50B | --- | --- | 0.47-0.55 | 0.60-0.90 | 0.17-0.37 | 0.035 | 0.035 | 0.30 | 0.30 | 0.15 | B 0.0005-0.0035; Cu 0.30 |
| SAE J403 JUN14 | Grade 10B50 | G10501 | --- | 0.48-0.55 | 0.60-0.90 | --- | 0.040 | 0.050 | --- | --- | --- | B 0.0005-0.0035 |
| ASTM A29/A29M-12e1 | Grade 15B22 | G15221 | --- | 0.18-0.24 | 1.10-1.40 | --- | 0.040 | 0.050 | --- | --- | --- | B 0.0005-0.003 |
| EN 10083-3:2006 C1:2008 | Grade 20MnB5 | --- | 1.5530 | 0.17-0.23 | 1.10-1.40 | 0.40 | 0.025 | 0.035 | --- | --- | --- | B 0.0008-0.0050 |
| SAE J403 JUN14 | Grade 15B22 | G15221 | --- | 0.18-0.24 | 1.10-1.40 | --- | 0.040 | 0.050 | --- | --- | --- | B 0.0005-0.003 |

**2.3 Chemical Composition of Alloy Steels for General Use (Continued)**

**2.3.6 Boron (B) Steels (Continued)**

| Specification | Designation | UNS No. | Steel No. | Weight, %max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASME SA-29/SA-29M | Grade 50B44 | G50441 | --- | 0.43-0.48 | 0.75-1.00 | 0.15-0.35 | 0.035 | 0.040 | 0.20-0.60 | --- | --- | B 0.0005-0.003 |
| | Grade 50B46 | G50461 | --- | 0.44-0.49 | 0.75-1.00 | 0.15-0.35 | 0.035 | 0.040 | 0.20-0.35 | --- | --- | B 0.0005-0.003 |
| | Grade 50B50 | G50501 | --- | 0.48-0.53 | 0.75-1.00 | 0.15-0.35 | 0.035 | 0.040 | 0.40-0.60 | --- | --- | B 0.0005-0.003 |
| ASTM A29/A29M-12e1 | Grade 50B44 | G50441 | --- | 0.43-0.48 | 0.75-1.00 | 0.15-0.35 | 0.035 | 0.040 | 0.20-0.60 | --- | --- | B 0.0005-0.003 |
| | Grade 50B46 | G50461 | --- | 0.44-0.49 | 0.75-1.00 | 0.15-0.35 | 0.035 | 0.040 | 0.20-0.35 | --- | --- | B 0.0005-0.003 |
| | Grade 50B50 | G50501 | --- | 0.48-0.53 | 0.75-1.00 | 0.15-0.35 | 0.035 | 0.040 | 0.40-0.60 | --- | --- | B 0.0005-0.003 |
| ASTM A322-13 | Grade 50B44 | G50441 | --- | 0.43-0.48 | 0.75-1.00 | 0.15-0.35 | 0.035 | 0.040 | 0.20-0.60 | --- | --- | B 0.0005-0.003 |
| | Grade 50B46 | G50461 | --- | 0.44-0.49 | 0.75-1.00 | 0.15-0.35 | 0.035 | 0.040 | 0.20-0.35 | --- | --- | B 0.0005-0.003 |
| | Grade 50B50 | G50501 | --- | 0.48-0.53 | 0.75-1.00 | 0.15-0.35 | 0.035 | 0.040 | 0.40-0.60 | --- | --- | B 0.0005-0.003 |
| ASTM A29/A29M-12e1 | Grade 51B35 | G51351 | --- | 0.33-0.38 | 0.60-0.80 | 0.15-0.35 | 0.035 | 0.040 | 0.80-1.05 | --- | --- | B 0.0005-0.003 |
| EN 10263-4:2001 C2:2003 | Grade 36CrB4 | --- | 1.7077 | 0.34-0.38 | 0.70-1.00 | 0.30 | 0.025 | 0.025 | 0.90-1.20 | --- | --- | B 0.0008-0.005; Cu 0.25 |
| ASME SA-29/SA-29M | Grade 50B60 | G50601 | --- | 0.56-0.64 | 0.75-1.00 | 0.15-0.35 | 0.035 | 0.040 | 0.40-0.60 | --- | --- | B 0.0005-0.003 |
| | Grade 51B60 | G51601 | --- | 0.56-0.64 | 0.75-1.00 | 0.15-0.35 | 0.035 | 0.040 | 0.70-0.90 | --- | --- | B 0.0005-0.003 |
| ASTM A29/A29M-12e1 | Grade 50B60 | G50601 | --- | 0.56-0.64 | 0.75-1.00 | 0.15-0.35 | 0.035 | 0.040 | 0.40-0.60 | --- | --- | B 0.0005-0.003 |
| | Grade 51B60 | G51601 | --- | 0.56-0.64 | 0.75-1.00 | 0.15-0.35 | 0.035 | 0.040 | 0.70-0.90 | --- | --- | B 0.0005-0.003 |
| ASTM A322-13 | Grade 50B60 | G50601 | --- | 0.56-0.64 | 0.75-1.00 | 0.15-0.35 | 0.035 | 0.040 | 0.40-0.60 | --- | --- | B 0.0005-0.003 |
| | Grade 51B60 | G51601 | --- | 0.56-0.64 | 0.75-1.00 | 0.15-0.35 | 0.035 | 0.040 | 0.70-0.90 | --- | --- | B 0.0005-0.003 |
| SAE J404 JAN09 | Grade 51B60 | G51601 | --- | 0.56-0.64 | 0.75-1.00 | 0.15-0.35 | 0.030 | 0.040 | 0.70-0.90 | 0.25 | 0.06 | B 0.0005-0.003; Cu 0.35 |

**2.3.7 Chromium-Vanadium (Cr-V) Steels**

| Specification | Designation | UNS No. | Steel No. | Weight, %max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASME SA-29/SA-29M | Grade 6150 | G61500 | --- | 0.48-0.53 | 0.70-0.90 | 0.15-0.35 | 0.035 | 0.040 | 0.80-1.10 | --- | --- | V 0.15 min. |
| ASTM A29/A29M-12e1 | Grade 6150 | G61500 | --- | 0.48-0.53 | 0.70-0.90 | 0.15-0.35 | 0.035 | 0.040 | 0.80-1.10 | --- | --- | V 0.15 min. |
| ASTM A322-13 | Grade 6150 | G61500 | --- | 0.48-0.53 | 0.70-0.90 | 0.15-0.35 | 0.035 | 0.040 | 0.80-1.10 | --- | --- | V 0.15 min. |
| EN 10083-3:2006 C1:2008 | 51CrV4 | --- | 1.8159 | 0.47-0.55 | 0.70-1.10 | 0.40 | 0.025 | 0.025 | 0.90-1.20 | --- | --- | V 0.10-0.25 |
| GB/T 3077-1999 | Grade 50CrVA | --- | --- | 0.47-0.54 | 0.50-0.80 | 0.17-0.37 | 0.025 | 0.025 | 0.80-1.10 | 0.30 | 0.10 | V 0.10-0.20 |
| ISO 683-1:1987 | Grade 51 CrV 4 | --- | --- | 0.47-0.50 | 0.60-1.00 | 0.10-0.40 | 0.035 | 0.035 | 0.80-1.10 | --- | --- | V 0.10-0.25 |
| SAE J404 JAN09 | Grade 6150 | G61500 | --- | 0.48-0.53 | 0.70-0.90 | 0.15-0.35 | 0.030 | 0.040 | 0.80-1.10 | 0.25 | 0.06 | V 0.15 min.; Cu 0.35 |

# Chapter 3

# *STRUCTURAL STEEL PLATES*

### ASME Standards

| | |
|---|---|
| ASME SA-36/SA-36M | Carbon Structural Steel |
| ASME SA-283/SA-283M | Low and Intermediate Tensile Strength Carbon Steel Plates |
| ASME SA-572/SA-572M | High-Strength Low-Alloy Columbium-Vanadium Structural Steel |
| ASME SA-1011/SA-1011M | Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength |

### ASTM Standards

| | |
|---|---|
| ASTM A36/A36M-14 | Carbon Structural Steel |
| ASTM A242/A242M-13 | High-Strength Low-Alloy Structural Steel |
| ASTM A283/A283M-13 | Low and Intermediate Tensile Strength Carbon Steel Plates |
| ASTM A514/A514M-14 | High-Yield-Strength, Quenched and Tempered Alloy Steel Plate, Suitable for Welding |
| ASTM A529/A529M-14 | High-Strength Carbon-Manganese Steel of Structural Quality |
| ASTM A572/A572M-15 | High-Strength Low-Alloy Columbium-Vanadium Structural Steel |
| ASTM A573/A573M-13 | Structural Carbon Steel Plates of Improved Toughness |
| ASTM A588/A588M-15 | High-Strength Low-Alloy Structural Steel, up to 50 ksi [345 MPa] Minimum Yield Point, with Atmospheric Corrosion Resistance |
| ASTM A606/A606M-09a | Steel, Sheet and Strip, High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, with Improved Atmospheric Corrosion Resistance |
| ASTM A633/A633M-13 | Normalized High-Strength Low-Alloy Structural Steel Plates |
| ASTM A656/A656M-13 | Hot-Rolled Structural Steel, High-Strength Low-Alloy Plate with Improved Formability |
| ASTM A709/A709M-13a | Structural Steel for Bridges |
| ASTM A710/A710M-02 (2013) | Precipitation-Strengthened Low-Carbon Nickel-Copper-Chromium-Molybdenum-Columbium Alloy Structural Steel Plates |
| ASTM A871/A871M-14 | High-Strength Low-Alloy Structural Steel Plate with Atmospheric Corrosion Resistance |
| ASTM A1011/A1011M-14 | Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength |

### CSA Standard

| | |
|---|---|
| CSA G40.21-13 | Structural Quality Steel - Plates, Sheet, Floor Plates, Bars, and Welded Shapes |

### EN Standard

| | |
|---|---|
| EN 10025-2:2004 | Hot rolled products of structural steels – Part 2: Technical delivery conditions for non-alloy structural steels |

### GB Standards

| | |
|---|---|
| GB 700-88 | Carbon Structural Steels |
| GB 711-88 | Hot-Rolled Quality Carbon Structural Steel Plates and Wide Strips |
| GB 712-2000 | Hull Structural Steel |
| GB/T 1591-94 | High Strength Low Alloy Structural Steels |
| GB/T 3524-92 | Hot-Rolled Carbon and Low Alloy Structural Steel Strips |
| GB 11251-89 | Hot-Rolled Alloy Structural Steel Plates |
| GB/T 16270-1996 | High Strength Structural Steel Plates and Strips: Products Supplied in the Heat-Treated or Controlled Rolled Condition |
| GB/T 18982-2003 | Corrosion Resistant Steel Plates and Strips for Container |

### ISO Standards

| | |
|---|---|
| ISO 630:1995 A1:2003 | Structural Steels - Plates, Wide Flats, Bars, Sections and Profiles |
| ISO 4950-2:1995 A1:2003 | High Yield Strength Flat Steel Products, Part 2: Products Supplied in the Normalized or Controlled Rolled Condition |
| ISO 4950-3:1995 A1:2003 | High Yield Strength Flat Steel Products – Part 3: Products Supplied in the Heat-Treated (Quenched + Tempered) Condition |
| ISO 4952:2006 | Structural Steels with Improved Atmospheric Corrosion Resistance - Second Edition |
| ISO 5952:2005 | Continuously Hot-Rolled Steel Sheet of Structural Quality with Improved Atmospheric Corrosion Resistance |

### JIS Standards

| | |
|---|---|
| JIS G 3101:2010 | Rolled steels for general structure |
| JIS G 3106:2008 | Rolled steels for welded structure |
| JIS G 3114:2008 | Hot-rolled atmospheric corrosion resisting steels for welded structure |
| JIS G 3125:2010 | Superior atmospheric corrosion resisting rolled steels |
| JIS G 3128:2009 | High yield strength steel plates for welded structure |
| JIS G 3136:2012 | Rolled steels for building structure |

### Heat Treatment Terms Applicable to this Chapter

| Standard | Heat Treatment Terms |
|---|---|
| ASME SA-36/SA-36M | --- |
| ASME SA-283/SA-283M | --- |
| ASME SA-572/SA-572M | --- |
| ASME SA-1011/SA-1011M | HR: hot-rolled |
| ASTM A36/A36M-14 | SR: stress relieved |
| ASTM A242/A242M-13 | --- |
| ASTM A283/A283M-13 | --- |
| ASTM A514/A514M-14 | QT: quenched and tempered; SR: stress relieved |
| ASTM A529/A529M-14 | --- |
| ASTM A572/A572M-15 | --- |
| ASTM A573/A573M-13 | --- |
| ASTM A588/A588M-15 | --- |
| ASTM A606/A606M-09a | HR: hot-rolled (as-rolled); CR: cold-rolled; A: annealed; N: normalized; HR+A: hot-rolled and annealed; HR+N: hot rolled and normalized |
| ASTM A633/A633M-13 | N: normalized; NN: double normalized |
| ASTM A656/A656M-13 | HR: hot-rolled |
| ASTM A709/A709M-13a | QT: quenched and tempered; AR: as rolled; CtR: control rolled; TMCP: thermo-mechanical control processed; |
| ASTM A710/A710M-02 (2013) | PHT: precipitation heat treatment; N+PHT: normalized followed by precipitation heat treatment; Q+PHT: quenched followed by precipitation heat treatment |
| ASTM A871/A871M-14 | N: normalized; QT: quenched and tempered; AR: as rolled |
| ASTM A1011/A1011M-14 | HR: hot-rolled |
| CSA G40.21-13 | AR: as-rolled; QT: quenched and tempered; N: normalized; CtR: control rolled; SR: stress relieved; A: annealed; |
| EN 10025-2:2004 | N: normalized rolled; TMCP: thermos-mechanically rolled; AR: as rolled |
| GB 700-88 | HR: hot-rolled; CtR: control-rolled; N: normalized |
| GB 711-88 | HR: hot-rolled; N: normalized; A: annealed; T: tempered |
| GB 712-2000 | N: normalized; TMCP: thermo-mechanically control processed; HR: hot-rolled; CtR: controlled-rolled; QT: quenched and tempered |
| GB/T 1591-94 | HR: hot-rolled; CtR: control rolled; N: normalized; NT: normalized and tempered; QT: quenched and tempered |
| GB/T 3524-92 | HR: hot-rolled |
| GB 11251-89 | A: annealed; N: normalized; NT: normalized and tempered; QT: quenched and tempered; |
| GB/T 16270-1996 | CtR: control rolled; N: normalized; QT: quenched and tempered; NT: normalized and tempered |
| GB/T 18982-2003 | HR: hot-rolled; CR: cold-rolled |
| ISO 630:1995 A1:2003 | AR: as rolled; N: normalized or equivalent (obtained by controlled rolling); BA: by agreement |
| ISO 4950-2:1995 A1:2003 | N: normalized; NT: normalized and tempered; CtR: controlled rolled condition |
| ISO 4950-3:1995 A1:2003 | QT: quenched and tempered |
| ISO 4952:2006 | AR: as rolled; N: normalized or equivalent (obtained by controlled rolling) |
| ISO 5952:2005 | HR: hot-rolled |
| JIS G 3101:2010 | HR: hot-rolled |
| JIS G 3106:2008 | N: normalized; QHT: quench-hardened and tempered; T: tempered; TMCP: thermo-mechanical control processed |
| JIS G 3114:2008 | N: normalized; QT: quenched and tempered; TMCP: thermo-mechanical control processed; T: tempered |
| JIS G 3125:2010 | CR: cold-rolled; HR: hot-rolled |
| JIS G 3128:2009 | QT: quenched and tempered |
| JIS G 3136:2012 | N: normalized; T: tempered; TMCP: thermo-mechanical control processed |

### Impact Testing Notes Applicable to this Chapter

see standard for supplementary impact testing: the standard includes impact testing as a supplementary requirement (optional to the purchaser).
see standard for impact data: impact testing requirements are listed in the standard for multiple test temperatures.

### 3.1 Carbon Steels for Structural Steel Plates

### 3.1A Mechanical Properties of Carbon Steels for Structural Steel Plates

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | % min. | | |
| ISO 630:1995 A1:2003 | Grade E 185 (Fe 310), Quality 0 | --- | --- | 3 ≤ t ≤ 16 | --- | 185 | --- | 300-540 | --- | 18 | AR | --- |
| | | | | 16 < t ≤ 25 | --- | 175 | --- | 300-540 | --- | 18 | AR | --- |
| ASME SA-283/SA-283M | Grade A | K01400 | --- | --- | --- | 165 | 24 | 310-415 | 45-60 | 30 | --- | --- |
| EN 10025-2:2004 | S185 | --- | 1.0035 | t < 3 | --- | 185 | --- | 310-540 | --- | --- | AR, N or TMCP | --- |
| | | | | 3 < t ≤ 16 | --- | 185 | --- | 290-510 | --- | 18 L, 16 T | AR, N or TMCP | --- |
| | | | | 16 < t ≤ 40 | --- | 175 | --- | 290-510 | --- | 18 L, 16 T | AR, N or TMCP | --- |
| | | | | 40 < t ≤ 63 | --- | 175 | --- | 290-510 | --- | 17 L, 15 T | AR, N or TMCP | --- |
| | | | | 63 < t ≤ 80 | --- | 175 | --- | 290-510 | --- | 16 L, 14 T | AR, N or TMCP | --- |
| | | | | 80 < t ≤ 100 | --- | 175 | --- | 290-510 | --- | 16 L, 14 T | AR, N or TMCP | --- |
| | | | | 100 < t ≤ 150 | --- | 165 | --- | 280-500 | --- | 15 L, 13 T | AR, N or TMCP | --- |
| | | | | 150 < t ≤ 200 | --- | 155 | --- | 270-490 | --- | 15 L, 13 T | AR, N or TMCP | --- |
| | | | | 200 < t ≤ 250 | --- | 145 | --- | 270-490 | --- | 15 L, 13 T | AR, N or TMCP | --- |
| GB 700-88 | Grade Q195 | --- | --- | t ≤ 16 | --- | --- | --- | 315-390 | --- | 33 | HR, CtR or N | --- |
| | | | | 16 < t ≤ 40 | --- | --- | --- | 315-390 | --- | 32 | HR, CtR or N | --- |
| | | | | t > 40 | --- | --- | --- | 315-390 | --- | --- | HR, CtR or N | --- |
| GB 711-88 | Grade 08F | --- | --- | t ≤ 60 | --- | --- | --- | 315 | --- | 34 | N, A, T or HR | --- |
| GB/T 3524-92 | Grade Q195 | --- | --- | --- | --- | 195 | --- | 315-430 | --- | 33 | HR | --- |
| GB 711-88 | Grade 08 | --- | --- | t ≤ 60 | --- | --- | --- | 325 | --- | 33 | N, A, T or HR | --- |
| | Grade 10F | --- | --- | t ≤ 60 | --- | --- | --- | 325 | --- | 32 | N, A, T or HR | --- |
| | Grade 10 | --- | --- | t ≤ 60 | --- | --- | --- | 335 | --- | 32 | N, A, T or HR | --- |
| JIS G 3101:2010 | Symbol SS330 | --- | --- | t ≤ 16 | --- | 205 | --- | 330-430 | --- | see standard | HR | --- |
| | | | | 16 < t ≤ 40 | --- | 195 | --- | 330-430 | --- | see standard | HR | --- |
| | | | | 40 < t ≤ 100 | --- | 175 | --- | 330-430 | --- | see standard | HR | --- |
| | | | | t > 100 | --- | 165 | --- | 330-430 | --- | see standard | HR | --- |

Note: This section continued on next page.

**3.1 Carbon Steels for Structural Steel Plates**

**3.1A Mechanical Properties of Carbon Steels for Structural Steel Plates (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter mm | Section Thickness/Diameter in. | Yield Strength, min. MPa | Yield Strength, min. ksi | Tensile Strength, min. MPa | Tensile Strength, min. ksi | Elongation % min. | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GB 700-88 | Grade Q215A | --- | --- | t ≤ 16 | --- | 215 | --- | 335-410 | --- | 31 | HR or CtR | --- |
| | | | | 16 < t ≤ 40 | --- | 205 | --- | 335-410 | --- | 30 | HR or CtR | --- |
| | | | | 40 < t ≤ 60 | --- | 195 | --- | 335-410 | --- | 29 | HR or CtR | --- |
| | | | | 60 < t ≤ 100 | --- | 185 | --- | 335-410 | --- | 28 | HR or CtR | --- |
| | | | | 100 < t ≤ 150 | --- | 175 | --- | 335-410 | --- | 27 | HR or CtR | --- |
| | | | | t > 150 | --- | 165 | --- | 335-410 | --- | 26 | HR or CtR | --- |
| | Grade Q215B | --- | --- | t ≤ 16 | --- | 215 | --- | 335-410 | --- | 31 | HR, CtR or N | L: 27 J @ 20°C |
| | | | | 16 < t ≤ 40 | --- | 205 | --- | 335-410 | --- | 30 | HR, CtR or N | L: 27 J @ 20°C |
| | | | | 40 < t ≤ 60 | --- | 195 | --- | 335-410 | --- | 29 | HR, CtR or N | L: 27 J @ 20°C |
| | | | | 60 < t ≤ 100 | --- | 185 | --- | 335-410 | --- | 28 | HR, CtR or N | L: 27 J @ 20°C |
| | | | | 100 < t ≤ 150 | --- | 175 | --- | 335-410 | --- | 27 | HR, CtR or N | L: 27 J @ 20°C |
| | | | | t > 150 | --- | 165 | --- | 335-410 | --- | 26 | HR, CtR or N | L: 27 J @ 20°C |
| GB/T 3524-92 | Grade Q215A | --- | --- | --- | --- | 215 | --- | 335-450 | --- | 31 | HR | --- |
| | Grade Q215B | --- | --- | --- | --- | 215 | --- | 335-450 | --- | 31 | HR | --- |
| ASME SA-1011/SA-1011M | Grade 30 [205], SS | --- | --- | 0.65 ≤ t < 1.6 | 0.025 ≤ t < 0.064 | 205 | 30 | 340 L | 49 L | 21 L | HR | --- |
| | | | | 1.6 ≤ t < 2.5 | 0.064 ≤ t < 0.097 | 205 | 30 | 340 L | 49 L | 24 L | HR | --- |
| | | | | 2.5 ≤ t < 6.0 | 0.097 ≤ t < 0.230 | 205 | 30 | 340 L | 49 L | 25 L | HR | --- |
| ASTM A1011/A1011M-14 | Grade 30 [205], SS | --- | --- | 0.65 ≤ t < 1.6 | 0.025 ≤ t < 0.064 | 205 | 30 | 340 L | 49 L | 21 L | HR | --- |
| | | | | 1.6 ≤ t < 2.5 | 0.064 ≤ t < 0.097 | 205 | 30 | 340 L | 49 L | 24 L | HR | --- |
| | | | | 2.5 ≤ t < 6.0 | 0.097 ≤ t < 0.230 | 205 | 30 | 340 L | 49 L | 25 L | HR | --- |
| ISO 630:1995 A1:2003 | Grade E 235 (Fe 360), Quality A | --- | --- | 3 ≤ t ≤ 16 | --- | 235 | --- | 340-470 | --- | 26 | AR | --- |
| | | | | 16 < t ≤ 40 | --- | 225 | --- | 340-470 | --- | 26 | AR | --- |
| | | | | 40 < t ≤ 63 | --- | 215 | --- | 340-470 | --- | 25 | AR | --- |
| | | | | 63 < t ≤ 80 | --- | 215 | --- | 340-470 | --- | 24 | AR | --- |
| | | | | 80 < t ≤ 100 | --- | 215 | --- | 340-470 | --- | 24 | AR | --- |
| | | | | 100 < t ≤ 150 | --- | 195 | --- | 340-470 | --- | 22 | AR | --- |
| | | | | 150 < t ≤ 200 | --- | 185 | --- | 340-470 | --- | 21 | AR | --- |
| | Grade E 235 (Fe 360), Quality B | --- | --- | 3 ≤ t ≤ 16 | --- | 235 | --- | 340-470 | --- | 26 | AR | --- |
| | | | | 16 < t ≤ 25 | --- | 225 | --- | 340-470 | --- | 26 | AR | --- |
| | Grade E 235 (Fe 360), Quality B NF | --- | --- | 3 ≤ t ≤ 16 | --- | 235 | --- | 340-470 | --- | 26 | AR | 27 J @ 20°C |
| | | | | 16 < t ≤ 40 | --- | 225 | --- | 340-470 | --- | 26 | AR | 27 J @ 20°C |
| | | | | 40 < t ≤ 63 | --- | 215 | --- | 340-470 | --- | 25 | AR | 27 J @ 20°C |
| | | | | 63 < t ≤ 80 | --- | 215 | --- | 340-470 | --- | 24 | AR | 27 J @ 20°C |
| | | | | 80 < t ≤ 100 | --- | 215 | --- | 340-470 | --- | 24 | AR | 27 J @ 20°C |
| | | | | 100 < t ≤ 150 | --- | 195 | --- | 340-470 | --- | 22 | AR | 27 J @ 20°C |
| | | | | 150 < t ≤ 200 | --- | 185 | --- | 340-470 | --- | 21 | AR | 27 J @ 20°C |

Note: This section continued on next page.

**3.1 Carbon Steels for Structural Steel Plates**

**3.1A Mechanical Properties of Carbon Steels for Structural Steel Plates (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | % min. | | |
| ISO 630:1995 A1:2003 | Grade E 235 (Fe 360), Quality C | --- | --- | 3 ≤ t ≤ 16 | --- | 235 | --- | 340-470 | --- | 26 | AR | 27 J @ 0°C |
| | | | | 16 < t ≤ 40 | --- | 225 | --- | 340-470 | --- | 26 | AR | 27 J @ 0°C |
| | | | | 40 < t ≤ 63 | --- | 215 | --- | 340-470 | --- | 25 | AR | 27 J @ 0°C |
| | | | | 63 < t ≤ 80 | --- | 215 | --- | 340-470 | --- | 24 | AR | 27 J @ 0°C |
| | | | | 80 < t ≤ 100 | --- | 215 | --- | 340-470 | --- | 24 | AR | 27 J @ 0°C |
| | | | | 100 < t ≤ 150 | --- | 195 | --- | 340-470 | --- | 22 | AR | 27 J @ 0°C |
| | | | | 150 < t ≤ 200 | --- | 185 | --- | 340-470 | --- | 21 | AR | 27 J @ 0°C |
| | Grade E 235 (Fe 360), Quality D | --- | --- | 3 ≤ t ≤ 16 | --- | 235 | --- | 340-470 | --- | 26 | N or BA | 27 J @ -20°C |
| | | | | 16 < t ≤ 40 | --- | 225 | --- | 340-470 | --- | 26 | N or BA | 27 J @ -20°C |
| | | | | 40 < t ≤ 63 | --- | 215 | --- | 340-470 | --- | 25 | N or BA | 27 J @ -20°C |
| | | | | 63 < t ≤ 80 | --- | 215 | --- | 340-470 | --- | 24 | N or BA | 27 J @ -20°C |
| | | | | 80 < t ≤ 100 | --- | 215 | --- | 340-470 | --- | 24 | N or BA | 27 J @ -20°C |
| | | | | 100 < t ≤ 150 | --- | 195 | --- | 340-470 | --- | 22 | N or BA | 27 J @ -20°C |
| | | | | 150 < t ≤ 200 | --- | 185 | --- | 340-470 | --- | 21 | N or BA | 27 J @ -20°C |
| ASME SA-283/SA-283M | Grade B | K01702 | --- | --- | --- | 185 | 27 | 345-450 | 50-65 | 28 | --- | --- |

**3.1 Carbon Steels for Structural Steel Plates**

**3.1A Mechanical Properties of Carbon Steels for Structural Steel Plates (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | % min. | | |
| GB 711-88 | Grade 15F | --- | --- | t ≤ 60 | --- | --- | --- | 355 | --- | 30 | N, A, T or HR | --- |
| ASME SA-1011/SA-1011M | Grade 33 [230], SS | --- | --- | 0.65 ≤ t < 1.6 | 0.025 ≤ t < 0.064 | 230 | 33 | 360 L | 52 L | 18 L | HR | --- |
| | | | | 1.6 ≤ t < 2.5 | 0.064 ≤ t < 0.097 | 230 | 33 | 360 L | 52 L | 22 L | HR | --- |
| | | | | 2.5 ≤ t < 6.0 | 0.097 ≤ t < 0.230 | 230 | 33 | 360 L | 52 L | 23 L | HR | --- |
| ASTM A1011/A1011M-14 | Grade 33 [230], SS | --- | --- | 0.65 ≤ t < 1.6 | 0.025 ≤ t < 0.064 | 230 | 33 | 360 L | 52 L | 18 L | HR | --- |
| | | | | 1.6 ≤ t < 2.5 | 0.064 ≤ t < 0.097 | 230 | 33 | 360 L | 52 L | 22 L | HR | --- |
| | | | | 2.5 ≤ t < 6.0 | 0.097 ≤ t < 0.230 | 230 | 33 | 360 L | 52 L | 23 L | HR | --- |
| EN 10025-2:2004 | S235JR | --- | 1.0038 | t < 3 | --- | 235 | --- | 360-510 | --- | --- | AR, N or TMCP | --- |
| | | | | 3 ≤ t ≤ 16 | --- | 235 | --- | 360-510 | --- | 26 L, 24 T | AR, N or TMCP | L: 27 J @ 20°C |
| | | | | 16 < t ≤ 40 | --- | 225 | --- | 360-510 | --- | 26 L, 24 T | AR, N or TMCP | L: 27 J @ 20°C |
| | | | | 40 < t ≤ 63 | --- | 215 | --- | 360-510 | --- | 25 L, 24 T | AR, N or TMCP | L: 27 J @ 20°C |
| | | | | 63 < t ≤ 80 | --- | 215 | --- | 360-510 | --- | 24 L, 22 T | AR, N or TMCP | L: 27 J @ 20°C |
| | | | | 80 < t ≤ 100 | --- | 215 | --- | 360-510 | --- | 24 L, 22 T | AR, N or TMCP | L: 27 J @ 20°C |
| | | | | 100 < t ≤ 150 | --- | 195 | --- | 350-500 | --- | 22 L, 22 T | AR, N or TMCP | L: 27 J @ 20°C |
| | | | | 150 < t ≤ 200 | --- | 185 | --- | 340-490 | --- | 21 L, 21 T | AR, N or TMCP | L: 27 J @ 20°C |
| | | | | 200 < t ≤ 250 | --- | 175 | --- | 340-490 | --- | 21 L, 21 T | AR, N or TMCP | L: 27 J @ 20°C |
| | S235J0 | --- | 1.0114 | t < 3 | --- | 235 | --- | 360-510 | --- | --- | AR, N or TMCP | --- |
| | | | | 3 ≤ t ≤ 16 | --- | 235 | --- | 360-510 | --- | 26 L, 24 T | AR, N or TMCP | L: 27 J @ 0°C |
| | | | | 16 < t ≤ 40 | --- | 225 | --- | 360-510 | --- | 26 L, 24 T | AR, N or TMCP | L: 27 J @ 0°C |
| | | | | 40 < t ≤ 63 | --- | 215 | --- | 360-510 | --- | 25 L, 24 T | AR, N or TMCP | L: 27 J @ 0°C |
| | | | | 63 < t ≤ 80 | --- | 215 | --- | 360-510 | --- | 24 L, 22 T | AR, N or TMCP | L: 27 J @ 0°C |
| | | | | 80 < t ≤ 100 | --- | 215 | --- | 360-510 | --- | 24 L, 22 T | AR, N or TMCP | L: 27 J @ 0°C |
| | | | | 100 < t ≤ 150 | --- | 195 | --- | 350-500 | --- | 22 L, 22 T | AR, N or TMCP | L: 27 J @ 0°C |
| | | | | 150 < t ≤ 200 | --- | 185 | --- | 340-490 | --- | 21 L, 21 T | AR, N or TMCP | L: 27 J @ 0°C |
| | | | | 200 < t ≤ 250 | --- | 175 | --- | 340-490 | --- | 21 L, 21 T | AR, N or TMCP | L: 27 J @ 0°C |
| ASME SA-1011/SA-1011M | Grade 36 [250], Type 1, SS | --- | --- | 0.65 ≤ t < 1.6 | 0.025 ≤ t < 0.064 | 250 | 36 | 365 L | 53 L | 17 L | HR | --- |
| | | | | 1.6 ≤ t < 2.5 | 0.064 ≤ t < 0.097 | 250 | 36 | 365 L | 53 L | 21 L | HR | --- |
| | | | | 2.5 ≤ t < 6.0 | 0.097 ≤ t < 0.230 | 250 | 36 | 365 L | 53 L | 22 L | HR | --- |
| ASTM A1011/A1011M-14 | Grade 36 [250], Type 1, SS | --- | --- | 0.65 ≤ t < 1.6 | 0.025 ≤ t < 0.064 | 250 | 36 | 365 L | 53 L | 17 L | HR | --- |
| | | | | 1.6 ≤ t < 2.5 | 0.064 ≤ t < 0.097 | 250 | 36 | 365 L | 53 L | 21 L | HR | --- |
| | | | | 2.5 ≤ t < 6.0 | 0.097 ≤ t < 0.230 | 250 | 36 | 365 L | 53 L | 22 L | HR | --- |
| GB 711-88 | Grade 15 | --- | --- | t ≤ 60 | --- | --- | --- | 370 | --- | 30 | N, A, T or HR | --- |

Note: This section continued on next page.

### 3.1 Carbon Steels for Structural Steel Plates

### 3.1A Mechanical Properties of Carbon Steels for Structural Steel Plates (Continued)

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | % min. | | |
| GB 700-88 | Grade Q235A | --- | --- | t ≤ 16 | --- | 235 | --- | 375-460 | --- | 26 | HR or CtR | --- |
| | | | | 16 < t ≤ 40 | --- | 225 | --- | 375-460 | --- | 25 | HR or CtR | --- |
| | | | | 40 < t ≤ 60 | --- | 215 | --- | 375-460 | --- | 24 | HR or CtR | --- |
| | | | | 60 < t ≤ 100 | --- | 205 | --- | 375-460 | --- | 23 | HR or CtR | --- |
| | | | | 100 < t ≤ 150 | --- | 195 | --- | 375-460 | --- | 22 | HR or CtR | --- |
| | | | | t > 150 | --- | 185 | --- | 375-460 | --- | 21 | HR or CtR | --- |
| | Grade Q235B | --- | --- | t ≤ 16 | --- | 235 | --- | 375-460 | --- | 26 | HR, CtR or N | L: 27 J @ 20°C |
| | | | | 16 < t ≤ 40 | --- | 225 | --- | 375-460 | --- | 25 | HR, CtR or N | L: 27 J @ 20°C |
| | | | | 40 < t ≤ 60 | --- | 215 | --- | 375-460 | --- | 24 | HR, CtR or N | L: 27 J @ 20°C |
| | | | | 60 < t ≤ 100 | --- | 205 | --- | 375-460 | --- | 23 | HR, CtR or N | L: 27 J @ 20°C |
| | | | | 100 < t ≤ 150 | --- | 195 | --- | 375-460 | --- | 22 | HR, CtR or N | L: 27 J @ 20°C |
| | | | | t > 150 | --- | 185 | --- | 375-460 | --- | 21 | HR, CtR or N | L: 27 J @ 20°C |
| | Grade Q235C | --- | --- | t ≤ 16 | --- | 235 | --- | 375-460 | --- | 26 | HR, CtR or N | L: 27 J @ 0°C |
| | | | | 16 < t ≤ 40 | --- | 225 | --- | 375-460 | --- | 25 | HR, CtR or N | L: 27 J @ 0°C |
| | | | | 40 < t ≤ 60 | --- | 215 | --- | 375-460 | --- | 24 | HR, CtR or N | L: 27 J @ 0°C |
| | | | | 60 < t ≤ 100 | --- | 205 | --- | 375-460 | --- | 23 | HR, CtR or N | L: 27 J @ 0°C |
| | | | | 100 < t ≤ 150 | --- | 195 | --- | 375-460 | --- | 22 | HR, CtR or N | L: 27 J @ 0°C |
| | | | | t > 150 | --- | 185 | --- | 375-460 | --- | 21 | HR, CtR or N | L: 27 J @ 0°C |
| | Grade Q235D | --- | --- | t ≤ 16 | --- | 235 | --- | 375-460 | --- | 26 | HR, CtR or N | L: 27 J @ -20°C |
| | | | | 16 < t ≤ 40 | --- | 225 | --- | 375-460 | --- | 25 | HR, CtR or N | L: 27 J @ -20°C |
| | | | | 40 < t ≤ 60 | --- | 215 | --- | 375-460 | --- | 24 | HR, CtR or N | L: 27 J @ -20°C |
| | | | | 60 < t ≤ 100 | --- | 205 | --- | 375-460 | --- | 23 | HR, CtR or N | L: 27 J @ -20°C |
| | | | | 100 < t ≤ 150 | --- | 195 | --- | 375-460 | --- | 22 | HR, CtR or N | L: 27 J @ -20°C |
| | | | | t > 150 | --- | 185 | --- | 375-460 | --- | 21 | HR, CtR or N | L: 27 J @ -20°C |
| GB/T 3524-92 | Grade Q235A | --- | --- | --- | --- | 235 | --- | 375-500 | --- | 26 | HR | --- |
| | Grade Q235B | --- | --- | --- | --- | 235 | --- | 375-500 | --- | 26 | HR | --- |
| GB 711-88 | Grade 20F | --- | --- | t ≤ 60 | --- | --- | --- | 380 | --- | 27 | N, A, T or HR | --- |
| ASME SA-283/SA-283M | Grade C | K02401 | --- | --- | --- | 205 | 30 | 380-515 | 55-75 | 25 | --- | --- |
| ASTM A283/A283M-13 | Grade C | K02401 | --- | --- | --- | 205 | 30 | 380-515 | 55-75 | 25 | --- | --- |
| ASME SA-1011/SA-1011M | Grade 40 [275], SS | --- | --- | 0.65 ≤ t < 1.6 | 0.025 ≤ t < 0.064 | 275 | 40 | 380 L | 55 L | 15 L | HR | --- |
| | | | | 1.6 ≤ t < 2.5 | 0.064 ≤ t < 0.097 | 275 | 40 | 380 L | 55 L | 20 L | HR | --- |
| | | | | 2.5 ≤ t < 6.0 | 0.097 ≤ t < 0.230 | 275 | 40 | 380 L | 55 L | 21 L | HR | --- |
| ASTM A1011/A1011M-14 | Grade 40 [275], SS | --- | --- | 0.65 ≤ t < 1.6 | 0.025 ≤ t < 0.064 | 275 | 40 | 380 L | 55 L | 15 L | HR | --- |
| | | | | 1.6 ≤ t < 2.5 | 0.064 ≤ t < 0.097 | 275 | 40 | 380 L | 55 L | 20 L | HR | --- |
| | | | | 2.5 ≤ t < 6.0 | 0.097 ≤ t < 0.230 | 275 | 40 | 380 L | 55 L | 21 L | HR | --- |

Note: This section continued on next page.

**3.1 Carbon Steels for Structural Steel Plates**

**3.1A Mechanical Properties of Carbon Steels for Structural Steel Plates (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation % min. | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | | | |
| ASTM A573/A573M-13 | Grade 58 [400] | K02301 | --- | t ≤ 40 | t ≤ 1.5 | 220 | 32 | 400-490 | 58-71 | 24 | --- | --- |
| GB 712-2000 | Grade A | --- | --- | --- | --- | 235 | --- | 400-520 | --- | 22 | N, TMCP, HR or CtR | see standard for impact data |
| | Grade B | --- | --- | --- | --- | 235 | --- | 400-520 | --- | 22 | N, TMCP, HR or CtR | |
| | Grade D | --- | --- | --- | --- | 235 | --- | 400-520 | --- | 22 | N, TMCP, HR or CtR | |
| | Grade E | --- | --- | --- | --- | 235 | --- | 400-520 | --- | 22 | see standard | |
| JIS G 3136:2012 | Grade SN400A | --- | --- | 6 ≤ t < 16 | --- | 235 | --- | 400-510 | --- | 17 | N, T or TMCP | --- |
| | | | | 16 ≤ t ≤ 40 | --- | 235 | --- | 400-510 | --- | 21 | N, T or TMCP | --- |
| | | | | 40 < t ≤ 100 | --- | 215 | --- | 400-510 | --- | 23 | N, T or TMCP | --- |
| | Grade SN400B | --- | --- | 6 ≤ t < 12 | --- | 235 | --- | 400-510 | --- | 18 | N, T or TMCP | --- |
| | | | | 12 ≤ t ≤ 16 | --- | 235-355 | --- | 400-510 | --- | 18 | N, T or TMCP | L: 27 J @ 0°C |
| | | | | 16 < t ≤ 40 | --- | 235-355 | --- | 400-510 | --- | 22 | N, T or TMCP | L: 27 J @ 0°C |
| | | | | 40 < t ≤ 100 | --- | 215-335 | --- | 400-510 | --- | 24 | N, T or TMCP | L: 27 J @ 0°C |
| | Grade SN400C | --- | --- | 6 ≤ t < 16 | --- | --- | --- | 400-510 | --- | 18 | N, T or TMCP | --- |
| | | | | 16 ≤ t ≤ 40 | --- | 235-355 | --- | 400-510 | --- | 22 | N, T or TMCP | L: 27 J @ 0°C |
| | | | | 40 < t ≤ 100 | --- | 215-335 | --- | 400-510 | --- | 24 | N, T or TMCP | L: 27 J @ 0°C |
| JIS G 3101:2010 | Symbol SS400 | --- | --- | t ≤ 16 | --- | 245 | --- | 400-510 | --- | see standard | HR | --- |
| | | | | 16 < t ≤ 40 | --- | 235 | --- | 400-510 | --- | see standard | HR | --- |
| | | | | 40 < t ≤ 100 | --- | 215 | --- | 400-510 | --- | see standard | HR | --- |
| | | | | t > 100 | --- | 205 | --- | 400-510 | --- | see standard | HR | --- |
| JIS G 3106:2008 | Grade SM400A | --- | --- | t ≤ 5 | --- | 245 | --- | 400-510 | --- | 23 | N, QHT, T or TMCP | --- |
| | | | | 5 < t ≤ 16 | --- | 245 | --- | 400-510 | --- | 18 | N, QHT, T or TMCP | --- |
| | | | | 16 < t ≤ 40 | --- | 235 | --- | 400-510 | --- | 22 | N, QHT, T or TMCP | --- |
| | | | | 40 < t ≤ 100 | --- | 215 | --- | 400-510 | --- | 24 | N, QHT, T or TMCP | --- |
| | | | | 100 < t ≤ 160 | --- | 205 | --- | 400-510 | --- | 24 | N, QHT, T or TMCP | --- |
| | | | | 160 < t ≤ 200 | --- | 195 | --- | 400-510 | --- | 24 | N, QHT, T or TMCP | --- |
| | Grade SM400B | --- | --- | t ≤ 5 | --- | 245 | --- | 400-510 | --- | 23 | N, QHT, T or TMCP | --- |
| | | | | 5 < t ≤ 16 | --- | 245 | --- | 400-510 | --- | 18 | N, QHT, T or TMCP | L: 27 J @ 0°C |
| | | | | 16 < t ≤ 40 | --- | 235 | --- | 400-510 | --- | 22 | N, QHT, T or TMCP | L: 27 J @ 0°C |
| | | | | 40 < t ≤ 100 | --- | 215 | --- | 400-510 | --- | 24 | N, QHT, T or TMCP | L: 27 J @ 0°C |
| | | | | 100 < t ≤ 160 | --- | 205 | --- | 400-510 | --- | 24 | N, QHT, T or TMCP | L: 27 J @ 0°C |
| | | | | 160 < t ≤ 200 | --- | 195 | --- | 400-510 | --- | 24 | N, QHT, T or TMCP | L: 27 J @ 0°C |
| | Grade SM400C | --- | --- | t ≤ 5 | --- | 245 | --- | 400-510 | --- | 23 | N, QHT, T or TMCP | --- |
| | | | | 5 < t ≤ 16 | --- | 245 | --- | 400-510 | --- | 18 | N, QHT, T or TMCP | L: 47 J @ 0°C |
| | | | | 16 < t ≤ 40 | --- | 235 | --- | 400-510 | --- | 22 | N, QHT, T or TMCP | L: 47 J @ 0°C |
| | | | | 40 < t ≤ 100 | --- | 215 | --- | 400-510 | --- | 24 | N, QHT, T or TMCP | L: 47 J @ 0°C |
| | | | | 100 < t ≤ 200 | --- | --- | --- | 400-510 | --- | 24 | N, QHT, T or TMCP | L: 47 J @ 0°C |

Note: This section continued on next page.

**3.1 Carbon Steels for Structural Steel Plates**

**3.1A Mechanical Properties of Carbon Steels for Structural Steel Plates (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | % min. | | |
| ASME SA-36/SA-36M | --- | K02595 | --- | 100 < t ≤ 200 | 4 < t ≤ 8 | 250 | 36 | 400-550 | 58-80 | 23 | --- | --- |
| | | | | t > 200 | t > 8 | 220 | 32 | 400-550 | 58-80 | 23 | --- | --- |
| | | K02596 | --- | 65 < t ≤ 100 | 2.5 < t ≤ 4 | 250 | 36 | 400-550 | 58-80 | 23 | --- | --- |
| | | K02597 | --- | 40 < t ≤ 65 | 1.5 < t ≤ 2.5 | 250 | 36 | 400-550 | 58-80 | 23 | --- | --- |
| | | K02598 | --- | 20 < t ≤ 40 | 0.75 < t ≤ 1.5 | 250 | 36 | 400-550 | 58-80 | 23 | --- | --- |
| | | K02599 | --- | t ≤ 20 | t ≤ 0.75 | 250 | 36 | 400-550 | 58-80 | 23 | --- | --- |
| ASME SA-1011/SA-1011M | Grade 36 [250], Type 2, SS | --- | --- | 0.65 ≤ t < 1.6 | 0.025 ≤ t < 0.064 | 250 | 36 | 400-550 L | 58-80 L | 16 L | HR | --- |
| | | | | 1.6 ≤ t < 2.5 | 0.064 ≤ t < 0.097 | 250 | 36 | 400-550 L | 58-80 L | 20 L | HR | --- |
| | | | | 2.5 ≤ t < 6.0 | 0.097 ≤ t < 0.230 | 250 | 36 | 400-550 L | 58-80 L | 21 L | HR | --- |
| ASTM A36/A36M-14 | --- | K02595 | --- | 100 < t ≤ 200 | 4 < t ≤ 8 | 250 | 36 | 400-550 | 58-80 | 23 | SR or none | --- |
| | | | | t > 200 | t > 8 | 220 | 32 | 400-550 | 58-80 | 23 | SR or none | --- |
| | | K02596 | --- | 65 < t ≤ 100 | 2.5 < t ≤ 4 | 250 | 36 | 400-550 | 58-80 | 23 | SR or none | --- |
| | | K02597 | --- | 40 < t ≤ 65 | 1.5 < t ≤ 2.5 | 250 | 36 | 400-550 | 58-80 | 23 | SR or none | --- |
| | | K02598 | --- | 20 < t ≤ 40 | 0.75 < t ≤ 1.5 | 250 | 36 | 400-550 | 58-80 | 23 | SR or none | --- |
| | | K02599 | --- | t ≤ 20 | t ≤ 0.75 | 250 | 36 | 400-550 | 58-80 | 23 | SR or none | --- |
| ASTM A709/A709M-13a | Grade 36 [250] | --- | --- | t ≤ 75 | t ≤ 3 | 250 | 36 | 400 | 58 | 21 | --- | see standard for impact data |
| | | | | t ≤ 100 | t ≤ 4 | 250 | 36 | 400-550 | 58-80 | 23 | QT | |
| | | | | t > 75 | t > 3 | 250 | 36 | 400 | 58 | 19 | --- | |
| ASTM A1011/A1011M-14 | Grade 36 [250], Type 2, SS | --- | --- | 0.65 ≤ t < 1.6 | 0.025 ≤ t < 0.064 | 250 | 36 | 400-550 L | 58-80 L | 16 L | HR | --- |
| | | | | 1.6 ≤ t < 2.5 | 0.064 ≤ t < 0.097 | 250 | 36 | 400-550 L | 58-80 L | 20 L | HR | --- |
| | | | | 2.5 ≤ t < 6.0 | 0.097 ≤ t < 0.230 | 250 | 36 | 400-550 L | 58-80 L | 21 L | HR | --- |

**3.1 Carbon Steels for Structural Steel Plates**

**3.1A Mechanical Properties of Carbon Steels for Structural Steel Plates (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter mm | Section Thickness/Diameter in. | Yield Strength, min. MPa | Yield Strength, min. ksi | Tensile Strength, min. MPa | Tensile Strength, min. ksi | Elongation % min. | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GB 711-88 | Grade 20 | --- | --- | t ≤ 60 | --- | --- | --- | 410 | --- | 28 | N, A, T or HR | --- |
| GB 700-88 | Grade Q255A | --- | --- | t ≤ 16 | --- | 255 | --- | 410-510 | --- | 24 | HR or CtR | --- |
| | | | | 16 < t ≤ 40 | --- | 245 | --- | 410-510 | --- | 23 | HR or CtR | --- |
| | | | | 40 < t ≤ 60 | --- | 235 | --- | 410-510 | --- | 22 | HR or CtR | --- |
| | | | | 60 < t ≤ 100 | --- | 225 | --- | 410-510 | --- | 21 | HR or CtR | --- |
| | | | | 100 < t ≤ 150 | --- | 215 | --- | 410-510 | --- | 20 | HR or CtR | --- |
| | | | | t > 150 | --- | 205 | --- | 410-510 | --- | 19 | HR or CtR | --- |
| | Grade Q255B | --- | --- | t ≤ 16 | --- | 255 | --- | 410-510 | --- | 24 | HR, CtR or N | L: 27 J @ 20°C |
| | | | | 16 < t ≤ 40 | --- | 245 | --- | 410-510 | --- | 23 | HR, CtR or N | L: 27 J @ 20°C |
| | | | | 40 < t ≤ 60 | --- | 235 | --- | 410-510 | --- | 22 | HR, CtR or N | L: 27 J @ 20°C |
| | | | | 60 < t ≤ 100 | --- | 225 | --- | 410-510 | --- | 21 | HR, CtR or N | L: 27 J @ 20°C |
| | | | | 100 < t ≤ 150 | --- | 215 | --- | 410-510 | --- | 20 | HR, CtR or N | L: 27 J @ 20°C |
| | | | | t > 150 | --- | 205 | --- | 410-510 | --- | 19 | HR, CtR or N | L: 27 J @ 20°C |
| GB/T 3524-92 | Grade Q255A | --- | --- | --- | --- | 255 | --- | 410-550 | --- | 24 | HR | --- |
| | Grade Q255B | --- | --- | --- | --- | 255 | --- | 410-550 | --- | 24 | HR | --- |
| ISO 630:1995 A1:2003 | Grade E 275 (Fe 430), Quality A | --- | --- | 3 ≤ t ≤ 16 | --- | 275 | --- | 410-540 | --- | 22 | AR | --- |
| | | | | 16 < t ≤ 40 | --- | 265 | --- | 410-540 | --- | 22 | AR | --- |
| | | | | 40 < t ≤ 63 | --- | 255 | --- | 410-540 | --- | 21 | AR | --- |
| | | | | 63 < t ≤ 80 | --- | 245 | --- | 410-540 | --- | 20 | AR | --- |
| | | | | 80 < t ≤ 100 | --- | 235 | --- | 410-540 | --- | 20 | AR | --- |
| | | | | 100 < t ≤ 150 | --- | 225 | --- | 410-540 | --- | 18 | AR | --- |
| | | | | 150 < t ≤ 200 | --- | 215 | --- | 410-540 | --- | 17 | AR | --- |
| | Grade E 275 (Fe 430), Quality B | --- | --- | 3 ≤ t ≤ 16 | --- | 275 | --- | 410-540 | --- | 22 | AR | 27 J @ 20°C |
| | | | | 16 < t ≤ 40 | --- | 265 | --- | 410-540 | --- | 22 | AR | 27 J @ 20°C |
| | | | | 40 < t ≤ 63 | --- | 255 | --- | 410-540 | --- | 21 | AR | 27 J @ 20°C |
| | | | | 63 < t ≤ 80 | --- | 245 | --- | 410-540 | --- | 20 | AR | 27 J @ 20°C |
| | | | | 80 < t ≤ 100 | --- | 235 | --- | 410-540 | --- | 20 | AR | 27 J @ 20°C |
| | | | | 100 < t ≤ 150 | --- | 225 | --- | 410-540 | --- | 18 | AR | 27 J @ 20°C |
| | | | | 150 < t ≤ 200 | --- | 215 | --- | 410-540 | --- | 17 | AR | 27 J @ 20°C |
| | Grade E 275 (Fe 430), Quality C | --- | --- | 3 ≤ t ≤ 16 | --- | 275 | --- | 410-540 | --- | 22 | AR | 27 J @ 0°C |
| | | | | 16 < t ≤ 40 | --- | 265 | --- | 410-540 | --- | 22 | AR | 27 J @ 0°C |
| | | | | 40 < t ≤ 63 | --- | 255 | --- | 410-540 | --- | 21 | AR | 27 J @ 0°C |
| | | | | 63 < t ≤ 80 | --- | 245 | --- | 410-540 | --- | 20 | AR | 27 J @ 0°C |
| | | | | 80 < t ≤ 100 | --- | 235 | --- | 410-540 | --- | 20 | AR | 27 J @ 0°C |
| | | | | 100 < t ≤ 150 | --- | 225 | --- | 410-540 | --- | 18 | AR | 27 J @ 0°C |
| | | | | 150 < t ≤ 200 | --- | 215 | --- | 410-540 | --- | 17 | AR | 27 J @ 0°C |

Note: This section continued on next page.

**3.1 Carbon Steels for Structural Steel Plates**

**3.1A Mechanical Properties of Carbon Steels for Structural Steel Plates (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | % min. | | |
| ISO 630:1995 A1:2003 | Grade E 275 (Fe 430), Quality D | --- | --- | 3 ≤ t ≤ 16 | --- | 275 | --- | 410-540 | --- | 22 | N or BA | 27 J @ -20°C |
| | | | | 16 < t ≤ 40 | --- | 265 | --- | 410-540 | --- | 22 | N or BA | 27 J @ -20°C |
| | | | | 40 < t ≤ 63 | --- | 255 | --- | 410-540 | --- | 21 | N or BA | 27 J @ -20°C |
| | | | | 63 < t ≤ 80 | --- | 245 | --- | 410-540 | --- | 20 | N or BA | 27 J @ -20°C |
| | | | | 80 < t ≤ 100 | --- | 235 | --- | 410-540 | --- | 20 | N or BA | 27 J @ -20°C |
| | | | | 100 < t ≤ 150 | --- | 225 | --- | 410-540 | --- | 18 | N or BA | 27 J @ -20°C |
| | | | | 150 < t ≤ 200 | --- | 215 | --- | 410-540 | --- | 17 | N or BA | 27 J @ -20°C |
| ASME SA-1011/SA-1011M | Grade 45 [310], SS | --- | --- | 0.65 ≤ t < 1.6 | 0.025 ≤ t < 0.064 | 310 | 45 | 410 L | 60 L | 13 L | HR | --- |
| | | | | 1.6 ≤ t < 2.5 | 0.064 ≤ t < 0.097 | 310 | 45 | 410 L | 60 L | 18 L | HR | --- |
| | | | | 2.5 ≤ t < 6.0 | 0.097 ≤ t < 0.230 | 310 | 45 | 410 L | 60 L | 19 L | HR | --- |
| ASTM A1011/A1011M-14 | Grade 45 [310], Type 1, SS | --- | --- | 0.65 ≤ t < 1.6 | 0.025 ≤ t < 0.064 | 310 | 45 | 410 L | 60 L | 13 L | HR | --- |
| | | | | 1.6 ≤ t < 2.5 | 0.064 ≤ t < 0.097 | 310 | 45 | 410 L | 60 L | 18 L | HR | --- |
| | | | | 2.5 ≤ t < 6.0 | 0.097 ≤ t < 0.230 | 310 | 45 | 410 L | 60 L | 19 L | HR | --- |
| | Grade 45 [310], Type 2, SS | --- | --- | 0.65 ≤ t < 1.6 | 0.025 ≤ t < 0.064 | 310-410 | 45-60 | 410 L | 60 L | 14 L | HR | --- |
| | | | | 1.6 ≤ t < 2.5 | 0.064 ≤ t < 0.097 | 310-410 | 45-60 | 410 L | 60 L | 19 L | HR | --- |
| | | | | 2.5 ≤ t < 6.0 | 0.097 ≤ t < 0.230 | 310-410 | 45-60 | 410 L | 60 L | 20 L | HR | --- |
| ASME SA-283/SA-283M | Grade D | K02702 | --- | --- | --- | 230 | 33 | 415-550 | 60-80 | 23 | --- | --- |
| ASTM A283/A283M-13 | Grade D | K02702 | --- | --- | --- | 230 | 33 | 415-550 | 60-80 | 23 | --- | --- |
| EN 10025-2:2004 | S275JR | --- | 1.0044 | t < 3 | --- | 275 | --- | 430-580 | --- | --- | AR, N or TMCP | --- |
| | | | | 3 ≤ t ≤ 16 | --- | 275 | --- | 410-560 | --- | 23 L, 21 T | AR, N or TMCP | L: 27 J @ 20°C |
| | | | | 16 < t ≤ 40 | --- | 265 | --- | 410-560 | --- | 23 L, 21 T | AR, N or TMCP | L: 27 J @ 20°C |
| | | | | 40 < t ≤ 63 | --- | 255 | --- | 410-560 | --- | 22 L, 20 T | AR, N or TMCP | L: 27 J @ 20°C |
| | | | | 63 < t ≤ 80 | --- | 245 | --- | 410-560 | --- | 21 L, 19 T | AR, N or TMCP | L: 27 J @ 20°C |
| | | | | 80 < t ≤ 100 | --- | 235 | --- | 410-560 | --- | 21 L, 19 T | AR, N or TMCP | L: 27 J @ 20°C |
| | | | | 100 < t ≤ 150 | --- | 225 | --- | 400-540 | --- | 19 L, 19 T | AR, N or TMCP | L: 27 J @ 20°C |
| | | | | 150 < t ≤ 200 | --- | 215 | --- | 380-540 | --- | 18 L, 18 T | AR, N or TMCP | L: 27 J @ 20°C |
| | | | | 200 < t ≤ 250 | --- | 205 | --- | 380-540 | --- | 18 L, 18 T | AR, N or TMCP | L: 27 J @ 20°C |
| | S275J0 | --- | 1.0143 | t < 3 | --- | 275 | --- | 430-580 | --- | --- | AR, N or TMCP | --- |
| | | | | 3 ≤ t ≤ 16 | --- | 275 | --- | 410-560 | --- | 23 L, 21 T | AR, N or TMCP | L: 27 J @ 0°C |
| | | | | 16 < t ≤ 40 | --- | 265 | --- | 410-560 | --- | 23 L, 21 T | AR, N or TMCP | L: 27 J @ 0°C |
| | | | | 40 < t ≤ 63 | --- | 255 | --- | 410-560 | --- | 22 L, 20 T | AR, N or TMCP | L: 27 J @ 0°C |
| | | | | 63 < t ≤ 80 | --- | 245 | --- | 410-560 | --- | 21 L, 19 T | AR, N or TMCP | L: 27 J @ 0°C |
| | | | | 80 < t ≤ 100 | --- | 235 | --- | 410-560 | --- | 21 L, 19 T | AR, N or TMCP | L: 27 J @ 0°C |
| | | | | 100 < t ≤ 150 | --- | 225 | --- | 400-540 | --- | 19 L, 19 T | AR, N or TMCP | L: 27 J @ 0°C |
| | | | | 150 < t ≤ 200 | --- | 215 | --- | 380-540 | --- | 18 L, 18 T | AR, N or TMCP | L: 27 J @ 0°C |
| | | | | 200 < t ≤ 250 | --- | 205 | --- | 380-540 | --- | 18 L, 18 T | AR, N or TMCP | L: 27 J @ 0°C |

Note: This section continued on next page.

**3.1 Carbon Steels for Structural Steel Plates**

**3.1A Mechanical Properties of Carbon Steels for Structural Steel Plates (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter mm | Section Thickness/Diameter in. | Yield Strength, min. MPa | Yield Strength, min. ksi | Tensile Strength, min. MPa | Tensile Strength, min. ksi | Elongation % min. | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GB 712-2000 | Grade A32 | --- | --- | --- | --- | 315 | --- | 440-570 | --- | 22 | N, TMCP, QT, HR or CtR | see standard for impact data |
| | Grade D32 | --- | --- | --- | --- | 315 | --- | 440-570 | --- | 22 | N, TMCP, QT, HR or CtR | |
| | Grade E32 | --- | --- | --- | --- | 315 | --- | 440-570 | --- | 22 | see standard | |
| | Grade F32 | --- | --- | --- | --- | 315 | --- | 440-570 | --- | 22 | see standard | |
| GB 711-88 | Grade 20Mn | --- | --- | t ≤ 60 | --- | --- | --- | 450 | --- | 24 | N, A, T or HR | --- |
| | Grade 25 | --- | --- | t ≤ 60 | --- | --- | --- | 450 | --- | 24 | N, A, T or HR | --- |
| ASTM A573/A573M-13 | Grade 65 [450] | K02404 | --- | t ≤ 40 | t ≤ 1.5 | 240 | 35 | 450-530 | 65-77 | 23 | --- | --- |
| ASTM A529/A529M-14 | Grade 50 [345] | K02703 | --- | t ≤ 25 | t ≤ 1 | 345 | 50 | 450-690 | 65-100 | 21 | --- | --- |
| ASME SA-1011/SA-1011M | Grade 50 [340], SS | --- | --- | 0.65 ≤ t < 1.6 | 0.025 ≤ t < 0.064 | 340 | 50 | 450 L | 65 L | 11 L | HR | --- |
| | | | | 1.6 ≤ t < 2.5 | 0.064 ≤ t < 0.097 | 340 | 50 | 450 L | 65 L | 16 L | HR | --- |
| | | | | 2.5 ≤ t < 6.0 | 0.097 ≤ t < 0.230 | 340 | 50 | 450 L | 65 L | 17 L | HR | --- |
| ASTM A1011/A1011M-14 | Grade 50 [340], SS | --- | --- | 0.65 ≤ t < 1.6 | 0.025 ≤ t < 0.064 | 340 | 50 | 450 L | 65 L | 11 L | HR | --- |
| | | | | 1.6 ≤ t < 2.5 | 0.064 ≤ t < 0.097 | 340 | 50 | 450 L | 65 L | 16 L | HR | --- |
| | | | | 2.5 ≤ t < 6.0 | 0.097 ≤ t < 0.230 | 340 | 50 | 450 L | 65 L | 17 L | HR | --- |
| ASME SA-1011/SA-1011M | Grade 55 [380], SS | --- | --- | 0.65 ≤ t < 1.6 | 0.025 ≤ t < 0.064 | 380 | 55 | 480 | 70 L | 9 L | HR | --- |
| | | | | 1.6 ≤ t < 2.5 | 0.064 ≤ t < 0.097 | 380 | 55 | 480 | 70 L | 14 L | HR | --- |
| | | | | 2.5 ≤ t < 6.0 | 0.097 ≤ t < 0.230 | 380 | 55 | 480 | 70 L | 15 L | HR | --- |
| ASTM A1011/A1011M-14 | Grade 55 [380], SS | --- | --- | 0.65 ≤ t < 1.6 | 0.025 ≤ t < 0.064 | 380 | 55 | 480 | 70 L | 9 L | HR | --- |
| | | | | 1.6 ≤ t < 2.5 | 0.064 ≤ t < 0.097 | 380 | 55 | 480 | 70 L | 14 L | HR | --- |
| | | | | 2.5 ≤ t < 6.0 | 0.097 ≤ t < 0.230 | 380 | 55 | 480 | 70 L | 15 L | HR | --- |
| ASTM A573/A573M-13 | Grade 70 [485] | K02701 | --- | t ≤ 40 | t ≤ 1.5 | 290 | 42 | 485-620 | 70-90 | 21 | --- | --- |
| ASTM A529/A529M-14 | Grade 55 [380] | K02703 | --- | t ≤ 25 | t ≤ 1 | 380 | 55 | 485-690 | 70-100 | 20 | --- | --- |
| GB 711-88 | Grade 25Mn | --- | --- | t ≤ 60 | --- | --- | --- | 490 | --- | 22 | N, A, T or HR | --- |
| | Grade 30 | --- | --- | t ≤ 60 | --- | --- | --- | 490 | --- | 22 | N, A, T or HR | --- |
| JIS G 3136:2012 | Grade SN490C | --- | --- | 6 ≤ t < 16 | --- | --- | --- | 490-610 | --- | 17 | N, T or TMCP | --- |
| | | | | 16 ≤ t ≤ 40 | --- | 325-445 | --- | 490-610 | --- | 21 | N, T or TMCP | L: 27 J @ 0°C |
| | | | | 40 < t ≤ 100 | --- | 295-415 | --- | 490-610 | --- | 23 | N, T or TMCP | L: 27 J @ 0°C |
| GB 700-88 | Grade Q275 | --- | --- | t ≤ 16 | --- | 275 | --- | 490-610 | --- | 20 | HR, CtR or N | --- |
| | | | | 16 < t ≤ 40 | --- | 265 | --- | 490-610 | --- | 19 | HR, CtR or N | --- |
| | | | | 40 < t ≤ 60 | --- | 255 | --- | 490-610 | --- | 18 | HR, CtR or N | --- |
| | | | | 60 < t ≤ 100 | --- | 245 | --- | 490-610 | --- | 17 | HR, CtR or N | --- |
| | | | | 100 < t ≤ 150 | --- | 235 | --- | 490-610 | --- | 16 | HR, CtR or N | --- |
| | | | | t > 150 | --- | 225 | --- | 490-610 | --- | 15 | HR, CtR or N | --- |
| GB/T 3524-92 | Grade Q275 | --- | --- | --- | --- | 275 | --- | 490-650 | --- | 20 | HR | --- |

Note: This section continued on next page.

**3.1 Carbon Steels for Structural Steel Plates**

**3.1A Mechanical Properties of Carbon Steels for Structural Steel Plates (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter mm | Section Thickness/Diameter in. | Yield Strength, min. MPa | Yield Strength, min. ksi | Tensile Strength, min. MPa | Tensile Strength, min. ksi | Elongation % min. | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| JIS G 3101:2010 | Symbol SS490 | --- | --- | t ≤ 16 | --- | 285 | --- | 490-610 | --- | see standard | HR | --- |
| | | | | 16 < t ≤ 40 | --- | 275 | --- | 490-610 | --- | see standard | HR | --- |
| | | | | 40 < t ≤ 100 | --- | 255 | --- | 490-610 | --- | see standard | HR | --- |
| | | | | t > 100 | --- | 245 | --- | 490-610 | --- | see standard | HR | --- |
| EN 10025-2:2004 | E295 | --- | 1.0050 | t < 3 | --- | 295 | --- | 490-660 | --- | --- | AR, N or TMCP | --- |
| | | | | 3 ≤ t ≤ 16 | --- | 295 | --- | 470-610 | --- | 20 L, 18 T | AR, N or TMCP | --- |
| | | | | 16 < t ≤ 40 | --- | 285 | --- | 470-610 | --- | 20 L, 18 T | AR, N or TMCP | --- |
| | | | | 40 < t ≤ 63 | --- | 275 | --- | 470-610 | --- | 19 L, 17 T | AR, N or TMCP | --- |
| | | | | 63 < t ≤ 80 | --- | 265 | --- | 470-610 | --- | 18 L, 16 T | AR, N or TMCP | --- |
| | | | | 80 < t ≤ 100 | --- | 255 | --- | 470-610 | --- | 18 L, 16 T | AR, N or TMCP | --- |
| | | | | 100 < t ≤ 150 | --- | 245 | --- | 450-610 | --- | 16 L, 15 T | AR, N or TMCP | --- |
| | | | | 150 < t ≤ 200 | --- | 235 | --- | 440-610 | --- | 15 L, 14 T | AR, N or TMCP | --- |
| | | | | 200 < t ≤ 250 | --- | 225 | --- | 440-610 | --- | 15 L, 14 T | AR, N or TMCP | --- |
| JIS G 3106:2008 | Grade SM490A | --- | --- | t ≤ 5 | --- | 325 | --- | 490-610 | --- | 22 | N, QHT, T or TMCP | --- |
| | | | | 5 < t ≤ 16 | --- | 325 | --- | 490-610 | --- | 17 | N, QHT, T or TMCP | --- |
| | | | | 16 < t ≤ 40 | --- | 315 | --- | 490-610 | --- | 21 | N, QHT, T or TMCP | --- |
| | | | | 40 < t ≤ 100 | --- | 295 | --- | 490-610 | --- | 23 | N, QHT, T or TMCP | --- |
| | | | | 100 < t ≤ 160 | --- | 285 | --- | 490-610 | --- | 23 | N, QHT, T or TMCP | --- |
| | | | | 160 < t ≤ 200 | --- | 275 | --- | 490-610 | --- | 23 | N, QHT, T or TMCP | --- |
| | Grade SM490B | --- | --- | t ≤ 5 | --- | 325 | --- | 490-610 | --- | 22 | N, QHT, T or TMCP | --- |
| | | | | 5 < t ≤ 16 | --- | 325 | --- | 490-610 | --- | 17 | N, QHT, T or TMCP | L: 27 J @ 0°C |
| | | | | 16 < t ≤ 40 | --- | 315 | --- | 490-610 | --- | 21 | N, QHT, T or TMCP | L: 27 J @ 0°C |
| | | | | 40 < t ≤ 100 | --- | 295 | --- | 490-610 | --- | 23 | N, QHT, T or TMCP | L: 27 J @ 0°C |
| | | | | 100 < t ≤ 160 | --- | 285 | --- | 490-610 | --- | 23 | N, QHT, T or TMCP | L: 27 J @ 0°C |
| | | | | 160 < t ≤ 200 | --- | 275 | --- | 490-610 | --- | 23 | N, QHT, T or TMCP | L: 27 J @ 0°C |
| | Grade SM490C | --- | --- | t ≤ 5 | --- | 325 | --- | 490-610 | --- | 22 | N, QHT, T or TMCP | --- |
| | | | | 5 < t ≤ 16 | --- | 325 | --- | 490-610 | --- | 17 | N, QHT, T or TMCP | L: 47 J @ 0°C |
| | | | | 16 < t ≤ 40 | --- | 315 | --- | 490-610 | --- | 21 | N, QHT, T or TMCP | L: 47 J @ 0°C |
| | | | | 40 < t ≤ 100 | --- | 295 | --- | 490-610 | --- | 23 | N, QHT, T or TMCP | L: 47 J @ 0°C |
| | | | | 100 < t ≤ 200 | --- | --- | --- | 490-610 | --- | 23 | N, QHT, T or TMCP | L: 47 J @ 0°C |
| JIS G 3136:2012 | Grade SN490B | --- | --- | 6 ≤ t < 12 | --- | 325 | --- | 490-610 | --- | 17 | N, T or TMCP | --- |
| | | | | 12 ≤ t ≤ 16 | --- | 325-445 | --- | 490-610 | --- | 17 | N, T or TMCP | L: 27 J @ 0°C |
| | | | | 16 < t ≤ 40 | --- | 325-445 | --- | 490-610 | --- | 21 | N, T or TMCP | L: 27 J @ 0°C |
| | | | | 40 < t ≤ 100 | --- | 295-415 | --- | 490-610 | --- | 23 | N, T or TMCP | L: 27 J @ 0°C |

Note: This section continued on next page.

**3.1 Carbon Steels for Structural Steel Plates**

**3.1A Mechanical Properties of Carbon Steels for Structural Steel Plates (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter mm | Section Thickness/Diameter in. | Yield Strength, min. MPa | Yield Strength, min. ksi | Tensile Strength, min. MPa | Tensile Strength, min. ksi | Elongation % min. | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GB 712-2000 | Grade A36 | --- | --- | --- | --- | 355 | --- | 490-630 | --- | 21 | N, TMCP, QT, HR or CtR | see standard for impact data |
| | Grade D36 | --- | --- | --- | --- | 355 | --- | 490-630 | --- | 21 | N, TMCP, QT, HR or CtR | |
| | Grade E36 | --- | --- | --- | --- | 355 | --- | 490-630 | --- | 21 | see standard | |
| | Grade F36 | --- | --- | --- | --- | 355 | --- | 490-630 | --- | 21 | see standard | |
| ISO 630:1995 A1:2003 | Grade E 355 (Fe 510), Quality C | --- | --- | 3 ≤ t ≤ 16 | --- | 355 | --- | 490-640 | --- | 22 | AR | 27 J @ 0°C |
| | | | | 16 < t ≤ 40 | --- | 345 | --- | 490-640 | --- | 22 | AR | 27 J @ 0°C |
| | | | | 40 < t ≤ 63 | --- | 335 | --- | 490-640 | --- | 21 | AR | 27 J @ 0°C |
| | | | | 63 < t ≤ 80 | --- | 325 | --- | 490-640 | --- | 20 | AR | 27 J @ 0°C |
| | | | | 80 < t ≤ 100 | --- | 315 | --- | 490-640 | --- | 20 | AR | 27 J @ 0°C |
| | | | | 100 < t ≤ 150 | --- | 295 | --- | 490-640 | --- | 18 | AR | 27 J @ 0°C |
| | | | | 150 < t ≤ 200 | --- | 285 | --- | 490-640 | --- | 17 | AR | 27 J @ 0°C |
| | Grade E 355 (Fe 510), Quality D | --- | --- | 3 ≤ t ≤ 16 | --- | 355 | --- | 490-640 | --- | 22 | N or BA | 27 J @ -20°C |
| | | | | 16 < t ≤ 40 | --- | 345 | --- | 490-640 | --- | 22 | N or BA | 27 J @ -20°C |
| | | | | 40 < t ≤ 63 | --- | 335 | --- | 490-640 | --- | 21 | N or BA | 27 J @ -20°C |
| | | | | 63 < t ≤ 80 | --- | 325 | --- | 490-640 | --- | 20 | N or BA | 27 J @ -20°C |
| | | | | 80 < t ≤ 100 | --- | 315 | --- | 490-640 | --- | 20 | N or BA | 27 J @ -20°C |
| | | | | 100 < t ≤ 150 | --- | 295 | --- | 490-640 | --- | 18 | N or BA | 27 J @ -20°C |
| | | | | 150 < t ≤ 200 | --- | 285 | --- | 490-640 | --- | 17 | N or BA | 27 J @ -20°C |
| JIS G 3106:2008 | Grade SM490YA | --- | --- | t ≤ 5 | --- | 365 | --- | 490-610 | --- | 19 | N, QHT, T or TMCP | --- |
| | | | | 5 < t ≤ 16 | --- | 365 | --- | 490-610 | --- | 15 | N, QHT, T or TMCP | --- |
| | | | | 16 < t ≤ 40 | --- | 355 | --- | 490-610 | --- | 19 | N, QHT, T or TMCP | --- |
| | | | | 40 < t ≤ 75 | --- | 335 | --- | 490-610 | --- | 21 | N, QHT, T or TMCP | --- |
| | | | | 75 < t ≤ 100 | --- | 325 | --- | 490-610 | --- | 21 | N, QHT, T or TMCP | --- |
| | Grade SM490YB | --- | --- | t ≤ 5 | --- | 365 | --- | 490-610 | --- | 19 | N, QHT, T or TMCP | --- |
| | | | | 5 < t ≤ 16 | --- | 365 | --- | 490-610 | --- | 15 | N, QHT, T or TMCP | L: 27 J @ 0°C |
| | | | | 16 < t ≤ 40 | --- | 355 | --- | 490-610 | --- | 19 | N, QHT, T or TMCP | L: 27 J @ 0°C |
| | | | | 40 < t ≤ 75 | --- | 335 | --- | 490-610 | --- | 21 | N, QHT, T or TMCP | L: 27 J @ 0°C |
| | | | | 75 < t ≤ 100 | --- | 325 | --- | 490-610 | --- | 21 | N, QHT, T or TMCP | L: 27 J @ 0°C |
| GB 11251-89 | Grade 40 B | --- | --- | --- | --- | --- | --- | 500-700 | --- | 20 | A, N or NT | --- |

**3.1 Carbon Steels for Structural Steel Plates**

**3.1A Mechanical Properties of Carbon Steels for Structural Steel Plates (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter mm | Section Thickness/Diameter in. | Yield Strength, min. MPa | Yield Strength, min. ksi | Tensile Strength, min. MPa | Tensile Strength, min. ksi | Elongation % min. | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| EN 10025-2:2004 | S355JR | --- | 1.0045 | t < 3 | --- | 355 | --- | 510-680 | --- | --- | AR, N or TMCP | --- |
| | | | | 3 ≤ t ≤ 16 | --- | 355 | --- | 470-630 | --- | 22 L, 20 T | AR, N or TMCP | L: 27 J @ 20°C |
| | | | | 16 < t ≤ 40 | --- | 345 | --- | 470-630 | --- | 22 L, 20 T | AR, N or TMCP | L: 27 J @ 20°C |
| | | | | 40 < t ≤ 63 | --- | 335 | --- | 470-630 | --- | 21 L, 19 T | AR, N or TMCP | L: 27 J @ 20°C |
| | | | | 63 < t ≤ 80 | --- | 325 | --- | 470-630 | --- | 20 L, 18 T | AR, N or TMCP | L: 27 J @ 20°C |
| | | | | 80 < t ≤ 100 | --- | 315 | --- | 470-630 | --- | 20 L, 18 T | AR, N or TMCP | L: 27 J @ 20°C |
| | | | | 100 < t ≤ 150 | --- | 295 | --- | 450-600 | --- | 18 L, 18 T | AR, N or TMCP | L: 27 J @ 20°C |
| | | | | 150 < t ≤ 200 | --- | 285 | --- | 450-600 | --- | 17 L, 17 T | AR, N or TMCP | L: 27 J @ 20°C |
| | | | | 200 < t ≤ 250 | --- | 275 | --- | 450-600 | --- | 17 L, 17 T | AR, N or TMCP | L: 27 J @ 20°C |
| | S355J0 | --- | 1.0553 | t < 3 | --- | 355 | --- | 510-680 | --- | --- | AR, N or TMCP | --- |
| | | | | 3 ≤ t ≤ 16 | --- | 355 | --- | 470-630 | --- | 22 L, 20 T | AR, N or TMCP | L: 27 J @ 0°C |
| | | | | 16 < t ≤ 40 | --- | 345 | --- | 470-630 | --- | 22 L, 20 T | AR, N or TMCP | L: 27 J @ 0°C |
| | | | | 40 < t ≤ 63 | --- | 335 | --- | 470-630 | --- | 21 L, 19 T | AR, N or TMCP | L: 27 J @ 0°C |
| | | | | 63 < t ≤ 80 | --- | 325 | --- | 470-630 | --- | 20 L, 18 T | AR, N or TMCP | L: 27 J @ 0°C |
| | | | | 80 < t ≤ 100 | --- | 315 | --- | 470-630 | --- | 20 L, 18 T | AR, N or TMCP | L: 27 J @ 0°C |
| | | | | 100 < t ≤ 150 | --- | 295 | --- | 450-600 | --- | 18 L, 18 T | AR, N or TMCP | L: 27 J @ 0°C |
| | | | | 150 < t ≤ 200 | --- | 285 | --- | 450-600 | --- | 17 L, 17 T | AR, N or TMCP | L: 27 J @ 0°C |
| | | | | 200 < t ≤ 250 | --- | 275 | --- | 450-600 | --- | 17 L, 17 T | AR, N or TMCP | L: 27 J @ 0°C |
| GB 712-2000 | Grade A40 | --- | --- | --- | --- | 390 | --- | 510-660 | --- | 20 | N, TMCP, QT, HR or CtR | see standard for impact data |
| | Grade D40 | --- | --- | --- | --- | 390 | --- | 510-660 | --- | 20 | N, TMCP or CtR | |
| | Grade E40 | --- | --- | --- | --- | 390 | --- | 510-660 | --- | 20 | N, TMCP, QT | |
| | Grade F40 | --- | --- | --- | --- | 390 | --- | 510-660 | --- | 20 | N, TMCP, QT | |
| JIS G 3106:2008 | Grade SM520B | --- | --- | t ≤ 5 | --- | 365 | --- | 520-640 | --- | 19 | N, QHT, T or TMCP | --- |
| | | | | 5 < t ≤ 16 | --- | 365 | --- | 520-640 | --- | 15 | N, QHT, T or TMCP | L: 27 J @ 0°C |
| | | | | 16 < t ≤ 40 | --- | 355 | --- | 520-640 | --- | 19 | N, QHT, T or TMCP | L: 27 J @ 0°C |
| | | | | 40 < t ≤ 75 | --- | 335 | --- | 520-640 | --- | 21 | N, QHT, T or TMCP | L: 27 J @ 0°C |
| | | | | 75 < t ≤ 100 | --- | 325 | --- | 520-640 | --- | 21 | N, QHT, T or TMCP | L: 27 J @ 0°C |
| | Grade SM520C | --- | --- | t ≤ 5 | --- | 365 | --- | 520-640 | --- | 19 | N, QHT, T or TMCP | --- |
| | | | | 5 < t ≤ 16 | --- | 365 | --- | 520-640 | --- | 15 | N, QHT, T or TMCP | L: 47 J @ 0°C |
| | | | | 16 < t ≤ 40 | --- | 355 | --- | 520-640 | --- | 19 | N, QHT, T or TMCP | L: 47 J @ 0°C |
| | | | | 40 < t ≤ 75 | --- | 335 | --- | 520-640 | --- | 21 | N, QHT, T or TMCP | L: 47 J @ 0°C |
| | | | | 75 < t ≤ 100 | --- | 325 | --- | 520-640 | --- | 21 | N, QHT, T or TMCP | L: 47 J @ 0°C |

Note: This section continued on next page.

**3.1 Carbon Steels for Structural Steel Plates**

**3.1A Mechanical Properties of Carbon Steels for Structural Steel Plates (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | % min. | | |
| GB 711-88 | Grade 35 | --- | --- | t ≤ 60 | --- | --- | --- | 530 | --- | 20 | N, A, T or HR | --- |
| | Grade 30Mn | --- | --- | t ≤ 60 | --- | --- | --- | 540 | --- | 20 | N, A, T or HR | --- |
| JIS G 3101:2010 | Symbol SS540 | --- | --- | t ≤ 16 | --- | 400 | --- | 540 | --- | see standard | HR | --- |
| | | | | 16 < t ≤ 40 | --- | 390 | --- | 540 | --- | see standard | HR | --- |
| GB 11251-89 | Grade 45 B | --- | --- | --- | --- | --- | --- | 550-750 | --- | 18 | A, N or NT | --- |
| | Grade 45Mn2 | --- | --- | --- | --- | --- | --- | 600-850 | --- | 13 | A, N or NT | --- |
| | Grade 50 B | --- | --- | --- | --- | --- | --- | 550-750 | --- | 16 | A, N or NT | --- |
| GB 711-88 | Grade 40 | --- | --- | t ≤ 60 | --- | --- | --- | 570 | --- | 19 | N, A, T or HR | --- |
| | Grade 40Mn | --- | --- | t ≤ 60 | --- | --- | --- | 590 | --- | 17 | N, A, T or HR | --- |
| | Grade 45 | --- | --- | t ≤ 60 | --- | --- | --- | 600 | --- | 17 | N, A, T or HR | --- |
| JIS G 3106:2008 | Grade SM570 | --- | --- | t ≤ 16 | --- | 460 | --- | 570-720 | --- | 19 | N, QHT, T or TMCP | L: 47 J @ -5°C |
| | | | | 16 < t ≤ 40 | --- | 450 | --- | 570-720 | --- | 26 | N, QHT, T or TMCP | L: 47 J @ -5°C |
| | | | | 40 < t ≤ 75 | --- | 430 | --- | 570-720 | --- | 26 | N, QHT, T or TMCP | L: 47 J @ -5°C |
| | | | | 75 < t ≤ 100 | --- | 420 | --- | 570-720 | --- | 26 | N, QHT, T or TMCP | L: 47 J @ -5°C |
| EN 10025-2:2004 | E335 | --- | 1.0060 | t < 3 | --- | 335 | --- | 590-770 | --- | --- | AR, N or TMCP | --- |
| | | | | 3 ≤ t ≤ 16 | --- | 335 | --- | 570-710 | --- | 16 L, 14 T | AR, N or TMCP | --- |
| | | | | 16 < t ≤ 40 | --- | 325 | --- | 570-710 | --- | 16 L, 14 T | AR, N or TMCP | --- |
| | | | | 40 < t ≤ 63 | --- | 315 | --- | 570-710 | --- | 15 L, 13 T | AR, N or TMCP | --- |
| | | | | 63 < t ≤ 80 | --- | 305 | --- | 570-710 | --- | 14 L, 12 T | AR, N or TMCP | --- |
| | | | | 80 < t ≤ 100 | --- | 295 | --- | 570-710 | --- | 14 L, 12 T | AR, N or TMCP | --- |
| | | | | 100 < t ≤ 150 | --- | 275 | --- | 550-710 | --- | 12 L, 11 T | AR, N or TMCP | --- |
| | | | | 150 < t ≤ 200 | --- | 265 | --- | 540-710 | --- | 11 L, 10 T | AR, N or TMCP | --- |
| | | | | 200 < t ≤ 250 | --- | 255 | --- | 540-710 | --- | 11 L, 10 T | AR, N or TMCP | --- |

**3.1 Carbon Steels for Structural Steel Plates**

**3.1A Mechanical Properties of Carbon Steels for Structural Steel Plates (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | % min. | | |
| GB 711-88 | Grade 50 | --- | --- | t ≤ 60 | --- | --- | --- | 625 | --- | 16 | N, A, T or HR | --- |
| | Grade 50Mn | --- | --- | t ≤ 60 | --- | --- | --- | 650 | --- | 13 | N, A, T or HR | --- |
| | Grade 55 | --- | --- | t ≤ 60 | --- | --- | --- | 645 | --- | 13 | N, A, T or HR | --- |
| | Grade 60 | --- | --- | t ≤ 60 | --- | --- | --- | 675 | --- | 12 | N, A, T or HR | --- |
| | Grade 60Mn | --- | --- | t ≤ 60 | --- | --- | --- | 695 | --- | 11 | N, A, T or HR | --- |
| | Grade 65 | --- | --- | t ≤ 60 | --- | --- | --- | 695 | --- | 10 | N, A, T or HR | --- |
| EN 10025-2:2004 | E360 | --- | 1.0070 | t < 3 | --- | 360 | --- | 690-900 | --- | --- | AR, N or TMCP | --- |
| | | | | 3 ≤ t ≤ 16 | --- | 360 | --- | 670-830 | --- | 11 L, 10 T | AR, N or TMCP | --- |
| | | | | 16 < t ≤ 40 | --- | 355 | --- | 670-830 | --- | 11 L, 10 T | AR, N or TMCP | --- |
| | | | | 40 < t ≤ 63 | --- | 345 | --- | 670-830 | --- | 10 L, 9 T | AR, N or TMCP | --- |
| | | | | 63 < t ≤ 80 | --- | 335 | --- | 670-830 | --- | 9 L, 8 T | AR, N or TMCP | --- |
| | | | | 80 < t ≤ 100 | --- | 325 | --- | 670-830 | --- | 9 L, 8 T | AR, N or TMCP | --- |
| | | | | 100 < t ≤ 150 | --- | 305 | --- | 650-830 | --- | 8 L, 7 T | AR, N or TMCP | --- |
| | | | | 150 < t ≤ 200 | --- | 295 | --- | 640-830 | --- | 7 L, 6 T | AR, N or TMCP | --- |
| | | | | 200 < t ≤ 250 | --- | 285 | --- | 640-830 | --- | 7 L, 6 T | AR, N or TMCP | --- |

**3.1 Carbon Steels for Structural Steel Plates**

**3.1B Chemical Composition of Carbon Steels for Structural Steel Plates**

| Specification | Designation | UNS No. | Steel No. | Section Thickness | | Weight, %max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ISO 630:1995 A1:2003 | Grade E 185 (Fe 310), Quality 0 | --- | --- | 3 ≤ t ≤ 25 | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| ASME SA-283/SA-283M | Grade A | K01400 | --- | t ≤ 40 | t ≤ 1.5 | 0.14 | 0.90 | 0.40 | 0.035 | 0.04 | --- | --- | --- | --- |
| | | | | t > 40 | t > 1.5 | 0.14 | 0.90 | 0.15-0.40 | 0.035 | 0.04 | --- | --- | --- | --- |
| EN 10025-2:2004 | S185 | --- | 1.0035 | t ≤ 250 | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| GB 700-88 | Grade Q195 | --- | --- | --- | --- | 0.06-0.12 | 0.25-0.50 | 0.30 | 0.045 | 0.050 | 0.30 | 0.30 | --- | Cu 0.30; N 0.008; As 0.080 |
| GB 711-88 | Grade 08F | --- | --- | t ≤ 60 | --- | 0.05-0.11 | 0.25-0.50 | 0.03 | 0.035 | 0.040 | 0.10 | 0.25 | --- | Cu 0.25; N 0.008 |
| GB/T 3524-92 | Grade Q195 | --- | --- | --- | --- | 0.06-0.12 | 0.25-0.50 | 0.30 | 0.045 | 0.050 | 0.30 | 0.30 | --- | Cu 0.30; N 0.008; As 0.080 |
| GB 711-88 | Grade 08 | --- | --- | t ≤ 60 | --- | 0.05-0.12 | 0.35-0.65 | 0.17-0.37 | 0.035 | 0.040 | 0.10 | 0.25 | --- | Cu 0.25; N 0.008 |
| | Grade 10F | --- | --- | t ≤ 60 | --- | 0.07-0.14 | 0.25-0.50 | 0.07 | 0.035 | 0.040 | 0.15 | 0.25 | --- | Cu 0.25; N 0.008 |
| | Grade 10 | --- | --- | t ≤ 60 | --- | 0.07-0.14 | 0.35-0.65 | 0.17-0.37 | 0.035 | 0.040 | 0.15 | 0.25 | --- | Cu 0.25; N 0.008 |
| JIS G 3101:2010 | Symbol SS330 | --- | --- | --- | --- | --- | --- | --- | 0.050 | 0.050 | --- | --- | --- | --- |
| GB 700-88 | Grade Q215A | --- | --- | --- | --- | 0.09-0.15 | 0.25-0.55 | 0.30 | 0.045 | 0.050 | 0.30 | 0.30 | --- | Cu 0.30; N 0.008; As 0.080 |
| | Grade Q215B | --- | --- | --- | --- | 0.09-0.15 | 0.25-0.55 | 0.30 | 0.045 | 0.045 | 0.30 | 0.30 | --- | Cu 0.30; N 0.008; As 0.080 |
| GB/T 3524-92 | Grade Q215A | --- | --- | --- | --- | 0.09-0.15 | 0.25-0.55 | 0.30 | 0.045 | 0.050 | 0.30 | 0.30 | --- | Cu 0.30; N 0.008; As 0.080 |
| | Grade Q215B | --- | --- | --- | --- | 0.09-0.15 | 0.25-0.55 | 0.30 | 0.045 | 0.045 | 0.30 | 0.30 | --- | Cu 0.30; N 0.008; As 0.080 |
| ASME SA-1011/SA-1011M | Grade 30 [205], SS | --- | --- | --- | --- | 0.25 | 0.90 | --- | 0.035 | 0.04 | 0.15 | 0.20 | 0.06 | V 0.008; Cu 0.20 nom.; Ti 0.025; Cb 0.008 |
| ASTM A1011/A1011M-14 | Grade 30 [205], SS | --- | --- | --- | --- | 0.25 | 0.90 | --- | 0.035 | 0.04 | 0.15 | 0.20 | 0.06 | V 0.008; Cu 0.20 nom.; Ti 0.025; Cb 0.008 |
| ISO 630:1995 A1:2003 | Grade E 235 (Fe 360), Quality A | --- | --- | t ≥ 3 | --- | 0.22 | --- | --- | 0.050 | 0.050 | --- | --- | --- | --- |
| | Grade E 235 (Fe 360), Quality B | --- | --- | 3 ≤ t ≤ 16 | --- | 0.17 | 1.40 | 0.40 | 0.045 | 0.045 | --- | --- | --- | --- |
| | | | | 16 < t ≤ 25 | --- | 0.20 | 1.40 | 0.40 | 0.045 | 0.045 | --- | --- | --- | --- |
| | Grade E 235 (Fe 360), Quality B NF | --- | --- | 3 ≤ t ≤ 40 | --- | 0.17 | 1.40 | 0.40 | 0.045 | 0.045 | --- | --- | --- | --- |
| | | | | t > 40 | --- | 0.20 | 1.40 | 0.40 | 0.045 | 0.045 | --- | --- | --- | --- |
| | Grade E 235 (Fe 360), Quality C | --- | --- | t ≥ 3 | --- | 0.17 | 1.40 | 0.40 | 0.040 | 0.040 | --- | --- | --- | --- |
| | Grade E 235 (Fe 360), Quality D | --- | --- | t ≥ 3 | --- | 0.17 | 1.40 | 0.40 | 0.035 | 0.035 | --- | --- | --- | --- |
| ASME SA-283/SA-283M | Grade B | K01702 | --- | t ≤ 40 | t ≤ 1.5 | 0.17 | 0.90 | 0.40 | 0.035 | 0.04 | --- | --- | --- | --- |
| | | | | t > 40 | t > 1.5 | 0.17 | 0.90 | 0.15-0.40 | 0.035 | 0.04 | --- | --- | --- | --- |

**3.1 Carbon Steels for Structural Steel Plates**

**3.1B Chemical Composition of Carbon Steels for Structural Steel Plates (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness | | Weight, %max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| GB 711-88 | Grade 15F | --- | --- | t ≤ 60 | --- | 0.12-0.19 | 0.25-0.50 | 0.07 | 0.035 | 0.040 | 0.25 | 0.25 | --- | Cu 0.25; N 0.008 |
| ASME SA-1011/SA-1011M | Grade 33 [230], SS | --- | --- | --- | --- | 0.25 | 0.90 | --- | 0.035 | 0.04 | 0.15 | 0.20 | 0.06 | V 0.008; Cu 0.20 nom.; Ti 0.025; Cb 0.008 |
| ASTM A1011/A1011M-14 | Grade 33 [230], SS | --- | --- | --- | --- | 0.25 | 0.90 | --- | 0.035 | 0.04 | 0.15 | 0.20 | 0.06 | V 0.008; Cu 0.20 nom.; Ti 0.025; Cb 0.008 |
| EN 10025-2:2004 | S235JR | --- | 1.0038 | t ≤ 40 | --- | 0.17 | 1.40 | --- | 0.035 | 0.035 | --- | --- | --- | Cu 0.55; N 0.012 |
| | | | | 40 < t ≤ 150 | --- | 0.20 | 1.40 | --- | 0.035 | 0.035 | --- | --- | --- | Cu 0.55; N 0.012 |
| | | | | 150 < t ≤ 250 | --- | 0.20 | 1.40 | --- | 0.035 | 0.035 | --- | --- | --- | Cu 0.55; N 0.012 |
| | S235J0 | --- | 1.0114 | t ≤ 40 | --- | 0.17 | 1.40 | --- | 0.030 | 0.030 | --- | --- | --- | Cu 0.55; N 0.012 |
| | | | | 40 < t ≤ 150 | --- | 0.17 | 1.40 | --- | 0.030 | 0.030 | --- | --- | --- | Cu 0.55; N 0.012 |
| | | | | 150 < t ≤ 250 | --- | 0.17 | 1.40 | --- | 0.030 | 0.030 | --- | --- | --- | Cu 0.55; N 0.012 |
| ASME SA-1011/SA-1011M | Grade 36 [250], Type 1, SS | --- | --- | --- | --- | 0.25 | 0.90 | --- | 0.035 | 0.04 | 0.15 | 0.20 | 0.06 | V 0.008; Cu 0.20 nom.; Ti 0.025; Cb 0.008 |
| ASTM A1011/A1011M-14 | Grade 36 [250], Type 1, SS | --- | --- | --- | --- | 0.25 | 0.90 | --- | 0.035 | 0.04 | 0.15 | 0.20 | 0.06 | V 0.008; Cu 0.20 nom.; Ti 0.025; Cb 0.008 |
| GB 711-88 | Grade 15 | --- | --- | t ≤ 60 | --- | 0.12-0.19 | 0.35-0.65 | 0.17-0.37 | 0.035 | 0.040 | 0.25 | 0.25 | --- | Cu 0.25; N 0.008 |
| GB 700-88 | Grade Q235A | --- | --- | --- | --- | 0.14-0.22 | 0.30-0.65 | 0.30 | 0.045 | 0.050 | 0.30 | 0.30 | --- | Cu 0.30; N 0.008; As 0.080 |
| | Grade Q235B | --- | --- | --- | --- | 0.12-0.20 | 0.30-0.70 | 0.30 | 0.045 | 0.045 | 0.30 | 0.30 | --- | Cu 0.30; N 0.008; As 0.080 |
| | Grade Q235C | --- | --- | --- | --- | 0.18 | 0.35-0.80 | 0.30 | 0.040 | 0.040 | 0.30 | 0.30 | --- | Cu 0.30; N 0.008; As 0.080 |
| | Grade Q235D | --- | --- | --- | --- | 0.17 | 0.35-0.80 | 0.30 | 0.035 | 0.035 | 0.30 | 0.30 | --- | Cu 0.30; N 0.008; As 0.080 |
| GB/T 3524-92 | Grade Q235A | --- | --- | --- | --- | 0.14-0.22 | 0.30-0.65 | 0.30 | 0.045 | 0.050 | 0.30 | 0.30 | --- | Cu 0.30; N 0.008; As 0.080 |
| | Grade Q235B | --- | --- | --- | --- | 0.12-0.20 | 0.30-0.70 | 0.30 | 0.045 | 0.045 | 0.30 | 0.30 | --- | Cu 0.30; N 0.008; As 0.080 |
| GB 711-88 | Grade 20F | --- | --- | t ≤ 60 | --- | 0.17-0.24 | 0.25-0.50 | 0.07 | 0.035 | 0.040 | 0.25 | 0.25 | --- | Cu 0.25; N 0.008 |
| ASME SA-283/SA-283M | Grade C | K02401 | --- | t ≤ 40 | t ≤ 1.5 | 0.24 | 0.90 | 0.40 | 0.035 | 0.04 | --- | --- | --- | --- |
| | | | | t > 40 | t > 1.5 | 0.24 | 0.90 | 0.15-0.40 | 0.035 | 0.04 | --- | --- | --- | --- |
| ASTM A283/A283M-13 | Grade C | K02401 | --- | t ≤ 40 | t ≤ 1.5 | 0.24 | 0.90 | 0.40 | 0.030 | 0.030 | --- | --- | --- | --- |
| | | | | t > 40 | t > 1.5 | 0.24 | 0.90 | 0.15-0.40 | 0.030 | 0.030 | --- | --- | --- | --- |
| ASME SA-1011/SA-1011M | Grade 40 [275], SS | --- | --- | --- | --- | 0.25 | 0.90 | --- | 0.035 | 0.04 | 0.15 | 0.20 | 0.06 | V 0.008; Cu 0.20 nom.; Ti 0.025; Cb 0.008 |
| ASTM A1011/A1011M-14 | Grade 40 [275], SS | --- | --- | --- | --- | 0.25 | 0.90 | --- | 0.035 | 0.04 | 0.15 | 0.20 | 0.06 | V 0.008; Cu 0.20 nom.; Ti 0.025; Cb 0.008 |
| ASTM A573/A573M-13 | Grade 58 [400] | K02301 | --- | t ≤ 13 | t ≤ 0.5 | 0.23 | 0.60-0.90 | 0.10-0.35 | 0.030 | 0.030 | --- | --- | --- | --- |
| | | | | 13 < t ≤ 40 | 0.5 < t ≤ 1.5 | 0.23 | 0.60-0.90 | 0.10-0.35 | 0.030 | 0.030 | --- | --- | --- | --- |
| GB 712-2000 | Grade A | --- | --- | --- | --- | 0.21 | --- | 0.50 | 0.035 | 0.035 | 0.20 | 0.40 | --- | Cu 0.35; Mn 2.5xC min. |
| | Grade B | --- | --- | --- | --- | 0.21 | 0.80-1.20 | 0.35 | 0.035 | 0.035 | 0.20 | 0.40 | --- | Cu 0.35 |
| | Grade D | --- | --- | --- | --- | 0.21 | 0.60-1.20 | 0.35 | 0.035 | 0.035 | 0.20 | 0.40 | --- | Cu 0.35 |
| | Grade E | --- | --- | --- | --- | 0.18 | 0.70-1.20 | 0.35 | 0.035 | 0.035 | 0.20 | 0.40 | --- | Cu 0.35 |

Note: This section continued on next page.

**3.1 Carbon Steels for Structural Steel Plates**

**3.1B Chemical Composition of Carbon Steels for Structural Steel Plates (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness | | Weight, %max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| JIS G 3136:2012 | Grade SN400A | --- | --- | 6 ≤ t ≤ 100 | --- | 0.24 | --- | --- | 0.050 | 0.050 | --- | --- | --- | --- |
| | Grade SN400B | --- | --- | 6 ≤ t ≤ 50 | --- | 0.20 | 0.60-1.50 | 0.35 | 0.030 | 0.015 | --- | --- | --- | --- |
| | | | | 50 < t ≤ 100 | --- | 0.22 | 0.60-1.50 | 0.35 | 0.030 | 0.015 | --- | --- | --- | --- |
| | Grade SN400C | --- | --- | 16 ≤ t ≤ 50 | --- | 0.20 | 0.60-1.50 | 0.35 | 0.020 | 0.008 | --- | --- | --- | --- |
| | | | | 50 < t ≤ 100 | --- | 0.22 | 0.60-1.50 | 0.35 | 0.020 | 0.008 | --- | --- | --- | --- |
| JIS G 3101:2010 | Symbol SS400 | --- | --- | --- | --- | --- | --- | --- | 0.050 | 0.050 | --- | --- | --- | --- |
| JIS G 3106:2008 | Grade SM400A | --- | --- | t ≤ 50 | --- | 0.23 | --- | --- | 0.035 | 0.035 | --- | --- | --- | --- |
| | | | | 50 < t ≤ 200 | --- | 0.25 | --- | --- | 0.035 | 0.035 | --- | --- | --- | --- |
| | Grade SM400B | --- | --- | t ≤ 50 | --- | 0.20 | 0.60-1.50 | 0.35 | 0.035 | 0.035 | --- | --- | --- | --- |
| | | | | 50 < t ≤ 200 | --- | 0.22 | 0.60-1.50 | 0.35 | 0.035 | 0.035 | --- | --- | --- | --- |
| | Grade SM400C | --- | --- | t ≤ 100 | --- | 0.18 | 0.60-1.50 | 0.35 | 0.035 | 0.035 | --- | --- | --- | --- |
| ASME SA-36/SA-36M | --- | K02595 | --- | t > 100 | t > 4 | 0.29 | 0.85-1.20 | 0.15-0.40 | 0.04 | 0.05 | --- | --- | --- | --- |
| | | K02596 | --- | 65 < t ≤ 100 | 2.5 < t ≤ 4 | 0.27 | 0.85-1.20 | 0.15-0.40 | 0.04 | 0.05 | --- | --- | --- | --- |
| | | K02597 | --- | 40 < t ≤ 65 | 1.5 < t ≤ 2.5 | 0.26 | 0.80-1.20 | 0.15-0.40 | 0.04 | 0.05 | --- | --- | --- | --- |
| | | K02598 | --- | 20 < t ≤ 40 | 0.75 < t ≤ 1.5 | 0.25 | 0.80-1.20 | 0.40 | 0.04 | 0.05 | --- | --- | --- | --- |
| | | K02599 | --- | t ≤ 20 | t ≤ 0.75 | 0.25 | --- | 0.40 | 0.04 | 0.05 | --- | --- | --- | --- |
| ASME SA-1011/SA-1011M | Grade 36 [250], Type 2, SS | --- | --- | --- | --- | 0.25 | 1.35 | --- | 0.035 | 0.04 | 0.15 | 0.20 | 0.06 | V 0.008; Cu 0.20 nom.; Ti 0.025; Cb 0.008 |
| ASTM A36/A36M-14 | --- | K02595 | --- | t > 100 | t > 4 | 0.29 | 0.85-1.20 | 0.15-0.40 | 0.04 | 0.05 | --- | --- | --- | --- |
| | | K02596 | --- | 65 < t ≤ 100 | 2.5 < t ≤ 4 | 0.27 | 0.85-1.20 | 0.15-0.40 | 0.04 | 0.05 | --- | --- | --- | --- |
| | | K02597 | --- | 40 < t ≤ 65 | 1.5 < t ≤ 2.5 | 0.26 | 0.80-1.20 | 0.15-0.40 | 0.04 | 0.05 | --- | --- | --- | --- |
| | | K02598 | --- | 20 < t ≤ 40 | 0.75 < t ≤ 1.5 | 0.25 | 0.80-1.20 | 0.40 | 0.04 | 0.05 | --- | --- | --- | --- |
| | | K02599 | --- | t ≤ 20 | t ≤ 0.75 | 0.25 | --- | 0.40 | 0.04 | 0.05 | --- | --- | --- | --- |
| ASTM A709/A709M-13a | Grade 36 [250] | --- | --- | t ≤ 20 | t ≤ 0.75 | 0.25 | --- | 0.40 | 0.04 | 0.05 | --- | --- | --- | --- |
| | | | | 20 < t ≤ 40 | 0.75 < t ≤ 1.5 | 0.25 | 0.80-1.20 | 0.40 | 0.04 | 0.05 | --- | --- | --- | --- |
| | | | | 40 < t ≤ 65 | 1.5 < t ≤ 2.5 | 0.26 | 0.80-1.20 | 0.15-0.40 | 0.04 | 0.05 | --- | --- | --- | --- |
| | | | | 65 < t ≤ 100 | 2.5 < t ≤ 4 | 0.27 | 0.85-1.20 | 0.15-0.40 | 0.04 | 0.05 | --- | --- | --- | --- |
| | | | | t ≤ 20 | t ≤ 0.75 | 0.26 | --- | 0.40 | 0.04 | 0.05 | --- | --- | --- | --- |
| | | | | 20 < t ≤ 40 | 0.75 < t ≤ 1.5 | 0.27 | 0.60-0.90 | 0.40 | 0.04 | 0.05 | --- | --- | --- | --- |
| | | | | 40 < t ≤ 100 | 1.5 < t ≤ 4 | 0.28 | 0.60-0.90 | 0.40 | 0.04 | 0.05 | --- | --- | --- | --- |
| | | | | --- | --- | 0.26 | --- | 0.40 | 0.04 | 0.05 | --- | --- | --- | --- |
| ASTM A1011/A1011M-14 | Grade 36 [250], Type 2, SS | --- | --- | --- | --- | 0.25 | 1.35 | --- | 0.035 | 0.04 | 0.15 | 0.20 | 0.06 | V 0.008; Cu 0.20 nom.; Ti 0.025; Cb 0.008 |

**3.1 Carbon Steels for Structural Steel Plates**

**3.1B Chemical Composition of Carbon Steels for Structural Steel Plates (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness mm | Section Thickness in. | Weight, %max, Unless Otherwise Specified C | Mn | Si | P | S | Cr | Ni | Mo | Others |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GB 711-88 | Grade 20 | --- | --- | t ≤ 60 | --- | 0.17-0.24 | 0.35-0.65 | 0.17-0.37 | 0.035 | 0.040 | 0.25 | 0.25 | --- | Cu 0.25; N 0.008 |
| GB 700-88 | Grade Q255A | --- | --- | --- | --- | 0.18-0.28 | 0.40-0.70 | 0.30 | 0.045 | 0.050 | 0.30 | 0.30 | --- | Cu 0.30; N 0.008; As 0.080 |
| | Grade Q255B | --- | --- | --- | --- | 0.18-0.28 | 0.40-0.70 | 0.30 | 0.045 | 0.045 | 0.30 | 0.30 | --- | Cu 0.30; N 0.008; As 0.080 |
| GB/T 3524-92 | Grade Q255A | --- | --- | --- | --- | 0.18-0.28 | 0.40-0.70 | 0.30 | 0.045 | 0.050 | 0.30 | 0.30 | --- | Cu 0.30; N 0.008; As 0.080 |
| | Grade Q255B | --- | --- | --- | --- | 0.18-0.28 | 0.40-0.70 | 0.30 | 0.045 | 0.045 | 0.30 | 0.30 | --- | Cu 0.30; N 0.008; As 0.080 |
| ISO 630:1995 A1:2003 | Grade E 275 (Fe 430), Quality A | --- | --- | t ≥ 3 | --- | 0.24 | --- | --- | 0.050 | 0.050 | --- | --- | --- | --- |
| | Grade E 275 (Fe 430), | --- | --- | 3 ≤ t ≤ 40 | --- | 0.21 | 1.50 | 0.40 | 0.045 | 0.045 | --- | --- | --- | --- |
| | Quality B | | | t > 40 | --- | 0.22 | 1.50 | 0.40 | 0.045 | 0.045 | --- | --- | --- | --- |
| | Grade E 275 (Fe 430), Quality C | --- | --- | t ≥ 3 | --- | 0.20 | 1.50 | 0.40 | 0.040 | 0.040 | --- | --- | --- | --- |
| | Grade E 275 (Fe 430), Quality D | --- | --- | t ≥ 3 | --- | 0.20 | 1.50 | 0.40 | 0.035 | 0.035 | --- | --- | --- | --- |
| ASME SA-1011/SA-1011M | Grade 45 [310], SS | --- | --- | --- | --- | 0.25 | 1.35 | --- | 0.035 | 0.04 | 0.15 | 0.20 | 0.06 | V 0.008; Cu 0.20 nom.; Ti 0.025; Cb 0.008 |
| ASTM A1011/A1011M-14 | Grade 45 [310], Type 1, SS | --- | --- | --- | --- | 0.25 | 1.35 | --- | 0.035 | 0.04 | 0.15 | 0.20 | 0.06 | V 0.008; Cu 0.20 nom.; Ti 0.025; Cb 0.008 |
| | Grade 45 [310], Type 2, SS | --- | --- | --- | --- | 0.02-0.08 | 0.30-1.00 | 0.60 | 0.030-0.070 | 0.025 | 0.15 | 0.20 | 0.06 | V 0.008; Cu 0.20 nom.; Ti 0.008; Cb 0.008; Al 0.02-0.08; N 0.010-0.030 |
| ASME SA-283/SA-283M | Grade D | K02702 | --- | t ≤ 40 | t ≤ 1.5 | 0.27 | 0.90 | 0.40 | 0.035 | 0.04 | --- | --- | --- | --- |
| | | | | t > 40 | t > 1.5 | 0.27 | 0.90 | 0.15-0.40 | 0.035 | 0.04 | --- | --- | --- | --- |
| ASTM A283/A283M-13 | Grade D | K02702 | --- | t ≤ 40 | t ≤ 1.5 | 0.27 | 0.90 | 0.40 | 0.030 | 0.030 | --- | --- | --- | --- |
| | | | | t > 40 | t > 1.5 | 0.27 | 0.90 | 0.15-0.40 | 0.030 | 0.030 | --- | --- | --- | --- |
| EN 10025-2:2004 | S275JR | --- | 1.0044 | t ≤ 40 | --- | 0.21 | 1.50 | --- | 0.035 | 0.035 | --- | --- | --- | Cu 0.55; N 0.012 |
| | | | | 40 < t ≤ 150 | --- | 0.22 | 1.50 | --- | 0.035 | 0.035 | --- | --- | --- | Cu 0.55; N 0.012 |
| | | | | 150 < t ≤ 250 | --- | 0.22 | 1.50 | --- | 0.035 | 0.035 | --- | --- | --- | Cu 0.55; N 0.012 |
| | S275J0 | --- | 1.0143 | t ≤ 40 | --- | 0.18 | 1.50 | --- | 0.030 | 0.030 | --- | --- | --- | Cu 0.55; N 0.012 |
| | | | | 40 < t ≤ 150 | --- | 0.18 | 1.50 | --- | 0.030 | 0.030 | --- | --- | --- | Cu 0.55; N 0.012 |
| | | | | 150 < t ≤ 250 | --- | 0.18 | 1.50 | --- | 0.030 | 0.030 | --- | --- | --- | Cu 0.55; N 0.012 |
| GB 712-2000 | Grade A32 | --- | --- | --- | --- | 0.18 | 0.90-1.60 | 0.50 | 0.035 | 0.035 | 0.20 | 0.40 | 0.08 | V 0.05-0.10; Cu 0.35; Ti 0.02; Nb 0.02-0.05 |
| | Grade D32 | --- | --- | --- | --- | 0.18 | 0.90-1.60 | 0.50 | 0.035 | 0.035 | 0.20 | 0.40 | 0.08 | V 0.05-0.10; Cu 0.35; Ti 0.02; Nb 0.02-0.05 |
| | Grade E32 | --- | --- | --- | --- | 0.18 | 0.90-1.60 | 0.50 | 0.035 | 0.035 | 0.20 | 0.40 | 0.08 | V 0.05-0.10; Cu 0.35; Ti 0.02; Nb 0.02-0.05 |
| | Grade F32 | --- | --- | --- | --- | 0.16 | 0.90-1.60 | 0.50 | 0.025 | 0.025 | 0.20 | 0.8 | 0.08 | V 0.05-0.10; Cu 0.35; Ti 0.02; Nb 0.02-0.05; N 0.009 |

Note: This section continued on next page.

**3.1 Carbon Steels for Structural Steel Plates**

**3.1B Chemical Composition of Carbon Steels for Structural Steel Plates (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness | | Weight, %max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| GB 711-88 | Grade 20Mn | --- | --- | t ≤ 60 | --- | 0.17-0.24 | 0.70-1.00 | 0.17-0.37 | 0.035 | 0.040 | 0.25 | 0.25 | --- | Cu 0.25; N 0.008 |
| | Grade 25 | --- | --- | t ≤ 60 | --- | 0.22-0.30 | 0.50-0.80 | 0.17-0.37 | 0.035 | 0.040 | 0.25 | 0.25 | --- | Cu 0.25; N 0.008 |
| ASTM A573/A573M-13 | Grade 65 [450] | K02404 | --- | t ≤ 13 | t ≤ 0.5 | 0.24 | 0.85-1.20 | 0.15-0.40 | 0.030 | 0.030 | --- | --- | --- | --- |
| | | | | 13 < t ≤ 40 | 0.5 < t ≤ 1.5 | 0.26 | 0.85-1.20 | 0.15-0.40 | 0.030 | 0.030 | --- | --- | --- | --- |
| ASTM A529/A529M-14 | Grade 50 [345] | K02703 | --- | t ≤ 25 | t ≤ 1 | 0.27 | 1.35 | 0.40 | 0.04 | 0.05 | --- | --- | --- | --- |
| ASME SA-1011/SA-1011M | Grade 50 [340], SS | --- | --- | --- | --- | 0.25 | 1.35 | --- | 0.035 | 0.04 | 0.15 | 0.20 | 0.06 | V 0.008; Cu 0.20 nom.; Ti 0.025; Cb 0.008 |
| ASTM A1011/A1011M-14 | Grade 50 [340], SS | --- | --- | --- | --- | 0.25 | 1.35 | --- | 0.035 | 0.04 | 0.15 | 0.20 | 0.06 | V 0.008; Cu 0.20 nom.; Ti 0.025; Cb 0.008 |
| ASME SA-1011/SA-1011M | Grade 55 [380], SS | --- | --- | --- | --- | 0.25 | 1.35 | --- | 0.035 | 0.04 | 0.15 | 0.20 | 0.06 | V 0.008; Cu 0.20 nom.; Ti 0.025; Cb 0.008 |
| ASTM A1011/A1011M-14 | Grade 55 [380], SS | --- | --- | --- | --- | 0.25 | 1.35 | --- | 0.035 | 0.04 | 0.15 | 0.20 | 0.06 | V 0.008; Cu 0.20 nom.; Ti 0.025; Cb 0.008 |
| ASTM A573/A573M-13 | Grade 70 [485] | K02701 | --- | t ≤ 13 | t ≤ 0.5 | 0.27 | 0.85-1.20 | 0.15-0.40 | 0.030 | 0.030 | --- | --- | --- | --- |
| | | | | 13 < t ≤ 40 | 0.5 < t ≤ 1.5 | 0.28 | 0.85-1.20 | 0.15-0.40 | 0.030 | 0.030 | --- | --- | --- | --- |
| ASTM A529/A529M-14 | Grade 55 [380] | K02703 | --- | t ≤ 25 | t ≤ 1 | 0.27 | 1.35 | 0.40 | 0.04 | 0.05 | --- | --- | --- | --- |
| GB 711-88 | Grade 25Mn | --- | --- | t ≤ 60 | --- | 0.22-0.30 | 0.70-1.00 | 0.17-0.37 | 0.035 | 0.040 | 0.25 | 0.25 | --- | Cu 0.25; N 0.008 |
| | Grade 30 | --- | --- | t ≤ 60 | --- | 0.27-0.35 | 0.50-0.80 | 0.17-0.37 | 0.035 | 0.040 | 0.25 | 0.25 | --- | Cu 0.25; N 0.008 |
| JIS G 3136:2012 | Grade SN490C | --- | --- | 16 ≤ t ≤ 50 | --- | 0.18 | 1.65 | 0.55 | 0.020 | 0.008 | --- | --- | --- | --- |
| | | | | 50 < t ≤ 100 | --- | 0.20 | 1.65 | 0.55 | 0.020 | 0.008 | --- | --- | --- | --- |
| GB 700-88 | Grade Q275 | --- | --- | --- | --- | 0.28-0.38 | 0.50-0.80 | 0.35 | 0.045 | 0.050 | 0.30 | 0.30 | --- | Cu 0.30; N 0.008; As 0.080 |
| GB/T 3524-92 | Grade Q275 | --- | --- | --- | --- | 0.28-0.38 | 0.50-0.80 | 0.35 | 0.045 | 0.050 | 0.30 | 0.30 | --- | Cu 0.30; N 0.008; As 0.080 |
| JIS G 3101:2010 | Symbol SS490 | --- | --- | --- | --- | --- | --- | --- | 0.050 | 0.050 | --- | --- | --- | --- |
| EN 10025-2:2004 | E295 | --- | 1.0050 | t ≤ 250 | --- | --- | --- | --- | 0.045 | 0.045 | --- | --- | --- | N 0.012 |
| JIS G 3106:2008 | Grade SM490A | --- | --- | t ≤ 50 | --- | 0.20 | 1.65 | 0.55 | 0.035 | 0.035 | --- | --- | --- | --- |
| | | | | 50 < t ≤ 200 | --- | 0.22 | 1.65 | 0.55 | 0.035 | 0.035 | --- | --- | --- | --- |
| | Grade SM490B | --- | --- | t ≤ 50 | --- | 0.18 | 1.65 | 0.55 | 0.035 | 0.035 | --- | --- | --- | --- |
| | | | | 50 < t ≤ 200 | --- | 0.20 | 1.65 | 0.55 | 0.035 | 0.035 | --- | --- | --- | --- |
| | Grade SM490C | --- | --- | t ≤ 100 | --- | 0.18 | 1.65 | 0.55 | 0.035 | 0.035 | --- | --- | --- | --- |
| JIS G 3136:2012 | Grade SN490B | --- | --- | 6 ≤ t ≤ 50 | --- | 0.18 | 1.65 | 0.55 | 0.030 | 0.015 | --- | --- | --- | --- |
| | | | | 50 < t ≤ 100 | --- | 0.20 | 1.65 | 0.55 | 0.030 | 0.015 | --- | --- | --- | --- |

Note: This section continued on next page.

**3.1 Carbon Steels for Structural Steel Plates**

**3.1B Chemical Composition of Carbon Steels for Structural Steel Plates (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness | | Weight, %max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| GB 712-2000 | Grade A36 | --- | --- | --- | --- | 0.18 | 0.90-1.60 | 0.50 | 0.035 | 0.035 | 0.20 | 0.40 | 0.08 | V 0.05-0.10; Cu 0.35; Ti 0.02; Nb 0.02-0.05 |
| | Grade D36 | --- | --- | --- | --- | 0.18 | 0.90-1.60 | 0.50 | 0.035 | 0.035 | 0.20 | 0.40 | 0.08 | V 0.05-0.10; Cu 0.35; Ti 0.02; Nb 0.02-0.05 |
| | Grade E36 | --- | --- | --- | --- | 0.18 | 0.90-1.60 | 0.50 | 0.035 | 0.035 | 0.20 | 0.40 | 0.08 | V 0.05-0.10; Cu 0.35; Ti 0.02; Nb 0.02-0.05 |
| | Grade F36 | --- | --- | --- | --- | 0.16 | 0.90-1.60 | 0.50 | 0.025 | 0.025 | 0.20 | 0.80 | 0.08 | V 0.05-0.10; Cu 0.35; Ti 0.02; Nb 0.02-0.05; N 0.009 |
| ISO 630:1995 A1:2003 | Grade E 355 (Fe 510), Quality C | --- | --- | 3 ≤ t ≤ 30 | --- | 0.20 | 1.60 | 0.55 | 0.040 | 0.040 | --- | --- | --- | --- |
| | | | | t > 30 | --- | 0.22 | 1.60 | 0.55 | 0.040 | 0.040 | --- | --- | --- | --- |
| | Grade E 355 (Fe 510), Quality D | --- | --- | 3 ≤ t ≤ 30 | --- | 0.20 | 1.60 | 0.55 | 0.035 | 0.035 | --- | --- | --- | --- |
| | | | | t > 30 | --- | 0.22 | 1.60 | 0.55 | 0.035 | 0.035 | --- | --- | --- | --- |
| JIS G 3106:2008 | Grade SM490YA | --- | --- | t ≤ 100 | --- | 0.20 | 1.65 | 0.55 | 0.035 | 0.035 | --- | --- | --- | --- |
| | Grade SM490YB | --- | --- | t ≤ 100 | --- | 0.20 | 1.65 | 0.55 | 0.035 | 0.035 | --- | --- | --- | --- |
| GB 11251-89 | Grade 40 B | --- | --- | --- | --- | 0.37-0.44 | 0.17-0.37 | 0.60-0.90 | --- | --- | --- | --- | --- | B 0.0005-0.0035 |

**3.1 Carbon Steels for Structural Steel Plates**

**3.1B Chemical Composition of Carbon Steels for Structural Steel Plates (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness | | Weight, %max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| EN 10025-2:2004 | S355JR | --- | 1.0045 | t ≤ 30 | --- | 0.24 | 1.60 | 0.55 | 0.035 | 0.035 | --- | --- | --- | Cu 0.55; N 0.012 |
| | | | | 30 < t ≤ 150 | --- | 0.24 | 1.60 | 0.55 | 0.035 | 0.035 | --- | --- | --- | Cu 0.55; N 0.012 |
| | | | | 150 < t ≤ 250 | --- | 0.24 | 1.60 | 0.55 | 0.035 | 0.035 | --- | --- | --- | Cu 0.55; N 0.012 |
| | S355J0 | --- | 1.0553 | t ≤ 30 | --- | 0.20 | 1.60 | 0.55 | 0.030 | 0.030 | --- | --- | --- | Cu 0.55; N 0.012 |
| | | | | 30 < t ≤ 40 | --- | 0.22 | 1.60 | 0.55 | 0.030 | 0.030 | --- | --- | --- | Cu 0.55; N 0.012 |
| | | | | 40 < t ≤ 150 | --- | 0.22 | 1.60 | 0.55 | 0.030 | 0.030 | --- | --- | --- | Cu 0.55; N 0.012 |
| | | | | 150 < t ≤ 250 | --- | 0.22 | 1.60 | 0.55 | 0.030 | 0.030 | --- | --- | --- | Cu 0.55; N 0.012 |
| GB 712-2000 | Grade A40 | --- | --- | --- | --- | 0.18 | 0.90-1.60 | 0.50 | 0.035 | 0.035 | 0.20 | 0.40 | 0.08 | V 0.05-0.10; Cu 0.35; Ti 0.02; Nb 0.02-0.05 |
| | Grade D40 | --- | --- | --- | --- | 0.18 | 0.90-1.60 | 0.50 | 0.035 | 0.035 | 0.20 | 0.40 | 0.08 | V 0.05-0.10; Cu 0.35; Ti 0.02; Nb 0.02-0.05 |
| | Grade E40 | --- | --- | --- | --- | 0.18 | 0.90-1.60 | 0.50 | 0.035 | 0.035 | 0.20 | 0.40 | 0.08 | V 0.05-0.10; Cu 0.35; Ti 0.02; Nb 0.02-0.05 |
| | Grade F40 | --- | --- | --- | --- | 0.16 | 0.90-1.60 | 0.50 | 0.025 | 0.025 | 0.20 | 0.80 | 0.08 | V 0.05-0.10; Cu 0.35; Ti 0.02; Nb 0.02-0.05; N 0.009 |
| JIS G 3106:2008 | Grade SM520B | --- | --- | t ≤ 100 | --- | 0.20 | 1.65 | 0.55 | 0.035 | 0.035 | --- | --- | --- | --- |
| | Grade SM520C | --- | --- | t ≤ 100 | --- | 0.20 | 1.65 | 0.55 | 0.035 | 0.035 | --- | --- | --- | --- |
| GB 711-88 | Grade 35 | --- | --- | t ≤ 60 | --- | 0.32-0.40 | 0.50-0.80 | 0.17-0.37 | 0.035 | 0.040 | 0.25 | 0.25 | --- | Cu 0.25; N 0.008 |
| | Grade 30Mn | --- | --- | t ≤ 60 | --- | 0.27-0.35 | 0.70-1.00 | 0.17-0.37 | 0.035 | 0.040 | 0.25 | 0.25 | --- | Cu 0.25; N 0.008 |
| JIS G 3101:2010 | Symbol SS540 | --- | --- | --- | --- | 0.30 | 1.60 | --- | 0.040 | 0.040 | --- | --- | --- | --- |
| GB 11251-89 | Grade 45 B | --- | --- | --- | --- | 0.42-0.49 | 0.60-0.90 | 0.17-0.37 | 0.035 | 0.035 | 0.30 | 0.30 | 0.15 | Cu 0.30; B 0.0005-0.0035 |
| | Grade 45Mn2 | --- | --- | --- | --- | 0.42-0.49 | 1.40-1.80 | 0.17-0.37 | 0.035 | 0.035 | 0.30 | 0.30 | 0.15 | Cu 0.30 |
| | Grade 50 B | --- | --- | --- | --- | 0.47-0.55 | 0.60-0.90 | 0.17-0.37 | 0.035 | 0.035 | 0.30 | 0.30 | 0.15 | Cu 0.30 |

**3.1 Carbon Steels for Structural Steel Plates**

**3.1B Chemical Composition of Carbon Steels for Structural Steel Plates (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness | | Weight, %max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| GB 711-88 | Grade 40 | --- | --- | t ≤ 60 | --- | 0.37-0.45 | 0.50-0.80 | 0.17-0.37 | 0.035 | 0.040 | 0.25 | 0.25 | --- | Cu 0.25; N 0.008 |
| | Grade 40Mn | --- | --- | t ≤ 60 | --- | 0.37-0.45 | 0.70-1.00 | 0.17-0.37 | 0.035 | 0.040 | 0.25 | 0.25 | --- | Cu 0.25; N 0.008 |
| | Grade 45 | --- | --- | t ≤ 60 | --- | 0.42-0.50 | 0.50-0.80 | 0.17-0.37 | 0.035 | 0.040 | 0.25 | 0.25 | --- | Cu 0.25; N 0.008 |
| JIS G 3106:2008 | Grade SM570 | --- | --- | t ≤ 100 | --- | 0.18 | 1.70 | 0.55 | 0.035 | 0.035 | --- | --- | --- | --- |
| EN 10025-2:2004 | E335 | --- | 1.0060 | t ≤ 250 | --- | --- | --- | --- | 0.045 | 0.045 | --- | --- | --- | N 0.012 |
| GB 711-88 | Grade 50 | --- | --- | t ≤ 60 | --- | 0.47-0.55 | 0.50-0.80 | 0.17-0.37 | 0.035 | 0.040 | 0.25 | 0.25 | --- | Cu 0.25; N 0.008 |
| | Grade 50Mn | --- | --- | t ≤ 60 | --- | 0.48-0.56 | 0.70-1.00 | 0.17-0.37 | 0.035 | 0.040 | 0.25 | 0.25 | --- | Cu 0.25; N 0.008 |
| | Grade 55 | --- | --- | t ≤ 60 | --- | 0.52-0.60 | 0.50-0.80 | 0.17-0.37 | 0.035 | 0.040 | 0.25 | 0.25 | --- | Cu 0.25; N 0.008 |
| | Grade 60 | --- | --- | t ≤ 60 | --- | 0.57-0.65 | 0.50-0.80 | 0.17-0.37 | 0.035 | 0.040 | 0.25 | 0.25 | --- | Cu 0.25; N 0.008 |
| | Grade 60Mn | --- | --- | t ≤ 60 | --- | 0.57-0.65 | 0.70-1.00 | 0.17-0.37 | 0.035 | 0.040 | 0.25 | 0.25 | --- | Cu 0.25; N 0.008 |
| | Grade 65 | --- | --- | t ≤ 60 | --- | 0.62-0.70 | 0.50-0.80 | 0.17-0.37 | 0.035 | 0.040 | 0.25 | 0.25 | --- | Cu 0.25; N 0.008 |
| EN 10025-2:2004 | E360 | --- | 1.0070 | t ≤ 250 | --- | --- | --- | --- | 0.045 | 0.045 | --- | --- | --- | N 0.012 |

### 3.2 Alloy Steels for Structural Steel Plates

#### 3.2.1A Mechanical Properties of High-Strength Low-Alloy Structural Steel Plates

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter mm | Section Thickness/Diameter in. | Yield Strength, min. MPa | Yield Strength, min. ksi | Tensile Strength, min. MPa | Tensile Strength, min. ksi | Elongation % min. | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GB/T 1591-94 | Grade Q295A | --- | --- | t ≤ 16 | --- | 295 | --- | 390-570 | --- | 23 | HR, CtR, N or NT | --- |
| | | | | 16 < t ≤ 35 | --- | 275 | --- | 390-570 | --- | 23 | HR, CtR, N or NT | --- |
| | | | | 35 < t ≤ 50 | --- | 255 | --- | 390-570 | --- | 23 | HR, CtR, N or NT | --- |
| | | | | 50 < t ≤ 100 | --- | 235 | --- | 390-570 | --- | 23 | HR, CtR, N or NT | --- |
| | Grade Q295B | --- | --- | t ≤ 16 | --- | 295 | --- | 390-570 | --- | 23 | HR, CtR, N or NT | L: 34 J @ 20°C |
| | | | | 16 < t ≤ 35 | --- | 275 | --- | 390-570 | --- | 23 | HR, CtR, N or NT | --- |
| | | | | 35 < t ≤ 50 | --- | 255 | --- | 390-570 | --- | 23 | HR, CtR, N or NT | --- |
| | | | | 50 < t ≤ 100 | --- | 235 | --- | 390-570 | --- | 23 | HR, CtR, N or NT | --- |
| CSA G40.21-13 | Grade 260W (38W) | --- | --- | --- | --- | 260 | 38 | 410-590 | 60-85 | 23 | AR, N or CtR | --- |
| | | | | t ≤ 65 | t ≤ 2.5 | 260 | 38 | 410-590 | 60-85 | 23 L, 21 T | AR, N or CtR | --- |
| | | | | 65 < t ≤ 200 | 2.5 ≤ t ≤ 8 | 250 | 36 | 410-590 | 60-85 | 23 L, 21 T | AR, N or CtR | --- |
| | Grade 260WT (38WT) | --- | --- | --- | --- | 260 | 38 | 410-590 | 60-85 | 23 | AR, N or CtR | see standard for impact data |
| | | | | t ≤ 65 | t ≤ 2.5 | 260 | 38 | 410-590 | 60-85 | 23 L, 21 T | AR, N or CtR | |
| | | | | 65 < t ≤ 200 | 2.5 < t ≤ 8 | 250 | 36 | 410-590 | 60-85 | 23 L, 21 T | AR, N or CtR | |
| ASME SA-1011/SA-1011M | Grade 45 [310], Class 1, HSLAS | --- | --- | t ≤ 2.5 | t ≤ 0.097 | 310 | 45 | 410 L | 60 L | 23 L | HR | --- |
| | | | | t > 2.5 | t > 0.097 | 310 | 45 | 410 L | 60 L | 25 L | HR | --- |
| ASTM A1011/A1011M-14 | Grade 45 [310], Class 1, HSLAS | --- | --- | t ≤ 2.5 | t ≤ 0.097 | 310 | 45 | 410 L | 60 L | 23 L | HR | --- |
| | | | | t > 2.5 | t > 0.097 | 310 | 45 | 410 L | 60 L | 25 L | HR | --- |
| ASME SA-1011/SA-1011M | Grade 50 [340], Class 2, HSLAS | --- | --- | t ≤ 2.5 | t ≤ 0.097 | 340 | 50 | 410 L | 60 L | 20 L | HR | --- |
| | | | | t > 2.5 | t > 0.097 | 340 | 50 | 410 L | 60 L | 22 L | HR | --- |
| ASTM A1011/A1011M-14 | Grade 50 [340], Class 2, HSLAS | --- | --- | t ≤ 2.5 | t ≤ 0.097 | 340 | 50 | 410 L | 60 L | 20 L | HR | --- |
| | | | | t > 2.5 | t > 0.097 | 340 | 50 | 410 L | 60 L | 22 L | HR | --- |
| ASME SA-572/SA-572M | Grade 42 [290], Type 1 | --- | --- | --- | --- | 290 | 42 | 415 | 60 | 24 | --- | --- |
| | Grade 42 [290], Type 2 | --- | --- | --- | --- | 290 | 42 | 415 | 60 | 24 | --- | --- |
| | Grade 42 [290], Type 3 | --- | --- | --- | --- | 290 | 42 | 415 | 60 | 24 | --- | --- |
| | Grade 42 [290], Type 5 | --- | --- | --- | --- | 290 | 42 | 415 | 60 | 24 | --- | --- |
| ASTM A572/A572M-15 | Grade 42 [290], Type 1 | --- | --- | --- | --- | 290 | 42 | 415 | 60 | 24 | --- | --- |
| | Grade 42 [290], Type 2 | --- | --- | --- | --- | 290 | 42 | 415 | 60 | 24 | --- | --- |
| | Grade 42 [290], Type 3 | --- | --- | --- | --- | 290 | 42 | 415 | 60 | 24 | --- | --- |
| | Grade 42 [290], Type 5 | --- | --- | --- | --- | 290 | 42 | 415 | 60 | 24 | --- | --- |
| ASTM A656/A656M-13 | Grade 50 [345], Type 3 | --- | --- | t ≤ 50 | t ≤ 2 | 345 | 50 | 415 | 60 | 23 | HR | --- |
| | Grade 50 [345], Type 7 | --- | --- | t ≤ 50 | t ≤ 2 | 345 | 50 | 415 | 60 | 23 | HR | --- |
| | Grade 50 [345], Type 8 | --- | --- | t ≤ 50 | t ≤ 2 | 345 | 50 | 415 | 60 | 23 | HR | --- |
| ASTM A633/A633M-13 | Grade A | K01802 | --- | t ≤ 100 | t ≤ 4 | 290 | 42 | 430-570 | 63-83 | 23 | N | --- |

Note: This section continued on next page.

**3.2 Alloy Steels for Structural Steel Plates**

**3.2.1A Mechanical Properties of High-Strength Low-Alloy Structural Steel Plates (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | % min. | | |
| CSA G40.21-13 | Grade 300W (44W) | --- | --- | --- | --- | 300 | 44 | 440-620 | 64-90 | 23 | AR, N or CtR | --- |
| | | | | --- | --- | 300 | 44 | 410-590 | 60-85 | 23 | SR, A or N | --- |
| | | | | t ≤ 65 | t ≤ 2.5 | 300 | 44 | 440-620 | 64-90 | 23 L, 21 T | AR, N or CtR | --- |
| | | | | 65 < t ≤ 200 | 2.5 ≤ t ≤ 8 | 280 | 40 | 440-620 | 64-90 | 23 L, 21 T | AR, N or CtR | --- |
| | Grade 300WT (44WT) | --- | --- | --- | --- | 300 | 44 | 440-620 | 64-90 | 23 | AR, N or CtR | see standard for impact data |
| | | | | t ≤ 65 | t ≤ 2.5 | 300 | 44 | 440-620 | 64-90 | 23 L, 21 T | AR, N or CtR | |
| | | | | 65 < t ≤ 200 | 2.5 < t ≤ 8 | 280 | 40 | 440-620 | 64-90 | 23 L, 21 T | AR, N or CtR | |
| ASME SA-1011/SA-1011M | Grade 50 [340], Class 1, HSLAS | --- | --- | t ≤ 2.5 | t ≤ 0.097 | 340 | 50 | 450 L | 65 L | 20 L | HR | --- |
| | | | | t > 2.5 | t > 0.097 | 340 | 50 | 450 L | 65 L | 22 L | HR | --- |
| ASTM A1011/A1011M-14 | Grade 50 [340], Class 1, HSLAS | --- | --- | t ≤ 2.5 | t ≤ 0.097 | 340 | 50 | 450 L | 65 L | 20 L | HR | --- |
| | | | | t > 2.5 | t > 0.097 | 340 | 50 | 450 L | 65 L | 22 L | HR | --- |
| ASME SA-572/SA-572M | Grade 50 [345], Type 1 | --- | --- | --- | --- | 345 | 50 | 450 | 65 | 21 | --- | --- |
| | Grade 50 [345], Type 2 | --- | --- | --- | --- | 345 | 50 | 450 | 65 | 21 | --- | --- |
| | Grade 50 [345], Type 3 | --- | --- | --- | --- | 345 | 50 | 450 | 65 | 21 | --- | --- |
| | Grade 50 [345], Type 5 | --- | --- | --- | --- | 345 | 50 | 450 | 65 | 21 | --- | --- |
| ASTM A572/A572M-15 | Grade 50 [345], Type 1 | --- | --- | --- | --- | 345 | 50 | 450 | 65 | 21 | --- | --- |
| | Grade 50 [345], Type 2 | --- | --- | --- | --- | 345 | 50 | 450 | 65 | 21 | --- | --- |
| | Grade 50 [345], Type 3 | --- | --- | --- | --- | 345 | 50 | 450 | 65 | 21 | --- | --- |
| | Grade 50 [345], Type 5 | --- | --- | --- | --- | 345 | 50 | 450 | 65 | 21 | --- | --- |
| ASTM A709/A709M-13a | Grade 50 [345], Type 1 | --- | --- | t ≤ 100 | t ≤ 4 | 345 | 50 | 450 | 65 | 21 | QT | see standard for impact data |
| | Grade 50 [345], Type 2 | --- | --- | t ≤ 100 | t ≤ 4 | 345 | 50 | 450 | 65 | 21 | QT | |
| | Grade 50 [345], Type 3 | --- | --- | t ≤ 100 | t ≤ 4 | 345 | 50 | 450 | 65 | 21 | QT | |
| | Grade 50 [345], Type 5 | --- | --- | t ≤ 100 | t ≤ 4 | 345 | 50 | 450 | 65 | 21 | QT | |
| CSA G40.21-13 | Grade 350W (50W) | --- | --- | --- | --- | 350 | 50 | 450-650 | 65-95 | 22 | AR, N or CtR | --- |
| | | | | --- | --- | 350 | 50 | 450-620 | 65-90 | 22 | SR, A or N | --- |
| | | | | t ≤ 65 | t ≤ 2.5 | 350 | 50 | 450-650 | 65-95 | 22 L, 20 T | AR, N or CtR | --- |
| | | | | 65 < t ≤ 200 | 2.5 ≤ t ≤ 8 | 320 | 46 | 450-650 | 65-95 | 22 L, 20 T | AR, N or CtR | --- |
| ASME SA-1011/SA-1011M | Grade 55 [380], Class 2, HSLAS | --- | --- | t ≤ 2.5 | t ≤ 0.097 | 380 | 55 | 450 L | 65 L | 18 L | HR | --- |
| | | | | t > 2.5 | t > 0.097 | 380 | 55 | 450 L | 65 L | 20 L | HR | --- |
| ASTM A1011/A1011M-14 | Grade 55 [380], Class 2, HSLAS | --- | --- | t ≤ 2.5 | t ≤ 0.097 | 380 | 55 | 450 L | 65 L | 18 L | HR | --- |
| | | | | t > 2.5 | t > 0.097 | 380 | 55 | 450 L | 65 L | 20 L | HR | --- |

**3.2 Alloy Steels for Structural Steel Plates**

**3.2.1A Mechanical Properties of High-Strength Low-Alloy Structural Steel Plates (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter mm | Section Thickness/Diameter in. | Yield Strength, min. MPa | Yield Strength, min. ksi | Tensile Strength, min. MPa | Tensile Strength, min. ksi | Elongation % min. | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GB/T 1591-94 | Grade Q345A | --- | --- | t ≤ 16 | --- | 345 | --- | 470-630 | --- | 21 | HR, CtR, N or NT | --- |
| | | | | 16 < t ≤ 35 | --- | 325 | --- | 470-630 | --- | 21 | HR, CtR, N or NT | --- |
| | | | | 35 < t ≤ 50 | --- | 295 | --- | 470-630 | --- | 21 | HR, CtR, N or NT | --- |
| | | | | 50 < t ≤ 100 | --- | 275 | --- | 470-630 | --- | 21 | HR, CtR, N or NT | --- |
| | Grade Q345B | --- | --- | t ≤ 16 | --- | 345 | --- | 470-630 | --- | 21 | HR, CtR, N or NT | L: 34 J @ 20°C |
| | | | | 16 < t ≤ 35 | --- | 325 | --- | 470-630 | --- | 21 | HR, CtR, N or NT | --- |
| | | | | 35 < t ≤ 50 | --- | 295 | --- | 470-630 | --- | 21 | HR, CtR, N or NT | --- |
| | | | | 50 < t ≤ 100 | --- | 275 | --- | 470-630 | --- | 21 | HR, CtR, N or NT | --- |
| | Grade Q345C | --- | --- | t ≤ 16 | --- | 345 | --- | 470-630 | --- | 22 | HR, CtR, N or NT | --- |
| | | | | 16 < t ≤ 35 | --- | 325 | --- | 470-630 | --- | 22 | HR, CtR, N or NT | L: 34 J @ 0°C |
| | | | | 35 < t ≤ 50 | --- | 295 | --- | 470-630 | --- | 22 | HR, CtR, N or NT | --- |
| | | | | 50 < t ≤ 100 | --- | 275 | --- | 470-630 | --- | 22 | HR, CtR, N or NT | --- |
| | Grade Q345D | --- | --- | t ≤ 16 | --- | 345 | --- | 470-630 | --- | 22 | HR, CtR, N or NT | --- |
| | | | | 16 < t ≤ 35 | --- | 325 | --- | 470-630 | --- | 22 | HR, CtR, N or NT | --- |
| | | | | 35 < t ≤ 50 | --- | 295 | --- | 470-630 | --- | 22 | HR, CtR, N or NT | L: 34 J @ -20°C |
| | | | | 50 < t ≤ 100 | --- | 275 | --- | 470-630 | --- | 22 | HR, CtR, N or NT | --- |
| | Grade Q345E | --- | --- | t ≤ 16 | --- | 345 | --- | 470-630 | --- | 22 | HR, CtR, N or NT | --- |
| | | | | 16 < t ≤ 35 | --- | 325 | --- | 470-630 | --- | 22 | HR, CtR, N or NT | --- |
| | | | | 35 < t ≤ 50 | --- | 295 | --- | 470-630 | --- | 22 | HR, CtR, N or NT | --- |
| | | | | 50 < t ≤ 100 | --- | 275 | --- | 470-630 | --- | 22 | HR, CtR, N or NT | L: 27 J @ -40°C |
| ASTM A242/A242M-13 | Type 1 | K11510 | --- | t ≤ 20 | t ≤ 0.75 | 345 | 50 | 480 | 70 | 21 | --- | --- |
| | | | | 20 < t ≤ 40 | 0.75 < t ≤ 1.5 | 315 | 46 | 460 | 67 | 21 | --- | --- |
| | | | | t ≤ 40 | t ≤ 1.5 | 345 | 50 | 485 | 70 | 21 | --- | --- |
| | | | | 40 < t ≤ 50 | 1.5 < t ≤ 2 | 315 | 46 | 460 | 67 | 21 | --- | --- |
| | | | | 40 < t ≤ 100 | 1.5 < t ≤ 4 | 290 | 42 | 435 | 63 | 21 | --- | --- |
| | | | | t > 50 | t > 2 | 290 | 42 | 435 | 63 | 21 | --- | --- |
| CSA G40.21-13 | Grade 350WT (50WT) | --- | --- | --- | --- | 350 | 50 | 450-650 | 65-95 | 22 | AR, N or CtR | see standard for impact data |
| | | | | --- | --- | 350 | 50 | 450-620 | 65-90 | 22 | SR, A or N | |
| | | | | t ≤ 65 | t ≤ 2.5 | 350 | 50 | 450-650 | 65-95 | 22 L, 20 T | AR, N or CtR | |
| | | | | 65 < t ≤ 200 | 2.5 < t ≤ 8 | 320 | 46 | 450-650 | 65-95 | 22 L, 20 T | AR, N or CtR | |
| | Grade 380W (55W) | --- | --- | --- | --- | 380 | 55 | 480-650 | 65-95 | 21 | AR, N or CtR | --- |
| | | | | --- | --- | 380 | 55 | 480-650 | 70-95 | 21 | SR, A or N | --- |
| | | | | t ≤ 65 | t ≤ 2.5 | 380 | 55 | 480-650 | 70-95 | 21 L | AR, N or CtR | --- |
| | | | | 65 < t ≤ 200 | 2.5 < t ≤ 8 | 350 | 50 | 480-650 | 70-95 | 21 L | AR, N or CtR | --- |
| ASME SA-1011/SA-1011M | Grade 55 [380], Class 1, HSLAS | --- | --- | t ≤ 2.5 | t ≤ 0.097 | 380 | 55 | 480 L | 70 L | 18 L | HR | --- |
| | | | | t > 2.5 | t > 0.097 | 380 | 55 | 480 L | 70 L | 20 L | HR | --- |
| | Grade 60 [410], Class 2, HSLAS | --- | --- | t ≤ 2.5 | t ≤ 0.097 | 410 | 60 | 480 L | 70 L | 16 L | HR | --- |
| | | | | t > 2.5 | t > 0.097 | 410 | 60 | 480 L | 70 L | 18 L | HR | --- |

Note: This section continued on next page.

**3.2 Alloy Steels for Structural Steel Plates**

**3.2.1A Mechanical Properties of High-Strength Low-Alloy Structural Steel Plates (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | % min. | | |
| ASTM A1011/A1011M-14 | Grade 55 [380], Class 1 HSLAS | --- | --- | t ≤ 2.5 | t ≤ 0.097 | 380 | 55 | 480 L | 70 L | 18 L | HR | --- |
| | | | | t > 2.5 | t > 0.097 | 380 | 55 | 480 L | 70 L | 20 L | HR | --- |
| | Grade 60 [410], Class 2 HSLAS | --- | --- | t ≤ 2.5 | t ≤ 0.097 | 410 | 60 | 480 L | 70 L | 16 L | HR | --- |
| | | | | t > 2.5 | t > 0.097 | 410 | 60 | 480 L | 70 L | 18 L | HR | --- |
| ASTM A588/A588M-15 | Grade A | K11947 | --- | --- | --- | 345 | 50 | 485 | 70 | 21 | --- | --- |
| | | | | t ≤ 100 | t ≤ 4 | 345 | 50 | 485 | 70 | 21 | --- | --- |
| | | | | 100 < t ≤ 125 | 4 < t ≤ 5 | 315 | 46 | 460 | 67 | 21 | --- | --- |
| | | | | 125 < t ≤ 200 | 5 < t ≤ 8 | 290 | 42 | 435 | 63 | 21 | --- | --- |
| | Grade B | K12043 | --- | --- | --- | 345 | 50 | 485 | 70 | 21 | --- | --- |
| | | | | t ≤ 100 | t ≤ 4 | 345 | 50 | 485 | 70 | 21 | --- | --- |
| | | | | 100 < t ≤ 125 | 4 < t ≤ 5 | 315 | 46 | 460 | 67 | 21 | --- | --- |
| | | | | 125 < t ≤ 200 | 5 < t ≤ 8 | 290 | 42 | 435 | 63 | 21 | --- | --- |
| | Grade K | --- | --- | --- | --- | 345 | 50 | 485 | 70 | 21 | --- | --- |
| | | | | t ≤ 100 | t ≤ 4 | 345 | 50 | 485 | 70 | 21 | --- | --- |
| | | | | 100 < t ≤ 125 | 4 < t ≤ 5 | 315 | 46 | 460 | 67 | 21 | --- | --- |
| | | | | 125 < t ≤ 200 | 5 < t ≤ 8 | 290 | 42 | 435 | 63 | 21 | --- | --- |
| ASTM A633/A633M-13 | Grade C | K12000 | --- | t ≤ 65 | t ≤ 2.5 | 345 | 50 | 485-620 | 70-90 | 23 | N | --- |
| | | | | 65 < t ≤ 100 | 2.5 < t ≤ 4 | 315 | 46 | 450-590 | 65-85 | 23 | N | --- |
| | Grade D | K12037 | --- | t ≤ 65 | t ≤ 2.5 | 345 | 50 | 485-620 | 70-90 | 23 | N | --- |
| | | | | 65 < t ≤ 100 | 2.5 < t ≤ 4 | 315 | 46 | 450-590 | 65-85 | 23 | N | --- |
| ASME SA-572/SA-572M | Grade 55 [380], Type 1 | --- | --- | --- | --- | 380 | 55 | 485 | 70 | 20 | --- | --- |
| | Grade 55 [380], Type 2 | --- | --- | --- | --- | 380 | 55 | 485 | 70 | 20 | --- | --- |
| | Grade 55 [380], Type 3 | --- | --- | --- | --- | 380 | 55 | 485 | 70 | 20 | --- | --- |
| | Grade 55 [380], Type 5 | --- | --- | --- | --- | 380 | 55 | 485 | 70 | 20 | --- | --- |
| ASTM A572/A572M-15 | Grade 55 [380], Type 1 | --- | --- | --- | --- | 380 | 55 | 485 | 70 | 20 | --- | --- |
| | Grade 55 [380], Type 2 | --- | --- | --- | --- | 380 | 55 | 485 | 70 | 20 | --- | --- |
| | Grade 55 [380], Type 3 | --- | --- | --- | --- | 380 | 55 | 485 | 70 | 20 | --- | --- |
| | Grade 55 [380], Type 5 | --- | --- | --- | --- | 380 | 55 | 485 | 70 | 20 | --- | --- |
| ASTM A656/A656M-13 | Grade 60 [415], Type 3 | --- | --- | t ≤ 40 | t ≤ 1.5 | 415 | 60 | 485 | 70 | 20 | HR | --- |
| | Grade 60 [415], Type 7 | --- | --- | t ≤ 40 | t ≤ 1.5 | 415 | 60 | 485 | 70 | 20 | HR | --- |
| | Grade 60 [415], Type 8 | --- | --- | t ≤ 40 | t ≤ 1.5 | 415 | 60 | 485 | 70 | 20 | HR | --- |

**3.2 Alloy Steels for Structural Steel Plates**

**3.2.1A Mechanical Properties of High-Strength Low-Alloy Structural Steel Plates (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | % min. | | |
| CSA G40.21-13 | Grade 400W (60W) | --- | --- | --- | --- | 400 | 60 | 520-690 | 75-100 | 18 | AR, N or CtR | --- |
| | | | | --- | --- | 400 | 60 | 520-690 | 75-100 | 20 | SR, A or N | --- |
| | | | | t ≤ 65 | t ≤ 2.5 | 400 | 60 | 520-690 | 75-100 | 18 L, 15 T | AR, N or CtR | --- |
| | | | | 65 < t ≤ 200 | 2.5 < t ≤ 8 | 370 | 54 | 520-690 | 75-100 | 18 L, 15 T | AR, N or CtR | --- |
| | Grade 400WT (60WT) | --- | --- | --- | --- | 400 | 60 | 520-690 | 75-100 | 20 | AR, N or CtR | see standard for impact data |
| | | | | --- | --- | 400 | 60 | 520-690 | 75-100 | 20 | SR, A or N | |
| | | | | t ≤ 65 | t ≤ 2.5 | 400 | 60 | 520-690 | 75-100 | 20 L, 17 T | AR, N or CtR | |
| | | | | 65 < t ≤ 200 | 2.5 < t ≤ 8 | 370 | 54 | 520-690 | 75-100 | 20 L, 17 T | AR, N or CtR | |
| ASME SA-1011/SA-1011M | Grade 60 [410], Class 1, HSLAS | --- | --- | t ≤ 2.5 | t ≤ 0.097 | 410 | 60 | 520 L | 75 L | 16 L | HR | --- |
| | | | | t > 2.5 | t > 0.097 | 410 | 60 | 520 L | 75 L | 18 L | HR | --- |
| | Grade 65 [450], Class 2, HSLAS | --- | --- | t ≤ 2.5 | t ≤ 0.097 | 450 | 65 | 520 L | 75 L | 14 L | HR | --- |
| | | | | t > 2.5 | t > 0.097 | 450 | 65 | 520 L | 75 L | 16 L | HR | --- |
| ASTM A1011/A1011M-14 | Grade 60 [410], Class 1, HSLAS | --- | --- | t ≤ 2.5 | t ≤ 0.097 | 410 | 60 | 520 L | 75 L | 16 L | HR | --- |
| | | | | t > 2.5 | t > 0.097 | 410 | 60 | 520 L | 75 L | 18 L | HR | --- |
| | Grade 65 [450], Class 2, HSLAS | --- | --- | t ≤ 2.5 | t ≤ 0.097 | 450 | 65 | 520 L | 75 L | 14 L | HR | --- |
| | | | | t > 2.5 | t > 0.097 | 450 | 65 | 520 L | 75 L | 16 L | HR | --- |
| ASME SA-572/SA-572M | Grade 60 [415], Type 1 | --- | --- | --- | --- | 415 | 60 | 520 | 75 | 18 | --- | --- |
| | Grade 60 [415], Type 2 | --- | --- | --- | --- | 415 | 60 | 520 | 75 | 18 | --- | --- |
| | Grade 60 [415], Type 3 | --- | --- | --- | --- | 415 | 60 | 520 | 75 | 18 | --- | --- |
| | Grade 60 [415], Type 5 | --- | --- | --- | --- | 415 | 60 | 520 | 75 | 18 | --- | --- |
| ASTM A572/A572M-15 | Grade 60 [415], Type 1 | --- | --- | --- | --- | 415 | 60 | 520 | 75 | 18 | --- | --- |
| | Grade 60 [415], Type 2 | --- | --- | --- | --- | 415 | 60 | 520 | 75 | 18 | --- | --- |
| | Grade 60 [415], Type 3 | --- | --- | --- | --- | 415 | 60 | 520 | 75 | 18 | --- | --- |
| | Grade 60 [415], Type 5 | --- | --- | --- | --- | 415 | 60 | 520 | 75 | 18 | --- | --- |
| GB/T 1591-94 | Grade Q420A | --- | --- | t ≤ 16 | --- | 420 | --- | 520-680 | --- | 18 | HR, CtR, N or NT | --- |
| | | | | 16 < t ≤ 35 | --- | 400 | --- | 520-680 | --- | 18 | HR, CtR, N or NT | --- |
| | | | | 35 < t ≤ 50 | --- | 380 | --- | 520-680 | --- | 18 | HR, CtR, N or NT | --- |
| | | | | 50 < t ≤ 100 | --- | 360 | --- | 520-680 | --- | 18 | HR, CtR, N or NT | --- |
| | Grade Q420B | --- | --- | t ≤ 16 | --- | 420 | --- | 520-680 | --- | 18 | HR, CtR, N or NT | L: 34 J @ 20°C |
| | | | | 16 < t ≤ 35 | --- | 400 | --- | 520-680 | --- | 18 | HR, CtR, N or NT | --- |
| | | | | 35 < t ≤ 50 | --- | 380 | --- | 520-680 | --- | 18 | HR, CtR, N or NT | --- |
| | | | | 50 < t ≤ 100 | --- | 360 | --- | 520-680 | --- | 18 | HR, CtR, N or NT | --- |
| | Grade Q420C | --- | --- | t ≤ 16 | --- | 420 | --- | 520-680 | --- | 19 | HR, CtR, N, NT or QT | --- |
| | | | | 16 < t ≤ 35 | --- | 400 | --- | 520-680 | --- | 19 | HR, CtR, N, NT or QT | L: 34 J @ 0°C |
| | | | | 35 < t ≤ 50 | --- | 380 | --- | 520-680 | --- | 19 | HR, CtR, N, NT or QT | --- |
| | | | | 50 < t ≤ 100 | --- | 360 | --- | 520-680 | --- | 19 | HR, CtR, N, NT or QT | --- |

Note: This section continued on next page.

**3.2 Alloy Steels for Structural Steel Plates**

**3.2.1A Mechanical Properties of High-Strength Low-Alloy Structural Steel Plates (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | % min. | | |
| GB/T 1591-94 | Grade Q420D | --- | --- | t ≤ 16 | --- | 420 | --- | 520-680 | --- | 19 | HR, CtR, N, NT or QT | --- |
| | | | | 16 < t ≤ 35 | --- | 400 | --- | 520-680 | --- | 19 | HR, CtR, N, NT or QT | --- |
| | | | | 35 < t ≤ 50 | --- | 380 | --- | 520-680 | --- | 19 | HR, CtR, N, NT or QT | L: 34 J @ -20°C |
| | | | | 50 < t ≤ 100 | --- | 360 | --- | 520-680 | --- | 19 | HR, CtR, N, NT or QT | --- |
| | Grade Q420E | --- | --- | t ≤ 16 | --- | 420 | --- | 520-680 | --- | 19 | HR, CtR, N, NT or QT | --- |
| | | | | 16 < t ≤ 35 | --- | 400 | --- | 520-680 | --- | 19 | HR, CtR, N, NT or QT | --- |
| | | | | 35 < t ≤ 50 | --- | 380 | --- | 520-680 | --- | 19 | HR, CtR, N, NT or QT | --- |
| | | | | 50 < t ≤ 100 | --- | 360 | --- | 520-680 | --- | 19 | HR, CtR, N, NT or QT | L: 27 J @ -40°C |
| GB/T 16270-1996 | Grade Q420C | --- | --- | t ≤ 50 | --- | 420 | --- | 520-670 T | --- | 18 T | CtR, N, QT or NT | see standard for impact data |
| | | | | 50 < t ≤ 100 | --- | 400 | --- | 520-670 T | --- | 18 T | CtR, N, QT or NT | |
| | Grade Q420D | --- | --- | t ≤ 50 | --- | 420 | --- | 520-670 T | --- | 18 T | CtR, N, QT or NT | |
| | | | | 50 < t ≤ 100 | --- | 400 | --- | 520-670 T | --- | 18 T | CtR, N, QT or NT | |
| | Grade Q420E | --- | --- | t ≤ 50 | --- | 420 | --- | 520-670 T | --- | 18 T | CtR, N, QT or NT | |
| | | | | 50 < t ≤ 100 | --- | 400 | --- | 520-670 T | --- | 18 T | CtR, N, QT or NT | |
| ASTM A633/A633M-13 | Grade E | K12202 | --- | t ≤ 100 | t ≤ 4 | 415 | 60 | 550-690 | 80-100 | 23 | N or NN | --- |
| | | | | 100 < t ≤ 150 | 4 < t ≤ 6 | 380 | 55 | 515-655 | 75-95 | 23 | NN | --- |
| ASME SA-572/SA-572M | Grade 65 [450], Type 1 | --- | --- | --- | --- | 450 | 65 | 550 | 80 | 17 | --- | --- |
| | Grade 65 [450], Type 2 | --- | --- | --- | --- | 450 | 65 | 550 | 80 | 17 | --- | --- |
| | Grade 65 [450], Type 3 | --- | --- | --- | --- | 450 | 65 | 550 | 80 | 17 | --- | --- |
| | Grade 65 [450], Type 5 | --- | --- | --- | --- | 450 | 65 | 550 | 80 | 17 | --- | --- |
| ASTM A572/A572M-15 | Grade 65 [450], Type 1 | --- | --- | --- | --- | 450 | 65 | 550 | 80 | 17 | --- | --- |
| | Grade 65 [450], Type 2 | --- | --- | --- | --- | 450 | 65 | 550 | 80 | 17 | --- | --- |
| | Grade 65 [450], Type 3 | --- | --- | --- | --- | 450 | 65 | 550 | 80 | 17 | --- | --- |
| | Grade 65 [450], Type 5 | --- | --- | --- | --- | 450 | 65 | 550 | 80 | 17 | --- | --- |
| ASME SA-1011/SA-1011M | Grade 65 [450], Class 1, HSLAS | --- | --- | t ≤ 2.5 | t ≤ 0.097 | 450 | 65 | 550 L | 80 L | 14 L | HR | --- |
| | | | | t > 2.5 | t > 0.097 | 450 | 65 | 550 L | 80 L | 16 L | HR | --- |
| ASTM A1011/A1011M-14 | Grade 65 [450], Class 1, HSLAS | --- | --- | t ≤ 2.5 | t ≤ 0.097 | 450 | 65 | 550 L | 80 L | 14 L | HR | --- |
| | | | | t > 2.5 | t > 0.097 | 450 | 65 | 550 L | 80 L | 16 L | HR | --- |
| ASTM A656/A656M-13 | Grade 70 [485], Type 3 | --- | --- | t ≤ 25 | t ≤ 1 | 485 | 70 | 550 | 80 | 17 | HR | --- |
| | Grade 70 [485], Type 7 | --- | --- | t ≤ 25 | t ≤ 1 | 485 | 70 | 550 | 80 | 17 | HR | --- |
| | Grade 70 [485], Type 8 | --- | --- | t ≤ 25 | t ≤ 1 | 485 | 70 | 550 | 80 | 17 | HR | --- |
| ASME SA-1011/SA-1011M | Grade 70 [480], Class 1, HSLAS | --- | --- | t ≤ 2.5 | t ≤ 0.097 | 480 | 70 | 585 L | 85 L | 12 L | HR | --- |
| | | | | t > 2.5 | t > 0.097 | 480 | 70 | 585 L | 85 L | 14 L | HR | --- |
| ASTM A1011/A1011M-14 | Grade 70 [480], Class 1, HSLAS | --- | --- | t ≤ 2.5 | t ≤ 0.097 | 480 | 70 | 585 L | 85 L | 12 L | HR | --- |
| | | | | t > 2.5 | t > 0.097 | 480 | 70 | 585 L | 85 L | 14 L | HR | --- |

**3.2 Alloy Steels for Structural Steel Plates**

**3.2.1B Chemical Composition of High-Strength Low-Alloy Structural Steel Plates**

| Specification | Designation | UNS No. | Steel No. | Section Thickness | | Weight, %max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| GB/T 1591-94 | Grade Q295A | --- | --- | --- | --- | 0.16 | 0.80-1.50 | 0.55 | 0.045 | 0.045 | 0.30 | 0.30 | --- | V 0.02-0.15; Cu 0.30; Ti 0.02-0.20; Nb 0.015-0.060 |
| | Grade Q295B | --- | --- | --- | --- | 0.16 | 0.80-1.50 | 0.55 | 0.040 | 0.040 | 0.30 | 0.30 | --- | V 0.02-0.15; Cu 0.30; Ti 0.02-0.20; Nb 0.015-0.060 |
| CSA G40.21-13 | Grade 260W (38W) | --- | --- | --- | --- | 0.20 | 0.50-1.50 | 0.40 | 0.04 | 0.05 | --- | --- | --- | --- |
| | Grade 260WT (38WT) | --- | --- | --- | --- | 0.20 | 0.80-1.50 | 0.15-0.40 | 0.03 | 0.04 | --- | --- | --- | --- |
| ASME SA-1011/SA-1011M | Grade 45 [310], Class 1, HSLAS | --- | --- | --- | --- | 0.22 | 1.35 | --- | 0.04 | 0.04 | 0.15 | 0.20 | 0.06 | V 0.005 min.; Cu 0.20 nom.; Ti 0.005 min.; Cb 0.005 min. |
| ASTM A1011/A1011M-14 | Grade 45 [310], Class 1, HSLAS | --- | --- | --- | --- | 0.22 | 1.35 | --- | 0.04 | 0.04 | 0.15 | 0.20 | 0.06 | V 0.005 min.; Cu 0.20 nom.; Ti 0.005 min.; Cb 0.005 min. |
| ASME SA-1011/SA-1011M | Grade 50 [340], Class 2, HSLAS | --- | --- | --- | --- | 0.15 | 1.35 | --- | 0.04 | 0.04 | 0.15 | 0.20 | 0.06 | V 0.005 min.; Cu 0.20 nom.; Ti 0.005 min.; Cb 0.005 min. |
| ASTM A1011/A1011M-14 | Grade 50 [340], Class 2, HSLAS | --- | --- | --- | --- | 0.15 | 1.35 | --- | 0.04 | 0.04 | 0.15 | 0.20 | 0.06 | V 0.005 min.; Cu 0.20 nom.; Ti 0.005 min.; Cb 0.005 min. |
| ASME SA-572/SA-572M | Grade 42 [290], Type 1 | --- | --- | t ≤ 150 | t ≤ 6 | 0.21 | 0.50-1.35 | 0.40 | 0.04 | 0.05 | --- | --- | --- | Cb 0.005-0.05 |
| | Grade 42 [290], Type 2 | --- | --- | t ≤ 150 | t ≤ 6 | 0.21 | 0.50-1.35 | 0.40 | 0.04 | 0.05 | --- | --- | --- | V 0.01-0.15 |
| | Grade 42 [290], Type 3 | --- | --- | t ≤ 150 | t ≤ 6 | 0.21 | 0.50-1.35 | 0.40 | 0.04 | 0.05 | --- | --- | --- | V 0.01-0.15; Cb 0.005-0.05; (Cb+V) 0.02-0.15 |
| | Grade 42 [290], Type 5 | --- | --- | t ≤ 150 | t ≤ 6 | 0.21 | 0.50-1.25 | 0.40 | 0.04 | 0.05 | --- | --- | --- | V 0.06; Ti 0.006-0.04; N 0.003-0.015 |
| ASTM A572/A572M-15 | Grade 42 [290], Type 1 | --- | --- | t ≤ 150 | t ≤ 6 | 0.21 | 0.50-1.35 | 0.40 | 0.030 | 0.030 | --- | --- | --- | Cb 0.005-0.05 |
| | Grade 42 [290], Type 2 | --- | --- | t ≤ 150 | t ≤ 6 | 0.21 | 0.50-1.35 | 0.40 | 0.030 | 0.030 | --- | --- | --- | V 0.01-0.15 |
| | Grade 42 [290], Type 3 | --- | --- | t ≤ 150 | t ≤ 6 | 0.21 | 0.50-1.35 | 0.40 | 0.030 | 0.030 | --- | --- | --- | V 0.01-0.15; Cb 0.005-0.05; (Cb+V) 0.02-0.15 |
| | Grade 42 [290], Type 5 | --- | --- | t ≤ 150 | t ≤ 6 | 0.21 | 0.50-1.25 | 0.40 | 0.030 | 0.030 | --- | --- | --- | V 0.06; Ti 0.006-0.04; N 0.003-0.015 |
| ASTM A656/A656M-13 | Grade 50 [345], Type 3 | --- | --- | t ≤ 50 | t ≤ 2 | 0.18 | 1.65 | 0.60 | 0.025 | 0.030 | --- | --- | --- | V 0.08; Cb 0.008-0.10; N 0.030 |
| | Grade 50 [345], Type 7 | --- | --- | t ≤ 50 | t ≤ 2 | 0.18 | 1.65 | 0.60 | 0.025 | 0.030 | --- | --- | --- | V 0.15; Cb 0.10; N 0.030 |
| | Grade 50 [345], Type 8 | --- | --- | t ≤ 50 | t ≤ 2 | 0.18 | 1.65 | 0.60 | 0.025 | 0.030 | --- | --- | --- | V 0.15; Ti 0.15; Cb 0.10; N 0.030 |
| ASTM A633/A633M-13 | Grade A | K01802 | --- | t ≤ 100 | t ≤ 4 | 0.18 | 1.00-1.35 | 0.15-0.50 | 0.030 | 0.030 | --- | --- | --- | Cb 0.05 |
| CSA G40.21-13 | Grade 300W (44W) | --- | --- | --- | --- | 0.22 | 0.50-1.50 | 0.40 | 0.04 | 0.05 | --- | --- | --- | --- |
| | Grade 300WT (44WT) | --- | --- | --- | --- | 0.22 | 0.80-1.50 | 0.15-0.40 | 0.03 | 0.04 | --- | --- | --- | --- |
| ASME SA-1011/SA-1011M | Grade 50 [340], Class 1, HSLAS | --- | --- | --- | --- | 0.23 | 1.35 | --- | 0.04 | 0.04 | 0.15 | 0.20 | 0.06 | V 0.005 min.; Cu 0.20 nom.; Ti 0.005 min.; Cb 0.005 min. |
| ASTM A1011/A1011M-14 | Grade 50 [340], Class 1, HSLAS | --- | --- | --- | --- | 0.23 | 1.35 | --- | 0.04 | 0.04 | 0.15 | 0.20 | 0.06 | V 0.005 min.; Cu 0.20 nom.; Ti 0.005 min.; Cb 0.005 min. |

Note: This section continued on next page.

**3.2 Alloy Steels for Structural Steel Plates**

**3.2.1B Chemical Composition of High-Strength Low-Alloy Structural Steel Plates (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness | | Weight, %max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASME SA-572/SA-572M | Grade 50 [345], Type 1 | --- | --- | t ≤ 100 | t ≤ 4 | 0.23 | 0.50-1.35 | 0.40 | 0.04 | 0.05 | --- | --- | --- | Cb 0.005-0.05 |
| | Grade 50 [345], Type 2 | --- | --- | t ≤ 100 | t ≤ 4 | 0.23 | 0.50-1.35 | 0.40 | 0.04 | 0.05 | --- | --- | --- | V 0.01-0.15 |
| | Grade 50 [345], Type 3 | --- | --- | t ≤ 100 | t ≤ 4 | 0.23 | 0.50-1.35 | 0.40 | 0.04 | 0.05 | --- | --- | --- | V 0.01-0.15; Cb 0.005-0.05; (Cb+V) 0.02-0.15 |
| | Grade 50 [345], Type 5 | --- | --- | t ≤ 100 | t ≤ 4 | 0.23 | 0.50-1.35 | 0.40 | 0.04 | 0.05 | --- | --- | --- | V 0.06; Ti 0.006-0.04; N 0.003-0.015 |
| ASTM A572/A572M-15 | Grade 50 [345], Type 1 | --- | --- | t ≤ 100 | t ≤ 4 | 0.23 | 0.50-1.35 | 0.40 | 0.030 | 0.030 | --- | --- | --- | Cb 0.005-0.05 |
| | Grade 50 [345], Type 2 | --- | --- | t ≤ 100 | t ≤ 4 | 0.23 | 0.50-1.35 | 0.40 | 0.030 | 0.030 | --- | --- | --- | V 0.01-0.15 |
| | Grade 50 [345], Type 3 | --- | --- | t ≤ 100 | t ≤ 4 | 0.23 | 0.50-1.35 | 0.40 | 0.030 | 0.030 | --- | --- | --- | V 0.01-0.15; Cb 0.005-0.05; (Cb+V) 0.02-0.15 |
| | Grade 50 [345], Type 5 | --- | --- | t ≤ 100 | t ≤ 4 | 0.23 | 0.50-1.35 | 0.40 | 0.030 | 0.030 | --- | --- | --- | V 0.06; Ti 0.006-0.04; N 0.003-0.015 |
| ASTM A709/A709M-13a | Grade 50 [345], Type 1 | --- | --- | t ≤ 100 | t ≤ 4 | 0.23 | 0.50-1.35 | 0.40 | 0.04 | 0.05 | --- | --- | --- | Cb 0.005-0.05 |
| | Grade 50 [345], Type 2 | --- | --- | t ≤ 100 | t ≤ 4 | 0.23 | 0.50-1.35 | 0.40 | 0.04 | 0.05 | --- | --- | --- | V 0.01-0.15 |
| | Grade 50 [345], Type 3 | --- | --- | t ≤ 100 | t ≤ 4 | 0.23 | 0.50-1.35 | 0.40 | 0.04 | 0.05 | --- | --- | --- | V 0.01-0.15; Cb 0.005-0.05; (Cb+V) 0.02-0.15 |
| | Grade 50 [345], Type 5 | --- | --- | t ≤ 100 | t ≤ 4 | 0.23 | 0.50-1.35 | 0.40 | 0.04 | 0.05 | --- | --- | --- | V 0.06; Ti 0.006-0.04; N 0.003-0.015 |
| CSA G40.21-13 | Grade 350W (50W) | --- | --- | --- | --- | 0.23 | 0.50-1.50 | 0.40 | 0.04 | 0.05 | --- | --- | --- | --- |
| ASME SA-1011/SA-1011M | Grade 55 [380], Class 2, HSLAS | --- | --- | --- | --- | 0.15 | 1.35 | --- | 0.04 | 0.04 | 0.15 | 0.20 | 0.06 | V 0.005 min.; Cu 0.20 nom.; Ti 0.005 min.; Cb 0.005 min. |
| ASTM A1011/A1011M-14 | Grade 55 [380], Class 2, HSLAS | --- | --- | --- | --- | 0.15 | 1.35 | --- | 0.04 | 0.04 | 0.15 | 0.20 | 0.06 | V 0.005 min.; Cu 0.20 nom.; Ti 0.005 min.; Cb 0.005 min. |
| GB/T 1591-94 | Grade Q345A | --- | --- | --- | --- | 0.20 | 1.00-1.60 | 0.55 | 0.045 | 0.045 | 0.30 | 0.30 | --- | V 0.02-0.15; Cu 0.30; Ti 0.02-0.20; Nb 0.015-0.060 |
| | Grade Q345B | --- | --- | --- | --- | 0.20 | 1.00-1.60 | 0.55 | 0.040 | 0.040 | 0.30 | 0.30 | --- | V 0.02-0.15; Cu 0.30; Ti 0.02-0.20; Nb 0.015-0.060 |
| | Grade Q345C | --- | --- | --- | --- | 0.20 | 1.00-1.60 | 0.55 | 0.035 | 0.035 | 0.30 | 0.30 | --- | V 0.02-0.15; Al 0.015 min.; Cu 0.30; Ti 0.02-0.20; Nb 0.015-0.060 |
| | Grade Q345D | --- | --- | --- | --- | 0.18 | 1.00-1.60 | 0.55 | 0.030 | 0.030 | 0.30 | 0.30 | --- | V 0.02-0.15; Al 0.015 min.; Cu 0.30; Ti 0.02-0.20; Nb 0.015-0.060 |
| | Grade Q345E | --- | --- | --- | --- | 0.18 | 1.00-1.60 | 0.55 | 0.025 | 0.025 | 0.30 | 0.30 | --- | V 0.02-0.15; Al 0.015 min.; Cu 0.30; Ti 0.02-0.20; Nb 0.015-0.060 |
| ASTM A242/A242M-13 | Type 1 | K11510 | --- | t ≤ 100 | t ≤ 4 | 0.15 | 1.00 | --- | 0.15 | 0.05 | --- | --- | --- | Cu 0.20 min. |

Note: This section continued on next page.

**3.2 Alloy Steels for Structural Steel Plates**

**3.2.1B Chemical Composition of High-Strength Low-Alloy Structural Steel Plates (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness | | Weight, %max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| CSA G40.21-13 | Grade 350WT (50WT) | --- | --- | --- | --- | 0.22 | 0.80-1.50 | 0.15-0.40 | 0.03 | 0.04 | --- | --- | --- | --- |
| | Grade 380W (55W) | --- | --- | --- | --- | 0.23 | 0.50-1.50 | 0.40 | 0.04 | 0.05 | --- | --- | --- | --- |
| ASME SA-1011/SA-1011M | Grade 55 [380], Class 1, HSLAS | --- | --- | --- | --- | 0.25 | 1.35 | --- | 0.04 | 0.04 | 0.15 | 0.20 | 0.06 | V 0.005 min.; Cu 0.20 nom.; Ti 0.005 min.; Cb 0.005 min. |
| | Grade 60 [410], Class 2, HSLAS | --- | --- | --- | --- | 0.15 | 1.50 | --- | 0.04 | 0.04 | 0.15 | 0.20 | 0.06 | V 0.005 min.; Cu 0.20 nom.; Ti 0.005 min.; Cb 0.005 min. |
| ASTM A1011/A1011M-14 | Grade 55 [380], Class 1, HSLAS | --- | --- | --- | --- | 0.25 | 1.35 | --- | 0.04 | 0.04 | 0.15 | 0.20 | 0.06 | V 0.005 min.; Cu 0.20 nom.; Ti 0.005 min.; Cb 0.005 min. |
| | Grade 60 [410], Class 2, HSLAS | --- | --- | --- | --- | 0.15 | 1.50 | --- | 0.04 | 0.04 | 0.15 | 0.20 | 0.06 | V 0.005 min.; Cu 0.20 nom.; Ti 0.005 min.; Cb 0.005 min. |
| ASTM A588/A588M-15 | Grade A | K11947 | --- | t ≤ 200 | t ≤ 8 | 0.19 | 0.80-1.25 | 0.30-0.65 | 0.030 | 0.030 | 0.40-0.65 | 0.40 | --- | V 0.02-0.10; Cu 0.25-0.40 |
| | Grade B | K12043 | --- | t ≤ 200 | t ≤ 8 | 0.20 | 0.75-1.35 | 0.15-0.50 | 0.030 | 0.030 | 0.40-0.70 | 0.50 | --- | V 0.01-0.10; Cu 0.20-0.40 |
| | Grade K | --- | --- | t ≤ 200 | t ≤ 8 | 0.17 | 0.50-1.20 | 0.25-0.50 | 0.030 | 0.030 | 0.40-0.70 | 0.40 | 0.10 | Cu 0.30-0.50; Cb 0.005-0.05 |
| ASTM A633/A633M-13 | Grade C | K12000 | --- | t ≤ 100 | t ≤ 4 | 0.20 | 1.15-1.50 | 0.15-0.50 | 0.030 | 0.030 | --- | --- | --- | Cb 0.01-0.05 |
| | Grade D | K12037 | --- | t ≤ 40 | t ≤ 1.5 | 0.20 | 0.70-1.35 | 0.15-0.50 | 0.030 | 0.030 | 0.25 | 0.25 | 0.08 | Cu 0.35 |
| | | | | 40 < t ≤ 100 | 1.5 < t ≤ 4 | 0.20 | 1.00-1.60 | 0.15-0.50 | 0.030 | 0.030 | 0.25 | 0.25 | 0.08 | Cu 0.35 |
| ASME SA-572/SA-572M | Grade 55 [380], Type 1 | --- | --- | t ≤ 50 | t ≤ 2 | 0.25 | 0.50-1.35 | 0.40 | 0.04 | 0.05 | --- | --- | --- | Cb 0.005-0.05 |
| | Grade 55 [380], Type 2 | --- | --- | t ≤ 50 | t ≤ 2 | 0.25 | 0.50-1.35 | 0.40 | 0.04 | 0.05 | --- | --- | --- | V 0.01-0.15 |
| | Grade 55 [380], Type 3 | --- | --- | t ≤ 50 | t ≤ 2 | 0.25 | 0.50-1.35 | 0.40 | 0.04 | 0.05 | --- | --- | --- | V 0.01-0.15; Cb 0.005-0.05; (Cb+V) 0.02-0.15 |
| | Grade 55 [380], Type 5 | --- | --- | t ≤ 50 | t ≤ 2 | 0.25 | 0.50-1.35 | 0.40 | 0.04 | 0.05 | --- | --- | --- | V 0.06; Ti 0.006-0.04; N 0.003-0.015 |
| ASTM A572/A572M-15 | Grade 55 [380], Type 1 | --- | --- | t ≤ 50 | t ≤ 2 | 0.25 | 0.50-1.35 | 0.40 | 0.030 | 0.030 | --- | --- | --- | Cb 0.005-0.05 |
| | Grade 55 [380], Type 2 | --- | --- | t ≤ 50 | t ≤ 2 | 0.25 | 0.50-1.35 | 0.40 | 0.030 | 0.030 | --- | --- | --- | V 0.01-0.15 |
| | Grade 55 [380], Type 3 | --- | --- | t ≤ 50 | t ≤ 2 | 0.25 | 0.50-1.35 | 0.40 | 0.030 | 0.030 | --- | --- | --- | V 0.01-0.15; Cb 0.005-0.05 (Cb+V) 0.02-0.15 |
| | Grade 55 [380], Type 5 | --- | --- | t ≤ 50 | t ≤ 2 | 0.25 | 0.50-1.35 | 0.40 | 0.030 | 0.030 | --- | --- | --- | V 0.06; Ti 0.006-0.04; N 0.003-0.015 |
| ASTM A656/A656M-13 | Grade 60 [415], Type 3 | --- | --- | t ≤ 40 | t ≤ 1.5 | 0.18 | 1.65 | 0.60 | 0.025 | 0.030 | --- | --- | --- | V 0.08; Cb 0.008-0.10; N 0.030 |
| | Grade 60 [415], Type 7 | --- | --- | t ≤ 40 | t ≤ 1.5 | 0.18 | 1.65 | 0.60 | 0.025 | 0.030 | --- | --- | --- | V 0.15; Cb 0.10; N 0.030 |
| | Grade 60 [415], Type 8 | --- | --- | t ≤ 40 | t ≤ 1.5 | 0.18 | 1.65 | 0.60 | 0.025 | 0.030 | --- | --- | --- | V 0.15; Ti 0.15; Cb 0.10; N 0.030 |

**3.2 Alloy Steels for Structural Steel Plates**

**3.2.1B Chemical Composition of High-Strength Low-Alloy Structural Steel Plates (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness mm | Section Thickness in. | Weight, %max, Unless Otherwise Specified C | Mn | Si | P | S | Cr | Ni | Mo | Others |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CSA G40.21-13 | Grade 400W (60W) | --- | --- | --- | --- | 0.23 | 0.50-1.50 | 0.40 | 0.04 | 0.05 | --- | --- | --- | --- |
| | Grade 400WT (60WT) | --- | --- | --- | --- | 0.22 | 0.80-1.60 | 0.15-0.40 | 0.03 | 0.04 | --- | --- | --- | --- |
| ASME SA-1011/SA-1011M | Grade 60 [410], Class 1, HSLAS | --- | --- | --- | --- | 0.26 | 1.50 | --- | 0.04 | 0.04 | 0.15 | 0.20 | 0.06 | V 0.005 min.; Cu 0.20 nom.; Ti 0.005 min.; Cb 0.005 min. |
| | Grade 65 [450], Class 2, HSLAS | --- | --- | --- | --- | 0.15 | 1.50 | --- | 0.04 | 0.04 | 0.15 | 0.20 | 0.06 | V 0.005 min.; Cu 0.20 nom.; Ti 0.005 min.; Cb 0.005 min. |
| ASTM A1011/A1011M-14 | Grade 60 [410], Class 1, HSLAS | --- | --- | --- | --- | 0.26 | 1.50 | --- | 0.04 | 0.04 | 0.15 | 0.20 | 0.06 | V 0.005 min.; Cu 0.20 nom.; Ti 0.005 min.; Cb 0.005 min. |
| | Grade 65 [450], Class 2, HSLAS | --- | --- | --- | --- | 0.15 | 1.50 | --- | 0.04 | 0.04 | 0.15 | 0.20 | 0.06 | V 0.005 min.; Cu 0.20 nom.; Ti 0.005 min.; Cb 0.005 min. |
| ASME SA-572/SA-572M | Grade 60 [415], Type 1 | --- | --- | t ≤ 32 | t ≤ 1.25 | 0.26 | 0.50-1.35 | 0.40 | 0.04 | 0.05 | --- | --- | --- | Cb 0.005-0.05 |
| | Grade 60 [415], Type 2 | --- | --- | t ≤ 32 | t ≤ 1.25 | 0.26 | 0.50-1.35 | 0.40 | 0.04 | 0.05 | --- | --- | --- | V 0.01-0.15 |
| | Grade 60 [415], Type 3 | --- | --- | t ≤ 32 | t ≤ 1.25 | 0.26 | 0.50-1.35 | 0.40 | 0.04 | 0.05 | --- | --- | --- | V 0.01-0.15; Cb 0.005-0.05; (Cb+V) 0.02 to 0.15 |
| | Grade 60 [415], Type 5 | --- | --- | t ≤ 32 | t ≤ 1.25 | 0.26 | 0.50-1.35 | 0.40 | 0.04 | 0.05 | --- | --- | --- | V 0.06; Ti 0.006-0.04; N 0.003-0.015 |
| ASTM A572/A572M-15 | Grade 60 [415], Type 1 | --- | --- | t ≤ 32 | t ≤ 1.25 | 0.26 | 0.50-1.35 | 0.40 | 0.030 | 0.030 | --- | --- | --- | Cb 0.005-0.05 |
| | Grade 60 [415], Type 2 | --- | --- | t ≤ 32 | t ≤ 1.25 | 0.26 | 0.50-1.35 | 0.40 | 0.030 | 0.030 | --- | --- | --- | V 0.01-0.15 |
| | Grade 60 [415], Type 3 | --- | --- | t ≤ 32 | t ≤ 1.25 | 0.26 | 0.50-1.35 | 0.40 | 0.030 | 0.030 | --- | --- | --- | V 0.01-0.15; Cb 0.005-0.05; (Cb+V) 0.02 to 0.15 |
| | Grade 60 [415], Type 5 | --- | --- | t ≤ 32 | t ≤ 1.25 | 0.26 | 0.50-1.35 | 0.40 | 0.030 | 0.030 | --- | --- | --- | V 0.06; Ti 0.006-0.04; N 0.003-0.015 |
| GB/T 1591-94 | Grade Q420A | --- | --- | --- | --- | 0.20 | 1.00-1.70 | 0.55 | 0.045 | 0.045 | 0.40 | 0.70 | --- | V 0.02-0.20; Cu 0.30; Ti 0.02-0.20; Nb 0.015-0.060 |
| | Grade Q420B | --- | --- | --- | --- | 0.20 | 1.00-1.70 | 0.55 | 0.040 | 0.040 | 0.40 | 0.70 | --- | V 0.02-0.20; Cu 0.30; Ti 0.02-0.20; Nb 0.015-0.060 |
| | Grade Q420C | --- | --- | --- | --- | 0.20 | 1.00-1.70 | 0.55 | 0.035 | 0.035 | 0.40 | 0.70 | --- | V 0.02-0.20; Al 0.015 min.; Cu 0.30; Ti 0.02-0.20; Nb 0.015-0.060 |
| | Grade Q420D | --- | --- | --- | --- | 0.20 | 1.00-1.70 | 0.55 | 0.030 | 0.030 | 0.40 | 0.70 | --- | V 0.02-0.20; Al 0.015 min.; Cu 0.30; Ti 0.02-0.20; Nb 0.015-0.060 |
| | Grade Q420E | --- | --- | --- | --- | 0.20 | 1.00-1.70 | 0.55 | 0.025 | 0.025 | 0.40 | 0.70 | --- | V 0.02-0.20; Al 0.015 min.; Cu 0.30; Ti 0.02-0.20; Nb 0.015-0.060 |
| GB/T 16270-1996 | Grade Q420C | --- | --- | --- | --- | 0.20 | 1.00-1.60 | 0.55 | 0.035 | 0.035 | 0.30 | 0.70 | 0.20 | V 0.10; Ti 0.20; Nb 0.06 |
| | Grade Q420D | --- | --- | --- | --- | 0.18 | 1.00-1.60 | 0.55 | 0.030 | 0.030 | 0.30 | 0.70 | 0.20 | V 0.10; Ti 0.20; Nb 0.06 |
| | Grade Q420E | --- | --- | --- | --- | 0.18 | 1.00-1.60 | 0.55 | 0.025 | 0.025 | 0.30 | 0.70 | 0.20 | V 0.10; Ti 0.20; Nb 0.06 |

Note: This section continued on next page.

**3.2 Alloy Steels for Structural Steel Plates**

**3.2.1B Chemical Composition of High-Strength Low-Alloy Structural Steel Plates (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness | | Weight, %max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASTM A633/A633M-13 | Grade E | K12202 | --- | t ≤ 150 | t ≤ 6 | 0.22 | 1.15-1.50 | 0.15-0.50 | 0.030 | 0.030 | --- | --- | --- | V 0.04-0.11; N 0.03; Cb 0.01-0.05 |
| ASME SA-572/SA-572M | Grade 65 [450], Type 1 | --- | --- | 13 < t ≤ 32 | 0.5 < t ≤ 1.25 | 0.23 | 0.80-1.65 | 0.40 | 0.04 | 0.05 | --- | --- | --- | Cb 0.005-0.05 |
| | | | | t ≤ 13 | t ≤ 0.5 | 0.26 | 0.50-1.35 | 0.40 | 0.04 | 0.05 | --- | --- | --- | Cb 0.005-0.05 |
| | Grade 65 [450], Type 2 | --- | --- | 13 < t ≤ 32 | 0.5 < t ≤ 1.25 | 0.23 | 0.80-1.65 | 0.40 | 0.04 | 0.05 | --- | --- | --- | V 0.01-0.15 |
| | | | | t ≤ 13 | t ≤ 0.5 | 0.26 | 0.50-1.35 | 0.40 | 0.04 | 0.05 | --- | --- | --- | V 0.01-0.15 |
| | Grade 65 [450], Type 3 | --- | --- | 13 < t ≤ 32 | 0.5 < t ≤ 1.25 | 0.23 | 0.80-1.65 | 0.40 | 0.04 | 0.05 | --- | --- | --- | V 0.01-0.15; Cb 0.005-0.05; (Cb+V) 0.02 to 0.15 |
| | | | | t ≤ 13 | t ≤ 0.5 | 0.26 | 0.50-1.35 | 0.40 | 0.04 | 0.05 | --- | --- | --- | V 0.01-0.15; Cb 0.005-0.05; (Cb+V) 0.02 to 0.15 |
| | Grade 65 [450], Type 5 | --- | --- | 13 < t ≤ 32 | 0.5 < t ≤ 1.25 | 0.23 | 0.80-1.65 | 0.40 | 0.04 | 0.05 | --- | --- | --- | V 0.06; Ti 0.006-0.04; N 0.003-0.015 |
| | | | | t ≤ 13 | t ≤ 0.5 | 0.26 | 0.50-1.35 | 0.40 | 0.04 | 0.05 | --- | --- | --- | V 0.06; Ti 0.006-0.04; N 0.003-0.015 |
| ASTM A572/A572M-15 | Grade 65 [450], Type 1 | --- | --- | 13 < t ≤ 32 | 0.5 < t ≤ 1.25 | 0.23 | 0.80-1.65 | 0.40 | 0.030 | 0.030 | --- | --- | --- | Cb 0.005-0.05 |
| | | | | t ≤ 13 | t ≤ 0.5 | 0.26 | 0.50-1.35 | 0.40 | 0.030 | 0.030 | --- | --- | --- | Cb 0.005-0.05 |
| | Grade 65 [450], Type 2 | --- | --- | 13 < t ≤ 32 | 0.5 < t ≤ 1.25 | 0.23 | 0.80-1.65 | 0.40 | 0.030 | 0.030 | --- | --- | --- | V 0.01-0.15 |
| | | | | t ≤ 13 | t ≤ 0.5 | 0.26 | 0.50-1.35 | 0.40 | 0.030 | 0.030 | --- | --- | --- | V 0.01-0.15 |
| | Grade 65 [450], Type 3 | --- | --- | 13 < t ≤ 32 | 0.5 < t ≤ 1.25 | 0.23 | 0.80-1.65 | 0.40 | 0.030 | 0.030 | --- | --- | --- | V 0.01-0.15; Cb 0.005-0.05 (Cb+V) 0.02 to 0.15 |
| | | | | t ≤ 13 | t ≤ 0.5 | 0.26 | 0.50-1.35 | 0.40 | 0.030 | 0.030 | --- | --- | --- | V 0.01-0.15; Cb 0.005-0.05 (Cb+V) 0.02 to 0.15 |
| | Grade 65 [450], Type 5 | --- | --- | 13 < t ≤ 32 | 0.5 < t ≤ 1.25 | 0.23 | 0.80-1.65 | 0.40 | 0.030 | 0.030 | --- | --- | --- | V 0.06; Ti 0.006-0.04; N 0.003-0.015 |
| | | | | t ≤ 13 | t ≤ 0.5 | 0.26 | 0.50-1.35 | 0.40 | 0.030 | 0.030 | --- | --- | --- | V 0.06; Ti 0.006-0.04; N 0.003-0.015 |
| ASME SA-1011/SA-1011M | Grade 65 [450], Class 1, HSLAS | --- | --- | --- | --- | 0.26 | 1.50 | --- | 0.04 | 0.04 | 0.15 | 0.20 | 0.06 | V 0.005 min.; Cu 0.20 nom.; Ti 0.005 min.; Cb 0.005 min. |
| ASTM A1011/A1011M-14 | Grade 65 [450], Class 1, HSLAS | --- | --- | --- | --- | 0.26 | 1.50 | --- | 0.04 | 0.04 | 0.15 | 0.20 | 0.06 | V 0.005 min.; Cu 0.20 nom.; Ti 0.005 min.; Cb 0.005 min. |
| ASTM A656/A656M-13 | Grade 70 [485], Type 3 | --- | --- | t ≤ 25 | t ≤ 1 | 0.18 | 1.65 | 0.60 | 0.025 | 0.030 | --- | --- | --- | V 0.08; Cb 0.008-0.10; N 0.030 |
| | Grade 70 [485], Type 7 | --- | --- | t ≤ 25 | t ≤ 1 | 0.18 | 1.65 | 0.60 | 0.025 | 0.030 | --- | --- | --- | V 0.15; Cb 0.10; N 0.030 |
| | Grade 70 [485], Type 8 | --- | --- | t ≤ 25 | t ≤ 1 | 0.18 | 1.65 | 0.60 | 0.025 | 0.030 | --- | --- | --- | V 0.15; Ti 0.15; Cb 0.10; N 0.030 |
| ASME SA-1011/SA-1011M | Grade 70 [480], Class 1, HSLAS | --- | --- | --- | --- | 0.26 | 1.65 | --- | 0.04 | 0.04 | 0.15 | 0.20 | 0.06 | V 0.005 min.; Cu 0.20 nom.; Ti 0.005 min.; Cb 0.005 min. |
| ASTM A1011/A1011M-14 | Grade 70 [480], Class 1, HSLAS | --- | --- | --- | --- | 0.26 | 1.65 | --- | 0.04 | 0.04 | 0.15 | 0.20 | 0.16 | V 0.005 min.; Cu 0.20 nom.; Ti 0.005 min.; Cb 0.005 min. |

**3.2 Alloy Steels for Structural Steel Plates**

**3.2.2A Mechanical Properties of Alloy Steels for Structural Steel Plates**

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter mm | Section Thickness/Diameter in. | Yield Strength, min. MPa | Yield Strength, min. ksi | Tensile Strength, min. MPa | Tensile Strength, min. ksi | Elongation % min. | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GB 11251-89 | Grade 15 Cr | --- | --- | --- | --- | --- | --- | 400-600 | --- | 21 | A, N or NT | --- |
| | Grade 20 Cr | --- | --- | --- | --- | --- | --- | 400-650 | --- | 20 | A, N or NT | --- |
| | Grade 20CrMnSiA | --- | --- | --- | --- | --- | --- | 450-700 | --- | 21 | A, N or NT | --- |
| ISO 4950-2:1995 A1:2003 | Grade E 355, Quality DD | --- | --- | 3 ≤ t ≤ 16 | --- | 355 | --- | 470-630 | --- | 22 | N, NT or CtR | see standard for impact data |
| | | | | 16 < t ≤ 35 | --- | 345 | --- | 470-630 | --- | 22 | N, NT or CtR | |
| | | | | 35 < t ≤ 50 | --- | 335 | --- | 470-630 | --- | 22 | N, NT or CtR | |
| | | | | 50 < t ≤ 70 | --- | 325 | --- | 470-630 | --- | 22 | N, NT or CtR | |
| | | | | 70 < t ≤ 100 | --- | 305 | --- | 450-610 | --- | 22 | N, NT or CtR | |
| | | | | 100 < t ≤ 125 | --- | 295 | --- | 440-600 | --- | 22 | N, NT or CtR | |
| | | | | 125 < t ≤ 150 | --- | 285 | --- | 430-590 | --- | 22 | N, NT or CtR | |
| | Grade E 355, Quality E | --- | --- | 3 ≤ t ≤ 16 | --- | 355 | --- | 470-630 | --- | 22 | N, NT or CtR | see standard for impact data |
| | | | | 16 < t ≤ 35 | --- | 345 | --- | 470-630 | --- | 22 | N, NT or CtR | |
| | | | | 35 < t ≤ 50 | --- | 335 | --- | 470-630 | --- | 22 | N, NT or CtR | |
| | | | | 50 < t ≤ 70 | --- | 325 | --- | 470-630 | --- | 22 | N, NT or CtR | |
| | | | | 70 < t ≤ 100 | --- | 305 | --- | 450-610 | --- | 22 | N, NT or CtR | |
| | | | | 100 < t ≤ 125 | --- | 295 | --- | 440-600 | --- | 22 | N, NT or CtR | |
| | | | | 125 < t ≤ 150 | --- | 285 | --- | 430-590 | --- | 22 | N, NT or CtR | |
| ASTM A709/A709M-13a | Grade 50W [345W], Type A | --- | --- | t ≤ 100 | t ≤ 4 | 345 | 50 | 485 | 70 | 21 | QT | see standard for impact data |
| | Grade 50W [345W], Type B | --- | --- | t ≤ 100 | t ≤ 4 | 345 | 50 | 485 | 70 | 21 | QT | |

Note: This section continued on next page.

**3.2 Alloy Steels for Structural Steel Plates**

**3.2.2A Mechanical Properties of Alloy Steels for Structural Steel Plates (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | % min. | | |
| GB/T 1591-94 | Grade Q390A | --- | --- | t ≤ 16 | --- | 390 | --- | 490-650 | --- | 19 | HR, CtR, N or NT | --- |
| | | | | 16 < t ≤ 35 | --- | 370 | --- | 490-650 | --- | 19 | HR, CtR, N or NT | --- |
| | | | | 35 < t ≤ 50 | --- | 350 | --- | 490-650 | --- | 19 | HR, CtR, N or NT | --- |
| | | | | 50 < t ≤ 100 | --- | 330 | --- | 490-650 | --- | 19 | HR, CtR, N or NT | --- |
| | Grade Q390B | --- | --- | t ≤ 16 | --- | 390 | --- | 490-650 | --- | 19 | HR, CtR, N or NT | L: 34 J @ 20°C |
| | | | | 16 < t ≤ 35 | --- | 370 | --- | 490-650 | --- | 19 | HR, CtR, N or NT | --- |
| | | | | 35 < t ≤ 50 | --- | 350 | --- | 490-650 | --- | 19 | HR, CtR, N or NT | --- |
| | | | | 50 < t ≤ 100 | --- | 330 | --- | 490-650 | --- | 19 | HR, CtR, N or NT | --- |
| | Grade Q390C | --- | --- | t ≤ 16 | --- | 390 | --- | 490-650 | --- | 20 | HR, CtR, N or NT | --- |
| | | | | 16 < t ≤ 35 | --- | 370 | --- | 490-650 | --- | 20 | HR, CtR, N or NT | L: 34 J @ 0°C |
| | | | | 35 < t ≤ 50 | --- | 350 | --- | 490-650 | --- | 20 | HR, CtR, N or NT | --- |
| | | | | 50 < t ≤ 100 | --- | 330 | --- | 490-650 | --- | 20 | HR, CtR, N or NT | --- |
| | Grade Q390D | --- | --- | t ≤ 16 | --- | 390 | --- | 490-650 | --- | 20 | HR, CtR, N or NT | --- |
| | | | | 16 < t ≤ 35 | --- | 370 | --- | 490-650 | --- | 20 | HR, CtR, N or NT | --- |
| | | | | 35 < t ≤ 50 | --- | 350 | --- | 490-650 | --- | 20 | HR, CtR, N or NT | L: 34 J @ -20°C |
| | | | | 50 < t ≤ 100 | --- | 330 | --- | 490-650 | --- | 20 | HR, CtR, N or NT | --- |
| | Grade Q390E | --- | --- | t ≤ 16 | --- | 390 | --- | 490-650 | --- | 20 | HR, CtR, N or NT | --- |
| | | | | 16 < t ≤ 35 | --- | 370 | --- | 490-650 | --- | 20 | HR, CtR, N or NT | --- |
| | | | | 35 < t ≤ 50 | --- | 350 | --- | 490-650 | --- | 20 | HR, CtR, N or NT | --- |
| | | | | 50 < t ≤ 100 | --- | 330 | --- | 490-650 | --- | 20 | HR, CtR, N or NT | L: 27 J @ -40°C |
| ASTM A710/A710M-02 (2013) | Grade A, Class 2 | K20747 | --- | t ≤ 25 | t ≤ 1 | 450 | 65 | 495 | 72 | 20 | N+PHT | --- |
| | | | | 25 < t ≤ 50 | 1 < t ≤ 2 | 415 | 60 | 495 | 72 | 20 | N+PHT | --- |
| | | | | 50 < t ≤ 100 | 2 < t ≤ 4 | 380 | 55 | 450 | 65 | 20 | N+PHT | --- |
| | | | | t > 100 | t > 4 | 345 | 50 | 415 | 60 | 20 | N+PHT | --- |
| GB 11251-89 | Grade 25CrMnSiA | --- | --- | --- | --- | --- | --- | 500-700 | --- | 20 | A, N or NT | 152-221 HB |
| | | | | --- | --- | --- | --- | 1000 | --- | 10 | QT | 39 J @ RT |
| | Grade 30 Cr | --- | --- | --- | --- | --- | --- | 500-700 | --- | 19 | A, N or NT | --- |

**3.2 Alloy Steels for Structural Steel Plates**

**3.2.2A Mechanical Properties of Alloy Steels for Structural Steel Plates (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter mm | Section Thickness/Diameter in. | Yield Strength, min. MPa | Yield Strength, min. ksi | Tensile Strength, min. MPa | Tensile Strength, min. ksi | Elongation % min. | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GB 11251-89 | Grade 30CrMnSiA | --- | --- | --- | --- | --- | --- | 550-750 | --- | 19 | A, N or NT | 152-221 HB |
| | | | | --- | --- | --- | --- | 1100 | --- | 10 | QT | 39 J @ RT |
| | Grade 35 Cr | --- | --- | --- | --- | --- | --- | 550-750 | --- | 18 | A, N or NT | --- |
| | Grade 27SiMn | --- | --- | --- | --- | --- | --- | 550-800 | --- | 18 | A, N or NT | --- |
| | Grade 40 Cr | --- | --- | --- | --- | --- | --- | 550-800 | --- | 16 | A, N or NT | --- |
| GB/T 1591-94 | Grade Q460C | --- | --- | t ≤ 16 | --- | 460 | --- | 550-720 | --- | 17 | HR, CtR, N, NT or QT | --- |
| | | | | 16 < t ≤ 35 | --- | 440 | --- | 550-720 | --- | 17 | HR, CtR, N, NT or QT | L: 34 J @ 0°C |
| | | | | 35 < t ≤ 50 | --- | 420 | --- | 550-720 | --- | 17 | HR, CtR, N, NT or QT | --- |
| | | | | 50 < t ≤ 100 | --- | 400 | --- | 550-720 | --- | 17 | HR, CtR, N, NT or QT | --- |
| | Grade Q460D | --- | --- | t ≤ 16 | --- | 460 | --- | 550-720 | --- | 17 | HR, CtR, N, NT or QT | --- |
| | | | | 16 < t ≤ 35 | --- | 440 | --- | 550-720 | --- | 17 | HR, CtR, N, NT or QT | --- |
| | | | | 35 < t ≤ 50 | --- | 420 | --- | 550-720 | --- | 17 | HR, CtR, N, NT or QT | L: 34 J @ -20°C |
| | | | | 50 < t ≤ 100 | --- | 400 | --- | 550-720 | --- | 17 | HR, CtR, N, NT or QT | --- |
| | Grade Q460E | --- | --- | t ≤ 16 | --- | 460 | --- | 550-720 | --- | 17 | HR, CtR, N, NT or QT | --- |
| | | | | 16 < t ≤ 35 | --- | 440 | --- | 550-720 | --- | 17 | HR, CtR, N, NT or QT | --- |
| | | | | 35 < t ≤ 50 | --- | 420 | --- | 550-720 | --- | 17 | HR, CtR, N, NT or QT | --- |
| | | | | 50 < t ≤ 100 | --- | 400 | --- | 550-720 | --- | 17 | HR, CtR, N, NT or QT | L: 27 J @ -40°C |
| GB/T 16270-1996 | Grade Q460C | --- | --- | t ≤ 50 | --- | 460 | --- | 550-710 T | --- | 17 T | CtR, N, QT or NT | see standard for |
| | | | | 50 < t ≤ 100 | --- | 440 | --- | 550-710 T | --- | 17 T | CtR, N, QT or NT | impact data |
| | Grade Q460D | --- | --- | t ≤ 50 | --- | 460 | --- | 550-710 T | --- | 17 T | CtR, N, QT or NT | see standard for |
| | | | | 50 < t ≤ 100 | --- | 440 | --- | 550-710 T | --- | 17 T | CtR, N, QT or NT | impact data |
| | Grade Q460E | --- | --- | t ≤ 50 | --- | 460 | --- | 550-710 T | --- | 17 T | CtR, N, QT or NT | see standard for |
| | | | | 50 < t ≤ 100 | --- | 440 | --- | 550-710 T | --- | 17 T | CtR, N, QT or NT | impact data |

Note: This section continued on next page.

**3.2 Alloy Steels for Structural Steel Plates**

**3.2.2A Mechanical Properties of Alloy Steels for Structural Steel Plates (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | % min. | | |
| ISO 4950-3:1995 A1:2003 | Grade E 460, Quality DD | --- | --- | 3 ≤ t ≤ 50 | --- | 460 | --- | 570-720 T | --- | 17 T | QT | see standard for impact data |
| | | | | 50 < t ≤ 70 | --- | 440 | --- | 570-720 T | --- | 17 T | QT | |
| | Grade E 460, Quality E | --- | --- | 3 ≤ t ≤ 50 | --- | 460 | --- | 570-720 T | --- | 17 T | QT | see standard for impact data |
| | | | | 50 < t ≤ 70 | --- | 440 | --- | 570-720 T | --- | 17 T | QT | |
| ASTM A709/A709M-13a | Grade HPS 70W [HPS 485W] | --- | --- | t ≤ 100 | t ≤ 4 | 485 | 70 | 585-760 | 85-110 | 19 | AR, CtR, TMCP or QT | see standard for impact data |
| ASTM A710/A710M-02 (2013) | Grade A, Class 3 | K20747 | --- | t ≤ 30 | t ≤ 1.25 | 550 | 80 | 585 | 85 | 20 | Q+PHT | --- |
| | | | | 30 < t ≤ 50 | 1.25 < t ≤ 2 | 515 | 75 | 585 | 85 | 20 | Q+PHT | --- |
| | | | | 50 < t ≤ 100 | 2 < t ≤ 4 | 450 | 65 | 515 | 75 | 20 | Q+PHT | --- |
| | | | | t > 100 | t > 4 | 415 | 60 | 485 | 70 | 20 | Q+PHT | --- |
| CSA G40.21-13 | Grade 480WT (70WT) | --- | --- | --- | --- | 480 | 70 | 590-790 | 85-115 | 17 | AR, N or CtR | see standard for impact data |
| | | | | --- | --- | 480 | 70 | 590-790 | 85-115 | 17 | SR, A or N | |
| | | | | t ≤ 65 | t ≤ 2.5 | 480 | 70 | 590-790 | 85-115 | 17 L, 14 T | AR, N or CtR | |
| | | | | 65 < t ≤ 200 | 2.5 < t ≤ 8 | 450 | 65 | 590-790 | 85-115 | 17 L, 14 T | AR, N or CtR | |
| GB 11251-89 | Grade 35CrMnSiA | --- | --- | --- | --- | --- | --- | 600-800 | --- | 16 | A, N or NT | --- |

**3.2 Alloy Steels for Structural Steel Plates**

**3.2.2A Mechanical Properties of Alloy Steels for Structural Steel Plates (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | % min. | | |
| GB/T 16270-1996 | Grade Q500D | --- | --- | t ≤ 50 | --- | 500 | --- | 610-770 T | --- | 16 T | CtR, N, QT or NT | see standard for impact data |
| | | | | 50 < t ≤ 100 | --- | 480 | --- | 610-770 T | --- | 16 T | CtR, N, QT or NT | |
| | Grade Q500E | --- | --- | t ≤ 50 | --- | 500 | --- | 610-770 T | --- | 16 T | CtR, N, QT or NT | |
| | | | | 50 < t ≤ 100 | --- | 480 | --- | 610-770 T | --- | 16 T | CtR, N, QT or NT | |
| CSA G40.21-13 | Grade 550WT (80WT) | --- | --- | --- | --- | 550 | 80 | 620-860 | 90-125 | 15 | SR, A or N | see standard for impact data |
| | | | | t ≤ 65 | t ≤ 2.5 | 550 | 80 | 620-860 | 90-125 | 15 L, 12 T | AR, N or CtR | |
| | | | | 65 < t ≤ 200 | 2.5 < t ≤ 8 | 520 | 75 | 620-860 | 90-125 | 15 L, 12 T | AR, N or CtR | |
| ASTM A710/A710M-02 (2013) | Grade A, Class 1 | K20747 | --- | t ≤ 8 | t ≤ 0.3125 | 585 | 85 | 620 | 90 | 20 | PHT | see standard for impact data |
| | | | | 8 < t ≤ 20 | 0.3125 < t ≤ 0.75 | 550 | 80 | 620 | 90 | 20 | PHT | |

**3.2 Alloy Steels for Structural Steel Plates**

**3.2.2A Mechanical Properties of Alloy Steels for Structural Steel Plates (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | % min. | | |
| GB/T 16270-1996 | Grade Q550D | --- | --- | t ≤ 50 | --- | 550 | --- | 670-830 T | --- | 16 T | CtR, N, QT or NT | see standard for impact data |
| | | | | 50 < t ≤ 100 | --- | 530 | --- | 670-830 T | --- | 16 T | CtR, N, QT or NT | |
| | Grade Q550E | --- | --- | t ≤ 50 | --- | 550 | --- | 670-830 T | --- | 16 T | CtR, N, QT or NT | |
| | | | | 50 < t ≤ 100 | --- | 530 | --- | 670-830 T | --- | 16 T | CtR, N, QT or NT | |
| | Grade Q620D | --- | --- | t ≤ 50 | --- | 620 | --- | 720-890 T | --- | 15 T | CtR, N, QT or NT | see standard for impact data |
| | | | | 50 < t ≤ 100 | --- | 600 | --- | 720-890 T | --- | 15 T | CtR, N, QT or NT | see standard for impact data |
| | Grade Q620E | --- | --- | t ≤ 50 | --- | 620 | --- | 720-890 T | --- | 15 T | CtR, N, QT or NT | see standard for impact data |
| | | | | 50 < t ≤ 100 | --- | 600 | --- | 720-890 T | --- | 15 T | CtR, N, QT or NT | see standard for impact data |
| ASTM A514/A514M-14 | Grade A | K11856 | --- | t ≤ 20 | t ≤ 0.75 | 690 | 100 | 760-895 | 110-130 | 18 L | QT or SR | 235-293 HB |
| | | | | 20 < t ≤ 32 | 0.75 < t ≤ 1.25 | 690 | 100 | 760-895 | 110-130 | 18 L | QT or SR | --- |
| | Grade B | K11630 | --- | t ≤ 20 | t ≤ 0.75 | 690 | 100 | 760-895 | 110-130 | 18 L | QT or SR | 235-293 HB |
| | | | | 20 < t ≤ 32 | 0.75 < t ≤ 1.25 | 690 | 100 | 760-895 | 110-130 | 18 L | QT or SR | --- |
| | Grade E | K21604 | --- | t ≤ 20 | t ≤ 0.75 | 690 | 100 | 760-895 | 110-130 | 18 L | QT or SR | 235-293 HB |
| | | | | 20 < t ≤ 65 | 0.75 < t ≤ 2.5 | 690 | 100 | 760-895 | 110-130 | 18 L | QT or SR | --- |
| | | | | 65 < t ≤ 150 | 2.5 < t ≤ 6 | 620 | 90 | 690-895 | 100-130 | 16 L | QT or SR | --- |
| | Grade F | K11576 | --- | t ≤ 20 | t ≤ 0.75 | 690 | 100 | 760-895 | 110-130 | 18 L | QT or SR | 235-293 HB |
| | | | | 20 < t ≤ 65 | 0.75 < t ≤ 2.5 | 690 | 100 | 760-895 | 110-130 | 18 L | QT or SR | --- |
| | Grade H | K11646 | --- | t ≤ 20 | t ≤ 0.75 | 690 | 100 | 760-895 | 110-130 | 18 L | QT or SR | 235-293 HB |
| | | | | 20 < t ≤ 50 | 0.75 < t ≤ 2 | 690 | 100 | 760-895 | 110-130 | 18 L | QT or SR | --- |
| | Grade P | K21650 | --- | t ≤ 20 | t ≤ 0.75 | 690 | 100 | 760-895 | 110-130 | 18 L | QT or SR | 235-293 HB |
| | | | | 20 < t ≤ 65 | 0.75 < t ≤ 2.5 | 690 | 100 | 760-895 | 110-130 | 18 L | QT or SR | --- |
| | | | | 65 < t ≤ 150 | 2.5 < t ≤ 6 | 620 | 90 | 690-895 | 100-130 | 16 L | QT or SR | --- |
| | Grade Q | --- | --- | t ≤ 20 | t ≤ 0.75 | 690 | 100 | 760-895 | 110-130 | 18 L | QT or SR | 235-293 HB |
| | | | | 20 < t ≤ 65 | 0.75 < t ≤ 2.5 | 690 | 100 | 760-895 | 110-130 | 18 L | QT or SR | --- |
| | | | | 65 < t ≤ 150 | 2.5 < t ≤ 6 | 620 | 90 | 690-895 | 100-130 | 16 L | QT or SR | --- |
| | Grade S | --- | --- | t ≤ 20 | t ≤ 0.75 | 690 | 100 | 760-895 | 110-130 | 18 L | QT or SR | 235-293 HB |
| | | | | 20 < t ≤ 65 | 0.75 < t ≤ 2.5 | 690 | 100 | 760-895 | 110-130 | 18 L | QT or SR | --- |

Note: This section continued on next page.

**3.2 Alloy Steels for Structural Steel Plates**

**3.2.2A Mechanical Properties of Alloy Steels for Structural Steel Plates (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | % min. | | |
| ASTM A709/A709M-13a | Grade HPS 100W [HPS 690W] | --- | --- | t ≤ 65 | t ≤ 2.5 | 690 | 100 | 760-895 | 110-130 | 18 | QT | see standard for impact data |
| | | | | 65 < t ≤ 100 | 2.5 < t ≤ 4 | 620 | 90 | 690-895 | 100-130 | 16 | QT | see standard for impact data |
| CSA G40.21-13 | Grade 700Q (100Q) | --- | --- | t ≤ 65 | t ≤ 2.5 | 700 | 100 | 760-895 | 110-130 | 18 L, 16 T | QT | --- |
| | | | | 65 < t ≤ 100 | 2.5 < t ≤ 4 | 620 | 90 | 760-895 | 110-130 | 18 L, 16 T | QT | --- |
| | Grade 700QT (100QT) | --- | --- | t ≤ 65 | t ≤ 2.5 | 700 | 100 | 760-895 | 110-130 | 18 L, 16 T | QT | see standard for |
| | | | | 65 < t ≤ 100 | 2.5 < t ≤ 4 | 620 | 90 | 760-895 | 110-130 | 18 L, 16 T | QT | impact data |
| GB/T 16270-1996 | Grade Q690D | --- | --- | t ≤ 50 | --- | 690 | --- | 770-940 T | --- | 14 T | CtR, N, QT or NT | see standard for impact data |
| | | | | 50 < t ≤ 100 | --- | 670 | --- | 770-940 T | --- | 14 T | CtR, N, QT or NT | see standard for impact data |
| | Grade Q690E | --- | --- | t ≤ 50 | --- | 690 | --- | 770-940 T | --- | 14 T | CtR, N, QT or NT | see standard for impact data |
| | | | | 50 < t ≤ 100 | --- | 670 | --- | 770-940 T | --- | 14 T | CtR, N, QT or NT | see standard for impact data |
| JIS G 3128:2009 | Grade SHY685 | --- | --- | 6 ≤ t ≤ 16 | --- | 685 | --- | 780-930 T | --- | 16 T | QT | see standard for impact data |
| | | | | 16 < t ≤ 20 | --- | 685 | --- | 780-930 T | --- | 24 T | QT | L: 47 J @ -20°C |
| | | | | 20 < t ≤ 50 | --- | 685 | --- | 780-930 T | --- | 16 T | QT | L: 47 J @ -20°C |
| | | | | 50 < t ≤ 100 | --- | 665 | --- | 760-910 T | --- | 16 T | QT | L: 47 J @ -20°C |
| | Grade SHY685N | --- | --- | 6 ≤ t ≤ 16 | --- | 685 | --- | 780-930 T | --- | 16 T | QT | see standard for impact data |
| | | | | 16 < t ≤ 20 | --- | 685 | --- | 780-930 T | --- | 24 T | QT | L: 47 J @ -20°C |
| | | | | 20 < t ≤ 50 | --- | 685 | --- | 780-930 T | --- | 16 T | QT | L: 47 J @ -20°C |
| | | | | 50 < t ≤ 100 | --- | 665 | --- | 760-910 T | --- | 16 T | QT | L: 47 J @ -20°C |
| | Grade SHY685NS | --- | --- | 6 ≤ t ≤ 16 | --- | 685 | --- | 780-930 T | --- | 16 T | QT | see standard for impact data |
| | | | | 16 < t ≤ 20 | --- | 685 | --- | 780-930 T | --- | 24 T | QT | 47 J @ -40°C |
| | | | | 20 < t ≤ 50 | --- | 685 | --- | 780-930 T | --- | 16 T | QT | 47 J @ -40°C |
| | | | | 50 < t ≤ 100 | --- | 665 | --- | 760-910 T | --- | 16 T | QT | see standard for impact data |

**3.2 Alloy Steels for Structural Steel Plates**

**3.2.2B Chemical Composition of Alloy Steels for Structural Steel Plates**

| Specification | Designation | UNS No. | Steel No. | Section Thickness | | Weight, %max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| GB 11251-89 | Grade 15 Cr | --- | --- | --- | --- | 0.12-0.18 | 0.40-0.70 | 0.17-0.37 | 0.035 | 0.035 | 0.70-1.00 | 0.30 | 0.15 | Cu 0.30 |
| | Grade 20 Cr | --- | --- | --- | --- | 0.18-0.24 | 0.50-0.80 | 0.17-0.37 | 0.035 | 0.035 | 0.70-1.00 | 0.30 | 0.15 | Cu 0.30 |
| | Grade 20CrMnSiA | --- | --- | --- | --- | 0.17-0.23 | 0.80-1.10 | 0.90-1.20 | --- | --- | --- | --- | --- | --- |
| ISO 4950-2:1995 A1:2003 | Grade E 355, Quality DD | --- | --- | --- | --- | 0.18 | 0.9-1.6 | 0.50 | 0.030 | 0.030 | 0.25 | 0.30 | 0.10 | V 0.02-0.10; Al 0.020 min.; Cu 0.35; Ti 0.02-0.20; Nb 0.015-0.060 |
| | Grade E 355, Quality E | --- | --- | --- | --- | 0.18 | 0.9-1.6 | 0.50 | 0.025 | 0.025 | 0.25 | 0.30 | 0.10 | V 0.02-0.10; Al 0.020 min.; Cu 0.35; Ti 0.02-0.20; Nb 0.015-0.060 |
| ASTM A709/A709M-13a | Grade 50W [345W], Type A | --- | --- | t ≤ 100 | t ≤ 4 | 0.19 | 0.80-1.25 | 0.30-0.65 | 0.04 | 0.05 | 0.40-0.65 | 0.40 | --- | V 0.02-0.10; Cu 0.25-0.40 |
| | Grade 50W [345W], Type B | --- | --- | t ≤ 100 | t ≤ 4 | 0.20 | 0.75-1.35 | 0.15-0.50 | 0.04 | 0.05 | 0.40-0.70 | 0.50 | --- | V 0.01-0.10; Cu 0.20-0.40 |
| GB/T 1591-94 | Grade Q390A | --- | --- | --- | --- | 0.20 | 1.00-1.60 | 0.55 | 0.045 | 0.045 | 0.30 | 0.70 | --- | V 0.02-0.20; Cu 0.30; Ti 0.02-0.20; Nb 0.015-0.060 |
| | Grade Q390B | --- | --- | --- | --- | 0.20 | 1.00-1.60 | 0.55 | 0.040 | 0.040 | 0.30 | 0.70 | --- | V 0.02-0.20; Cu 0.30; Ti 0.02-0.20; Nb 0.015-0.060 |
| | Grade Q390C | --- | --- | --- | --- | 0.20 | 1.00-1.60 | 0.55 | 0.035 | 0.035 | 0.30 | 0.70 | --- | V 0.02-0.20; Al 0.015 min.; Cu 0.30; Ti 0.02-0.20; Nb 0.015-0.060 |
| | Grade Q390D | --- | --- | --- | --- | 0.20 | 1.00-1.60 | 0.55 | 0.030 | 0.030 | 0.30 | 0.70 | --- | V 0.02-0.20; Al 0.015 min.; Cu 0.30; Ti 0.02-0.20; Nb 0.015-0.060 |
| | Grade Q390E | --- | --- | --- | --- | 0.20 | 1.00-1.60 | 0.55 | 0.025 | 0.025 | 0.30 | 0.70 | --- | V 0.02-0.20; Al 0.015 min.; Cu 0.30; Ti 0.02-0.20; Nb 0.015-0.060 |
| ASTM A710/A710M-02 (2013) | Grade A, Class 2 | K20747 | --- | --- | --- | 0.07 | 0.40-0.70 | 0.40 | 0.025 | 0.025 | 0.60-0.90 | 0.70-1.00 | 0.15-0.25 | Cu 1.00-1.30; Cb 0.02 min. |
| GB 11251-89 | Grade 25CrMnSiA | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| | Grade 30 Cr | --- | --- | --- | --- | 0.27-0.34 | 0.50-0.80 | 0.17-0.37 | --- | --- | 0.80-1.10 | --- | --- | --- |

**3.2 Alloy Steels for Structural Steel Plates**

**3.2.2B Chemical Composition of Alloy Steels for Structural Steel Plates (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness | | Weight, %max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| GB 11251-89 | Grade 30CrMnSiA | --- | --- | --- | --- | 0.28-0.34 | 0.80-1.10 | 0.90-1.20 | --- | --- | 0.80-1.10 | --- | --- | --- |
| | Grade 35 Cr | --- | --- | --- | --- | 0.32-0.39 | 0.50-0.80 | 0.17-0.37 | --- | --- | --- | --- | --- | --- |
| | Grade 27SiMn | --- | --- | --- | --- | 0.24-0.32 | 1.10-1.40 | 1.10-1.40 | --- | --- | --- | --- | --- | --- |
| | Grade 40 Cr | --- | --- | --- | --- | 0.37-0.44 | 0.50-0.80 | 0.17-0.37 | --- | --- | 0.80-1.10 | --- | --- | --- |
| GB/T 1591-94 | Grade Q460C | --- | --- | --- | --- | 0.20 | 1.00-1.70 | 0.55 | 0.035 | 0.035 | 0.70 | 0.70 | --- | V 0.02-0.20; Al 0.015 min.; Cu 0.30; Ti 0.02-0.20; Nb 0.015-0.060 |
| | Grade Q460D | --- | --- | --- | --- | 0.20 | 1.00-1.70 | 0.55 | 0.030 | 0.030 | 0.70 | 0.70 | --- | V 0.02-0.20; Al 0.015 min.; Cu 0.30; Ti 0.02-0.20; Nb 0.015-0.060 |
| | Grade Q460E | --- | --- | --- | --- | 0.20 | 1.00-1.70 | 0.55 | 0.025 | 0.025 | 0.70 | 0.70 | --- | V 0.02-0.20; Al 0.015 min.; Cu 0.30; Ti 0.02-0.20; Nb 0.015-0.060 |
| GB/T 16270-1996 | Grade Q460C | --- | --- | --- | --- | 0.20 | 1.00-1.60 | 0.55 | 0.035 | 0.035 | 0.30 | 0.70 | 0.20 | V 0.10; Ti 0.20; Nb 0.06 |
| | Grade Q460D | --- | --- | --- | --- | 0.18 | 1.00-1.60 | 0.55 | 0.030 | 0.030 | 0.30 | 0.70 | 0.20 | V 0.10; Ti 0.20; Nb 0.06 |
| | Grade Q460E | --- | --- | --- | --- | 0.18 | 1.00-1.60 | 0.55 | 0.025 | 0.025 | 0.30 | 0.70 | 0.20 | V 0.10; Ti 0.20; Nb 0.06 |
| ISO 4950-3:1995 A1:2003 | Grade E 460, Quality DD | --- | --- | --- | --- | 0.20 | 0.7-1.7 | 0.55 | 0.035 | 0.035 | 2 | 2 | 1 | V 0.10; Cu 1.5; Ti 0.20; Nb 0.060; N 0.020; B 0.005; Zr 0.15 |
| | Grade E 460, Quality E | --- | --- | --- | --- | 0.20 | 0.7-1.7 | 0.55 | 0.030 | 0.030 | 2 | 2 | 1 | V 0.10; Cu 1.5; Ti 0.20; Nb 0.060; N 0.020; B 0.005; Zr 0.15 |
| ASTM A709/A709M-13a | Grade HPS 70W [HPS 485W] | --- | --- | --- | --- | 0.11 | 1.10-1.35 | 0.30-0.50 | 0.020 | 0.006 | 0.45-0.70 | 0.25-0.40 | 0.02-0.08 | V 0.04-0.08; Al 0.010-0.040; Cu 0.25-0.40; N 0.015 |

Note: This section continued on next page.

**3.2 Alloy Steels for Structural Steel Plates**

**3.2.2B Chemical Composition of Alloy Steels for Structural Steel Plates (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness | | Weight, %max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASTM A710/A710M-02 (2013) | Grade A, Class 3 | K20747 | --- | --- | --- | 0.07 | 0.40-0.70 | 0.40 | 0.025 | 0.025 | 0.60-0.90 | 0.70-1.00 | 0.15-0.25 | Cu 1.00-1.30; Cb 0.02 min. |
| CSA G40.21-13 | Grade 480WT (70WT) | --- | --- | --- | --- | 0.26 | 0.80-1.50 | 0.15-0.40 | 0.03 | 0.04 | --- | --- | --- | --- |
| GB 11251-89 | Grade 35CrMnSiA | --- | --- | --- | --- | 0.32-0.39 | 0.80-1.10 | 1.10-1.40 | --- | --- | 1.10-1.40 | --- | --- | --- |
| GB/T 16270-1996 | Grade Q500D | --- | --- | --- | --- | 0.18 | 1.00-1.60 | 0.55 | 0.030 | 0.030 | 0.60 | 1.00 | 0.40 | V 0.10; Ti 0.20; Nb 0.06; B 0.003 |
| | Grade Q500E | --- | --- | --- | --- | 0.18 | 1.00-1.60 | 0.55 | 0.025 | 0.025 | 0.60 | 1.00 | 0.40 | V 0.10; Ti 0.20; Nb 0.06; B 0.003 |
| CSA G40.21-13 | Grade 550WT (80WT) | --- | --- | --- | --- | 0.15 | 1.75 | 0.15-0.40 | 0.03 | 0.04 | --- | --- | --- | -- |
| ASTM A710/A710M-02 (2013) | Grade A, Class 1 | K20747 | --- | t ≤ 20 | t ≤ 0.75 | 0.07 | 0.40-0.70 | 0.40 | 0.025 | 0.025 | 0.60-0.90 | 0.70-1.00 | 0.15-0.25 | Cu 1.00-1.30; Cb 0.02 min. |

**3.2 Alloy Steels for Structural Steel Plates**

**3.2.2B Chemical Composition of Alloy Steels for Structural Steel Plates (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness | | Weight, %max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| GB/T 16270-1996 | Grade Q550D | --- | --- | --- | --- | 0.18 | 1.00-1.60 | 0.55 | 0.030 | 0.030 | 0.60 | 1.00 | 0.40 | V 0.10; Ti 0.20; Nb 0.06; B 0.003 |
| | Grade Q550E | --- | --- | --- | --- | 0.18 | 1.00-1.60 | 0.55 | 0.025 | 0.025 | 0.60 | 1.00 | 0.40 | V 0.10; Ti 0.20; Nb 0.06; B 0.003 |
| | Grade Q620D | --- | --- | --- | --- | 0.18 | 1.00-1.60 | 0.55 | 0.030 | 0.030 | 0.80 | 1.20 | 0.60 | V 0.10; Ti 0.20; Nb 0.06; B 0.003 |
| | Grade Q620E | --- | --- | --- | --- | 0.18 | 1.00-1.60 | 0.55 | 0.025 | 0.025 | 0.80 | 1.20 | 0.60 | V 0.10; Ti 0.20; Nb 0.06; B 0.003 |
| ASTM A514/A514M-14 | Grade A | K11856 | --- | t ≤ 32 | t ≤ 1.25 | 0.15-0.21 | 0.80-1.10 | 0.40-0.80 | 0.030 | 0.030 | 0.50-0.80 | --- | 0.18-0.28 | B 0.0025; Zr 0.05-0.15 |
| | Grade B | K11630 | --- | t ≤ 32 | t ≤ 1.25 | 0.12-0.21 | 0.70-1.00 | 0.20-0.35 | 0.030 | 0.030 | 0.40-0.65 | --- | 0.15-0.25 | V 0.03-0.08; Ti 0.01-0.10; B 0.0005-0.005 |
| | Grade E | K21604 | --- | t ≤ 150 | t ≤ 6 | 0.12-0.20 | 0.40-0.70 | 0.20-0.40 | 0.030 | 0.030 | 1.40-2.00 | --- | 0.40-0.60 | Ti 0.01-0.10; B 0.001-0.005 |
| | Grade F | K11576 | --- | t ≤ 65 | t ≤ 2.5 | 0.10-0.20 | 0.60-1.00 | 0.15-0.35 | 0.030 | 0.030 | 0.40-0.65 | 0.70-1.00 | 0.40-0.60 | V 0.03-0.08; Cu 0.15-0.50; B 0.0005-0.006 |
| | Grade H | K11646 | --- | t ≤ 50 | t ≤ 2 | 0.12-0.21 | 0.95-1.30 | 0.20-0.35 | 0.030 | 0.030 | 0.40-0.65 | 0.30-0.70 | 0.20-0.30 | V 0.03-0.08; B 0.0005-0.005 |
| | Grade P | K21650 | --- | t ≤ 150 | t ≤ 6 | 0.12-0.21 | 0.45-0.70 | 0.20-0.35 | 0.030 | 0.030 | 0.85-1.20 | 1.20-1.50 | 0.45-0.60 | B 0.001-0.005 |
| | Grade Q | --- | --- | t ≤ 150 | t ≤ 6 | 0.14-0.21 | 0.95-1.30 | 0.15-0.35 | 0.030 | 0.030 | 1.00-1.50 | 1.20-1.50 | 0.40-0.60 | V 0.03-0.08 |
| | Grade S | --- | --- | t ≤ 65 | t ≤ 2.5 | 0.11-0.21 | 1.10-1.50 | 0.15-0.45 | 0.030 | 0.020 | --- | --- | 0.10-0.60 | V 0.06; Cb 0.06; B 0.001-0.005 |
| ASTM A709/A709M-13a | Grade HPS 100W [HPS 690W] | --- | --- | t ≤ 100 | t ≤ 4 | 0.08 | 0.95-1.50 | 0.15-0.35 | 0.015 | 0.006 | 0.40-0.65 | 0.65-0.90 | 0.40-0.65 | V 0.04-0.08; Cb 0.01-0.03; Cu 0.90-1.20; N 0.015; Al 0.020-0.050 |

Note: This section continued on next page.

**3.2 Alloy Steels for Structural Steel Plates**

**3.2.2B Chemical Composition of Alloy Steels for Structural Steel Plates (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness | | Weight, %max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| CSA G40.21-13 | Grade 700Q (100Q) | --- | --- | --- | --- | 0.20 | 1.50 | 0.15-0.40 | 0.03 | 0.04 | --- | --- | --- | B 0.0005-0.005 |
| | Grade 700QT (100QT) | --- | --- | --- | --- | 0.20 | 1.50 | 0.15-0.40 | 0.03 | 0.04 | --- | --- | --- | B 0.0005-0.005 |
| GB/T 16270-1996 | Grade Q690D | --- | --- | --- | --- | 0.18 | 1.00-1.60 | 0.55 | 0.030 | 0.030 | 1.20 | 1.50 | 0.60 | V 0.10; Ti 0.20; Nb 0.06; B 0.003 |
| | Grade Q690E | --- | --- | --- | --- | 0.18 | 1.00-1.60 | 0.55 | 0.025 | 0.025 | 1.20 | 1.50 | 0.60 | V 0.10; Ti 0.20; Nb 0.06; B 0.003 |
| JIS G 3128:2009 | Grade SHY685 | --- | --- | 6 ≤ t ≤ 50 | --- | 0.18 | 1.50 | 0.55 | 0.030 | 0.025 | 1.20 | --- | 0.60 | V 0.10; Cu 0.50; B 0.005 |
| | | | | 50 < t ≤ 75 | --- | 0.18 | 1.50 | 0.55 | 0.030 | 0.025 | 1.20 | --- | 0.60 | V 0.10; Cu 0.50; B 0.005 |
| | | | | 75 < t ≤ 100 | --- | 0.18 | 1.50 | 0.55 | 0.030 | 0.025 | 1.20 | --- | 0.60 | V 0.10; Cu 0.50; B 0.005 |
| | Grade SHY685N | --- | --- | 6 ≤ t ≤ 50 | --- | 0.18 | 1.50 | 0.55 | 0.030 | 0.025 | 0.80 | 0.30-1.50 | 0.60 | V 0.10; Cu 0.50; B 0.005 |
| | | | | 50 < t ≤ 75 | --- | 0.18 | 1.50 | 0.55 | 0.030 | 0.025 | 0.80 | 0.30-1.50 | 0.60 | V 0.10; Cu 0.50; B 0.005 |
| | | | | 75 < t ≤ 100 | --- | 0.18 | 1.50 | 0.55 | 0.030 | 0.025 | 0.80 | 0.30-1.50 | 0.60 | V 0.10; Cu 0.50; B 0.005 |
| | Grade SHY685NS | --- | --- | 6 ≤ t ≤ 50 | --- | 0.14 | 1.50 | 0.55 | 0.015 | 0.015 | 0.80 | 0.30-1.50 | 0.60 | V 0.05; Cu 0.50; B 0.005 |
| | | | | 50 < t ≤ 75 | --- | 0.14 | 1.50 | 0.55 | 0.015 | 0.015 | 0.80 | 0.30-1.50 | 0.60 | V 0.05; Cu 0.50; B 0.005 |
| | | | | 75 < t ≤ 100 | --- | 0.14 | 1.50 | 0.55 | 0.015 | 0.015 | 0.80 | 0.30-1.50 | 0.60 | V 0.05; Cu 0.50; B 0.005 |

### 3.3 Structural Steels with Improved Atmospheric Corrosion Resistance

### 3.3A Mechanical Properties of Structural Steels with Improved Atmospheric Corrosion-Resistance

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | % min. | | |
| ISO 4952:2006 | Grade S235W, Quality B | --- | --- | t ≤ 16 | --- | 235 | --- | 360-520 | --- | 26 | AR | 27 J @ 20°C |
| | | | | 16 < t ≤ 40 | --- | 225 | --- | 360-520 | --- | 26 | AR | 27 J @ 20°C |
| | | | | 40 < t ≤ 63 | --- | 215 | --- | 360-520 | --- | 25 | AR | 27 J @ 20°C |
| | Grade S235W, Quality C | --- | --- | t ≤ 16 | --- | 235 | --- | 360-520 | --- | 26 | AR | 27 J @ 0°C |
| | | | | 16 < t ≤ 40 | --- | 225 | --- | 360-520 | --- | 26 | AR | 27 J @ 0°C |
| | | | | 40 < t ≤ 63 | --- | 215 | --- | 360-520 | --- | 25 | AR | 27 J @ 0°C |
| | Grade S235W, Quality D | --- | --- | t ≤ 16 | --- | 235 | --- | 360-520 | --- | 26 | AR or N | 27 J @ -20°C |
| | | | | 16 < t ≤ 40 | --- | 225 | --- | 360-520 | --- | 26 | AR or N | 27 J @ -20°C |
| | | | | 40 < t ≤ 63 | --- | 215 | --- | 360-520 | --- | 25 | AR or N | 27 J @ -20°C |
| ISO 5952:2005 | Grade HSA 235W, Class B | --- | --- | t < 3 | --- | 235 | --- | 360-510 | --- | 20 | HR | --- |
| | | | | t ≥ 3 | --- | 235 | --- | 340-470 | --- | 24 | HR | --- |
| | Grade HSA 235W, Class D | --- | --- | t < 3 | --- | 235 | --- | 360-510 | --- | 20 | HR | --- |
| | | | | t ≥ 3 | --- | 235 | --- | 340-470 | --- | 24 | HR | --- |
| GB/T 18982-2003 | Grade Q295GNHJ | --- | --- | --- | --- | 295 | --- | 390 L | --- | 24 L | HR | L: 47 J @ 20°C |

**3.3 Structural Steels with Improved Atmospheric Corrosion Resistance**

**3.3A Mechanical Properties of Structural Steels with Improved Atmospheric Corrosion-Resistance (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | % min. | | |
| ISO 5952:2005 | Grade HSA 245W, Class B | --- | --- | t < 3 | --- | 245 | --- | 400-540 | --- | 20 | HR | --- |
| | | | | t ≥ 3 | --- | 245 | --- | 400-540 | --- | 24 | HR | --- |
| | Grade HSA 245W, Class D | --- | --- | t < 3 | --- | 245 | --- | 400-540 | --- | 20 | HR | --- |
| | | | | t ≥ 3 | --- | 245 | --- | 400-540 | --- | 24 | HR | --- |
| JIS G 3114:2008 | Symbol SMA400AW | --- | --- | t ≤ 16 | --- | 245 | --- | 400-540 | --- | see standard | N, QT, T or TMCP | --- |
| | | | | 16 < t ≤ 40 | --- | 235 | --- | 400-540 | --- | see standard | N, QT, T or TMCP | --- |
| | | | | 40 < t ≤ 100 | --- | 215 | --- | 400-540 | --- | see standard | N, QT, T or TMCP | --- |
| | | | | 100 < t ≤ 160 | --- | 205 | --- | 400-540 | --- | see standard | N, QT, T or TMCP | --- |
| | | | | 160 < t ≤ 200 | --- | 195 | --- | 400-540 | --- | see standard | N, QT, T or TMCP | --- |
| | Symbol SMA400BW | --- | --- | t ≤ 16 | --- | 245 | --- | 400-540 | --- | see standard | N, QT, T or TMCP | L: 27 J @ 0°C |
| | | | | 16 < t ≤ 40 | --- | 235 | --- | 400-540 | --- | see standard | N, QT, T or TMCP | L: 27 J @ 0°C |
| | | | | 40 < t ≤ 100 | --- | 215 | --- | 400-540 | --- | see standard | N, QT, T or TMCP | L: 27 J @ 0°C |
| | | | | 100 < t ≤ 160 | --- | 205 | --- | 400-540 | --- | see standard | N, QT, T or TMCP | L: 27 J @ 0°C |
| | | | | 160 < t ≤ 200 | --- | 195 | --- | 400-540 | --- | see standard | N, QT, T or TMCP | L: 27 J @ 0°C |
| | Symbol SMA400CW | --- | --- | t ≤ 16 | --- | 245 | --- | 400-540 | --- | see standard | N, QT, T or TMCP | L: 47 J @ 0°C |
| | | | | 16 < t ≤ 40 | --- | 235 | --- | 400-540 | --- | see standard | N, QT, T or TMCP | L: 47 J @ 0°C |
| | | | | 40 < t ≤ 100 | --- | 215 | --- | 400-540 | --- | see standard | N, QT, T or TMCP | L: 47 J @ 0°C |
| | Symbol SMA400AP | --- | --- | t ≤ 16 | --- | 245 | --- | 400-540 | --- | see standard | N, QT, T or TMCP | --- |
| | | | | 16 < t ≤ 40 | --- | 235 | --- | 400-540 | --- | see standard | N, QT, T or TMCP | --- |
| | | | | 40 < t ≤ 100 | --- | 215 | --- | 400-540 | --- | see standard | N, QT, T or TMCP | --- |
| | | | | 100 < t ≤ 160 | --- | 205 | --- | 400-540 | --- | see standard | N, QT, T or TMCP | --- |
| | | | | 160 < t ≤ 200 | --- | 195 | --- | 400-540 | --- | see standard | N, QT, T or TMCP | --- |
| | Symbol SMA400BP | --- | --- | t ≤ 16 | --- | 245 | --- | 400-540 | --- | see standard | N, QT, T or TMCP | L: 27 J @ 0°C |
| | | | | 16 < t ≤ 40 | --- | 235 | --- | 400-540 | --- | see standard | N, QT, T or TMCP | L: 27 J @ 0°C |
| | | | | 40 < t ≤ 100 | --- | 215 | --- | 400-540 | --- | see standard | N, QT, T or TMCP | L: 27 J @ 0°C |
| | | | | 100 < t ≤ 160 | --- | 205 | --- | 400-540 | --- | see standard | N, QT, T or TMCP | L: 27 J @ 0°C |
| | | | | 160 < t ≤ 200 | --- | 195 | --- | 400-540 | --- | see standard | N, QT, T or TMCP | L: 27 J @ 0°C |
| | Symbol SMA400CP | --- | --- | t ≤ 16 | --- | 245 | --- | 400-540 | --- | see standard | N, QT, T or TMCP | L: 47 J @ 0°C |
| | | | | 16 < t ≤ 40 | --- | 235 | --- | 400-540 | --- | see standard | N, QT, T or TMCP | L: 47 J @ 0°C |
| | | | | 40 < t ≤ 100 | --- | 215 | --- | 400-540 | --- | see standard | N, QT, T or TMCP | L: 47 J @ 0°C |
| GB/T 18982-2003 | Grade Q245NHYJ | --- | --- | --- | --- | 245 | --- | 400 L | --- | 19 L | HR | --- |
| | Grade Q310GNHJ | --- | --- | --- | --- | 310 | --- | 440 L | --- | 26 L | CR | --- |
| | Grade Q310GNHLJ | --- | --- | --- | --- | 310 | --- | 440 L | --- | 26 L | CR | --- |

**3.3 Structural Steels with Improved Atmospheric Corrosion Resistance**

**3.3A Mechanical Properties of Structural Steels with Improved Atmospheric Corrosion-Resistance (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation % min. | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | | | |
| JIS G 3125:2010 | Symbol SPA-C | --- | --- | 0.6 ≤ t ≤ 2.3 | --- | 315 | --- | 450 | --- | 26 | CR | --- |
| ISO 4952:2006 | Grade S355WP, Quality A | --- | --- | t ≤ 12 | --- | 355 | --- | 470-630 | --- | 21 | AR | --- |
| | Grade S355WP, Quality D | --- | --- | t ≤ 12 | --- | 355 | --- | 470-630 | --- | 21 | AR | 27 J @ -20°C |
| | Grade S355W, Quality B | --- | --- | t ≤ 16 | --- | 355 | --- | 470-630 | --- | 22 | AR | 27 J @ 20°C |
| | | | | 16 < t ≤ 40 | --- | 345 | --- | 470-630 | --- | 22 | AR | 27 J @ 20°C |
| | | | | 40 < t ≤ 63 | --- | 335 | --- | 470-630 | --- | 21 | AR | 27 J @ 20°C |
| | Grade S355W, Quality C | --- | --- | t ≤ 16 | --- | 355 | --- | 470-630 | --- | 22 | AR | 27 J @ 0°C |
| | | | | 16 < t ≤ 40 | --- | 345 | --- | 470-630 | --- | 22 | AR | 27 J @ 0°C |
| | | | | 40 < t ≤ 63 | --- | 335 | --- | 470-630 | --- | 21 | AR | 27 J @ 0°C |
| | Grade S355W, Quality D | --- | --- | t ≤ 16 | --- | 355 | --- | 470-630 | --- | 22 | AR | 27 J @ -20°C |
| | | | | 16 < t ≤ 40 | --- | 345 | --- | 470-630 | --- | 22 | AR | 27 J @ -20°C |
| | | | | 40 < t ≤ 63 | --- | 335 | --- | 470-630 | --- | 21 | AR | 27 J @ -20°C |
| ASTM A606/A606M-09a | Type 2 | --- | --- | --- | --- | 340 | 50 | 480 | 70 | 22 | HR | --- |
| | | | | --- | --- | 310 | 45 | 450 | 65 | 22 | HR+A or HR+N | --- |
| | | | | --- | --- | 310 | 45 | 450 | 65 | 22 | CR | --- |
| | Type 4 | --- | --- | --- | --- | 340 | 50 | 480 | 70 | 22 | HR | --- |
| | | | | --- | --- | 310 | 45 | 450 | 65 | 22 | HR+A or HR+N | --- |
| | | | | --- | --- | 310 | 45 | 450 | 65 | 22 | CR | --- |
| CSA G40.21-13 | Grade 350A (50A) | --- | --- | --- | --- | 350 | 50 | 480-650 | 70-95 | 21 | AR, N or CtR | --- |
| | | | | --- | --- | 350 | 50 | 480-650 | 70-95 | 21 | SR, A or N | --- |
| | | | | t ≤ 100 | t ≤ 4 | 350 | 50 | 480-650 | 70-95 | 21 L, 19 T | AR, N or CtR | --- |
| | Grade 350AT (50AT) | --- | --- | --- | --- | 350 | 50 | 480-650 | 70-95 | 21 | AR, N or CtR | see standard for impact data |
| | | | | --- | --- | 350 | 50 | 480-650 | 70-95 | 21 | SR, A or N | |
| | | | | t ≤ 100 | t ≤ 4 | 350 | 50 | 480-650 | 70-95 | 21 L, 19 T | AR, N or CtR | |
| | Grade 350R (50R) | --- | --- | --- | --- | 350 | 50 | 480-650 | 70-95 | 21 | AR, N or CtR | --- |
| | | | | t ≤ 65 | t ≤ 2.5 | 350 | 50 | 480-650 | 70-95 | 21 L, 18 T | AR, N or CtR | --- |
| GB/T 18982-2003 | Grade Q325NHYJ | --- | --- | --- | --- | 325 | --- | 490 L | --- | 18 L | HR | --- |
| | Grade Q345GNHJ | --- | --- | --- | --- | 345 | --- | 480 L | --- | 24 L | HR | L: 47 J @ 20°C |
| | Grade Q345GNHLJ | --- | --- | --- | --- | 345 | --- | 480 L | --- | 24 L | HR | L: 47 J @ 20°C |
| ISO 5952:2005 | Grade HSA 365W, Class B | --- | --- | t < 3 | --- | 365 | --- | 490-610 | --- | 15 | HR | --- |
| | | | | 3 ≤ t ≤ 6 | --- | 365 | --- | 490-610 | --- | 17 | HR | --- |
| | | | | t > 6 | --- | 365 | --- | 490-610 | --- | 21 | HR | --- |
| | Grade HSA 365W, Class D | --- | --- | t < 3 | --- | 365 | --- | 490-610 | --- | 15 | HR | --- |
| | | | | 3 ≤ t ≤ 6 | --- | 365 | --- | 490-610 | --- | 17 | HR | --- |
| | | | | t > 6 | --- | 365 | --- | 490-610 | --- | 21 | HR | --- |

Note: This section continued on next page

**3.3 Structural Steels with Improved Atmospheric Corrosion Resistance**

**3.3A Mechanical Properties of Structural Steels with Improved Atmospheric Corrosion-Resistance (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | % min. | | |
| JIS G 3114:2008 | Symbol SMA490AW | --- | --- | t ≤ 16 | --- | 365 | --- | 490-610 | --- | see standard | N, QT, T or TMCP | --- |
| | | | | 16 < t ≤ 40 | --- | 355 | --- | 490-610 | --- | see standard | N, QT, T or TMCP | --- |
| | | | | 40 < t ≤ 75 | --- | 335 | --- | 490-610 | --- | see standard | N, QT, T or TMCP | --- |
| | | | | 75 < t ≤ 100 | --- | 325 | --- | 490-610 | --- | see standard | N, QT, T or TMCP | --- |
| | | | | 100 < t ≤ 160 | --- | 305 | --- | 490-610 | --- | see standard | N, QT, T or TMCP | --- |
| | | | | 160 < t ≤ 200 | --- | 295 | --- | 490-610 | --- | see standard | N, QT, T or TMCP | --- |
| | Symbol SMA490AP | --- | --- | t ≤ 16 | --- | 365 | --- | 490-610 | --- | see standard | N, QT, T or TMCP | --- |
| | | | | 16 < t ≤ 40 | --- | 355 | --- | 490-610 | --- | see standard | N, QT, T or TMCP | --- |
| | | | | 40 < t ≤ 75 | --- | 335 | --- | 490-610 | --- | see standard | N, QT, T or TMCP | --- |
| | | | | 75 < t ≤ 100 | --- | 325 | --- | 490-610 | --- | see standard | N, QT, T or TMCP | --- |
| | | | | 100 < t ≤ 160 | --- | 305 | --- | 490-610 | --- | see standard | N, QT, T or TMCP | --- |
| | | | | 160 < t ≤ 200 | --- | 295 | --- | 490-610 | --- | see standard | N, QT, T or TMCP | --- |
| | Symbol SMA490BW | --- | --- | t ≤ 16 | --- | 365 | --- | 490-610 | --- | see standard | N, QT, T or TMCP | L: 27 J @ 0°C |
| | | | | 16 < t ≤ 40 | --- | 355 | --- | 490-610 | --- | see standard | N, QT, T or TMCP | L: 27 J @ 0°C |
| | | | | 40 < t ≤ 75 | --- | 335 | --- | 490-610 | --- | see standard | N, QT, T or TMCP | L: 27 J @ 0°C |
| | | | | 75 < t ≤ 100 | --- | 325 | --- | 490-610 | --- | see standard | N, QT, T or TMCP | L: 27 J @ 0°C |
| | | | | 100 < t ≤ 160 | --- | 305 | --- | 490-610 | --- | see standard | N, QT, T or TMCP | L: 27 J @ 0°C |
| | | | | 160 < t ≤ 200 | --- | 295 | --- | 490-610 | --- | see standard | N, QT, T or TMCP | L: 27 J @ 0°C |
| | Symbol SMA490BP | --- | --- | t ≤ 16 | --- | 365 | --- | 490-610 | --- | see standard | N, QT, T or TMCP | L: 27 J @ 0°C |
| | | | | 16 < t ≤ 40 | --- | 355 | --- | 490-610 | --- | see standard | N, QT, T or TMCP | L: 27 J @ 0°C |
| | | | | 40 < t ≤ 75 | --- | 335 | --- | 490-610 | --- | see standard | N, QT, T or TMCP | L: 27 J @ 0°C |
| | | | | 75 < t ≤ 100 | --- | 325 | --- | 490-610 | --- | see standard | N, QT, T or TMCP | L: 27 J @ 0°C |
| | | | | 100 < t ≤ 160 | --- | 305 | --- | 490-610 | --- | see standard | N, QT, T or TMCP | L: 27 J @ 0°C |
| | | | | 160 < t ≤ 200 | --- | 295 | --- | 490-610 | --- | see standard | N, QT, T or TMCP | L: 27 J @ 0°C |
| | Symbol SMA490CW | --- | --- | t ≤ 16 | --- | 365 | --- | 490-610 | --- | see standard | N, QT, T or TMCP | L: 47 J @ 0°C |
| | | | | 16 < t ≤ 40 | --- | 355 | --- | 490-610 | --- | see standard | N, QT, T or TMCP | L: 47 J @ 0°C |
| | | | | 40 < t ≤ 75 | --- | 335 | --- | 490-610 | --- | see standard | N, QT, T or TMCP | L: 47 J @ 0°C |
| | | | | 75 < t ≤ 100 | --- | 325 | --- | 490-610 | --- | see standard | N, QT, T or TMCP | L: 47 J @ 0°C |
| | Symbol SMA490CP | --- | --- | t ≤ 16 | --- | 365 | --- | 490-610 | --- | see standard | N, QT, T or TMCP | L: 47 J @ 0°C |
| | | | | 16 < t ≤ 40 | --- | 355 | --- | 490-610 | --- | see standard | N, QT, T or TMCP | L: 47 J @ 0°C |
| | | | | 40 < t ≤ 75 | --- | 335 | --- | 490-610 | --- | see standard | N, QT, T or TMCP | L: 47 J @ 0°C |
| | | | | 75 < t ≤ 100 | --- | 325 | --- | 490-610 | --- | see standard | N, QT, T or TMCP | L: 47 J @ 0°C |
| JIS G 3125:2010 | Symbol SPA-H | --- | --- | t ≤ 6.0 | --- | 355 | --- | 490 | --- | 22 | HR | --- |
| | | | | 6.0 < t ≤ 16 | --- | 355 | --- | 490 | --- | 15 | HR | --- |

### 3.3 Structural Steels with Improved Atmospheric Corrosion Resistance

### 3.3A Mechanical Properties of Structural Steels with Improved Atmospheric Corrosion-Resistance (Continued)

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | % min. | | |
| ASTM A871/A871M-14 | Grade 60, Type I | --- | --- | --- | --- | 415 | 60 | 520 | 75 | 18 | AR, N or QT | see standard for impact data |
| | Grade 60, Type II | --- | --- | --- | --- | 415 | 60 | 520 | 75 | 18 | AR, N or QT | |
| | Grade 60, Type IV | --- | --- | --- | --- | 415 | 60 | 520 | 75 | 18 | AR, N or QT | |
| CSA G40.21-13 | Grade 400A (60A) | --- | --- | --- | --- | 400 | 60 | 520-690 | 75-100 | 21 | AR, N or CtR | --- |
| | | | | --- | --- | 400 | 60 | 520-690 | 75-100 | 20 | SR, A or N | --- |
| | | | | t ≤ 65 | t ≤ 2.5 | 400 | 60 | 520-690 | 75-100 | 21 L, 18 T | AR, N or CtR | --- |
| | Grade 400AT (60AT) | --- | --- | --- | --- | 400 | 60 | 520-690 | 75-100 | 21 | AR, N or CtR | see standard for impact data |
| | | | | --- | --- | 400 | 60 | 520-690 | 75-100 | 20 | SR, A or N | |
| | | | | t ≤ 65 | t ≤ 2.5 | 400 | 60 | 520-690 | 75-100 | 21 L, 18 T | AR, N or CtR | |
| ISO 5952:2005 | Grade HSA 355W1, Class A | --- | --- | t < 3 | --- | 355 | --- | 510-680 | --- | 15 | HR | --- |
| | | | | 3 ≤ t ≤ 6 | --- | 355 | --- | 490-630 | --- | 20 | HR | --- |
| | | | | t > 6 | --- | 355 | --- | 490-630 | --- | 24 | HR | --- |
| | Grade HSA 355W1, Class D | --- | --- | t < 3 | --- | 355 | --- | 510-680 | --- | 15 | HR | --- |
| | | | | 3 ≤ t ≤ 6 | --- | 355 | --- | 490-630 | --- | 20 | HR | --- |
| | | | | t > 6 | --- | 355 | --- | 490-630 | --- | 24 | HR | --- |
| | Grade HSA 355W2, Class C | --- | --- | t < 3 | --- | 355 | --- | 510-680 | --- | 18 | HR | --- |
| | | | | 3 ≤ t ≤ 6 | --- | 355 | --- | 490-630 | --- | 20 | HR | --- |
| | | | | t > 6 | --- | 355 | --- | 490-630 | --- | 24 | HR | --- |
| | Grade HSA 355W2, Class D | --- | --- | t < 3 | --- | 355 | --- | 510-680 | --- | 18 | HR | --- |
| | | | | 3 ≤ t ≤ 6 | --- | 355 | --- | 490-630 | --- | 20 | HR | --- |
| | | | | t > 6 | --- | 355 | --- | 490-630 | --- | 24 | HR | --- |

**3.3 Structural Steels with Improved Atmospheric Corrosion Resistance**

**3.3A Mechanical Properties of Structural Steels with Improved Atmospheric Corrosion-Resistance (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | % min. | | |
| ASTM A871/A871M-14 | Grade 65, Type I | --- | --- | --- | --- | 450 | 65 | 550 | 80 | 17 | AR, N or QT | see standard for impact data |
| | Grade 65, Type II | --- | --- | --- | --- | 450 | 65 | 550 | 80 | 17 | AR, N or QT | |
| | Grade 65, Type IV | --- | --- | --- | --- | 450 | 65 | 550 | 80 | 17 | AR, N or QT | |
| JIS G 3114:2008 | Symbol SMA570W | --- | --- | t ≤ 16 | --- | 460 | --- | 570-720 | --- | see standard | N, QT, T or TMCP | L: 47 J @ -5°C |
| | | | | 16 < t ≤ 40 | --- | 450 | --- | 570-720 | --- | see standard | N, QT, T or TMCP | L: 47 J @ -5°C |
| | | | | 40 < t ≤ 75 | --- | 430 | --- | 570-720 | --- | see standard | N, QT, T or TMCP | L: 47 J @ -5°C |
| | | | | 75 < t ≤ 100 | --- | 420 | --- | 570-720 | --- | see standard | N, QT, T or TMCP | L: 47 J @ -5°C |
| | Symbol SMA570P | --- | --- | t ≤ 16 | --- | 460 | --- | 570-720 | --- | see standard | N, QT, T or TMCP | L: 47 J @ -5°C |
| | | | | 16 < t ≤ 40 | --- | 450 | --- | 570-720 | --- | see standard | N, QT, T or TMCP | L: 47 J @ -5°C |
| | | | | 40 < t ≤ 75 | --- | 430 | --- | 570-720 | --- | see standard | N, QT, T or TMCP | L: 47 J @ -5°C |
| | | | | 75 < t ≤ 100 | --- | 420 | --- | 570-720 | --- | see standard | N, QT, T or TMCP | L: 47 J @ -5°C |
| CSA G40.21-13 | Grade 480A (70A) | --- | --- | --- | --- | 480 | 70 | 590-790 | 85-115 | 17 | SR, A or N | --- |
| | | | | t ≤ 65 | t ≤ 2.5 | 480 | 70 | 590-790 | 85-115 | 17 L, 14 T | AR, N or CtR | --- |
| | Grade 480AT (70AT) | --- | --- | --- | --- | 480 | 70 | 590-790 | 85-115 | 17 | SR, A or N | see standard for impact data |
| | | | | t ≤ 65 | t ≤ 2.5 | 480 | 70 | 590-790 | 85-115 | 17 L, 14 T | AR, N or CtR | |
| | Grade 550A (80A) | --- | --- | --- | --- | 550 | 80 | 620-860 | 90-125 | 15 | SR, A or N | --- |
| | | | | t ≤ 65 | t ≤ 2.5 | 550 | 80 | 620-860 | 90-125 | 15 L, 12 T | AR, N or CtR | --- |
| | Grade 550AT (80AT) | --- | --- | --- | --- | 550 | 80 | 620-860 | 90-125 | 15 | SR, A or N | see standard for impact data |
| | | | | t ≤ 65 | t ≤ 2.5 | 550 | 80 | 620-860 | 90-125 | 15 L, 12 T | AR, N or CtR | |

### 3.3 Structural Steels with Improved Atmospheric Corrosion Resistance

### 3.3B Chemical Composition of Structural Steels with Improved Atmospheric Corrosion-Resistance

| Specification | Designation | UNS No. | Steel No. | Section Thickness | | Weight, %max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ISO 4952:2006 | Grade S235W, Quality B | --- | --- | --- | --- | 0.13 | 0.20-0.60 | 0.10-0.40 | 0.040 | 0.035 | 0.40-0.80 | 0.65 | --- | V 0.02-0.15; Al 0.020 min.; Cu 0.25-0.55; Ti 0.02-0.10; Nb 0.015-0.060 |
| | Grade S235W, Quality C | --- | --- | --- | --- | 0.13 | 0.20-0.60 | 0.10-0.40 | 0.040 | 0.035 | 0.40-0.80 | 0.65 | --- | V 0.02-0.15; Al 0.020 min.; Cu 0.25-0.55; Ti 0.02-0.10; Nb 0.015-0.060 |
| | Grade S235W, Quality D | --- | --- | --- | --- | 0.13 | 0.20-0.60 | 0.10-0.40 | 0.040 | 0.035 | 0.40-0.80 | 0.65 | --- | V 0.02-0.15; Al 0.020 min.; Cu 0.25-0.55; Ti 0.02-0.10; Nb 0.015-0.060 |
| ISO 5952:2005 | Grade HSA 235W, Class B | --- | --- | --- | --- | 0.13 | 0.20-0.60 | 0.100-0.40 | 0.040 | 0.035 | 0.40-0.80 | 0.65 | --- | Cu 0.25-0.55 |
| | Grade HSA 235W, Class D | --- | --- | --- | --- | 0.13 | 0.20-0.60 | 0.100-0.40 | 0.040 | 0.035 | 0.40-0.80 | 0.65 | --- | Al 0.020 min.; Cu 0.25-0.55 |
| GB/T 18982-2003 | Grade Q295GNHJ | --- | --- | --- | --- | 0.12 | 0.25-0.55 | 0.20-0.40 | 0.07-0.12 | 0.030 | --- | --- | --- | Cu 0.25-0.50; Ti 0.030 |
| ISO 5952:2005 | Grade HSA 245W, Class B | --- | --- | --- | --- | 0.18 | 1.25 | 0.15-0.65 | 0.035 | 0.035 | 0.45-0.75 | 0.05-0.30 | --- | Cu 0.30-0.50; (Mo+Nb+Ti+V+Zr) 0.15 |
| | Grade HSA 245W, Class D | --- | --- | --- | --- | 0.18 | 1.25 | 0.15-0.65 | 0.035 | 0.035 | 0.45-0.75 | 0.05-0.30 | --- | Al 0.020 min.; Cu 0.30-0.50; (Mo+Nb+Ti+V+Zr) 0.15 |
| JIS G 3114:2008 | Symbol SMA400AW | --- | --- | t ≤ 200 | --- | 0.18 | 1.25 | 0.15-0.65 | 0.035 | 0.035 | 0.45-0.75 | 0.05-0.30 | --- | Cu 0.30-0.50 |
| | Symbol SMA400BW | --- | --- | t ≤ 200 | --- | 0.18 | 1.25 | 0.15-0.65 | 0.035 | 0.035 | 0.45-0.75 | 0.05-0.30 | --- | Cu 0.30-0.50 |
| | Symbol SMA400CW | --- | --- | t ≤ 100 | --- | 0.18 | 1.25 | 0.15-0.65 | 0.035 | 0.035 | 0.45-0.75 | 0.05-0.30 | --- | Cu 0.30-0.50 |
| | Symbol SMA400AP | --- | --- | t ≤ 200 | --- | 0.18 | 1.25 | 0.55 | 0.035 | 0.035 | 0.30-0.55 | --- | --- | Cu 0.20-0.35 |
| | Symbol SMA400BP | --- | --- | t ≤ 200 | --- | 0.18 | 1.25 | 0.55 | 0.035 | 0.035 | 0.30-0.55 | --- | --- | Cu 0.20-0.35 |
| | Symbol SMA400CP | --- | --- | t ≤ 100 | --- | 0.18 | 1.25 | 0.55 | 0.035 | 0.035 | 0.30-0.55 | --- | --- | Cu 0.20-0.35 |
| GB/T 18982-2003 | Grade Q245NHYJ | --- | --- | --- | --- | 0.14 | 1.50 | 0.55 | 0.030 | 0.030 | 0.80-1.30 | --- | 0.30 | Cu 0.15-0.40 |
| | Grade Q310GNHJ | --- | --- | --- | --- | 0.12 | 0.15-0.70 | 0.10-0.50 | 0.06-0.12 | 0.030 | --- | --- | --- | Cu 0.20-0.50; Ti 0.030 |
| | Grade Q310GNHLJ | --- | --- | --- | --- | 0.12 | 0.20-0.50 | 0.25-0.75 | 0.07-0.12 | 0.030 | 0.30-1.25 | 0.65 | --- | Cu 0.25-0.50 |

**3.3 Structural Steels with Improved Atmospheric Corrosion Resistance**

**3.3B Chemical Composition of Structural Steels with Improved Atmospheric Corrosion-Resistance (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness | | Weight, %max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| JIS G 3125:2010 | Symbol SPA-C | --- | --- | 0.6 ≤ t ≤ 2.3 | --- | 0.12 | 0.60 | 0.20-0.75 | 0.070-0.150 | 0.035 | 0.30-1.25 | 0.65 | --- | Cu 0.25-0.55 |
| ISO 4952:2006 | Grade S355WP, Quality A | --- | --- | --- | --- | 0.12 | 1.00 | 0.20-0.75 | 0.06-0.15 | 0.035 | 0.30-1.25 | 0.65 | --- | V 0.02-0.15; Al 0.020 min.; Cu 0.25-0.55; Ti 0.02-0.10; Nb 0.015-0.060 |
| | Grade S355WP, Quality D | --- | --- | --- | --- | 0.12 | 1.00 | 0.20-0.75 | 0.06-0.15 | 0.035 | 0.30-1.25 | 0.65 | --- | V 0.02-0.15; Al 0.020 min.; Cu 0.25-0.55; Ti 0.02-0.10; Nb 0.015-0.060 |
| | Grade S355W, Quality B | --- | --- | --- | --- | 0.19 | 0.50-1.50 | 0.50 | 0.040 | 0.035 | 0.40-0.80 | 0.65 | 0.30 | V 0.02-0.15; Al 0.020 min.; Cu 0.25-0.55; Ti 0.02-0.10; Nb 0.015-0.060; Zr 0.15 |
| | Grade S355W, Quality C | --- | --- | --- | --- | 0.19 | 0.50-1.50 | 0.50 | 0.040 | 0.035 | 0.40-0.80 | 0.65 | 0.30 | V 0.02-0.15; Al 0.020 min.; Cu 0.25-0.55; Ti 0.02-0.10; Nb 0.015-0.060; Zr 0.15 |
| | Grade S355W, Quality D | --- | --- | --- | --- | 0.19 | 0.50-1.50 | 0.50 | 0.040 | 0.035 | 0.40-0.80 | 0.65 | 0.30 | V 0.02-0.15; Al 0.020 min.; Cu 0.25-0.55; Ti 0.02-0.10; Nb 0.015-0.060; Zr 0.15 |
| ASTM A606/A606M-09a | Type 2 | --- | --- | --- | --- | 0.22 | 1.25 | --- | --- | 0.04 | --- | --- | --- | Cu 0.20 min. |
| | Type 4 | --- | --- | --- | --- | 0.22 | 1.25 | --- | --- | 0.04 | --- | --- | --- | --- |
| CSA G40.21-13 | Grade 350A (50A) | --- | --- | --- | --- | 0.20 | 0.75-1.35 | 0.15-0.50 | 0.03 | 0.04 | 0.70 | 0.90 | --- | Cu 0.20-0.60; (Cr+Ni) 0.40 |
| | Grade 350AT (50AT) | --- | --- | --- | --- | 0.20 | 0.75-1.35 | 0.15-0.50 | 0.03 | 0.04 | 0.70 | 0.90 | --- | Cu 0.20-0.60; (Cr+Ni) 0.40 |
| | Grade 350R (50R) | --- | --- | --- | --- | 0.16 | 0.75 | 0.75 | 0.05-0.15 | 0.04 | 0.30-1.25 | 0.90 | --- | Cu 0.20-0.60; (Cr+Ni+Cu) 1.00 |
| GB/T 18982-2003 | Grade Q325NHYJ | --- | --- | --- | --- | 0.14 | 1.50 | 0.55 | 0.030 | 0.030 | 0.80-1.30 | --- | --- | Nb 0.10 |
| | Grade Q345GNHJ | --- | --- | --- | --- | 0.12 | 0.20-0.70 | 0.20-0.50 | 0.07-0.12 | 0.030 | --- | --- | --- | Cu 0.25-0.50; Ti 0.030 |
| | Grade Q345GNHLJ | --- | --- | --- | --- | 0.12 | 0.20-0.50 | 0.25-0.75 | 0.07-0.12 | 0.030 | 0.30-1.25 | 0.65 | --- | Cu 0.25-0.50 |
| ISO 5952:2005 | Grade HSA 365W, Class B | --- | --- | --- | --- | 0.18 | 1.40 | 0.15-0.65 | 0.035 | 0.035 | 0.45-0.75 | 0.05-0.30 | --- | Cu 0.30-0.50; (Mo+Nb+Ti+V+Zr) 0.15 |
| | Grade HSA 365W, Class D | --- | --- | --- | --- | 0.18 | 1.40 | 0.15-0.65 | 0.035 | 0.035 | 0.45-0.75 | 0.05-0.30 | --- | Al 0.020 min.; Cu 0.30-0.50; (Mo+Nb+Ti+V+Zr) 0.15 |

Note: This section continued on next page

**3.3 Structural Steels with Improved Atmospheric Corrosion Resistance**

**3.3B Chemical Composition of Structural Steels with Improved Atmospheric Corrosion-Resistance (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness | | Weight, %max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| JIS G 3114:2008 | Symbol SMA490AW | --- | --- | t ≤ 200 | --- | 0.18 | 1.40 | 0.15-0.65 | 0.035 | 0.035 | 0.45-0.75 | 0.05-0.30 | --- | Cu 0.30-0.50 |
| | Symbol SMA490AP | --- | --- | t ≤ 200 | --- | 0.18 | 1.40 | 0.55 | 0.035 | 0.035 | 0.30-0.55 | --- | --- | Cu 0.20-0.35 |
| | Symbol SMA490BW | --- | --- | t ≤ 200 | --- | 0.18 | 1.40 | 0.15-0.65 | 0.035 | 0.035 | 0.45-0.75 | 0.05-0.30 | --- | Cu 0.30-0.50 |
| | Symbol SMA490BP | --- | --- | t ≤ 200 | --- | 0.18 | 1.40 | 0.55 | 0.035 | 0.035 | 0.30-0.55 | --- | --- | Cu 0.20-0.35 |
| | Symbol SMA490CW | --- | --- | t ≤ 100 | --- | 0.18 | 1.40 | 0.15-0.65 | 0.035 | 0.035 | 0.45-0.75 | 0.05-0.30 | --- | Cu 0.30-0.50 |
| | Symbol SMA490CP | --- | --- | t ≤ 100 | --- | 0.18 | 1.40 | 0.55 | 0.035 | 0.035 | 0.30-0.55 | --- | --- | Cu 0.20-0.35 |
| JIS G 3125:2010 | Symbol SPA-H | --- | --- | t ≤ 16 | --- | 0.12 | 0.60 | 0.20-0.75 | 0.070-0.150 | 0.035 | 0.30-1.25 | 0.65 | --- | Cu 0.25-0.55 |
| ASTM A871/A871M-14 | Grade 60, Type I | --- | --- | --- | --- | 0.19 | 0.80-1.35 | 0.30-0.65 | 0.030 | 0.030 | 0.40-0.70 | 0.40 | --- | V 0.02-0.10; Cu 0.25-0.40 |
| | Grade 60, Type II | --- | --- | --- | --- | 0.20 | 0.75-1.35 | 0.15-0.50 | 0.030 | 0.030 | 0.40-0.70 | 0.50 | --- | V 0.01-0.10; Cu 0.20-0.40 |
| | Grade 60, Type IV | --- | --- | --- | --- | 0.17 | 0.50-1.20 | 0.25-0.50 | 0.030 | 0.030 | 0.40-0.70 | 0.40 | 0.10 | Cu 0.30-0.50; Cb 0.005-0.05 |
| CSA G40.21-13 | Grade 400A (60A) | --- | --- | --- | --- | 0.20 | 0.75-1.35 | 0.15-0.50 | 0.03 | 0.04 | 0.70 | 0.90 | --- | Cu 0.20-0.60; (Cr+Ni) 0.40 |
| | Grade 400AT (60AT) | --- | --- | --- | --- | 0.20 | 0.75-1.35 | 0.15-0.50 | 0.03 | 0.04 | 0.70 | 0.90 | --- | Cu 0.20-0.60; (Cr+Ni) 0.40 |
| ISO 5952:2005 | Grade HSA 355W1, Class A | --- | --- | --- | --- | 0.12 | 1.00 | 0.20-0.75 | 0.06-0.15 | 0.035 | 0.30-1.25 | 0.65 | --- | Cu 0.25-0.55 |
| | Grade HSA 355W1, Class D | --- | --- | --- | --- | 0.12 | 1.00 | 0.20-0.75 | 0.06-0.15 | 0.035 | 0.30-1.25 | 0.65 | --- | Al 0.020 min.; Cu 0.25-0.55 |
| | Grade HSA 355W2, Class C | --- | --- | --- | --- | 0.16 | 0.50-1.50 | 0.50 | 0.035 | 0.035 | 0.40-0.80 | 0.65 | 0.3 | Cu 0.25-0.55; Zr 0.15 |
| | Grade HSA 355W2, Class D | --- | --- | --- | --- | 0.16 | 0.50-1.50 | 0.50 | 0.035 | 0.035 | 0.40-0.80 | 0.65 | 0.3 | Al 0.020 min.; Cu 0.25-0.55; Zr 0.15 |

**3.3 Structural Steels with Improved Atmospheric Corrosion Resistance**

**3.3B Chemical Composition of Structural Steels with Improved Atmospheric Corrosion-Resistance (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness | | Weight, %max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASTM A871/A871M-14 | Grade 65, Type I | --- | --- | --- | --- | 0.19 | 0.80-1.35 | 0.30-0.65 | 0.030 | 0.030 | 0.40-0.70 | 0.40 | --- | V 0.02-0.10; Cu 0.25-0.40 |
| | Grade 65, Type II | --- | --- | --- | --- | 0.20 | 0.75-1.35 | 0.15-0.50 | 0.030 | 0.030 | 0.40-0.70 | 0.50 | --- | V 0.01-0.10; Cu 0.20-0.40 |
| | Grade 65, Type IV | --- | --- | --- | --- | 0.17 | 0.50-1.20 | 0.25-0.50 | 0.030 | 0.030 | 0.40-0.70 | 0.40 | 0.10 | Cu 0.30-0.50; Cb 0.005-0.05 |
| JIS G 3114:2008 | Symbol SMA570W | --- | --- | t ≤ 100 | --- | 0.18 | 1.40 | 0.15-0.65 | 0.035 | 0.035 | 0.45-0.75 | 0.05-0.30 | --- | Cu 0.30-0.50 |
| | Symbol SMA570P | --- | --- | t ≤ 100 | --- | 0.18 | 1.40 | 0.55 | 0.035 | 0.035 | 0.30-0.55 | --- | --- | Cu 0.20-0.35 |
| CSA G40.21-13 | Grade 480A (70A) | --- | --- | --- | --- | 0.20 | 1.00-1.60 | 0.15-0.50 | 0.025 | 0.035 | 0.70 | 0.25-0.50 | --- | Cu 0.20-0.60; (Cr+Ni) 0.40 |
| | Grade 480AT (70AT) | --- | --- | --- | --- | 0.20 | 1.00-1.60 | 0.15-0.50 | 0.025 | 0.035 | 0.70 | 0.25-0.50 | --- | Cu 0.20-0.60; (Cr+Ni) 0.40 |
| | Grade 550A (80A) | --- | --- | --- | --- | 0.15 | 1.75 | 0.15-0.50 | 0.025 | 0.035 | 0.70 | 0.25-0.50 | --- | Cu 0.20-0.60; (Cr+Ni) 0.40 |
| | Grade 550AT (80AT) | --- | --- | --- | --- | 0.15 | 1.75 | 0.15-0.40 | 0.025 | 0.035 | 0.70 | 0.25-0.50 | --- | Cu 0.20-0.60; (Cr+Ni) 0.40 |

# Chapter 4

# *PRESSURE VESSEL STEEL PLATES*

### ASME Standards

| | |
|---|---|
| ASME SA-203/SA-203M | Pressure Vessel Plates, Alloy Steel, Nickel |
| ASME SA-204/SA-204M | Pressure Vessel Plates, Alloy Steel, Molybdenum |
| ASME SA-240/SA-240M | Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications |
| ASME SA-302/SA-302M | Pressure Vessel Plates, Alloy Steel, Manganese-Molybdenum and Manganese-Molybdenum-Nickel |
| ASME SA-353/SA-353M | Pressure Vessel Plates, Alloy Steel, Double-Normalized and Tempered 9 Percent Nickel |
| ASME SA-387/SA-387M | Pressure Vessel Plates, Alloy Steel, Chromium-Molybdenum |
| ASME SA-414/SA-414M | Steel, Sheet, Carbon, for Pressure Vessels |
| ASME SA-479/SA-479M | Stainless Steel Bars and Shapes for Use in Boilers and Other Pressure Vessels |
| ASME SA-515/SA-515M | Pressure Vessel Plates, Carbon Steel, for Intermediate-and-Higher-Temperature Service |
| ASME SA-516/SA-516M | Pressure Vessel Plates, Carbon Steel, for Moderate-and-Lower-Temperature Service |
| ASME SA-533/SA-533M | Pressure Vessel Plates, Alloy Steel, Quenched and Tempered, Manganese-Molybdenum and Manganese-Molybdenum-Nickel |
| ASME SA-537/SA-537M | Pressure Vessel Plates, Heat-Treated, Carbon-Manganese-Silicon Steel |
| ASME SA-553/SA-553M | Pressure Vessel Plates, Alloy Steel, Quenched and Tempered 8 and 9 Percent Nickel |
| ASME SA-612/SA-612M | Pressure Vessel Plates, Carbon Steel, High Strength, for Moderate and Lower Temperature Service |
| ASME SA-662/SA-662M | Pressure Vessel Plates, Carbon-Manganese-Silicon Steel, for Moderate and Lower Temperature Service |
| ASME SA-666 | Annealed or Cold-Worked Austenitic Stainless Steel, Sheet, Strip, Plate, and Flat Bar |
| ASME SA-737/SA-737M | Pressure Vessel Plates, High-Strength Low-Alloy Steel |
| ASME SA-738/SA-738M | Pressure Vessel Plates, Heat-Treated, Carbon-Manganese-Silicon Steel, for Moderate and Lower Temperature Service |
| ASME SA-841/SA-841M | Steel Plates for Pressure Vessels, Produced by Thermo-Mechanical Control Process (TMCP) |

### ASTM Standards

| | |
|---|---|
| ASTM A203/A203M-12 | Pressure Vessel Plates, Alloy Steel, Nickel |
| ASTM A204/A204M-12 | Pressure Vessel Plates, Alloy Steel, Molybdenum |
| ASTM A240/A240M-15a | Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications |
| ASTM A302/A302M-12 | Pressure Vessel Plates, Alloy Steel, Manganese-Molybdenum and Manganese-Molybdenum-Nickel |
| ASTM A353/A353M-09 (2014) | Pressure Vessel Plates, Alloy Steel, Double-Normalized and Tempered 9 Percent Nickel |
| ASTM A387/A387M-11 | Pressure Vessel Plates, Alloy Steel, Chromium-Molybdenum |
| ASTM A414/A414M-14 | Steel, Sheet, Carbon, and High-Strength, Low-Alloy for Pressure Vessels |
| ASTM A479/A479M-14 | Stainless Steel Bars and Shapes for Use in Boilers and Other Pressure Vessels |
| ASTM A515/A515M-10 | Pressure Vessel Plates, Carbon Steel, for Intermediate- and Higher-Temperature Service |
| ASTM A516/A516M-10 | Pressure Vessel Plates, Carbon Steel, for Moderate- and Lower-Temperature Service |
| ASTM A533/A533M-09 (2014) | Pressure Vessel Plates, Alloy Steel, Quenched and Tempered, Manganese-Molybdenum and Manganese-Molybdenum-Nickel |
| ASTM A537/A537M-13 | Pressure Vessel Plates, Heat-Treated, Carbon-Manganese-Silicon Steel |
| ASTM A553/A553M-14 | Pressure Vessel Plates, Alloy Steel, Quenched and Tempered 7, 8, and 9 Percent Nickel |
| ASTM A612/A612M-12 | Pressure Vessel Plates, Carbon Steel, High Strength, for Moderate and Lower Temperature Service |
| ASTM A662/A662M-12 | Pressure Vessel Plates, Carbon-Manganese-Silicon Steel, for Moderate and Lower Temperature Service |
| ASTM A666-15 | Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar |
| ASTM A737/A737M-09 (2013) | Pressure Vessel Plates, High-Strength, Low-Alloy Steel |
| ASTM A738/A738M-12a | Pressure Vessel Plates, Heat-Treated, Carbon-Manganese-Silicon Steel, for Moderate and Lower Temperature Service |
| ASTM A841/A841M-13 | Steel Plates for Pressure Vessels, Produced by Thermo-Mechanical Control Process (TMCP) |
| ASTM A844/A844M-09 | Steel Plates, 9 Percent Nickel Alloy, for Pressure Vessels, Produced by the Direct-Quenching Process |

### EN Standards

| | |
|---|---|
| EN 10028-2:2009 | Flat products made of steels for pressure purposes - Part 2: Non-alloy and alloy steels with specified elevated temperature properties |
| EN 10028-3:2009 | Flat products made of steels for pressure purposes - Part 3: Weldable fine grain steels, normalized |
| EN 10028-4:2009 | Flat products made of steels for pressure purposes - Part 4: Nickel alloy steels with specified low temperature properties |
| EN 10028-7:2007 | Flat products made of steels for pressure purposes - Part 7: Stainless steels |
| EN 10088-2:2014 | Stainless steels - Part 2: Technical delivery conditions for sheet/plate and strip of corrosion resisting steels for general purposes |
| EN 10088-3:2014 | Stainless steels - Part 3: Technical delivery conditions for semi-finished products, bars, rods, wire, sections and bright products of corrosion resisting steels for general purposes |
| EN 10120:2008 | Steel sheet and strip for welded gas cylinders |

### GB Standards

| | |
|---|---|
| GB 713-1997 | Steel Plates for Boilers |
| GB 3280-92 | Cold Rolled Stainless Steel Sheets and Plates |
| GB 3531-1996 | Low Alloy Steel Plates for Low Temperature Pressure Vessels |
| GB 4237-92 | Hot Rolled Stainless Steel Sheets and Plates |
| GB 4238-92 | Heat-Resisting Steel Sheets and Plates |
| GB 6653-94 | Steel Plates for Welded Gas Cylinders |
| GB 6654-1996 | Steel Plates for Pressure Vessels |

### ISO Standards

| | |
|---|---|
| ISO 4706:1989 | Refillable Welded Steel Gas Cylinders |
| ISO 4978:1983 | Flat Rolled Steel Products for Welded Gas Cylinders |
| ISO 9328-2:2004 | Steel Plates and Strips for Pressure Purposes - Technical Delivery Conditions - Part 2: Unalloyed and Low- Alloyed Steels With Specified Room Temperature and Elevated Temperature Properties |
| ISO 9328-4:2004 | Steel Plates and Strips for Pressure Purposes - Technical Delivery Conditions - Part 4: Weldable Fine Grain Steels With High Proof Stress Supplied In The Normalized or Quenched and Tempered Condition |
| ISO 9328-7:2004 | Steel Flat Products for Pressure Purposes - Technical Delivery Conditions - Part 7: Stainless Steels |

### JIS Standards

| | |
|---|---|
| JIS G 3103:2012 | Carbon steel and molybdenum alloy steel plates for boilers and pressure vessels |
| JIS G 3115:2010 | Steel plates for pressure vessels for intermediate temperature service |
| JIS G 3116:2013 | Steel sheet, plates and strip for gas cylinders |
| JIS G 3118:2010 | Carbon steel plates for pressure vessels for intermediate and moderate temperature service |
| JIS G 3119:2013 | Manganese-molybdenum and manganese-molybdenum-nickel alloy steel plates for boilers and pressure vessels |
| JIS G 3120:2014 | Manganese-molybdenum and manganese-molybdenum-nickel alloy steel plates quenched and tempered for pressure vessels |
| JIS G 3124:2009 | High strength steel plates for pressure vessel for intermediate and moderate temperature service |
| JIS G 3126:2009 | Carbon steel plates for pressure vessels for low temperature service |
| JIS G 3127:2013 | Nickel steel plates for pressure vessels for low temperature services |
| JIS G 4109:2013 | Chromium-molybdenum alloy steel plates for boilers and pressure vessels |
| JIS G 4110:2008 | High strength chromium-molybdenum and chromium-molybdenum-vanadium alloy steel plates for pressure vessels under high-temperature service |
| JIS G 4304:2012 | Hot-rolled stainless steel plates, sheets and strip |
| JIS G 4305:2012 | Cold-rolled stainless steel plates, sheets and strip |
| JIS G 4312:2011 | Heat-resisting steel plate, sheet and strip |

### Heat Treatment Terms Applicable to this Chapter

| Standard | Heat Treatment Terms |
|---|---|
| ASME SA-203/SA-203M | N: normalized; Q+T: quenched and tempered |
| ASME SA-204/SA-204M | AR: as-rolled; SR: stress relieved; N: normalized; SR+N: stress relieved and normalized |
| ASME SA-240/SA-240M | See standard; Q+SA: quenched in water and solution annealed |
| ASME SA-302/SA-302M | AR: as-rolled; N: normalized; SR: stress relieved; N+SR: normalized and stress relieved |
| ASME SA-353/SA-353M | NN+T: double-normalized and tempered |
| ASME SA-387/SA-387M | A: annealed; N+T: normalized and tempered; SR: stress relieved; Q+T: quenched and tempered |
| ASME SA-414/SA-414M | HR: hot-rolled |
| ASME SA-479/SA-479M | A: annealed |
| ASME SA-515/SA-515M | AR: as-rolled; N: normalized; SR: stress relieved; N+SR: normalized and stress relieved |
| ASME SA-516/SA-516M | AR: as-rolled; N: normalized; SR: stress relieved; N+SR: normalized and stress relieved |
| ASME SA-533/SA-533M | Q+T: quenched and tempered |
| ASME SA-537/SA-537M | N: normalized; Q+T: quenched and tempered |
| ASME SA-553/SA-553M | Q+T: quenched and tempered |
| ASME SA-612/SA-612M | AR: as-rolled; N: normalized; SR: stress relieved; N+SR: normalized and stress relieved |
| ASME SA-662/SA-662M | AR: as-rolled; N: normalized; SR: stress relieved; N+SR: normalized and stress relieved |
| ASME SA-666 | A: annealed |
| ASME SA-737/SA-737M | N: normalized |
| ASME SA-738/SA-738M | N: normalized; Q+T: quenched and tempered |
| ASME SA-841/SA-841M | TMCP: thermo-mechanical control process |
| ASTM A203/A203M-12 | N: normalized; Q+T: quenched and tempered |
| ASTM A204/A204M-12 | AR: as-rolled; N: normalized; SR: stress relieved; SR+N: stress relieved and normalized |
| ASTM A240/A240M-15a | See standard; SA: solution annealed |
| ASTM A302/A302M-12 | AR: as-rolled; N: normalized; SR: stress relieved; N+SR: normalized and stress relieved |
| ASTM A353/A353M-09(2014) | NN+T: double-normalized and tempered |
| ASTM A387/A387M-11 | A: annealed; N+T: normalized and tempered; Q+T: quenched and tempered; SR: stress relieved |
| ASTM A414/A414M-14 | HR: hot-rolled |
| ASTM A479/A479M-14 | SA: solution annealed |
| ASTM A515/A515M-10 | AR: as-rolled; N: normalized; SR: stress relieved; N+SR: normalized and stress relieved |
| ASTM A516/A516M-10 | AR: as-rolled; N: normalized; SR: stress relieved; N+SR: normalized and stress relieved |
| ASTM A533/A533M-09(2014) | Q+T: quenched and tempered |
| ASTM A537/A537M-13 | N: normalized; Q+T: quenched and tempered |
| ASTM A553/A553M-14 | Q+T: quenched and tempered |
| ASTM A612/A612M-12 | AR: as-rolled; N: normalized; SR: stress relieved; N+SR: normalized and stress relieved |
| ASTM A662/A662M-12 | AR: as-rolled; N: normalized; SR: stress relieved; N+SR: normalized and stress relieved |
| ASTM A666-15 | A: annealed |
| ASTM A737/A737M-09(2013) | N: normalized |
| ASTM A738/A738M-12a | N: normalized; Q+T: quenched and tempered |
| ASTM A841/A841M-13 | TMCP: thermo-mechanical control processed |
| ASTM A844/A844M-09 | Q+T: quenched and tempered |
| EN 10028-2:2009 | AR: as-rolled; N: normalized; N+T: normalized and tempered; Q+T: quenched and tempered; |
| EN 10028-3:2009 | AR: as-rolled; N: normalized |
| EN 10028-4:2009 | N+T: normalized and tempered; N: normalized; Q+T: quenched and tempered; |
| EN 10028-7:2007 | A: annealed; Q+T: quenched and tempered; SA: solution annealed |
| EN 10088-2:2014 | A: annealed; SA: solution annealed |
| EN 10088-3:2014 | SA: solution annealed |
| EN 10120:2008 | HR or HR+N: hot-rolled or hot-rolled and normalized |

### Heat Treatment Terms Applicable to this Chapter (continued)

| Standard | Heat Treatment Terms |
|---|---|
| GB 713-1997 | HR: hot-rolled; CtR: controlled-rolled; N or N+T: normalized or normalized and tempered |
| GB 3280-92 | A: annealed; ST: solution treated |
| GB 3531-1996 | N or N+T: normalized or normalized and tempered |
| GB 4237-92 | A: annealed; ST: solution treated |
| GB 4238-92 | A: annealed; ST: solution treated |
| GB 6653-94 | HR: hot-rolled; CtR: control-rolled; A: annealed |
| GB 6654-1996 | N: normalized; N+T: normalized and tempered |
| ISO 4706:1989 | N or SR: normalized or stress relieved |
| ISO 4978:1983 | N+C(A): normalized and air cooled |
| ISO 9328-2:2004 | N: normalized; BA: as rolled if agreed upon at the time of enquiry |
| ISO 9328-4:2004 | N: normalized; N+T: normalized and (if appropriate) tempered; Q+T: quenched and tempered |
| ISO 9328-7:2004 | SA: solution annealed; A: annealed; Q+T: quenched and tempered |
| JIS G 3103:2012 | AR: as-rolled; N: normalized; SR: stress relieved |
| JIS G 3115:2010 | AR: as-rolled; N: normalized; Q+T: quenched and tempered; TMCP: thermo-mechanical control processed |
| JIS G 3116:2013 | HR: hot-rolled |
| JIS G 3118:2010 | AR: as-rolled; N: normalized; Q+T: quenched and tempered; TMCP: thermo-mechanical control processed |
| JIS G 3119:2013 | AR: as-rolled; N: normalized; A: annealed; Q+T: quenched and tempered; N+A: normalized and annealed |
| JIS G 3120:2014 | AR: as-rolled; A: annealed; Q+T: quenched and tempered |
| JIS G 3124:2009 | AR: as-rolled; N: normalized; N+T: normalized and tempered; A: annealed |
| JIS G 3126:2009 | N: normalized; Q+T: quench hardened and tempered; TMCP: thermo-mechanical control process |
| JIS G 3127:2013 | N: normalized; NNT: double normalized and tempered; N+T: normalized and tempered; TMCP: thermo-mechanical control processed; Q+T: quenched and tempered |
| JIS G 4109:2013 | A: annealed; N+T: normalized and tempered |
| JIS G 4110:2008 | N+T: normalized and tempered; Q+T: quench and tempered |
| JIS G 4304:2012 | A: annealed; ST: solution treated |
| JIS G 4305:2012 | A: annealed; ST: solution treated |
| JIS G 4312:2011 | A: annealed |

### Impact Testing Notes Applicable to this Chapter

see standard for supplementary impact testing: the standard includes impact testing as a supplementary requirement (optional to the purchaser).
see standard for impact data: impact testing requirements are listed in the standard for multiple test temperatures.

### 4.1 Carbon Steels for Pressure Vessel Plates

#### 4.1A Mechanical Properties of Carbon Steels for Pressure Vessel Plates

| Specification | Designation | UNS No. | Steel No. | Section Thickness / Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation % min. | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | | | |
| EN 10028-2:2009 | P235GH | --- | 1.0345 | t ≤ 16 | --- | 235 | --- | 360-480 | --- | 24 | AR, N | see standard for impact data |
| | | | | 16 < t ≤ 40 | --- | 225 | --- | 360-480 | --- | 24 | AR, N | |
| | | | | 40 < t ≤ 60 | --- | 215 | --- | 360-480 | --- | 24 | AR, N | |
| | | | | 60 < t ≤ 100 | --- | 200 | --- | 360-480 | --- | 24 | AR, N | |
| | | | | 100 < t ≤ 150 | --- | 185 | --- | 350-480 | --- | 24 | AR, N | |
| | | | | 150 < t ≤ 250 | --- | 170 | --- | 340-480 | --- | 24 | AR, N | |
| ISO 4978:1983 | Grade 2 | --- | --- | t < 3 | --- | 235 | --- | 360-460 | --- | 22 | N+C(A) | --- |
| | | | | 3 ≤ t ≤ 6 | --- | 235 | --- | 360-460 | --- | 30 | N+C(A) | --- |
| ISO 9328-2:2004 | Grade P235GH | --- | --- | t ≤ 16 | --- | 235 | --- | 360-480 | --- | 24 | N or BA | see standard for impact data |
| | | | | 16 < t ≤ 40 | --- | 225 | --- | 360-480 | --- | 24 | N or BA | |
| | | | | 40 < t ≤ 60 | --- | 215 | --- | 360-480 | --- | 24 | N or BA | |
| | | | | 60 < t ≤ 100 | --- | 200 | --- | 360-480 | --- | 24 | N or BA | |
| | | | | 100 < t ≤ 150 | --- | 185 | --- | 350-480 | --- | 24 | N or BA | |
| | | | | 150 < t ≤ 250 | --- | 170 | --- | 340-480 | --- | 24 | N or BA | |
| EN 10120:2008 | P245NB | --- | 1.0111 | t ≤ 5 | --- | 245 | --- | 360-450 T | --- | 34 T | HR or HR+N | --- |
| ASME SA-414/SA-414M | Grade C | K02503 | --- | 1.5 ≤ t < 2.2 | 0.057 ≤ t < 0.089 | 230 | 33 | 380-485 T | 55-70 T | 19 T | HR | --- |
| | | | | 2.2 ≤ t < 3.8 | 0.089 ≤ t < 0.145 | 230 | 33 | 380-485 T | 55-70 T | 20 T | HR | --- |
| | | | | 3.8 ≤ t < 7.0 | 0.145 ≤ t < 0.270 | 230 | 33 | 380-485 T | 55-70 T | 22 T | HR | --- |
| ASTM A414/A414M-14 | Grade C | K02503 | --- | 1.5 ≤ t < 2.2 | 0.057 ≤ t < 0.089 | 230 | 33 | 380-485 T | 55-70 T | 19 T | HR | --- |
| | | | | 2.2 ≤ t < 3.8 | 0.089 ≤ t < 0.145 | 230 | 33 | 380-485 T | 55-70 T | 20 T | HR | --- |
| | | | | 3.8 ≤ t < 7.0 | 0.145 ≤ t < 0.270 | 230 | 33 | 380-485 T | 55-70 T | 22 T | HR | --- |
| GB 6653-94 | Grade HP245 | --- | --- | --- | --- | 245 | --- | 390 T | --- | 28 T | HR, CtR or A | see standard for impact data |
| EN 10028-3:2009 | P275NH | --- | 1.0487 | t ≤ 16 | --- | 275 | --- | 390-510 | --- | 24 | AR, N | see standard for impact data |
| | | | | 16 < t ≤ 40 | --- | 265 | --- | 390-510 | --- | 24 | AR, N | |
| | | | | 40 < t ≤ 60 | --- | 255 | --- | 390-510 | --- | 24 | AR, N | |
| | | | | 60 < t ≤ 100 | --- | 235 | --- | 370-490 | --- | 23 | AR, N | |
| | | | | 100 < t ≤ 150 | --- | 225 | --- | 360-480 | --- | 23 | AR, N | |
| | | | | 150 < t ≤ 250 | --- | 215 | --- | 350-470 | --- | 23 | AR, N | |
| JIS G 3116:2013 | Symbol SG255 | --- | --- | 1.6 ≤ t ≤ 6.0 | --- | 255 | --- | 400 L | --- | 28 L | HR | --- |

Note: This section continued on next page.

**4.1 Carbon Steels for Pressure Vessel Plates**

**4.1A Mechanical Properties of Carbon Steels for Pressure Vessel Plates (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness / Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation % min. | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | | | |
| JIS G 3115:2010 | Symbol SPV235 | --- | --- | 6 < t ≤ 16 | --- | 235 | --- | 400-510 | --- | 17 | AR or N | see standard for impact data |
| | | | | 16 < t ≤ 40 | --- | 235 | --- | 400-510 | --- | 21 | AR or N | L: 47 J @ 0°C |
| | | | | 40 < t ≤ 50 | --- | 235 | --- | 400-510 | --- | 24 | AR or N | L: 47 J @ 0°C |
| | | | | 50 < t ≤ 100 | --- | 215 | --- | 400-510 | --- | 24 | AR or N | L: 47 J @ 0°C |
| | | | | 100 < t ≤ 200 | --- | 195 | --- | 400-510 | --- | 24 | AR or N | L: 47 J @ 0°C |
| GB 6654-1996 | Grade 20R | --- | --- | 6 < t ≤ 16 | --- | 245 | --- | 400-520 | --- | 25 | N | T: 31 J @ 20°C |
| | | | | 16 < t ≤ 36 | --- | 235 | --- | 400-520 | --- | 25 | N | T: 31 J @ 20°C |
| | | | | 36 < t ≤ 60 | --- | 225 | --- | 400-520 | --- | 25 | N | T: 31 J @ 20°C |
| | | | | 60 < t ≤ 100 | --- | 205 | --- | 390-510 | --- | 24 | N | T: 31 J @ 20°C |
| GB 713-1997 | Grade 20g | --- | --- | 6 ≤ t ≤ 16 | --- | 245 | --- | 400-530 | --- | 26 | HR, CtR, N or N+T | see standard for impact data |
| | | | | 16 < t ≤ 25 | --- | 235 | --- | 400-520 | --- | 25 | HR, CtR, N or N+T | |
| | | | | 25 < t ≤ 36 | --- | 225 | --- | 400-520 | --- | 24 | HR, CtR, N or N+T | |
| | | | | 36 < t ≤ 60 | --- | 225 | --- | 400-520 | --- | 23 | HR, CtR, N or N+T | |
| | | | | 60 < t ≤ 100 | --- | 205 | --- | 390-510 | --- | 22 | HR, CtR, N or N+T | |
| | | | | 100 < t ≤ 150 | --- | 185 | --- | 380-500 | --- | 22 | HR, CtR, N or N+T | |
| EN 10028-2:2009 | P265GH | --- | 1.0425 | t ≤ 16 | --- | 265 | --- | 410-530 | --- | 22 | AR, N | see standard for impact data |
| | | | | 16 < t ≤ 40 | --- | 255 | --- | 410-530 | --- | 22 | AR, N | |
| | | | | 40 < t ≤ 60 | --- | 245 | --- | 410-530 | --- | 22 | AR, N | |
| | | | | 60 < t ≤ 100 | --- | 215 | --- | 410-530 | --- | 22 | AR, N | |
| | | | | 100 < t ≤ 150 | --- | 200 | --- | 400-530 | --- | 22 | AR, N | |
| | | | | 150 < t ≤ 250 | --- | 185 | --- | 390-530 | --- | 22 | AR, N | |
| EN 10120:2008 | P265NB | --- | 1.0423 | t ≤ 5 | --- | 265 | --- | 410-500 T | --- | 32 T | HR or HR+N | --- |
| GB 6653-94 | Grade HP265 | --- | --- | --- | --- | 265 | --- | 410 T | --- | 27 T | HR, CtR or A | see standard for impact data |
| ISO 4978:1983 | Grade 3 | --- | --- | t < 3 | --- | 265 | --- | 410-510 | --- | 20 | N+C(A) | --- |
| | | | | 3 ≤ t ≤ 6 | --- | 265 | --- | 410-510 | --- | 28 | N+C(A) | --- |
| ISO 9328-2:2004 | Grade P265GH | --- | --- | t ≤ 16 | --- | 265 | --- | 410-530 | --- | 22 | N or BA | see standard for impact data |
| | | | | 16 < t ≤ 40 | --- | 255 | --- | 410-530 | --- | 22 | N or BA | |
| | | | | 40 < t ≤ 60 | --- | 245 | --- | 410-530 | --- | 22 | N or BA | |
| | | | | 60 < t ≤ 100 | --- | 215 | --- | 410-530 | --- | 22 | N or BA | |
| | | | | 100 < t ≤ 150 | --- | 200 | --- | 400-530 | --- | 22 | N or BA | |
| | | | | 150 < t ≤ 250 | --- | 185 | --- | 390-530 | --- | 22 | N or BA | |
| JIS G 3103:2012 | Symbol SB410 | --- | --- | 6 ≤ t ≤ 50 | --- | 225 | --- | 410-550 | --- | 21 | AR, N or SR | --- |
| | | | | 50 < t ≤ 200 | --- | 225 | --- | 410-550 | --- | 25 | N | --- |

Note: This section continued on next page.

**4.1 Carbon Steels for Pressure Vessel Plates**

**4.1A Mechanical Properties of Carbon Steels for Pressure Vessel Plates (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness / Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | % min. | | |
| JIS G 3118:2010 | Symbol SGV410 | --- | --- | 6 ≤ t ≤ 50 | --- | 225 | --- | 410-490 T | --- | 21 | AR, N, Q+T or TMCP | --- |
| | | | | 50 < t ≤ 200 | --- | 225 | --- | 410-490 T | --- | 25 | N, Q+T, TMCP | --- |
| ASME SA-515/SA-515M | Grade 60 [415] | K02401 | --- | t ≤ 50 | t ≤ 2 | 220 | 32 | 415-550 | 60-80 | 25 | AR or N or SR or N+SR | --- |
| | | | | t > 50 | t > 2 | 220 | 32 | 415-550 | 60-80 | 25 | N | --- |
| ASME SA-516/SA-516M | Grade 60 [415] | K02100 | --- | t ≤ 40 | t ≤ 1.50 | 220 | 32 | 415-550 | 60-80 | 25 | AR or N or SR or N+SR | --- |
| | | | | t > 40 | t > 1.50 | 220 | 32 | 415-550 | 60-80 | 25 | N | --- |
| ASTM A515/A515M-10 | Grade 60 [415] | K02401 | --- | t ≤ 50 | t ≤ 2 | 220 | 32 | 415-550 | 60-80 | 25 | AR, N, SR or N+SR | --- |
| | | | | t > 50 | t > 2 | 220 | 32 | 415-550 | 60-80 | 25 | N | --- |
| ASTM A516/A516M-10 | Grade 60 [415] | K02100 | --- | t ≤ 40 | t ≤ 1.50 | 220 | 32 | 415-550 | 60-80 | 25 | AR, N, SR or N+SR | --- |
| | | | | t > 40 | t > 1.50 | 220 | 32 | 415-550 | 60-80 | 25 | N | --- |
| ASME SA-414/SA-414M | Grade D | K02505 | --- | 1.5 ≤ t < 2.2 | 0.057 ≤ t < 0.089 | 240 | 35 | 415-515 T | 60-75 T | 17 T | HR | --- |
| | | | | 2.2 ≤ t < 3.8 | 0.089 ≤ t < 0.145 | 240 | 35 | 415-515 T | 60-75 T | 18 T | HR | --- |
| | | | | 3.8 ≤ t < 7.0 | 0.145 ≤ t < 0.270 | 240 | 35 | 415-515 T | 60-75 T | 20 T | HR | --- |
| ASTM A414/A414M-14 | Grade D | K02505 | --- | 1.5 ≤ t < 2.2 | 0.057 ≤ t < 0.089 | 240 | 35 | 415-515 T | 60-75 T | 17 T | HR | --- |
| | | | | 2.2 ≤ t < 3.8 | 0.089 ≤ t < 0.145 | 240 | 35 | 415-515 T | 60-75 T | 18 T | HR | --- |
| | | | | 3.8 ≤ t < 7.0 | 0.145 ≤ t < 0.270 | 240 | 35 | 415-515 T | 60-75 T | 20 T | HR | --- |
| GB 6653-94 | Grade HP295 | --- | --- | --- | --- | 295 | --- | 440 T | --- | 26 T | HR, CtR or A | see standard for impact data |
| JIS G 3116:2013 | Symbol SG295 | --- | --- | 1.6 ≤ t ≤ 6.0 | --- | 295 | --- | 440 L | --- | 26 L | HR | --- |
| ASME SA-515/SA-515M | Grade 65 [450] | K02800 | --- | t ≤ 50 | t ≤ 2 | 240 | 35 | 450-585 | 65-85 | 23 | AR or N or SR or N+SR | --- |
| | | | | t > 50 | t > 2 | 240 | 35 | 450-585 | 65-85 | 23 | N | --- |
| ASME SA-516/SA-516M | Grade 65 [450] | K02403 | --- | t ≤ 40 | t ≤ 1.50 | 240 | 35 | 450-585 | 65-85 | 23 | AR or N or SR or N+SR | --- |
| | | | | t > 40 | t > 1.50 | 240 | 35 | 450-585 | 65-85 | 23 | N | --- |
| ASTM A515/A515M-10 | Grade 65 [450] | K02800 | --- | t ≤ 50 | t ≤ 2 | 240 | 35 | 450-585 | 65-85 | 23 | AR, N, SR or N+SR | --- |
| | | | | t > 50 | t > 2 | 240 | 35 | 450-585 | 65-85 | 23 | N | --- |
| ASTM A516/A516M-10 | Grade 65 [450] | K02403 | --- | t ≤ 40 | t ≤ 1.50 | 240 | 35 | 450-585 | 65-85 | 23 | AR, N, SR or N+SR | --- |
| | | | | t > 40 | t > 1.50 | 240 | 35 | 450-585 | 65-85 | 23 | N | --- |
| JIS G 3103:2012 | Symbol SB450 | --- | --- | 6 ≤ t ≤ 50 | --- | 245 | --- | 450-590 | --- | 19 | AR, N or SR | --- |
| | | | | 50 < t ≤ 200 | --- | 245 | --- | 450-590 | --- | 23 | N | --- |
| JIS G 3118:2010 | Symbol SGV450 | --- | --- | 6 ≤ t ≤ 50 | --- | 245 | --- | 450-540 T | --- | 19 | AR, N, Q+T or TMCP | --- |
| | | | | 50 < t ≤ 200 | --- | 245 | --- | 450-540 T | --- | 23 | N, Q+T, TMCP | --- |
| ASME SA-414/SA-414M | Grade E | K02704 | --- | 1.5 ≤ t < 2.2 | 0.057 ≤ t < 0.089 | 260 | 38 | 450-585 T | 65-85 T | 15 T | HR | --- |
| | | | | 2.2 ≤ t < 3.8 | 0.089 ≤ t < 0.145 | 260 | 38 | 450-585 T | 65-85 T | 16 T | HR | --- |
| | | | | 3.8 ≤ t < 7.0 | 0.145 ≤ t < 0.270 | 260 | 38 | 450-585 T | 65-85 T | 18 T | HR | --- |
| ASTM A414/A414M-14 | Grade E | K02704 | --- | 1.5 ≤ t < 2.2 | 0.057 ≤ t < 0.089 | 260 | 38 | 450-585 T | 65-85 T | 15 T | HR | --- |
| | | | | 2.2 ≤ t < 3.8 | 0.089 ≤ t < 0.145 | 260 | 38 | 450-585 T | 65-85 T | 16 T | HR | --- |
| | | | | 3.8 ≤ t < 7.0 | 0.145 ≤ t < 0.270 | 260 | 38 | 450-585 T | 65-85 T | 18 T | HR | --- |

**4.1 Carbon Steels for Pressure Vessel Plates**

**4.1A Mechanical Properties of Carbon Steels for Pressure Vessel Plates (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness / Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | % min. | | |
| EN 10028-2:2009 | P295GH | --- | 1.0481 | t ≤ 16 | --- | 295 | --- | 460-580 | --- | 21 | AR, N | see standard for impact data |
| | | | | 16 < t ≤ 40 | --- | 290 | --- | 460-580 | --- | 21 | AR, N | |
| | | | | 40 < t ≤ 60 | --- | 285 | --- | 460-580 | --- | 21 | AR, N | |
| | | | | 60 < t ≤ 100 | --- | 260 | --- | 460-580 | --- | 21 | AR, N | |
| | | | | 100 < t ≤ 150 | --- | 235 | --- | 440-570 | --- | 21 | AR, N | |
| | | | | 150 < t ≤ 250 | --- | 220 | --- | 430-570 | --- | 21 | AR, N | |
| EN 10120:2008 | P310NB | --- | 1.0437 | t ≤ 5 | --- | 310 | --- | 460-550 T | --- | 28 T | HR or HR+N | --- |
| JIS G 3103:2012 | Symbol SB480 | --- | --- | 6 ≤ t ≤ 50 | --- | 265 | --- | 480-620 | --- | 17 | AR, N or SR | --- |
| | | | | 50 < t ≤ 200 | --- | 265 | --- | 480-620 | --- | 21 | N | --- |
| JIS G 3118:2010 | Symbol SGV480 | --- | --- | 6 ≤ t ≤ 50 | --- | 265 | --- | 480-590 T | --- | 17 | AR, N, Q+T or TMCP | --- |
| | | | | 50 < t ≤ 200 | --- | 265 | --- | 480-590 T | --- | 21 | N, Q+T, TMCP | --- |
| ASME SA-515/SA-515M | Grade 70 [485] | K03101 | --- | t ≤ 50 | t ≤ 2 | 260 | 38 | 485-620 | 70-90 | 21 | AR or N or SR or N+SR | --- |
| | | | | t > 50 | t > 2 | 260 | 38 | 485-620 | 70-90 | 21 | N | --- |
| ASME SA-516/SA-516M | Grade 70 [485] | K02700 | --- | t ≤ 40 | t ≤ 1.50 | 260 | 38 | 485-620 | 70-90 | 21 | AR or N or SR or N+SR | --- |
| | | | | t > 40 | t > 1.50 | 260 | 38 | 485-620 | 70-90 | 21 | N | --- |
| ASME SA-537/SA-537M | Class 1 | K12437 | --- | t ≤ 65 | t ≤ 2.5 | 345 | 50 | 485-620 | 70-90 | 22 | N | --- |
| | | | | 65 < t ≤ 100 | 2.5 < t ≤ 4 | 310 | 45 | 450-585 | 65-85 | 22 | N | --- |
| ASME SA-737/SA-737M | Grade B | K12001 | --- | --- | --- | 345 | 50 | 485-620 | 70-90 | 23 | N | --- |
| ASTM A515/A515M-10 | Grade 70 [485] | K03101 | --- | t ≤ 50 | t ≤ 2 | 260 | 38 | 485-620 | 70-90 | 21 | AR, N, SR or N+SR | --- |
| | | | | t > 50 | t > 2 | 260 | 38 | 485-620 | 70-90 | 21 | N | --- |
| ASTM A516/A516M-10 | Grade 70 [485] | K02700 | --- | t ≤ 40 | t ≤ 1.50 | 260 | 38 | 485-620 | 70-90 | 21 | AR, N, SR or N+SR | --- |
| | | | | t > 40 | t > 1.50 | 260 | 38 | 485-620 | 70-90 | 21 | N | --- |
| ASME SA-414/SA-414M | Grade F | K03102 | --- | 1.5 ≤ t < 2.2 | 0.057 ≤ t < 0.089 | 290 | 42 | 485-620 T | 70-90 T | 13 T | HR | --- |
| | | | | 2.2 ≤ t < 3.8 | 0.089 ≤ t < 0.145 | 290 | 42 | 485-620 T | 70-90 T | 14 T | HR | --- |
| | | | | 3.8 ≤ t < 7.0 | 0.145 ≤ t < 0.270 | 290 | 42 | 485-620 T | 70-90 T | 16 T | HR | --- |
| ASTM A414/A414M-14 | Grade F | K03102 | --- | 1.5 ≤ t < 2.2 | 0.057 ≤ t < 0.089 | 290 | 42 | 485-620 T | 70-90 T | 13 T | HR | --- |
| | | | | 2.2 ≤ t < 3.8 | 0.089 ≤ t < 0.145 | 290 | 42 | 485-620 T | 70-90 T | 14 T | HR | --- |
| | | | | 3.8 ≤ t < 7.0 | 0.145 ≤ t < 0.270 | 290 | 42 | 485-620 T | 70-90 T | 16 T | HR | --- |
| ASTM A537/A537M-13 | Class 1 | K12437 | --- | t ≤ 65 | t ≤ 2.5 | 345 | 50 | 485-620 | 70-90 | 22 | N | --- |
| | | | | 65 < t ≤ 100 | 2.5 < t ≤ 4 | 310 | 45 | 450-585 | 65-85 | 22 | N | --- |
| ASTM A737/A737M-09 (2013) | Grade B | K12001 | --- | --- | --- | 345 | 50 | 485-620 | 70-90 | 23 | N | --- |

Note: This section continued on next page.

**4.1 Carbon Steels for Pressure Vessel Plates**

**4.1A Mechanical Properties of Carbon Steels for Pressure Vessel Plates (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness / Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | % min. | | |
| ISO 4706:1989 | carbon steel | --- | --- | t < 3 | --- | --- | --- | 490 max. | --- | 22 | N or SR | --- |
| | | | | t ≥ 3 | --- | --- | --- | 490 max. | --- | 29 | N or SR | --- |
| | alloy steel | --- | --- | t < 3 | --- | --- | --- | 490 | --- | 15 | N or SR | --- |
| | | | | t ≥ 3 | --- | --- | --- | 490 | --- | 20 | N or SR | --- |
| GB 3531-1996 | Grade 16MnDR | --- | --- | 6 ≤ t ≤ 16 | --- | 315 | --- | 490-620 | --- | 21 | N or N+T | --- |
| | | | | 16 < t ≤ 36 | --- | 295 | --- | 470-600 | --- | 21 | N or N+T | --- |
| | | | | 36 < t ≤ 60 | --- | 275 | --- | 450-580 | --- | 21 | N or N+T | --- |
| | | | | 60 < t ≤ 100 | --- | 255 | --- | 450-580 | --- | 21 | N or N+T | --- |
| JIS G 3115:2010 | Symbol SPV315 | --- | --- | 6 < t ≤ 16 | --- | 315 | --- | 490-610 | --- | 16 | AR, N, Q+T or TMCP | see standard for impact data |
| | | | | 16 < t ≤ 40 | --- | 315 | --- | 490-610 | --- | 20 | AR, N, Q+T or TMCP | L: 47 J @ 0°C |
| | | | | 40 < t ≤ 50 | --- | 315 | --- | 490-610 | --- | 23 | AR, N, Q+T or TMCP | L: 47 J @ 0°C |
| | | | | 50 < t ≤ 100 | --- | 295 | --- | 490-610 | --- | 23 | AR, N, Q+T or TMCP | L: 47 J @ 0°C |
| | | | | 100 < t ≤ 150 | --- | 275 | --- | 490-610 | --- | 23 | AR, N, Q+T or TMCP | L: 47 J @ 0°C |
| GB 6653-94 | Grade HP325 | --- | --- | --- | --- | 325 | --- | 490 T | --- | 21 T | HR, CtR or A | see standard for impact data |
| JIS G 3116:2013 | Symbol SG325 | --- | --- | 1.6 ≤ t ≤ 6.0 | --- | 325 | --- | 490 L | --- | 22 L | HR | --- |
| ISO 4978:1983 | Grade 4 | --- | --- | t < 3 | --- | 345 | --- | 490-610 | --- | 17 | N+C(A) | --- |
| | | | | 3 ≤ t ≤ 6 | --- | 345 | --- | 490-610 | --- | 24 | N+C(A) | --- |
| EN 10028-3:2009 | P355N | --- | 1.0562 | t ≤ 16 | --- | 355 | --- | 490-630 | --- | 22 | AR, N | see standard for impact data |
| | | | | 16 < t ≤ 40 | --- | 345 | --- | 490-630 | --- | 22 | AR, N | |
| | | | | 40 < t ≤ 60 | --- | 335 | --- | 490-630 | --- | 22 | AR, N | |
| | | | | 60 < t ≤ 100 | --- | 315 | --- | 470-610 | --- | 21 | AR, N | |
| | | | | 100 < t ≤ 150 | --- | 305 | --- | 460-600 | --- | 21 | AR, N | |
| | | | | 150 < t ≤ 250 | --- | 295 | --- | 450-590 | --- | 21 | AR, N | |
| | P355NH | --- | 1.0565 | t ≤ 16 | --- | 355 | --- | 490-630 | --- | 22 | AR, N | see standard for impact data |
| | | | | 16 < t ≤ 40 | --- | 345 | --- | 490-630 | --- | 22 | AR, N | |
| | | | | 40 < t ≤ 60 | --- | 335 | --- | 490-630 | --- | 22 | AR, N | |
| | | | | 60 < t ≤ 100 | --- | 315 | --- | 470-610 | --- | 21 | AR, N | |
| | | | | 100 < t ≤ 150 | --- | 305 | --- | 460-600 | --- | 21 | AR, N | |
| | | | | 150 < t ≤ 250 | --- | 295 | --- | 450-590 | --- | 21 | AR, N | |

**4.1 Carbon Steels for Pressure Vessel Plates**

**4.1A Mechanical Properties of Carbon Steels for Pressure Vessel Plates (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness / Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | % min. | | |
| GB 6654-1996 | Grade 16MnR | --- | --- | 6 < t ≤ 16 | --- | 345 | --- | 510-640 | --- | 21 | N | T: 31 J @ 20°C |
| | | | | 16 < t ≤ 36 | --- | 325 | --- | 490-620 | --- | 21 | N | T: 31 J @ 20°C |
| | | | | 36 < t ≤ 60 | --- | 305 | --- | 470-600 | --- | 21 | N | T: 31 J @ 20°C |
| | | | | 60 < t ≤ 100 | --- | 285 | --- | 460-590 | --- | 20 | N | T: 31 J @ 20°C |
| | | | | 100 < t ≤ 120 | --- | 275 | --- | 450-580 | --- | 20 | N | T: 31 J @ 20°C |
| GB 713-1997 | Grade 16Mng | --- | --- | 6 ≤ t ≤ 16 | --- | 345 | --- | 510-655 | --- | 21 | HR, CtR, N or N+T | see standard for impact data |
| | | | | 16 < t ≤ 25 | --- | 325 | --- | 490-635 | --- | 19 | HR, CtR, N or N+T | |
| | | | | 25 < t ≤ 36 | --- | 305 | --- | 470-620 | --- | 19 | HR, CtR, N or N+T | |
| | | | | 36 < t ≤ 60 | --- | 285 | --- | 470-620 | --- | 19 | HR, CtR, N or N+T | |
| | | | | 60 < t ≤ 100 | --- | 265 | --- | 440-590 | --- | 18 | HR, CtR, N or N+T | |
| | | | | 100 < t ≤ 150 | --- | 245 | --- | 440-590 | --- | 18 | HR, CtR, N or N+T | |
| | Grade 19Mng | --- | --- | 6 ≤ t ≤ 16 | --- | 355 | --- | 510-650 | --- | 20 | HR, CtR, N or N+T | T: 31 J @ 0°C |
| | | | | 16 < t ≤ 40 | --- | 345 | --- | 510-650 | --- | 20 | HR, CtR, N or N+T | T: 31 J @ 0°C |
| | | | | 40 < t ≤ 60 | --- | 335 | --- | 510-650 | --- | 20 | HR, CtR, N or N+T | T: 31 J @ 0°C |
| | | | | 60 < t ≤ 100 | --- | 315 | --- | 490-630 | --- | 20 | HR, CtR, N or N+T | T: 31 J @ 0°C |
| | | | | 100 < t ≤ 150 | --- | 295 | --- | 480-630 | --- | 20 | HR, CtR, N or N+T | T: 31 J @ 0°C |
| GB 6653-94 | Grade HP345 | --- | --- | --- | --- | 345 | --- | 510 T | --- | 20 T | HR, CtR or A | see standard for impact data |
| EN 10028-2:2009 | P355GH | --- | 1.0473 | t ≤ 16 | --- | 355 | --- | 510-650 | --- | 20 | AR, N | see standard for impact data |
| | | | | 16 < t ≤ 40 | --- | 345 | --- | 510-650 | --- | 20 | AR, N | |
| | | | | 40 < t ≤ 60 | --- | 335 | --- | 510-650 | --- | 20 | AR, N | |
| | | | | 60 < t ≤ 100 | --- | 315 | --- | 490-630 | --- | 20 | AR, N | |
| | | | | 100 < t ≤ 150 | --- | 295 | --- | 480-630 | --- | 20 | AR, N | |
| | | | | 150 < t ≤ 250 | --- | 280 | --- | 470-630 | --- | 20 | AR, N | |
| EN 10120:2008 | P355NB | --- | 1.0557 | t ≤ 5 | --- | 355 | --- | 510-620 T | --- | 24 T | HR or HR+N | --- |
| JIS G 3124:2009 | Symbol SEV 245 | --- | --- | 6 ≤ t ≤ 50 | --- | 370 | --- | 510-650 T | --- | 16 | AR, N, N+T or A | T: 31 J @ 0°C |
| | | | | 50 < t ≤ 100 | --- | 355 | --- | 510-650 T | --- | 20 | AR, N, N+T or A | T: 31 J @ 0°C |
| | | | | 100 < t ≤ 125 | --- | 345 | --- | 500-640 T | --- | 20 | AR, N, N+T or A | T: 31 J @ 0°C |
| | | | | 125 < t ≤ 150 | --- | 335 | --- | 490-630 T | --- | 20 | AR, N, N+T or A | T: 31 J @ 0°C |
| GB 713-1997 | Grade 22Mng | --- | --- | t > 25 | --- | 275 | --- | 515-655 | --- | 19 | HR, CtR, N or N+T | T: 27 J @ RT |
| ASME SA-414/SA-414M | Grade G | K03103 | --- | 1.5 ≤ t < 2.2 | 0.057 ≤ t < 0.089 | 310 | 45 | 515-655 T | 75-95 T | 13 T | HR | --- |
| | | | | 2.2 ≤ t < 3.8 | 0.089 ≤ t < 0.145 | 310 | 45 | 515-655 T | 75-95 T | 14 T | HR | --- |
| | | | | 3.8 ≤ t < 7.0 | 0.145 ≤ t < 0.270 | 310 | 45 | 515-655 T | 75-95 T | 16 T | HR | --- |

Note: This section continued on next page.

**4.1 Carbon Steels for Pressure Vessel Plates**

**4.1A Mechanical Properties of Carbon Steels for Pressure Vessel Plates (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness / Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | % min. | | |
| ASTM A414/A414M-14 | Grade G | K03103 | --- | 1.5 ≤ t < 2.2 | 0.057 ≤ t < 0.089 | 310 | 45 | 515-655 | 75-95 | 13 | HR | --- |
| | | | | 2.2 ≤ t < 3.8 | 0.089 ≤ t < 0.145 | 310 | 45 | 515-655 | 75-95 | 14 | HR | --- |
| | | | | 3.8 ≤ t < 7.0 | 0.145 ≤ t < 0.270 | 310 | 45 | 515-655 | 75-95 | 16 | HR | --- |
| ASME SA-738/SA-738M | Grade A | K12447 | --- | t ≤ 65 | t ≤ 2.5 | 310 | 45 | 515-655 | 75-95 | 20 | N or Q+T | --- |
| | | | | t > 65 | t > 2.5 | 310 | 45 | 515-655 | 75-95 | 20 | Q+T | --- |
| ASTM A738/A738M-12a | Grade A | K12447 | --- | t ≤ 65 | t ≤ 2.5 | 310 | 45 | 515-655 | 75-95 | 20 | N or Q+T | --- |
| | | | | t > 65 | t > 2.5 | 310 | 45 | 515-655 | 75-95 | 20 | Q+T | --- |
| JIS G 3115:2010 | Symbol SPV355 | --- | --- | 6 < t ≤ 16 | --- | 355 | --- | 520-640 | --- | 14 | AR, N, Q+T or TMCP | see standard for impact data |
| | | | | 16 < t ≤ 40 | --- | 355 | --- | 520-640 | --- | 18 | AR, N, Q+T or TMCP | L: 47 J @ 0°C |
| | | | | 40 < t ≤ 50 | --- | 355 | --- | 520-640 | --- | 21 | AR, N, Q+T or TMCP | L: 47 J @ 0°C |
| | | | | 50 < t ≤ 100 | --- | 335 | --- | 520-640 | --- | 21 | AR, N, Q+T or TMCP | L: 47 J @ 0°C |
| | | | | 100 < t ≤ 150 | --- | 315 | --- | 520-640 | --- | 21 | AR, N, Q+T or TMCP | L: 47 J @ 0°C |
| GB 6654-1996 | Grade 15MnVR | --- | --- | 6 < t ≤ 16 | --- | 390 | --- | 530-665 | --- | 19 | N | T: 31 J @ 20°C |
| | | | | 16 < t ≤ 36 | --- | 370 | --- | 510-645 | --- | 19 | N | T: 31 J @ 20°C |
| | | | | 36 < t ≤ 60 | --- | 350 | --- | 490-625 | --- | 19 | N | T: 31 J @ 20°C |
| GB 6653-94 | Grade HP365 | --- | --- | --- | --- | 365 | --- | 540 T | --- | 20 T | HR, CtR or A | see standard for impact data |
| JIS G 3116:2013 | Symbol SG365 | --- | --- | 1.6 ≤ t ≤ 6.0 | --- | 365 | --- | 540 L | --- | 20 L | HR | --- |
| ASME SA-537/SA-537M | Class 3 | K12437 | --- | t ≤ 65 | t ≤ 2.5 | 380 | 55 | 550-690 | 80-100 | 22 | Q+T | --- |
| | | | | 65 < t ≤ 100 | 2.5 < t ≤ 4 | 345 | 50 | 515-655 | 75-95 | 22 | Q+T | --- |
| | | | | 100 < t ≤ 150 | 4 < t ≤ 6 | 275 | 40 | 485-620 | 70-90 | 20 | Q+T | --- |
| | Class 2 | K12437 | --- | t ≤ 65 | t ≤ 2.5 | 415 | 60 | 550-690 | 80-100 | 22 | Q+T | --- |
| | | | | 65 < t ≤ 100 | 2.5 < t ≤ 4 | 380 | 55 | 515-655 | 75-95 | 22 | Q+T | --- |
| | | | | 100 < t ≤ 150 | 4 < t ≤ 6 | 315 | 46 | 485-620 | 70-90 | 20 | Q+T | --- |
| ASTM A537/A537M-13 | Class 3 | K12437 | --- | t ≤ 65 | t ≤ 2.5 | 380 | 55 | 550-690 | 80-100 | 22 | Q+T | --- |
| | | | | 65 < t ≤ 100 | 2.5 < t ≤ 4 | 345 | 50 | 515-655 | 75-95 | 22 | Q+T | --- |
| | | | | 100 < t ≤ 150 | 4 < t ≤ 6 | 275 | 40 | 485-620 | 70-90 | 20 | Q+T | --- |
| | Class 2 | K12437 | --- | t ≤ 65 | t ≤ 2.5 | 415 | 60 | 550-690 | 80-100 | 22 | Q+T | --- |
| | | | | 65 < t ≤ 100 | 2.5 < t ≤ 4 | 380 | 55 | 515-655 | 75-95 | 22 | Q+T | --- |
| | | | | 100 < t ≤ 150 | 4 < t ≤ 6 | 315 | 46 | 485-620 | 70-90 | 20 | Q+T | --- |

Note: This section continued on next page.

**4.1 Carbon Steels for Pressure Vessel Plates**

**4.1A Mechanical Properties of Carbon Steels for Pressure Vessel Plates (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness / Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation % min. | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | | | |
| JIS G 3115:2010 | Symbol SPV410 | --- | --- | 6 < t ≤ 16 | --- | 410 | --- | 550-670 | --- | 12 | N, Q+T or TMCP | see standard for impact data |
| | | | | 16 < t ≤ 40 | --- | 410 | --- | 550-670 | --- | 16 | N, Q+T or TMCP | L: 47 J @ -10°C |
| | | | | 40 < t ≤ 50 | --- | 410 | --- | 550-670 | --- | 18 | N, Q+T or TMCP | L: 47 J @ -10°C |
| | | | | 50 < t ≤ 100 | --- | 390 | --- | 550-670 | --- | 18 | N, Q+T or TMCP | L: 47 J @ -10°C |
| | | | | 100 < t ≤ 150 | --- | 370 | --- | 550-670 | --- | 18 | N, Q+T or TMCP | L: 47 J @ -10°C |
| ASME SA-737/SA-737M | Grade C | K12202 | --- | --- | --- | 415 | 60 | 550-690 | 80-100 | 23 | N | --- |
| ASTM A737/A737M-09 (2013) | Grade C | K12202 | --- | --- | --- | 415 | 60 | 550-690 | 80-100 | 23 | N | --- |
| ASME SA-738/SA-738M | Grade C | K02008 | --- | t ≤ 65 | t ≤ 2.5 | 415 | 60 | 550-690 | 80-100 | 22 | Q+T | --- |
| | | | | 65 < t ≤ 100 | 2.5 < t ≤ 4 | 380 | 55 | 515-655 | 75-95 | 22 | Q+T | --- |
| | | | | t > 100 | t > 4 | 315 | 46 | 485-620 | 70-90 | 20 | Q+T | --- |
| ASTM A738/A738M-12a | Grade C | K02008 | --- | t ≤ 65 | t ≤ 2.5 | 415 | 60 | 550-690 | 80-100 | 22 | Q+T | --- |
| | | | | 65 < t ≤ 100 | 2.5 < t ≤ 4 | 380 | 55 | 515-655 | 75-95 | 22 | Q+T | --- |
| | | | | t > 100 | t > 4 | 315 | 46 | 485-620 | 70-90 | 20 | Q+T | --- |
| ASME SA-612/SA-612M | --- | --- | --- | t ≤ 12.5 | t ≤ 0.5 | 345 | 50 | 570-725 | 83-105 | 22 | AR or N or SR or N+SR | --- |
| | | | | 12.5 < t ≤ 25 | 0.5 < t ≤ 1 | 345 | 50 | 560-695 | 81-101 | 22 | AR or N or SR or N+SR | --- |
| ASTM A612/A612M-12 | --- | --- | --- | t ≤ 12.5 | t ≤ 0.5 | 345 | 50 | 570-725 | 83-105 | 22 | AR, N, SR or N+SR | --- |
| | | | | 12.5 < t ≤ 25 | 0.5 < t ≤ 1 | 345 | 50 | 560-695 | 81-101 | 22 | AR, N, SR or N+SR | --- |
| JIS G 3115:2010 | Symbol SPV450 | --- | --- | 6 < t ≤ 16 | --- | 450 | --- | 570-700 | --- | 19 | N or Q+T | see standard for impact data |
| | | | | 16 < t ≤ 20 | --- | 450 | --- | 570-700 | --- | 26 | N or Q+T | L: 47 J @ -10°C |
| | | | | 20 < t ≤ 50 | --- | 450 | --- | 570-700 | --- | 20 | N or Q+T | L: 47 J @ -10°C |
| | | | | 50 < t ≤ 100 | --- | 430 | --- | 570-700 | --- | 20 | N or Q+T | L: 47 J @ -10°C |
| | | | | 100 < t ≤ 150 | --- | 410 | --- | 570-700 | --- | 20 | N or Q+T | L: 47 J @ -10°C |
| ASME SA-738/SA-738M | Grade B | --- | --- | --- | --- | 415 | 60 | 585-705 | 85-102 | 20 | Q+T | --- |
| ASTM A738/A738M-12a | Grade B | --- | --- | --- | --- | 415 | 60 | 585-705 | 85-102 | 20 | Q+T | --- |

**4.1 Carbon Steels for Pressure Vessel Plates**

**4.1B Chemical Composition of Carbon Steels for Pressure Vessel Plates**

| Specification | Designation | UNS No. | Steel No. | Section Thickness | | Weight, %max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| EN 10028-2:2009 | P235GH | --- | 1.0345 | --- | --- | 0.16 | 0.60-1.20 | 0.35 | 0.025 | 0.010 | 0.30 | 0.30 | 0.08 | V 0.02; Al 0.020 min.; Cu 0.30; Ti 0.03; Nb 0.020; N 0.012; (Cr+Cu+Mo+Ni) 0.70 |
| ISO 4978:1983 | Grade 2 | --- | --- | --- | --- | 0.16 | 0.25 min. | 0.15 | 0.035 | 0.035 | --- | --- | --- | Al 0.015 min. |
| ISO 9328-2:2004 | Grade P235GH | --- | --- | --- | --- | 0.16 | 0.60-1.20 | 0.30 | 0.025 | 0.015 | 0.30 | 0.30 | 0.08 | V 0.02; Al 0.02; Cu 0.30; Ti 0.03; Nb 0.02; (Cr+Cu+Mo+Ni) 0.70 |
| EN 10120:2008 | P245NB | --- | 1.0111 | --- | --- | 0.16 | 0.30 min. | 0.25 | 0.025 | 0.015 | --- | --- | --- | Al 0.020 min.; Ti 0.03; Nb 0.050; N 0.009 |
| ASME SA-414/SA-414M | Grade C | K02503 | --- | --- | --- | 0.25 | 0.90 | 0.30 | 0.035 | 0.035 | --- | --- | --- | Al 0.02-0.08 |
| ASTM A414/A414M-14 | Grade C | K02503 | --- | --- | --- | 0.25 | 0.90 | 0.30 | 0.035 | 0.035 | 0.30 | 0.40 | 0.12 | Cu 0.40; Al 0.02-0.08; V 0.03; Ti 0.025; Cb 0.02 |
| GB 6653-94 | Grade HP245 | --- | --- | --- | --- | 0.16 | 0.60 | 0.35 | 0.035 | 0.035 | 0.30 | 0.30 | 0.30 | V 0.12; Al 0.020 min.; Cu 0.20; Ti 0.20; Nb 0.060; (P+S) 0.060 |
| EN 10028-3:2009 | P275NH | --- | 1.0487 | --- | --- | 0.16 | 0.80-1.50 | 0.40 | 0.025 | 0.010 | 0.30 | 0.50 | 0.08 | V 0.05; Al 0.020 min.; Cu 0.30; Ti 0.03; Nb 0.05; N 0.012; (Nb+Ti+V) 0.05; (Cr+Cu+Mo) 0.45 |
| JIS G 3116:2013 | Symbol SG255 | --- | --- | $1.6 \le t \le 6.0$ | --- | 0.20 | 0.30 | --- | 0.020 | 0.020 | --- | --- | --- | --- |
| JIS G 3115:2010 | Symbol SPV235 | --- | --- | $6 \le t \le 100$ | --- | 0.18 | 1.40 | 0.35 | 0.030 | 0.030 | --- | --- | --- | --- |
| | | | | $100 < t \le 200$ | --- | 0.20 | 1.40 | 0.35 | 0.030 | 0.030 | --- | --- | --- | --- |
| GB 6654-1996 | Grade 20R | --- | --- | --- | --- | 0.20 | 0.40-0.90 | 0.15-0.30 | 0.035 | 0.030 | 0.30 | 0.30 | --- | Cu 0.30 |
| GB 713-1997 | Grade 20g | --- | --- | --- | --- | 0.20 | 0.50-0.90 | 0.15-0.30 | 0.035 | 0.035 | 0.30 | 0.30 | 0.10 | V 0.010; Cu 0.30 |

**4.1 Carbon Steels for Pressure Vessel Plates**

**4.1B Chemical Composition of Carbon Steels for Pressure Vessel Plates (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness mm | Section Thickness in | Weight, %max, Unless Otherwise Specified C | Mn | Si | P | S | Cr | Ni | Mo | Others |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| EN 10028-2:2009 | P265GH | --- | 1.0425 | --- | --- | 0.20 | 0.80-1.40 | 0.40 | 0.025 | 0.010 | 0.30 | 0.30 | 0.08 | V 0.02; Al 0.020 min.; Cu 0.30; Ti 0.03; Nb 0.020; N 0.012; (Cr+Cu+Mo+Ni) 0.70 |
| EN 10120:2008 | P265NB | --- | 1.0423 | --- | --- | 0.19 | 0.40 min. | 0.25 | 0.025 | 0.015 | --- | --- | --- | Al 0.020 min.; Ti 0.03; Nb 0.050; N 0.009 |
| GB 6653-94 | Grade HP265 | --- | --- | --- | --- | 0.19 | 0.80 | 0.35 | 0.035 | 0.035 | 0.30 | 0.30 | 0.30 | V 0.12; Al 0.020 min.; Cu 0.20; Ti 0.20; Nb 0.060; (P+S) 0.060 |
| ISO 4978:1983 | Grade 3 | --- | --- | --- | --- | 0.19 | 0.40 min. | 0.20 | 0.035 | 0.035 | --- | --- | --- | Al 0.015 min. |
| ISO 9328-2:2004 | Grade P265GH | --- | --- | --- | --- | 0.20 | 0.80-1.40 | 0.40 | 0.025 | 0.015 | 0.30 | 0.30 | 0.08 | V 0.02; Al 0.02; Cu 0.30; Ti 0.03; Nb 0.02; (Cr+Cu+Mo+Ni) 0.70 |
| JIS G 3103:2012 | Symbol SB410 | --- | --- | 6 ≤ t ≤ 25 | --- | 0.24 | 0.90 | 0.15-0.40 | 0.020 | 0.020 | 0.30 | 0.40 | 0.12 | V 0.03; Cu 0.40; Ti 0.03; Nb 0.02; B 0.0010; (Cu+Ni+Mo+Cr) 1.00; (Cr+Mo) 0.32 |
| | | | | 25 < t ≤ 50 | --- | 0.27 | 0.90 | 0.15-0.40 | 0.020 | 0.020 | 0.30 | 0.40 | 0.12 | V 0.03; Cu 0.40; Ti 0.03; Nb 0.02; B 0.0010; (Cu+Ni+Mo+Cr) 1.00; (Cr+Mo) 0.32 |
| | | | | 50 < t ≤ 100 | --- | 0.29 | 0.90 | 0.15-0.40 | 0.020 | 0.020 | 0.30 | 0.40 | 0.12 | V 0.03; Cu 0.40; Ti 0.03; Nb 0.02; B 0.0010; (Cu+Ni+Mo+Cr) 1.00; (Cr+Mo) 0.32 |
| | | | | 100 < t ≤ 200 | --- | 0.30 | 0.90 | 0.15-0.40 | 0.020 | 0.020 | 0.30 | 0.40 | 0.12 | V 0.03; Cu 0.40; Ti 0.03; Nb 0.02; B 0.0010; (Cu+Ni+Mo+Cr) 1.00; (Cr+Mo) 0.32 |
| JIS G 3118:2010 | Symbol SGV410 | --- | --- | 6 ≤ t ≤ 12.5 | --- | 0.21 | 0.85-1.20 | 0.15-0.40 | 0.030 | 0.030 | --- | --- | --- | --- |
| | | | | 12.5 < t ≤ 50 | --- | 0.23 | 0.85-1.20 | 0.15-0.40 | 0.030 | 0.030 | --- | --- | --- | --- |
| | | | | 50 < t ≤ 100 | --- | 0.25 | 0.85-1.20 | 0.15-0.40 | 0.030 | 0.030 | --- | --- | --- | --- |
| | | | | 100 < t ≤ 200 | --- | 0.27 | 0.85-1.20 | 0.15-0.40 | 0.030 | 0.030 | --- | --- | --- | --- |
| ASME SA-515/SA-515M* | Grade 60 [415] | K02401 | --- | t ≤ 25 | t ≤ 1 | 0.24 | 0.90 | 0.15-0.40 | 0.035 | 0.035 | 0.30 | 0.40 | 0.12 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| | | | | 25 < t ≤ 50 | 1 < t ≤ 2 | 0.27 | 0.90 | 0.15-0.40 | 0.035 | 0.035 | 0.30 | 0.40 | 0.12 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| | | | | 50 < t ≤ 100 | 2 < t ≤ 4 | 0.29 | 0.90 | 0.15-0.40 | 0.035 | 0.035 | 0.30 | 0.40 | 0.12 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| | | | | t > 100 | t > 4 | 0.31 | 0.90 | 0.15-0.40 | 0.035 | 0.035 | 0.30 | 0.40 | 0.12 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |

Note: This section continued on next page.

**4.1 Carbon Steels for Pressure Vessel Plates**

**4.1B Chemical Composition of Carbon Steels for Pressure Vessel Plates (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness | | Weight, %max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASME SA-516/SA-516M* | Grade 60 [415] | K02100 | --- | t ≤ 12.5 | t ≤ 0.5 | 0.21 | 0.60-0.90 | 0.15-0.40 | 0.035 | 0.035 | 0.30 | 0.40 | 0.12 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| | | | | 12.5 < t ≤ 50 | 0.5 < t ≤ 2 | 0.23 | 0.85-1.20 | 0.15-0.40 | 0.035 | 0.035 | 0.30 | 0.40 | 0.12 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| | | | | 50 < t ≤ 100 | 2 < t ≤ 4 | 0.25 | 0.85-1.20 | 0.15-0.40 | 0.035 | 0.035 | 0.30 | 0.40 | 0.12 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| | | | | t > 100 | t > 4 | 0.27 | 0.85-1.20 | 0.15-0.40 | 0.035 | 0.035 | 0.30 | 0.40 | 0.12 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| ASTM A515/A515M-10* | Grade 60 [415] | K02401 | --- | t ≤ 25 | t ≤ 1 | 0.24 | 0.90 | 0.15-0.40 | 0.025 | 0.025 | 0.30 | 0.40 | 0.12 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| | | | | 25 < t ≤ 50 | 1 < t ≤ 2 | 0.27 | 0.90 | 0.15-0.40 | 0.025 | 0.025 | 0.30 | 0.40 | 0.12 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| | | | | 50 < t ≤ 100 | 2 < t ≤ 4 | 0.29 | 0.90 | 0.15-0.40 | 0.025 | 0.025 | 0.30 | 0.40 | 0.12 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| | | | | t > 100 | t > 4 | 0.31 | 0.90 | 0.15-0.40 | 0.025 | 0.025 | 0.30 | 0.40 | 0.12 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| ASTM A516/A516M-10* | Grade 60 [415] | K02100 | --- | t ≤ 12.5 | t ≤ 0.5 | 0.21 | 0.60-0.90 | 0.15-0.40 | 0.025 | 0.025 | 0.30 | 0.40 | 0.12 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| | | | | 12.5 < t ≤ 50 | 0.5 < t ≤ 2 | 0.23 | 0.85-1.20 | 0.15-0.40 | 0.025 | 0.025 | 0.30 | 0.40 | 0.12 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| | | | | 50 < t ≤ 100 | 2 < t ≤ 4 | 0.25 | 0.85-1.20 | 0.15-0.40 | 0.025 | 0.025 | 0.30 | 0.40 | 0.12 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| | | | | t > 100 | t > 4 | 0.27 | 0.85-1.20 | 0.15-0.40 | 0.025 | 0.025 | 0.30 | 0.40 | 0.12 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| ASME SA-414/SA-414M | Grade D | K02505 | --- | --- | --- | 0.25 | 1.20 | 0.30 | 0.035 | 0.035 | --- | --- | --- | Al 0.02-0.08 |
| ASTM A414/A414M-14 | Grade D | K02505 | --- | --- | --- | 0.25 | 1.20 | 0.30 | 0.035 | 0.035 | 0.30 | 0.40 | 0.12 | Cu 0.40; Al 0.02-0.08; V 0.03; Ti 0.025; Cb 0.02 |
| GB 6653-94 | Grade HP295 | --- | --- | --- | --- | 0.20 | 1.00 | 0.35 | 0.035 | 0.035 | 0.30 | 0.30 | 0.30 | V 0.12; Al 0.020 min.; Cu 0.20; Ti 0.20; Nb 0.060; (P+S) 0.060 |
| JIS G 3116:2013 | Symbol SG295 | --- | --- | 1.6 ≤ t ≤ 6.0 | --- | 0.20 | 1.00 | 0.35 | 0.020 | 0.020 | --- | --- | --- | --- |
| ASME SA-515/SA-515M* | Grade 65 [450] | K02800 | --- | t ≤ 25 | t ≤ 1 | 0.28 | 0.90 | 0.15-0.40 | 0.035 | 0.035 | 0.30 | 0.40 | 0.12 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| | | | | 25 < t ≤ 50 | 1 < t ≤ 2 | 0.31 | 0.90 | 0.15-0.40 | 0.035 | 0.035 | 0.30 | 0.40 | 0.12 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| | | | | t > 50 | t > 2 | 0.33 | 0.90 | 0.15-0.40 | 0.035 | 0.035 | 0.30 | 0.40 | 0.12 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |

*: See ASTM A20/A20M-14 for additional information.

Note: This section continued on next page.

**4.1 Carbon Steels for Pressure Vessel Plates**

**4.1B Chemical Composition of Carbon Steels for Pressure Vessel Plates (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness | | Weight, %max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASME SA-516/SA-516M* | Grade 65 [450] | K02403 | --- | t ≤ 12.5 | t ≤ 0.5 | 0.24 | 0.85-1.20 | 0.15-0.40 | 0.035 | 0.035 | 0.30 | 0.40 | 0.12 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| | | | | 12.5 < t ≤ 50 | 0.5 < t ≤ 2 | 0.26 | 0.85-1.20 | 0.15-0.40 | 0.035 | 0.035 | 0.30 | 0.40 | 0.12 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| | | | | 50 < t ≤ 100 | 2 < t ≤ 4 | 0.28 | 0.85-1.20 | 0.15-0.40 | 0.035 | 0.035 | 0.30 | 0.40 | 0.12 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| | | | | t > 100 | t > 4 | 0.29 | 0.85-1.20 | 0.15-0.40 | 0.035 | 0.035 | 0.30 | 0.40 | 0.12 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| ASTM A515/A515M-10* | Grade 65 [450] | K02800 | --- | t ≤ 25 | t ≤ 1 | 0.28 | 0.90 | 0.15-0.40 | 0.025 | 0.025 | 0.30 | 0.40 | 0.12 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| | | | | 25 < t ≤ 50 | 1 < t ≤ 2 | 0.31 | 0.90 | 0.15-0.40 | 0.025 | 0.025 | 0.30 | 0.40 | 0.12 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| | | | | t > 50 | t > 2 | 0.33 | 0.90 | 0.15-0.40 | 0.025 | 0.025 | 0.30 | 0.40 | 0.12 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| ASTM A516/A516M-10* | Grade 65 [450] | K02403 | --- | t ≤ 12.5 | t ≤ 0.5 | 0.24 | 0.85-1.20 | 0.15-0.40 | 0.025 | 0.025 | 0.30 | 0.40 | 0.12 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| | | | | 12.5 < t ≤ 50 | 0.5 < t ≤ 2 | 0.26 | 0.85-1.20 | 0.15-0.40 | 0.025 | 0.025 | 0.30 | 0.40 | 0.12 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| | | | | 50 < t ≤ 100 | 2 < t ≤ 4 | 0.28 | 0.85-1.20 | 0.15-0.40 | 0.025 | 0.025 | 0.30 | 0.40 | 0.12 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| | | | | t > 100 | t > 4 | 0.29 | 0.85-1.20 | 0.15-0.40 | 0.025 | 0.025 | 0.30 | 0.40 | 0.12 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| JIS G 3103:2012 | Symbol SB450 | --- | --- | 6 ≤ t ≤ 25 | --- | 0.28 | 0.90 | 0.15-0.40 | 0.020 | 0.020 | 0.30 | 0.40 | 0.12 | V 0.03; Cu 0.40; Ti 0.03; Nb 0.02; B 0.0010; (Cu+Ni+Mo+Cr) 1.00; (Cr+Mo) 0.32 |
| | | | | 25 < t ≤ 50 | --- | 0.31 | 0.90 | 0.15-0.40 | 0.020 | 0.020 | 0.30 | 0.40 | 0.12 | V 0.03; Cu 0.40; Ti 0.03; Nb 0.02; B 0.0010; (Cu+Ni+Mo+Cr) 1.00; (Cr+Mo) 0.32 |
| | | | | 50 < t ≤ 200 | --- | 0.33 | 0.90 | 0.15-0.40 | 0.020 | 0.020 | 0.30 | 0.40 | 0.12 | V 0.03; Cu 0.40; Ti 0.03; Nb 0.02; B 0.0010; (Cu+Ni+Mo+Cr) 1.00; (Cr+Mo) 0.32 |
| JIS G 3118:2010 | Symbol SGV450 | --- | --- | 6 ≤ t ≤ 12.5 | --- | 0.24 | 0.85-1.20 | 0.15-0.40 | 0.030 | 0.030 | --- | --- | --- | --- |
| | | | | 12.5 < t ≤ 50 | --- | 0.26 | 0.85-1.20 | 0.15-0.40 | 0.030 | 0.030 | --- | --- | --- | --- |
| | | | | 50 < t ≤ 100 | --- | 0.28 | 0.85-1.20 | 0.15-0.40 | 0.030 | 0.030 | --- | --- | --- | --- |
| | | | | 100 < t ≤ 200 | --- | 0.29 | 0.85-1.20 | 0.15-0.40 | 0.030 | 0.030 | --- | --- | --- | --- |
| ASME SA-414/SA-414M | Grade E | K02704 | --- | --- | --- | 0.27 | 1.20 | 0.30 | 0.035 | 0.035 | --- | --- | --- | Al 0.02-0.08 |
| ASTM A414/A414M-14 | Grade E | K02704 | --- | --- | --- | 0.27 | 1.20 | 0.30 | 0.035 | 0.035 | 0.30 | 0.40 | 0.12 | Cu 0.40; Al 0.02-0.08; V 0.03; Ti 0.025; Cb 0.02 |

*: See ASTM A20/A20M-14 for additional information.

**4.1 Carbon Steels for Pressure Vessel Plates**

**4.1B Chemical Composition of Carbon Steels for Pressure Vessel Plates (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness mm | Section Thickness in | Weight, %max, Unless Otherwise Specified C | Mn | Si | P | S | Cr | Ni | Mo | Others |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| EN 10028-2:2009 | P295GH | --- | 1.0481 | --- | --- | 0.08-0.20 | 0.90-1.50 | 0.40 | 0.025 | 0.010 | 0.30 | 0.30 | 0.08 | V 0.02; Al 0.020 min.; Cu 0.30; Ti 0.03; Nb 0.020; N 0.012; (Cr+Cu+Mo+Ni) 0.70 |
| EN 10120:2008 | P310NB | --- | 1.0437 | --- | --- | 0.20 | 0.70 min. | 0.50 | 0.025 | 0.015 | --- | --- | --- | Al 0.020 min.; Ti 0.03; Nb 0.050; N 0.009 |
| JIS G 3103:2012 | Symbol SB480 | --- | --- | 6 ≤ t ≤ 25 | --- | 0.31 | 1.20 | 0.15-0.40 | 0.020 | 0.020 | 0.30 | 0.40 | 0.12 | V 0.03; Cu 0.40; Ti 0.03; Nb 0.02; B 0.0010; (Cu+Ni+Mo+Cr) 1.00; (Cr+Mo) 0.32 |
| | | | | 25 < t ≤ 50 | --- | 0.33 | 1.20 | 0.15-0.40 | 0.020 | 0.020 | 0.30 | 0.40 | 0.12 | V 0.03; Cu 0.40; Ti 0.03; Nb 0.02; B 0.0010; (Cu+Ni+Mo+Cr) 1.00; (Cr+Mo) 0.32 |
| | | | | 50 < t ≤ 200 | --- | 0.35 | 1.20 | 0.15-0.40 | 0.020 | 0.020 | 0.30 | 0.40 | 0.12 | V 0.03; Cu 0.40; Ti 0.03; Nb 0.02; B 0.0010; (Cu+Ni+Mo+Cr) 1.00; (Cr+Mo) 0.32 |
| JIS G 3118:2010 | Symbol SGV480 | --- | --- | 6 ≤ t ≤ 12.5 | --- | 0.27 | 0.85-1.20 | 0.15-0.40 | 0.030 | 0.030 | --- | --- | --- | --- |
| | | | | 12.5 < t ≤ 50 | --- | 0.28 | 0.85-1.20 | 0.15-0.40 | 0.030 | 0.030 | --- | --- | --- | --- |
| | | | | 50 < t ≤ 100 | --- | 0.30 | 0.85-1.20 | 0.15-0.40 | 0.030 | 0.030 | --- | --- | --- | --- |
| | | | | 100 < t ≤ 200 | --- | 0.31 | 0.85-1.20 | 0.15-0.40 | 0.030 | 0.030 | --- | --- | --- | --- |
| ASME SA-515/SA-515M* | Grade 70 [485] | K03101 | --- | t ≤ 25 | t ≤ 1 | 0.31 | 1.20 | 0.15-0.40 | 0.035 | 0.035 | 0.30 | 0.40 | 0.12 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| | | | | 25 < t ≤ 50 | 1 < t ≤ 2 | 0.33 | 1.20 | 0.15-0.40 | 0.035 | 0.035 | 0.30 | 0.40 | 0.12 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| | | | | t > 50 | t > 2 | 0.35 | 1.20 | 0.15-0.40 | 0.035 | 0.035 | 0.30 | 0.40 | 0.12 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| ASME SA-516/SA-516M* | Grade 70 [485] | K02700 | --- | t ≤ 12.5 | t ≤ 0.5 | 0.27 | 0.85-1.20 | 0.15-0.40 | 0.035 | 0.035 | 0.30 | 0.40 | 0.12 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| | | | | 12.5 < t ≤ 50 | 0.5 < t ≤ 2 | 0.28 | 0.85-1.20 | 0.15-0.40 | 0.035 | 0.035 | 0.30 | 0.40 | 0.12 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| | | | | 50 < t ≤ 100 | 2 < t ≤ 4 | 0.30 | 0.85-1.20 | 0.15-0.40 | 0.035 | 0.035 | 0.30 | 0.40 | 0.12 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| | | | | t > 100 | t > 4 | 0.31 | 0.85-1.20 | 0.15-0.40 | 0.035 | 0.035 | 0.30 | 0.40 | 0.12 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| ASME SA-537/SA-537M* | Class 1 | K12437 | --- | t ≤ 40 | t ≤ 1.5 | 0.24 | 0.70-1.35 | 0.15-0.50 | 0.035 | 0.035 | 0.25 | 0.25 | 0.08 | V 0.03; Cu 0.35; Ti 0.03; Cb 0.02; B 0.0010 |
| | | | | 40 < t ≤ 100 | 1.5 < t ≤ 4 | 0.24 | 1.00-1.60 | 0.15-0.50 | 0.035 | 0.035 | 0.25 | 0.25 | 0.08 | V 0.03; Cu 0.35; Ti 0.03; Cb 0.02; B 0.0010 |
| ASME SA-737/SA-737M* | Grade B | K12001 | --- | --- | --- | 0.20 | 1.15-1.50 | 0.15-0.50 | 0.025 | 0.025 | 0.30 | 0.40 | 0.12 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.05; B 0.0010 |

*: See ASTM A20/A20M-14 for additional information.

Note: This section continued on next page.

**4.1 Carbon Steels for Pressure Vessel Plates**

**4.1B Chemical Composition of Carbon Steels for Pressure Vessel Plates (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness mm | Section Thickness in | Weight, %max, Unless Otherwise Specified C | Mn | Si | P | S | Cr | Ni | Mo | Others |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ASTM A515/A515M-10* | Grade 70 [485] | K03101 | --- | t ≤ 25 | t ≤ 1 | 0.31 | 1.20 | 0.15-0.40 | 0.025 | 0.025 | 0.30 | 0.40 | 0.12 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| | | | | 25 < t ≤ 50 | 1 < t ≤ 2 | 0.33 | 1.20 | 0.15-0.40 | 0.025 | 0.025 | 0.30 | 0.40 | 0.12 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| | | | | t > 50 | t > 2 | 0.35 | 1.20 | 0.15-0.40 | 0.025 | 0.025 | 0.30 | 0.40 | 0.12 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| ASTM A516/A516M-10* | Grade 70 [485] | K02700 | --- | t ≤ 25 | t ≤ 1 | 0.27 | 0.85-1.20 | 0.15-0.40 | 0.025 | 0.025 | 0.30 | 0.40 | 0.12 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| | | | | 25 < t ≤ 50 | 1 < t ≤ 2 | 0.28 | 0.85-1.20 | 0.15-0.40 | 0.025 | 0.025 | 0.30 | 0.40 | 0.12 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| | | | | 50 < t ≤ 100 | 2 < t ≤ 4 | 0.30 | 0.85-1.20 | 0.15-0.40 | 0.025 | 0.025 | 0.30 | 0.40 | 0.12 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| | | | | t > 100 | t > 4 | 0.31 | 0.85-1.20 | 0.15-0.40 | 0.025 | 0.025 | 0.30 | 0.40 | 0.12 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| ASME SA-414/SA-414M | Grade F | K03102 | --- | --- | --- | 0.31 | 1.20 | 0.30 | 0.035 | 0.035 | --- | --- | --- | Al 0.02-0.08 |
| ASTM A414/A414M-14 | Grade F | K03102 | --- | --- | --- | 0.31 | 1.20 | 0.30 | 0.035 | 0.035 | 0.30 | 0.40 | 0.12 | Cu 0.40; Al 0.02-0.08; V 0.03; Ti 0.025; Cb 0.02 |
| ASTM A537/A537M-13* | Class 1 | K12437 | --- | t ≤ 40 | t ≤ 1.5 | 0.24 | 0.70-1.35 | 0.15-0.50 | 0.025 | 0.025 | 0.25 | 0.25 | 0.08 | V 0.03; Cu 0.35; Ti 0.03; Cb 0.02; B 0.0010 |
| | | | | t > 40 | t > 1.5 | 0.24 | 1.00-1.60 | 0.15-0.50 | 0.025 | 0.025 | 0.25 | 0.25 | 0.08 | V 0.03; Cu 0.35; Ti 0.03; Cb 0.02; B 0.0010 |
| ASTM A737/A737M-09 (2013)* | Grade B | K12001 | --- | --- | --- | 0.20 | 1.15-1.50 | 0.15-0.50 | 0.025 | 0.025 | 0.30 | 0.40 | 0.12 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.05; B 0.0010 |
| ISO 4706:1989 | carbon steel | --- | --- | --- | --- | 0.22 | 1.60 | 0.45 | 0.04 | 0.04 | --- | --- | --- | (P+S) 0.07 |
| | alloy steel | --- | --- | --- | --- | 0.22 | 1.60 | 0.45 | 0.04 | 0.04 | --- | --- | --- | V 0.20; Ti 0.20; Nb 0.08; (P+S) 0.07; (Nb+V) 0.20 |
| GB 3531-1996 | Grade 16MnDR | --- | --- | --- | --- | 0.20 | 1.20-1.60 | 0.15-0.50 | 0.030 | 0.025 | 0.25 | 0.40 | 0.08 | Al 0.020 min.; Cu 0.25 |
| JIS G 3115:2010 | Symbol SPV315 | --- | --- | 6 ≤ t ≤ 150 | --- | 0.18 | 1.60 | 0.55 | 0.030 | 0.030 | --- | --- | --- | --- |
| GB 6653-94 | Grade HP325 | --- | --- | --- | --- | 0.20 | 1.50 | 0.35 | 0.035 | 0.035 | 0.30 | 0.30 | 0.30 | V 0.12; Al 0.020 min.; Cu 0.20; Ti 0.20; Nb 0.060; (P+S) 0.060 |
| JIS G 3116:2013 | Symbol SG325 | --- | --- | 1.6 ≤ t ≤ 6.0 | --- | 0.20 | 1.50 | 0.55 | 0.020 | 0.020 | --- | --- | --- | --- |
| ISO 4978:1983 | Grade 4 | --- | --- | --- | --- | 0.20 | 0.70 min. | 0.45 | 0.035 | 0.035 | --- | --- | --- | Al 0.015 min. |
| EN 10028-3:2009 | P355N | --- | 1.0562 | --- | --- | 0.18 | 1.10-1.70 | 0.50 | 0.025 | 0.010 | 0.30 | 0.50 | 0.08 | V 0.10; Al 0.020 min.; Cu 0.30; Ti 0.03; Nb 0.05; N 0.012; (Nb+Ti+V) 0.12; (Cr+Cu+Mo) 0.45 |
| | P355NH | --- | 1.0565 | --- | --- | 0.18 | 1.10-1.70 | 0.50 | 0.025 | 0.010 | 0.30 | 0.50 | 0.08 | V 0.10; Al 0.020 min.; Cu 0.30; Ti 0.03; Nb 0.05; N 0.012; (Nb+Ti+V) 0.12; (Cr+Cu+Mo) 0.45 |

*: See ASTM A20/A20M-14 for additional information.

**4.1 Carbon Steels for Pressure Vessel Plates**

**4.1B Chemical Composition of Carbon Steels for Pressure Vessel Plates (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness mm | Section Thickness in | Weight, %max, Unless Otherwise Specified C | Mn | Si | P | S | Cr | Ni | Mo | Others |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GB 6654-1996 | Grade 16MnR | --- | --- | --- | --- | 0.20 | 1.20-1.60 | 0.20-0.55 | 0.035 | 0.030 | 0.30 | 0.30 | --- | Cu 0.30 |
| GB 713-1997 | Grade 16Mng | --- | --- | --- | --- | 0.20 | 1.20-1.60 | 0.20-0.55 | 0.035 | 0.030 | 0.30 | 0.30 | 0.10 | V 0.010; Cu 0.30 |
| | Grade 19Mng | --- | --- | --- | --- | 0.15-0.22 | 1.00-1.60 | 0.30-0.60 | 0.030 | 0.025 | 0.30 | 0.30 | 0.10 | V 0.010; Cu 0.30 |
| GB 6653-94 | Grade HP345 | --- | --- | --- | --- | 0.20 | 1.50 | 0.35 | 0.035 | 0.035 | 0.30 | 0.30 | 0.30 | V 0.12; Al 0.020 min.; Cu 0.20; Ti 0.20; Nb 0.060; (P+S) 0.060 |
| EN 10028-2:2009 | P355GH | --- | 1.0473 | --- | --- | 0.10-0.22 | 1.10-1.70 | 0.60 | 0.025 | 0.010 | 0.30 | 0.30 | 0.08 | V 0.02; Al 0.020 min.; Cu 0.30; Ti 0.03; Nb 0.040; N 0.012; (Cr+Cu+Mo+Ni) 0.70 |
| EN 10120:2008 | P355NB | --- | 1.0557 | --- | --- | 0.20 | 0.70 min. | 0.50 | 0.025 | 0.015 | --- | --- | --- | Al 0.020 min.; Ti 0.03; Nb 0.050; N 0.009 |
| JIS G 3124:2009 | Symbol SEV245 | --- | --- | 6 ≤ t ≤ 150 | --- | 0.20 | 0.80-1.60 | 0.15-0.60 | 0.030 | 0.030 | --- | --- | 0.35 | V 0.10; Cu 0.40; Nb 0.05 |
| GB 713-1997 | Grade 22Mng | --- | --- | --- | --- | 0.30 | 0.90-1.50 | 0.15-0.40 | 0.025 | 0.025 | 0.30 | 0.30 | 0.10 | V 0.010; Cu 0.30 |
| ASME SA-414/SA-414M | Grade G | K03103 | --- | --- | --- | 0.31 | 1.35 | 0.30 | 0.035 | 0.035 | --- | --- | --- | Al 0.02-0.08 |
| ASTM A414/A414M-14 | Grade G | K03103 | --- | --- | --- | 0.31 | 1.35 | 0.30 | 0.035 | 0.035 | 0.30 | 0.40 | 0.12 | Cu 0.40; Al 0.02-0.08; V 0.03; Ti 0.025; Cb 0.02 |
| ASME SA-738/SA-738M | Grade A | K12447 | --- | t ≤ 65 | t ≤ 2.5 | 0.24 | 1.50 | 0.15-0.50 | 0.035 | 0.035 | 0.25 | 0.50 | 0.08 | V 0.07; Cu 0.35; Cb 0.04; (Cb+V) 0.08 |
| | | | | 65 < t ≤ 150 | 2.5 < t ≤ 6 | 0.24 | 1.60 | 0.15-0.50 | 0.035 | 0.035 | 0.25 | 0.50 | 0.08 | V 0.07; Cu 0.35; Cb 0.04; (Cb+V) 0.08 |
| ASTM A738/A738M-12a | Grade A | K12447 | --- | t ≤ 65 | t ≤ 2.5 | 0.24 | 1.50 | 0.15-0.50 | 0.025 | 0.025 | 0.25 | 0.50 | 0.08 | V 0.07; Cu 0.35; Cb 0.04; (Cb+V) 0.08 |
| | | | | 65 < t ≤ 150 | 2.5 < t ≤ 6 | 0.24 | 1.60 | 0.15-0.50 | 0.025 | 0.025 | 0.25 | 0.50 | 0.08 | V 0.07; Cu 0.35; Cb 0.04; (Cb+V) 0.08 |
| JIS G 3115:2010 | Symbol SPV355 | --- | --- | 6 ≤ t ≤ 150 | --- | 0.20 | 1.60 | 0.55 | 0.030 | 0.030 | --- | --- | --- | --- |
| GB 6654-1996 | Grade 15MnVR | --- | --- | --- | --- | 0.18 | 1.20-1.60 | 0.20-0.55 | 0.035 | 0.030 | 0.30 | 0.30 | --- | V 0.04-0.12; Cu 0.30 |
| GB 6653-94 | Grade HP365 | --- | --- | --- | --- | 0.20 | 1.50 | 0.35 | 0.035 | 0.035 | 0.30 | 0.30 | 0.30 | V 0.12; Al 0.020 min.; Cu 0.20; Ti 0.20; Nb 0.060; (P+S) 0.060 |
| JIS G 3116:2013 | Symbol SG365 | --- | --- | 1.6 ≤ t ≤ 6.0 | --- | 0.20 | 1.50 | 0.55 | 0.020 | 0.020 | --- | --- | --- | --- |

Note: This section continued on next page.

**4.1 Carbon Steels for Pressure Vessel Plates**

**4.1B Chemical Composition of Carbon Steels for Pressure Vessel Plates (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness | | Weight, %max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASME SA-537/SA-537M* | Class 3 | K12437 | --- | t ≤ 40 | t ≤ 1.5 | 0.24 | 0.70-1.35 | 0.15-0.50 | 0.035 | 0.035 | 0.25 | 0.25 | 0.08 | V 0.03; Cu 0.35; Ti 0.03; Cb 0.02; B 0.0010 |
| | | | | 40 < t ≤ 150 | 1.5 < t ≤ 6 | 0.24 | 1.00-1.60 | 0.15-0.50 | 0.035 | 0.035 | 0.25 | 0.25 | 0.08 | V 0.03; Cu 0.35; Ti 0.03; Cb 0.02; B 0.0010 |
| | Class 2 | K12437 | --- | t ≤ 40 | t ≤ 1.5 | 0.24 | 0.70-1.35 | 0.15-0.50 | 0.035 | 0.035 | 0.25 | 0.25 | 0.08 | V 0.03; Cu 0.35; Ti 0.03; Cb 0.02; B 0.0010 |
| | | | | 40 < t ≤ 150 | 1.5 < t ≤ 6 | 0.24 | 1.00-1.60 | 0.15-0.50 | 0.035 | 0.035 | 0.25 | 0.25 | 0.08 | V 0.03; Cu 0.35; Ti 0.03; Cb 0.02; B 0.0010 |
| ASTM A537/A537M-13* | Class 3 | K12437 | --- | t ≤ 40 | t ≤ 1.5 | 0.24 | 0.70-1.35 | 0.15-0.50 | 0.025 | 0.025 | 0.25 | 0.25 | 0.08 | V 0.03; Cu 0.35; Ti 0.03; Cb 0.02; B 0.0010 |
| | | | | 40 < t ≤ 150 | 1.5 < t ≤ 6 | 0.24 | 1.00-1.60 | 0.15-0.50 | 0.025 | 0.025 | 0.25 | 0.25 | 0.08 | V 0.03; Cu 0.35; Ti 0.03; Cb 0.02; B 0.0010 |
| | Class 2 | K12437 | --- | t ≤ 40 | t ≤ 1.5 | 0.24 | 0.70-1.35 | 0.15-0.50 | 0.025 | 0.025 | 0.25 | 0.25 | 0.08 | V 0.03; Cu 0.35; Ti 0.03; Cb 0.02; B 0.0010 |
| | | | | 40 < t ≤ 150 | 1.5 < t ≤ 6 | 0.24 | 1.00-1.60 | 0.15-0.50 | 0.025 | 0.025 | 0.25 | 0.25 | 0.08 | V 0.03; Cu 0.35; Ti 0.03; Cb 0.02; B 0.0010 |
| JIS G 3115:2010 | Symbol SPV410 | --- | --- | 6 ≤ t ≤ 150 | --- | 0.18 | 1.60 | 0.75 | 0.030 | 0.030 | --- | --- | --- | --- |
| ASME SA-737/SA-737M* | Grade C | K12202 | --- | --- | --- | 0.22 | 1.15-1.50 | 0.15-0.50 | 0.025 | 0.025 | 0.30 | 0.40 | 0.12 | V 0.04-0.11; Cu 0.40; Ti 0.03; Cb 0.05; N 0.03; B 0.0010 |
| ASTM A737/A737M-09 (2013)* | Grade C | K12202 | --- | --- | --- | 0.22 | 1.15-1.50 | 0.15-0.50 | 0.025 | 0.025 | 0.30 | 0.40 | 0.12 | V 0.04-0.11; Cu 0.40; Ti 0.03; Cb 0.05; N 0.03; B 0.0010 |
| ASME SA-738/SA-738M | Grade C | K02008 | --- | t ≤ 65 | t ≤ 2.5 | 0.20 | 1.50 | 0.15-0.50 | 0.025 | 0.025 | 0.25 | 0.50 | 0.08 | V 0.05; Cu 0.35 |
| | | | | 65 < t ≤ 150 | 2.5 < t ≤ 6 | 0.20 | 1.60 | 0.15-0.50 | 0.025 | 0.025 | 0.25 | 0.50 | 0.08 | V 0.05; Cu 0.35 |
| ASTM A738/A738M-12a | Grade C | K02008 | --- | t ≤ 65 | t ≤ 2.5 | 0.20 | 1.50 | 0.15-0.50 | 0.025 | 0.025 | 0.25 | 0.50 | 0.08 | V 0.05; Cu 0.35 |
| | | | | 65 < t ≤ 150 | 2.5 < t ≤ 6 | 0.20 | 1.60 | 0.15-0.50 | 0.025 | 0.025 | 0.25 | 0.50 | 0.08 | V 0.05; Cu 0.35 |
| ASME SA-612/SA-612M | --- | --- | --- | --- | --- | 0.25 | 1.00-1.50 | 0.15-0.50 | 0.025 | 0.025 | 0.25 | 0.25 | 0.08 | V 0.08; Cu 0.35 |
| ASTM A612/A612M-12 | --- | --- | --- | --- | --- | 0.25 | 1.00-1.50 | 0.15-0.50 | 0.025 | 0.025 | 0.25 | 0.25 | 0.08 | V 0.08; Cu 0.35 |
| JIS G 3115:2010 | Symbol SPV450 | --- | --- | 6 ≤ t ≤ 150 | --- | 0.18 | 1.60 | 0.75 | 0.030 | 0.030 | --- | --- | --- | --- |
| ASME SA-738/SA-738M | Grade B | --- | --- | t ≤ 40 | t ≤ 1.5 | 0.20 | 0.90-1.50 | 0.15-0.55 | 0.030 | 0.030 | 0.30 | 0.60 | 0.20 | V 0.07; Cu 0.35; Cb 0.04; (Cb+V) 0.08 |
| | | | | 40 < t ≤ 65 | 1.5 < t ≤ 2.5 | 0.20 | 0.90-1.50 | 0.15-0.55 | 0.030 | 0.030 | 0.30 | 0.60 | 0.20 | V 0.07; Cu 0.35; Cb 0.04; (Cb+V) 0.08 |
| | | | | 65 < t ≤ 100 | 2.5 < t ≤ 4 | 0.20 | 0.90-1.60 | 0.15-0.55 | 0.030 | 0.030 | 0.30 | 0.60 | 0.20 | V 0.07; Cu 0.35; Cb 0.04; (Cb+V) 0.08 |
| ASTM A738/A738M-12a | Grade B | --- | --- | t ≤ 40 | t ≤ 1.5 | 0.20 | 0.90-1.50 | 0.15-0.55 | 0.025 | 0.025 | 0.30 | 0.60 | 0.20 | V 0.07; Cu 0.35; Cb 0.04; (Cb+V) 0.08 |
| | | | | 40 < t ≤ 65 | 1.5 < t ≤ 2.5 | 0.20 | 0.90-1.50 | 0.15-0.55 | 0.025 | 0.025 | 0.30 | 0.60 | 0.20 | V 0.07; Cu 0.35; Cb 0.04; (Cb+V) 0.08 |
| | | | | 65 < t ≤ 100 | 2.5 < t ≤ 4 | 0.20 | 0.90-1.60 | 0.15-0.55 | 0.025 | 0.025 | 0.30 | 0.60 | 0.20 | V 0.07; Cu 0.35; Cb 0.04; (Cb+V) 0.08 |

*: See ASTM A20/A20M-14 for additional information.

### 4.2 Carbon Steels for Pressure Vessel Plates – With Impact Testing Below -20°C

### 4.2A Mechanical Properties of Carbon Steels for Pressure Vessel Plates – With Impact Testing Below -20°C

| Specification | Designation | UNS No. | Steel No. | Section Thickness / Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | % min. | | |
| EN 10028-3:2009 | P275NL1 | --- | 1.0488 | t ≤ 16 | --- | 275 | --- | 390-510 | --- | 24 | AR, N | see standard for impact data |
| | | | | 16 < t ≤ 40 | --- | 265 | --- | 390-510 | --- | 24 | AR, N | |
| | | | | 40 < t ≤ 60 | --- | 255 | --- | 390-510 | --- | 24 | AR, N | |
| | | | | 60 < t ≤ 100 | --- | 235 | --- | 370-490 | --- | 23 | AR, N | |
| | | | | 100 < t ≤ 150 | --- | 225 | --- | 360-480 | --- | 23 | AR, N | |
| | | | | 150 < t ≤ 250 | --- | 215 | --- | 350-470 | --- | 23 | AR, N | |
| | P275NL2 | --- | 1.1104 | t ≤ 16 | --- | 275 | --- | 390-510 | --- | 24 | AR, N | see standard for impact data |
| | | | | 16 < t ≤ 40 | --- | 265 | --- | 390-510 | --- | 24 | AR, N | |
| | | | | 40 < t ≤ 60 | --- | 255 | --- | 390-510 | --- | 24 | AR, N | |
| | | | | 60 < t ≤ 100 | --- | 235 | --- | 370-490 | --- | 23 | AR, N | |
| | | | | 100 < t ≤ 150 | --- | 225 | --- | 360-480 | --- | 23 | AR, N | |
| | | | | 150 < t ≤ 250 | --- | 215 | --- | 350-470 | --- | 23 | AR, N | |
| ASME SA-662/SA-662M | Grade A | K01701 | --- | --- | --- | 275 | 40 | 400-540 | 58-78 | 23 | N | --- |
| ASTM A662/A662M-12 | Grade A | K01701 | --- | --- | --- | 275 | 40 | 400-540 | 58-78 | 23 | N | --- |
| JIS G 3126:2009 | Symbol SLA235A | --- | --- | 6 ≤ t ≤ 16 | --- | 235 | --- | 400-510 T | --- | 18 | N or TMCP | see standard for impact data |
| | | | | 16 < t ≤ 40 | --- | 235 | --- | 400-510 T | --- | 22 | N or TMCP | |
| | | | | 40 < t ≤ 50 | --- | 215 | --- | 400-510 T | --- | 24 | N or TMCP | |
| | Symbol SLA235B | --- | --- | 6 ≤ t ≤ 16 | --- | 235 | --- | 400-510 T | --- | 18 | N or TMCP | see standard for impact data |
| | | | | 16 < t ≤ 40 | --- | 235 | --- | 400-510 T | --- | 22 | N or TMCP | |
| | | | | 40 < t ≤ 50 | --- | 215 | --- | 400-510 T | --- | 24 | N or TMCP | |
| | Symbol SLA325A | --- | --- | 6 ≤ t ≤ 16 | --- | 325 | --- | 440-560 T | --- | 22 | N or TMCP | see standard for impact data |
| | | | | 16 < t ≤ 20 | --- | 325 | --- | 440-560 T | --- | 30 | N or TMCP | |
| | | | | 20 < t ≤ 38 | --- | 325 | --- | 440-560 T | --- | 22 | N or TMCP | |
| | Symbol SLA325B | --- | --- | 6 ≤ t ≤ 16 | --- | 325 | --- | 440-560 T | --- | 22 | Q+T or TMCP | see standard for impact data |
| | | | | 16 < t ≤ 20 | --- | 325 | --- | 440-560 T | --- | 30 | Q+T or TMCP | |
| | | | | 20 < t ≤ 38 | --- | 325 | --- | 440-560 T | --- | 22 | Q+T or TMCP | |

**4.2 Carbon Steels for Pressure Vessel Plates – With Impact Testing Below -20°C**

**4.2A Mechanical Properties of Carbon Steels for Pressure Vessel Plates – With Impact Testing Below -20°C (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness / Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | % min. | | |
| ASME SA-662/SA-662M | Grade B | K02203 | --- | t ≤ 40 | t ≤ 1.5 | 275 | 40 | 450-585 | 65-85 | 23 | AR, N, SR or N+SR | --- |
| | | | | t > 40 | t > 1.5 | 275 | 40 | 450-585 | 65-85 | 23 | N | --- |
| | Grade C | K02007 | --- | t ≤ 40 | t ≤ 1.5 | 295 | 43 | 485-620 | 70-90 | 22 | AR, N, SR or N+SR | --- |
| | | | | t > 40 | t > 1.5 | 295 | 43 | 485-620 | 70-90 | 22 | N | --- |
| ASTM A662/A662M-12 | Grade B | K02203 | --- | t ≤ 40 | t ≤ 1.5 | 275 | 40 | 450-585 | 65-85 | 23 | AR, N, SR or N+SR | --- |
| | | | | t > 40 | t > 1.5 | 275 | 40 | 450-585 | 65-85 | 23 | N | --- |
| | Grade C | K02007 | --- | t ≤ 40 | t ≤ 1.5 | 295 | 43 | 485-620 | 70-90 | 22 | AR, N, SR or N+SR | --- |
| | | | | t > 40 | t > 1.5 | 295 | 43 | 485-620 | 70-90 | 22 | N | --- |
| ASME SA-841/SA-841M | Grade A, Class 1 | K02010 | --- | t ≤ 65 | t ≤ 2.5 | 345 | 50 | 480-620 | 70-90 | 22 | TMCP | L: 20 J @ -40°C |
| | | | | 65 < t ≤ 100 | 2.5 < t ≤ 4 | 315 | 45 | 450-585 | 65-85 | 22 | TMCP | L: 20 J @ -40°C |
| | Grade B, Class 1 | --- | --- | t ≤ 65 | t ≤ 2.5 | 345 | 50 | 480-620 | 70-90 | 22 | TMCP | L: 20 J @ -40°C |
| | | | | 65 < t ≤ 100 | 2.5 < t ≤ 4 | 315 | 45 | 450-585 | 65-85 | 22 | TMCP | L: 20 J @ -40°C |
| | Grade C, Class 1 | --- | --- | t ≤ 65 | t ≤ 2.5 | 345 | 50 | 480-620 | 70-90 | 22 | TMCP | L: 20 J @ -40°C |
| | | | | 65 < t ≤ 100 | 2.5 < t ≤ 4 | 315 | 45 | 450-585 | 65-85 | 22 | TMCP | L: 20 J @ -40°C |
| ASTM A841/A841M-13 | Grade A, Class 1 | K02010 | --- | t ≤ 65 | t ≤ 2.5 | 345 | 50 | 480-620 | 70-90 | 22 | TMCP | L: 20 J @ -40°C |
| | | | | 65 < t ≤ 100 | 2.5 < t ≤ 4 | 315 | 45 | 450-585 | 65-85 | 22 | TMCP | L: 20 J @ -40°C |
| | Grade B, Class 1 | --- | --- | t ≤ 65 | t ≤ 2.5 | 345 | 50 | 480-620 | 70-90 | 22 | TMCP | L: 20 J @ -40°C |
| | | | | 65 < t ≤ 100 | 2.5 < t ≤ 4 | 315 | 45 | 450-585 | 65-85 | 22 | TMCP | L: 20 J @ -40°C |
| | Grade C, Class 1 | --- | --- | t ≤ 65 | t ≤ 2.5 | 345 | 50 | 480-620 | 70-90 | 22 | TMCP | L: 20 J @ -40°C |
| | | | | 65 < t ≤ 100 | 2.5 < t ≤ 4 | 315 | 45 | 450-585 | 65-85 | 22 | TMCP | L: 20 J @ -40°C |
| EN 10028-3:2009 | P355NL1 | --- | 1.0566 | t ≤ 16 | --- | 355 | --- | 490-630 | --- | 22 | AR, N | see standard for impact data |
| | | | | 16 < t ≤ 40 | --- | 345 | --- | 490-630 | --- | 22 | AR, N | |
| | | | | 40 < t ≤ 60 | --- | 335 | --- | 490-630 | --- | 22 | AR, N | |
| | | | | 60 < t ≤ 100 | --- | 315 | --- | 470-610 | --- | 21 | AR, N | |
| | | | | 100 < t ≤ 150 | --- | 305 | --- | 460-600 | --- | 21 | AR, N | |
| | | | | 150 < t ≤ 250 | --- | 295 | --- | 450-590 | --- | 21 | AR, N | |
| | P355NL2 | --- | 1.1106 | t ≤ 16 | --- | 355 | --- | 490-630 | --- | 22 | AR, N | see standard for impact data |
| | | | | 16 < t ≤ 40 | --- | 345 | --- | 490-630 | --- | 22 | AR, N | |
| | | | | 40 < t ≤ 60 | --- | 335 | --- | 490-630 | --- | 22 | AR, N | |
| | | | | 60 < t ≤ 100 | --- | 315 | --- | 470-610 | --- | 21 | AR, N | |
| | | | | 100 < t ≤ 150 | --- | 305 | --- | 460-600 | --- | 21 | AR, N | |
| | | | | 150 < t ≤ 250 | --- | 295 | --- | 450-590 | --- | 21 | AR, N | |
| JIS G 3126:2009 | Symbol SLA365 | --- | --- | 6 ≤ t ≤ 16 | --- | 365 | --- | 490-610 T | --- | 20 | Q+T or TMCP | see standard for impact data |
| | | | | 16 < t ≤ 20 | --- | 365 | --- | 490-610 T | --- | 28 | Q+T or TMCP | |
| | | | | 20 < t ≤ 38 | --- | 365 | --- | 490-610 T | --- | 20 | Q+T or TMCP | |

**4.2 Carbon Steels for Pressure Vessel Plates – With Impact Testing Below -20°C**

**4.2A Mechanical Properties of Carbon Steels for Pressure Vessel Plates – With Impact Testing Below -20°C (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness / Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | % min. | | |
| JIS G 3126:2009 | Symbol SLA410 | --- | --- | 6 ≤ t ≤ 16 | --- | 410 | --- | 520-640 T | --- | 18 | Q+T or TMCP | see standard for impact data |
| | | | | 16 < t ≤ 20 | --- | 410 | --- | 520-640 T | --- | 26 | Q+T or TMCP | |
| | | | | 20 < t ≤ 38 | --- | 410 | --- | 520-640 T | --- | 18 | Q+T or TMCP | |
| ASME SA-841/SA-841M | Grade A, Class 2 | K02010 | --- | t ≤ 65 | t ≤ 2.5 | 415 | 60 | 550-690 | 80-100 | 22 | TMCP | L: 20 J @ -40°C |
| | | | | 65 < t ≤ 100 | 2.5 < t ≤ 4 | 380 | 55 | 515-655 | 75-95 | 22 | TMCP | L: 20 J @ -40°C |
| | Grade B, Class 2 | --- | --- | t ≤ 65 | t ≤ 2.5 | 415 | 60 | 550-690 | 80-100 | 22 | TMCP | L: 20 J @ -40°C |
| | | | | 65 < t ≤ 100 | 2.5 < t ≤ 4 | 380 | 55 | 515-655 | 75-95 | 22 | TMCP | L: 20 J @ -40°C |
| | Grade C, Class 2 | --- | --- | t ≤ 65 | t ≤ 2.5 | 415 | 60 | 550-690 | 80-100 | 22 | TMCP | L: 20 J @ -40°C |
| | | | | 65 < t ≤ 100 | 2.5 < t ≤ 4 | 380 | 55 | 515-655 | 75-95 | 22 | TMCP | L: 20 J @ -40°C |
| ASTM A841/A841M-13 | Grade A, Class 2 | K02010 | --- | t ≤ 65 | t ≤ 2.5 | 415 | 60 | 550-690 | 80-100 | 22 | TMCP | L: 20 J @ -40°C |
| | | | | 65 < t ≤ 100 | 2.5 < t ≤ 4 | 380 | 55 | 515-655 | 75-95 | 22 | TMCP | L: 20 J @ -40°C |
| | Grade B, Class 2 | --- | --- | t ≤ 65 | t ≤ 2.5 | 415 | 60 | 550-690 | 80-100 | 22 | TMCP | L: 20 J @ -40°C |
| | | | | 65 < t ≤ 100 | 2.5 < t ≤ 4 | 380 | 55 | 515-655 | 75-95 | 22 | TMCP | L: 20 J @ -40°C |
| | Grade C, Class 2 | --- | --- | t ≤ 65 | t ≤ 2.5 | 415 | 60 | 550-690 | 80-100 | 22 | TMCP | L: 20 J @ -40°C |
| | | | | 65 < t ≤ 100 | 2.5 < t ≤ 4 | 380 | 55 | 515-655 | 75-95 | 22 | TMCP | L: 20 J @ -40°C |

**4.2 Carbon Steels for Pressure Vessel Plates – With Impact Testing Below -20°C**

**4.2B Chemical Composition of Carbon Steels for Pressure Vessel Plates – With Impact Testing Below -20°C**

| Specification | Designation | UNS No. | Steel No. | Section Thickness | | Weight, %max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| EN 10028-3:2009 | P275NL1 | --- | 1.0488 | --- | --- | 0.16 | 0.80-1.50 | 0.40 | 0.025 | 0.008 | 0.30 | 0.50 | 0.08 | V 0.05; Al 0.020 min.; Cu 0.30; Ti 0.03; Nb 0.05; N 0.012; (Nb+Ti+V) 0.05; (Cr+Cu+Mo) 0.45 |
| | P275NL2 | --- | 1.1104 | --- | --- | 0.16 | 0.80-1.50 | 0.40 | 0.020 | 0.005 | 0.30 | 0.50 | 0.08 | V 0.05; Al 0.020 min.; Cu 0.30; Ti 0.03; Nb 0.05; N 0.012; (Nb+Ti+V) 0.05; (Cr+Cu+Mo) 0.45 |
| ASME SA-662/SA-662M* | Grade A | K01701 | --- | --- | --- | 0.14 | 0.90-1.35 | 0.15-0.40 | 0.025 | 0.025 | 0.30 | 0.40 | 0.12 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| ASTM A662/A662M-12* | Grade A | K01701 | --- | --- | --- | 0.14 | 0.90-1.35 | 0.15-0.40 | 0.025 | 0.025 | 0.30 | 0.40 | 0.12 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| JIS G 3126:2009 | Symbol SLA235A | --- | --- | 6 ≤ t ≤ 50 | --- | 0.15 | 0.70-1.50 | 0.30 | 0.025 | 0.020 | --- | --- | --- | --- |
| | Symbol SLA235B | --- | --- | 6 ≤ t ≤ 50 | --- | 0.15 | 0.70-1.50 | 0.30 | 0.025 | 0.020 | --- | --- | --- | --- |
| | Symbol SLA325A | --- | --- | 6 ≤ t ≤ 38 | --- | 0.16 | 0.80-1.60 | 0.55 | 0.025 | 0.020 | --- | --- | --- | --- |
| | Symbol SLA325B | --- | --- | 6 ≤ t ≤ 38 | --- | 0.16 | 0.80-1.60 | 0.55 | 0.025 | 0.020 | --- | --- | --- | --- |

* See ASTM A20/A20M-14 for additional information.

**4.2 Carbon Steels for Pressure Vessel Plates – With Impact Testing Below -20°C**

**4.2B Chemical Composition of Carbon Steels for Pressure Vessel Plates – With Impact Testing Below -20°C (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness | | Weight, %max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASME SA-662/SA-662M* | Grade B | K02203 | --- | --- | --- | 0.19 | 0.85-1.50 | 0.15-0.40 | 0.025 | 0.025 | 0.30 | 0.40 | 0.12 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| | Grade C | K02007 | --- | --- | --- | 0.20 | 1.00-1.60 | 0.15-0.50 | 0.025 | 0.025 | 0.30 | 0.40 | 0.12 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| ASTM A662/A662M-12* | Grade B | K02203 | --- | --- | --- | 0.19 | 0.85-1.50 | 0.15-0.40 | 0.025 | 0.025 | 0.30 | 0.40 | 0.12 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| | Grade C | K02007 | --- | --- | --- | 0.20 | 1.00-1.60 | 0.15-0.50 | 0.025 | 0.025 | 0.30 | 0.40 | 0.12 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| ASME SA-841/SA-841M* | Grade A, Class 1 | K02010 | --- | t ≤ 40 | t ≤ 1.5 | 0.20 | 0.70-1.35 | 0.15-0.50 | 0.030 | 0.030 | 0.25 | 0.25 | 0.08 | V 0.06; Al 0.020 min.; Cu 0.35; Ti 0.03; Cb 0.03; B 0.0010 |
| | | | | 40 < t ≤ 100 | 1.5 < t ≤ 4 | 0.20 | 1.00-1.60 | 0.15-0.50 | 0.030 | 0.030 | 0.25 | 0.25 | 0.08 | V 0.06; Al 0.020 min.; Cu 0.35; Ti 0.03; Cb 0.03; B 0.0010 |
| | Grade B, Class 1 | --- | --- | t ≤ 40 | t ≤ 1.5 | 0.15 | 0.70-1.35 | 0.15-0.50 | 0.030 | 0.025 | 0.25 | 0.60 | 0.30 | V 0.06; Al 0.020 min.; Cu 0.35; Ti 0.03; Cb 0.03; B 0.0010 |
| | | | | 40 < t ≤ 100 | 1.5 < t ≤ 4 | 0.15 | 1.00-1.60 | 0.15-0.50 | 0.030 | 0.025 | 0.25 | 0.60 | 0.30 | V 0.06; Al 0.020 min.; Cu 0.35; Ti 0.03; Cb 0.03; B 0.0010 |
| | Grade C, Class 1 | --- | --- | t ≤ 40 | t ≤ 1.5 | 0.10 | 0.70-1.60 | 0.15-0.50 | 0.030 | 0.015 | 0.25 | 0.25 | 0.08 | V 0.06; Cu 0.35; Ti 0.006-0.02; Cb 0.06; B 0.0010 |
| | | | | 40 < t ≤ 100 | 1.5 < t ≤ 4 | 0.10 | 1.00-1.60 | 0.15-0.50 | 0.030 | 0.015 | 0.25 | 0.25 | 0.08 | V 0.06; Cu 0.35; Ti 0.006-0.02; Cb 0.06; B 0.0010 |
| ASTM A841/A841M-13* | Grade A, Class 1 | K02010 | --- | t ≤ 40 | t ≤ 1.5 | 0.20 | 0.70-1.35 | 0.15-0.50 | 0.030 | 0.030 | 0.25 | 0.25 | 0.08 | V 0.06; Al 0.020 min.; Cu 0.35; Ti 0.03; Cb 0.03; B 0.0010 |
| | | | | 40 < t ≤ 100 | 1.5 < t ≤ 4 | 0.20 | 1.00-1.60 | 0.15-0.50 | 0.030 | 0.030 | 0.25 | 0.25 | 0.08 | V 0.06; Al 0.020 min.; Cu 0.35; Ti 0.03; Cb 0.03; B 0.0010 |
| | Grade B, Class 1 | --- | --- | t ≤ 40 | t ≤ 1.5 | 0.15 | 0.70-1.35 | 0.15-0.50 | 0.030 | 0.025 | 0.25 | 0.60 | 0.30 | V 0.06; Al 0.020 min.; Cu 0.35; Ti 0.03; Cb 0.03; B 0.0010 |
| | | | | 40 < t ≤ 100 | 1.5 < t ≤ 4 | 0.15 | 1.00-1.60 | 0.15-0.50 | 0.030 | 0.025 | 0.25 | 0.60 | 0.30 | V 0.06; Al 0.020 min.; Cu 0.35; Ti 0.03; Cb 0.03; B 0.0010 |
| | Grade C, Class 1 | --- | --- | t ≤ 40 | t ≤ 1.5 | 0.10 | 0.70-1.60 | 0.15-0.50 | 0.030 | 0.015 | 0.25 | 0.25 | 0.08 | V 0.06; Cu 0.35; Ti 0.006-0.02; Cb 0.06; B 0.0010 |
| | | | | 40 < t ≤ 100 | 1.5 < t ≤ 4 | 0.10 | 1.00-1.60 | 0.15-0.50 | 0.030 | 0.015 | 0.25 | 0.25 | 0.08 | V 0.06; Cu 0.35; Ti 0.006-0.02; Cb 0.06; B 0.0010 |
| EN 10028-3:2009 | P355NL1 | --- | 1.0566 | --- | --- | 0.18 | 1.10-1.70 | 0.50 | 0.025 | 0.008 | 0.30 | 0.50 | 0.08 | V 0.10; Al 0.020 min.; Cu 0.30; Ti 0.03; Nb 0.05; N 0.012; (Nb+Ti+V) 0.12; (Cr+Cu+Mo) 0.45 |
| | P355NL2 | --- | 1.1106 | --- | --- | 0.18 | 1.10-1.70 | 0.50 | 0.020 | 0.005 | 0.30 | 0.50 | 0.08 | V 0.10; Al 0.020 min.; Cu 0.30; Ti 0.03; Nb 0.05; N 0.012; (Nb+Ti+V) 0.12; (Cr+Cu+Mo) 0.45 |
| JIS G 3126:2009 | Symbol SLA365 | --- | --- | 6 ≤ t ≤ 38 | --- | 0.18 | 0.80-1.60 | 0.55 | 0.025 | 0.020 | --- | --- | --- | --- |

*: See ASTM A20/A20M-14 for additional information.

**4.2 Carbon Steels for Pressure Vessel Plates – With Impact Testing Below -20°C**

**4.2B Chemical Composition of Carbon Steels for Pressure Vessel Plates – With Impact Testing Below -20°C (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness | | Weight, %max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| JIS G 3126:2009 | Symbol SLA410 | --- | --- | 6 ≤ t ≤ 38 | --- | 0.18 | 0.80-1.60 | 0.55 | 0.025 | 0.020 | --- | --- | --- | --- |
| ASME SA-841/SA-841M* | Grade A, Class 2 | K02010 | --- | t ≤ 40 | t ≤ 1.5 | 0.20 | 0.70-1.35 | 0.15-0.50 | 0.030 | 0.030 | 0.25 | 0.25 | 0.08 | V 0.06; Al 0.020 min.; Cu 0.35; Ti 0.03; Cb 0.03; B 0.0010 |
| | | | | 40 < t ≤ 100 | 1.5 < t ≤ 4 | 0.20 | 1.00-1.60 | 0.15-0.50 | 0.030 | 0.030 | 0.25 | 0.25 | 0.08 | V 0.06; Al 0.020 min.; Cu 0.35; Ti 0.03; Cb 0.03; B 0.0010 |
| | Grade B, Class 2 | --- | --- | t ≤ 40 | t ≤ 1.5 | 0.15 | 0.70-1.35 | 0.15-0.50 | 0.030 | 0.025 | 0.25 | 0.60 | 0.30 | V 0.06; Al 0.020 min.; Cu 0.35; Ti 0.03; Cb 0.03; B 0.0010 |
| | | | | 40 < t ≤ 100 | 1.5 < t ≤ 4 | 0.15 | 1.00-1.60 | 0.15-0.50 | 0.030 | 0.025 | 0.25 | 0.60 | 0.30 | V 0.06; Al 0.020 min.; Cu 0.35; Ti 0.03; Cb 0.03; B 0.0010 |
| | Grade C, Class 2 | --- | --- | t ≤ 40 | t ≤ 1.5 | 0.10 | 0.70-1.60 | 0.15-0.50 | 0.030 | 0.015 | 0.25 | 0.25 | 0.08 | V 0.06; Cu 0.35; Ti 0.006-0.02; Cb 0.06; B 0.0010 |
| | | | | 40 < t ≤ 100 | 1.5 < t ≤ 4 | 0.10 | 1.00-1.60 | 0.15-0.50 | 0.030 | 0.015 | 0.25 | 0.25 | 0.08 | V 0.06; Cu 0.35; Ti 0.006-0.02; Cb 0.06; B 0.0010 |
| ASTM A841/A841M-13* | Grade A, Class 2 | K02010 | --- | t ≤ 40 | t ≤ 1.5 | 0.20 | 0.70-1.35 | 0.15-0.50 | 0.030 | 0.030 | 0.25 | 0.25 | 0.08 | V 0.06; Al 0.020 min.; Cu 0.35; Ti 0.03; Cb 0.03; B 0.0010 |
| | | | | 40 < t ≤ 100 | 1.5 < t ≤ 4 | 0.20 | 1.00-1.60 | 0.15-0.50 | 0.030 | 0.030 | 0.25 | 0.25 | 0.08 | V 0.06; Al 0.020 min.; Cu 0.35; Ti 0.03; Cb 0.03; B 0.0010 |
| | Grade B, Class 2 | --- | --- | t ≤ 40 | t ≤ 1.5 | 0.15 | 0.70-1.35 | 0.15-0.50 | 0.030 | 0.025 | 0.25 | 0.60 | 0.30 | V 0.06; Al 0.020 min.; Cu 0.35; Ti 0.03; Cb 0.03; B 0.0010 |
| | | | | 40 < t ≤ 100 | 1.5 < t ≤ 4 | 0.15 | 1.00-1.60 | 0.15-0.50 | 0.030 | 0.025 | 0.25 | 0.60 | 0.30 | V 0.06; Al 0.020 min.; Cu 0.35; Ti 0.03; Cb 0.03; B 0.0010 |
| | Grade C, Class 2 | --- | --- | t ≤ 40 | t ≤ 1.5 | 0.10 | 0.70-1.60 | 0.15-0.50 | 0.030 | 0.015 | 0.25 | 0.25 | 0.08 | V 0.06; Cu 0.35; Ti 0.006-0.02; Cb 0.06; B 0.0010 |
| | | | | 40 < t ≤ 100 | 1.5 < t ≤ 4 | 0.10 | 1.00-1.60 | 0.15-0.50 | 0.030 | 0.015 | 0.25 | 0.25 | 0.08 | V 0.06; Cu 0.35; Ti 0.006-0.02; Cb 0.06; B 0.0010 |

*: See ASTM A20/A20M-14 for additional information.

### 4.3 ½ Mo Alloy Steels for Pressure Vessel Plates

#### 4.3A Chemical Composition of ½Mo Alloy Steels for Pressure Vessel Plates

| Specification | Designation | UNS No. | Steel No. | Section Thickness | | Weight, %max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| EN 10028-2:2009 | 18MnMo4-5 | --- | 1.5414 | --- | --- | 0.20 | 0.90-1.50 | 0.40 | 0.015 | 0.005 | 0.30 | 0.30 | 0.45-0.60 | Cu 0.30; N 0.012 |
| | 16Mo3 | --- | 1.5415 | --- | --- | 0.12-0.20 | 0.40-0.90 | 0.35 | 0.025 | 0.010 | 0.30 | 0.30 | 0.25-0.35 | Cu 0.30; N 0.012 |
| GB 713-1997 | Grade 13MnNiMoNbg | --- | --- | --- | --- | 0.15 | 1.00-1.60 | 0.10-0.50 | 0.025 | 0.025 | 0.20-0.40 | 0.60-1.00 | 0.20-0.40 | V 0.010; Cu 0.30; Nb 0.005-0.020 |
| ISO 9328-2:2004 | Grade 16Mo3 | --- | --- | --- | --- | 0.12-0.20 | 0.40-0.90 | 0.35 | 0.025 | 0.010 | 0.30 | 0.30 | 0.25-0.35 | Cu 0.30 |
| ASME SA-204/SA-204M* | Grade A | K11820 | --- | t ≤ 25 | t ≤ 1 | 0.18 | 0.90 | 0.15-0.40 | 0.025 | 0.025 | 0.30 | 0.40 | 0.45-0.60 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| | | | | 25 < t ≤ 50 | 1 < t ≤ 2 | 0.21 | 0.90 | 0.15-0.40 | 0.025 | 0.025 | 0.30 | 0.40 | 0.45-0.60 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| | | | | 50 < t ≤ 100 | 2 < t ≤ 4 | 0.23 | 0.90 | 0.15-0.40 | 0.025 | 0.025 | 0.30 | 0.40 | 0.45-0.60 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| | | | | t > 100 | t > 4 | 0.25 | 0.90 | 0.15-0.40 | 0.025 | 0.025 | 0.30 | 0.40 | 0.45-0.60 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| | Grade B | K12020 | --- | t ≤ 25 | t ≤ 1 | 0.20 | 0.90 | 0.15-0.40 | 0.025 | 0.025 | 0.30 | 0.40 | 0.45-0.60 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| | | | | 25 < t ≤ 50 | 1 < t ≤ 2 | 0.23 | 0.90 | 0.15-0.40 | 0.025 | 0.025 | 0.30 | 0.40 | 0.45-0.60 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| | | | | 50 < t ≤ 100 | 2 < t ≤ 4 | 0.25 | 0.90 | 0.15-0.40 | 0.025 | 0.025 | 0.30 | 0.40 | 0.45-0.60 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| | | | | t > 100 | t > 4 | 0.27 | 0.90 | 0.15-0.40 | 0.025 | 0.025 | 0.30 | 0.40 | 0.45-0.60 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| | Grade C | K12320 | --- | t ≤ 25 | t ≤ 1 | 0.23 | 0.90 | 0.15-0.40 | 0.025 | 0.025 | 0.30 | 0.40 | 0.45-0.60 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| | | | | 25 < t ≤ 50 | 1 < t ≤ 2 | 0.26 | 0.90 | 0.15-0.40 | 0.025 | 0.025 | 0.30 | 0.40 | 0.45-0.60 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| | | | | t > 50 | t > 2 | 0.28 | 0.90 | 0.15-0.40 | 0.025 | 0.025 | 0.30 | 0.40 | 0.45-0.60 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| ASTM A204/A204M-12* | Grade A | K11820 | --- | t ≤ 25 | t ≤ 1 | 0.18 | 0.90 | 0.15-0.40 | 0.025 | 0.025 | 0.30 | 0.40 | 0.45-0.60 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| | | | | 25 < t ≤ 50 | 1 < t ≤ 2 | 0.21 | 0.90 | 0.15-0.40 | 0.025 | 0.025 | 0.30 | 0.40 | 0.45-0.60 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| | | | | 50 < t ≤ 100 | 2 < t ≤ 4 | 0.23 | 0.90 | 0.15-0.40 | 0.025 | 0.025 | 0.30 | 0.40 | 0.45-0.60 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| | | | | t > 100 | t > 4 | 0.25 | 0.90 | 0.15-0.40 | 0.025 | 0.025 | 0.30 | 0.40 | 0.45-0.60 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |

*: See ASTM A20/A20M-14 for additional information.

Note: This section continued on next page.

**4.3 ½ Mo Alloy Steels for Pressure Vessel Plates**

**4.3A Chemical Composition of ½Mo Alloy Steels for Pressure Vessel Plates (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness | | Weight, %max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASTM A204/A204M-12* | Grade B | K12020 | --- | t ≤ 25 | t ≤ 1 | 0.20 | 0.90 | 0.15-0.40 | 0.025 | 0.025 | 0.30 | 0.40 | 0.45-0.60 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| | | | | 25 < t ≤ 50 | 1 < t ≤ 2 | 0.23 | 0.90 | 0.15-0.40 | 0.025 | 0.025 | 0.30 | 0.40 | 0.45-0.60 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| | | | | 50 < t ≤ 100 | 2 < t ≤ 4 | 0.25 | 0.90 | 0.15-0.40 | 0.025 | 0.025 | 0.30 | 0.40 | 0.45-0.60 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| | | | | t > 100 | t > 4 | 0.27 | 0.90 | 0.15-0.40 | 0.025 | 0.025 | 0.30 | 0.40 | 0.45-0.60 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| | Grade C | K12320 | --- | t ≤ 25 | t ≤ 1 | 0.23 | 0.90 | 0.15-0.40 | 0.025 | 0.025 | 0.30 | 0.40 | 0.45-0.60 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| | | | | 25 < t ≤ 50 | 1 < t ≤ 2 | 0.26 | 0.90 | 0.15-0.40 | 0.025 | 0.025 | 0.30 | 0.40 | 0.45-0.60 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| | | | | t > 50 | t > 2 | 0.28 | 0.90 | 0.15-0.40 | 0.025 | 0.025 | 0.30 | 0.40 | 0.45-0.60 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| JIS G 3103:2012 | Symbol SB450M | --- | --- | 6 ≤ t ≤ 25 | --- | 0.18 | 0.90 | 0.15-0.40 | 0.020 | 0.020 | 0.30 | 0.40 | 0.45-0.60 | V 0.03; Cu 0.40; Ti 0.03; Nb 0.02; B 0.0010 |
| | | | | 25 < t ≤ 50 | --- | 0.21 | 0.90 | 0.15-0.40 | 0.020 | 0.020 | 0.30 | 0.40 | 0.45-0.60 | V 0.03; Cu 0.40; Ti 0.03; Nb 0.02; B 0.0010 |
| | | | | 50 < t ≤ 100 | --- | 0.23 | 0.90 | 0.15-0.40 | 0.020 | 0.020 | 0.30 | 0.40 | 0.45-0.60 | V 0.03; Cu 0.40; Ti 0.03; Nb 0.02; B 0.0010 |
| | | | | 100 < t ≤ 150 | --- | 0.25 | 0.90 | 0.15-0.40 | 0.020 | 0.020 | 0.30 | 0.40 | 0.45-0.60 | V 0.03; Cu 0.40; Ti 0.03; Nb 0.02; B 0.0010 |
| | Symbol SB480M | --- | --- | 6 ≤ t ≤ 25 | --- | 0.20 | 0.90 | 0.15-0.40 | 0.020 | 0.020 | 0.30 | 0.40 | 0.45-0.60 | V 0.03; Cu 0.40; Ti 0.03; Nb 0.02; B 0.0010 |
| | | | | 25 < t ≤ 50 | --- | 0.23 | 0.90 | 0.15-0.40 | 0.020 | 0.020 | 0.30 | 0.40 | 0.45-0.60 | V 0.03; Cu 0.40; Ti 0.03; Nb 0.02; B 0.0010 |
| | | | | 50 < t ≤ 100 | --- | 0.25 | 0.90 | 0.15-0.40 | 0.020 | 0.020 | 0.30 | 0.40 | 0.45-0.60 | V 0.03; Cu 0.40; Ti 0.03; Nb 0.02; B 0.0010 |
| | | | | 100 < t ≤ 150 | --- | 0.27 | 0.90 | 0.15-0.40 | 0.020 | 0.020 | 0.30 | 0.40 | 0.45-0.60 | V 0.03; Cu 0.40; Ti 0.03; Nb 0.02; B 0.0010 |

**4.3 ½ Mo Alloy Steels for Pressure Vessel Plates**

**4.3A Chemical Composition of ½Mo Alloy Steels for Pressure Vessel Plates (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness | | Weight, %max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASME SA-302/SA-302M* | Grade A | K12021 | --- | t ≤ 25 | t ≤ 1 | 0.20 | 0.95-1.30 | 0.15-0.40 | 0.025 | 0.025 | 0.30 | 0.40 | 0.45-0.60 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| | | | | 25 < t ≤ 50 | 1 < t ≤ 2 | 0.23 | 0.95-1.30 | 0.15-0.40 | 0.025 | 0.025 | 0.30 | 0.40 | 0.45-0.60 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| | | | | t > 50 | t > 2 | 0.25 | 0.95-1.30 | 0.15-0.40 | 0.025 | 0.025 | 0.30 | 0.40 | 0.45-0.60 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| ASTM A302/A302M-12* | Grade A | K12021 | --- | t ≤ 25 | t ≤ 1 | 0.20 | 0.95-1.30 | 0.15-0.40 | 0.025 | 0.025 | 0.30 | 0.40 | 0.45-0.60 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| | | | | 25 < t ≤ 50 | 1 < t ≤ 2 | 0.23 | 0.95-1.30 | 0.15-0.40 | 0.025 | 0.025 | 0.30 | 0.40 | 0.45-0.60 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| | | | | t > 50 | t > 2 | 0.25 | 0.95-1.30 | 0.15-0.40 | 0.025 | 0.025 | 0.30 | 0.40 | 0.45-0.60 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| JIS G 3119:2013 | Symbol SBV1A | --- | --- | 6 ≤ t ≤ 25 | --- | 0.20 | 0.95-1.30 | 0.15-0.40 | 0.020 | 0.020 | 0.30 | 0.40 | 0.45-0.60 | V 0.03; Cu 0.40; Ti 0.03; Nb 0.02; B 0.0010 |
| | | | | 25 < t ≤ 50 | --- | 0.23 | 0.95-1.30 | 0.15-0.40 | 0.020 | 0.020 | 0.30 | 0.40 | 0.45-0.60 | V 0.03; Cu 0.40; Ti 0.03; Nb 0.02; B 0.0010 |
| | | | | 50 < t ≤ 150 | --- | 0.25 | 0.95-1.30 | 0.15-0.40 | 0.020 | 0.020 | 0.30 | 0.40 | 0.45-0.60 | V 0.03; Cu 0.40; Ti 0.03; Nb 0.02; B 0.0010 |
| JIS G 3124:2009 | Symbol SEV295 | --- | --- | 6 ≤ t ≤ 150 | --- | 0.19 | 0.80-1.60 | 0.15-0.60 | 0.030 | 0.030 | --- | --- | 0.10-0.40 | V 0.10; Cu 0.70; Nb 0.05 |

* See ASTM A20/A20M-14 for additional information.

**4.3 ½ Mo Alloy Steels for Pressure Vessel Plates**

**4.3A Chemical Composition of ½Mo Alloy Steels for Pressure Vessel Plates (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness | | Weight, %max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASME SA-302/SA-302M* | Grade B | K12022 | --- | t ≤ 25 | t ≤ 1 | 0.20 | 1.15-1.50 | 0.15-0.40 | 0.025 | 0.025 | 0.30 | 0.40 | 0.45-0.60 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| | | | | 25 < t ≤ 50 | 1 < t ≤ 2 | 0.23 | 1.15-1.50 | 0.15-0.40 | 0.025 | 0.025 | 0.30 | 0.40 | 0.45-0.60 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| | | | | t > 50 | t > 2 | 0.25 | 1.15-1.50 | 0.15-0.40 | 0.025 | 0.025 | 0.30 | 0.40 | 0.45-0.60 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| ASME SA-533/SA-533M* | Type A, Class 1 | K12521 | --- | --- | --- | 0.25 | 1.15-1.50 | 0.15-0.40 | 0.025 | 0.025 | 0.30 | 0.40 | 0.45-0.60 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| | Type A, Class 2 | K12521 | --- | --- | --- | 0.25 | 1.15-1.50 | 0.15-0.40 | 0.025 | 0.025 | 0.30 | 0.40 | 0.45-0.60 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| | Type A, Class 3 | K12521 | --- | --- | --- | 0.25 | 1.15-1.50 | 0.15-0.40 | 0.025 | 0.025 | 0.30 | 0.40 | 0.45-0.60 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| ASTM A302/A302M-12* | Grade B | K12022 | --- | t ≤ 25 | t ≤ 1 | 0.20 | 1.15-1.50 | 0.15-0.40 | 0.025 | 0.025 | 0.30 | 0.40 | 0.45-0.60 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| | | | | 25 < t ≤ 50 | 1 < t ≤ 2 | 0.23 | 1.15-1.50 | 0.15-0.40 | 0.025 | 0.025 | 0.30 | 0.40 | 0.45-0.60 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| | | | | t > 50 | t > 2 | 0.25 | 1.15-1.50 | 0.15-0.40 | 0.025 | 0.025 | 0.30 | 0.40 | 0.45-0.60 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| ASTM A533/A533M-09 (2014)* | Type A, Class 1 | K12521 | --- | --- | --- | 0.25 | 1.15-1.50 | 0.15-0.40 | 0.025 | 0.025 | 0.30 | 0.40 | 0.45-0.60 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| | Type A, Class 2 | K12521 | --- | --- | --- | 0.25 | 1.15-1.50 | 0.15-0.40 | 0.025 | 0.025 | 0.30 | 0.40 | 0.45-0.60 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| | Type A, Class 3 | K12521 | --- | --- | --- | 0.25 | 1.15-1.50 | 0.15-0.40 | 0.025 | 0.025 | 0.30 | 0.40 | 0.45-0.60 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| GB 6654-1996 | Grade 18MnMoNbR | --- | --- | --- | --- | 0.22 | 1.20-1.60 | 0.15-0.50 | 0.035 | 0.030 | 0.30 | 0.30 | 0.45-0.65 | Cu 0.30; Nb 0.025-0.050 |
| JIS G 3119:2013 | Symbol SBV1B | --- | --- | 6 ≤ t ≤ 25 | --- | 0.20 | 1.15-1.50 | 0.15-0.40 | 0.020 | 0.020 | 0.30 | 0.40 | 0.45-0.60 | V 0.03; Cu 0.40; Ti 0.03; Nb 0.02; B 0.0010 |
| | | | | 25 < t ≤ 50 | --- | 0.23 | 1.15-1.50 | 0.15-0.40 | 0.020 | 0.020 | 0.30 | 0.40 | 0.45-0.60 | V 0.03; Cu 0.40; Ti 0.03; Nb 0.02; B 0.0010 |
| | | | | 50 < t ≤ 150 | --- | 0.25 | 1.15-1.50 | 0.15-0.40 | 0.020 | 0.020 | 0.30 | 0.40 | 0.45-0.60 | V 0.03; Cu 0.40; Ti 0.03; Nb 0.02; B 0.0010 |
| JIS G 3120:2014 | Symbol SQV1A | --- | --- | --- | --- | 0.25 | 1.15-1.50 | 0.15-0.40 | 0.020 | 0.020 | 0.30 | 0.40 | 0.45-0.60 | V 0.03; Cu 0.40; Ti 0.03; Nb 0.02; B 0.0010 |
| | Symbol SQV1B | --- | --- | --- | --- | 0.25 | 1.15-1.50 | 0.15-0.40 | 0.020 | 0.020 | 0.30 | 0.40 | 0.45-0.60 | V 0.03; Cu 0.40; Ti 0.03; Nb 0.02; B 0.0010 |
| JIS G 3124:2009 | Symbol SEV345 | --- | --- | 6 ≤ t ≤ 150 | --- | 0.19 | 0.80-1.70 | 0.15-0.60 | 0.030 | 0.030 | --- | --- | 0.15-0.50 | V 0.10; Cu 0.70; Nb 0.05 |

*: See ASTM A20/A20M-14 for additional information.

**4.3 ½Mo Alloy Steels for Pressure Vessel Plates**

**4.3B Mechanical Properties of ½Mo Alloy Steels for Pressure Vessel Plates**

| Specification | Designation | UNS No. | Steel No. | Section Thickness / Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | % min. | | |
| EN 10028-2:2009 | 18MnMo4-5 | --- | 1.5414 | t ≤ 60 | --- | 345 | --- | 510-650 | --- | 20 | N+T | see standard for impact data |
| | | | | 60 < t ≤ 150 | --- | 325 | --- | 510-650 | --- | 20 | N+T | |
| | | | | 150 < t ≤ 250 | --- | 310 | --- | 480-620 | --- | 20 | Q+T | |
| | 16Mo3 | --- | 1.5415 | t ≤ 16 | --- | 275 | --- | 440-590 | --- | 22 | AR, N or N+T | see standard for impact data |
| | | | | 16 < t ≤ 40 | --- | 270 | --- | 440-590 | --- | 22 | AR, N or N+T | |
| | | | | 40 < t ≤ 60 | --- | 260 | --- | 440-590 | --- | 22 | AR, N or N+T | |
| | | | | 60 < t ≤ 100 | --- | 240 | --- | 430-580 | --- | 22 | AR, N or N+T | |
| | | | | 100 < t ≤ 150 | --- | 220 | --- | 420-570 | --- | 22 | AR, N or N+T | |
| | | | | 150 < t ≤ 250 | --- | 210 | --- | 410-570 | --- | 22 | AR, N or N+T | |
| GB 713-1997 | Grade 13MnNiMoNbg | --- | --- | t ≤ 100 | --- | 390 | --- | 570-740 | --- | 18 | HR, CtR, N or N+T | T: 31 J @ 0°C |
| | | | | 100 < t ≤ 120 | --- | 380 | --- | 570-740 | --- | 18 | HR, CtR, N or N+T | T: 31 J @ 0°C |
| | | | | 120 < t ≤ 150 | --- | 375 | --- | 570-740 | --- | 18 | HR, CtR, N or N+T | T: 31 J @ 0°C |
| ISO 9328-2:2004 | Grade 16Mo3 | --- | --- | t ≤ 16 | --- | 275 | --- | 440-590 | --- | 22 | N or BA | see standard for impact data |
| | | | | 16 < t ≤ 40 | --- | 270 | --- | 440-590 | --- | 22 | N or BA | |
| | | | | 40 < t ≤ 60 | --- | 260 | --- | 440-590 | --- | 22 | N or BA | |
| | | | | 60 < t ≤ 100 | --- | 240 | --- | 430-580 | --- | 22 | N or BA | |
| | | | | 100 < t ≤ 150 | --- | 220 | --- | 420-570 | --- | 22 | N or BA | |
| | | | | 150 < t ≤ 250 | --- | 210 | --- | 410-570 | --- | 22 | N or BA | |
| ASME SA-204/SA-204M | Grade A | K11820 | --- | t ≤ 40 | t ≤ 1.5 | 255 | 37 | 450-585 | 65-85 | 23 | AR or SR or N or SR+N | --- |
| | | | | t > 40 | t > 1.5 | 255 | 37 | 450-585 | 65-85 | 23 | N | --- |
| | Grade B | K12020 | --- | t ≤ 40 | t ≤ 1.5 | 275 | 40 | 485-620 | 70-90 | 21 | AR or SR or N or SR+N | --- |
| | | | | t > 40 | t > 1.5 | 275 | 40 | 485-620 | 70-90 | 21 | N | --- |
| | Grade C | K12320 | --- | t ≤ 40 | t ≤ 1.5 | 295 | 43 | 515-655 | 75-95 | 20 | AR or SR or N or SR+N | --- |
| | | | | t > 40 | t > 1.5 | 295 | 43 | 515-655 | 75-95 | 20 | N | --- |
| ASTM A204/A204M-12 | Grade A | K11820 | --- | t ≤ 40 | t ≤ 1.5 | 255 | 37 | 450-585 | 65-85 | 23 | AR, SR, N or SR+N | --- |
| | | | | t > 40 | t > 1.5 | 255 | 37 | 450-585 | 65-85 | 23 | N | --- |
| | Grade B | K12020 | --- | t ≤ 40 | t ≤ 1.5 | 275 | 40 | 485-620 | 70-90 | 21 | AR, SR, N or SR+N | --- |
| | | | | t > 40 | t > 1.5 | 275 | 40 | 485-620 | 70-90 | 21 | N | --- |
| | Grade C | K12320 | --- | t ≤ 40 | t ≤ 1.5 | 295 | 43 | 515-655 | 75-95 | 20 | AR, SR, N or SR+N | --- |
| | | | | t > 40 | t > 1.5 | 295 | 43 | 515-655 | 75-95 | 20 | N | --- |
| JIS G 3103:2012 | Symbol SB450M | --- | --- | 6 ≤ t ≤ 50 | --- | 255 | --- | 450-590 | --- | 19 | AR, N or SR | --- |
| | | | | 50 < t ≤ 150 | --- | 255 | --- | 450-590 | --- | 23 | N | --- |
| | Symbol SB480M | --- | --- | 6 ≤ t ≤ 50 | --- | 275 | --- | 480-620 | --- | 17 | AR, N or SR | --- |
| | | | | 50 < t ≤ 150 | --- | 275 | --- | 480-620 | --- | 21 | N | --- |

**4.3 ½Mo Alloy Steels for Pressure Vessel Plates**

**4.3B Mechanical Properties of ½Mo Alloy Steels for Pressure Vessel Plates (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness / Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | % min. | | |
| ASME SA-302/SA-302M | Grade A | K12021 | --- | t ≤ 50 | t ≤ 2 | 310 | 45 | 515-655 | 75-95 | 19 | AR or N or SR or N+SR | --- |
| | | | | t > 50 | t > 2 | 310 | 45 | 515-655 | 75-95 | 19 | N | --- |
| ASTM A302/A302M-12 | Grade A | K12021 | --- | t ≤ 50 | t ≤ 2 | 310 | 45 | 515-655 | 75-95 | 19 | AR, N, SR or N+SR | --- |
| | | | | t > 50 | t > 2 | 310 | 45 | 515-655 | 75-95 | 19 | N | --- |
| JIS G 3119:2013 | Symbol SBV1A | --- | --- | 6 ≤ t ≤ 50 | --- | 315 | --- | 520-660 | --- | 15 | AR, N, A, Q+T or N+A | --- |
| | | | | 50 < t ≤ 150 | --- | 315 | --- | 520-660 | --- | 19 | N or Q+T | --- |
| JIS G 3124:2009 | Symbol SEV295 | --- | --- | 6 ≤ t ≤ 50 | --- | 420 | --- | 540-690 T | --- | 15 | AR, N, N+T or A | T: 31 J @ 0°C |
| | | | | 50 < t ≤ 100 | --- | 400 | --- | 540-690 T | --- | 19 | AR, N, N+T or A | T: 31 J @ 0°C |
| | | | | 100 < t ≤ 125 | --- | 390 | --- | 530-680 T | --- | 19 | AR, N, N+T or A | T: 31 J @ 0°C |
| | | | | 125 < t ≤ 150 | --- | 380 | --- | 520-670 T | --- | 19 | AR, N, N+T or A | T: 31 J @ 0°C |
| ASME SA-302/SA-302M | Grade B | K12022 | --- | t ≤ 50 | t ≤ 2 | 345 | 50 | 550-690 | 80-100 | 18 | AR or N or SR or N+SR | --- |
| | | | | t > 50 | t > 2 | 345 | 50 | 550-690 | 80-100 | 18 | N | --- |
| ASME SA-533/SA-533M | Type A, Class 1 | K12521 | --- | t ≥ 6.5 | t ≥ 0.25 | 345 | 50 | 550-690 | 80-100 | 18 | Q+T | --- |
| | Type A, Class 2 | K12521 | --- | t ≥ 6.5 | t ≥ 0.25 | 485 | 70 | 620-795 | 90-115 | 16 | Q+T | --- |
| | Type A, Class 3 | K12521 | --- | 6.5 ≤ t ≤ 65 | 0.25 ≤ t ≤ 2.5 | 570 | 83 | 690-860 | 100-125 | 16 | Q+T | --- |
| ASTM A302/A302M-12 | Grade B | K12022 | --- | t ≤ 50 | t ≤ 2 | 345 | 50 | 550-690 | 80-100 | 18 | AR, N, SR or N+SR | --- |
| | | | | t > 50 | t > 2 | 345 | 50 | 550-690 | 80-100 | 18 | N | --- |
| ASTM A533/A533M-09 (2014) | Type A, Class 1 | K12521 | --- | t ≥ 6.5 | t ≥ 0.25 | 345 | 50 | 550-690 | 80-100 | 18 | Q+T | --- |
| | Type A, Class 2 | K12521 | --- | t ≥ 6.5 | t ≥ 0.25 | 485 | 70 | 620-795 | 90-115 | 16 | Q+T | --- |
| | Type A, Class 3 | K12521 | --- | 6.5 ≤ t ≤ 65 | 0.25 ≤ t ≤ 2.5 | 570 | 83 | 690-860 | 100-125 | 16 | Q+T | --- |
| GB 6654-1996 | Grade 18MnMoNbR | --- | --- | 30 < t ≤ 60 | --- | 440 | --- | 590-740 | --- | 17 | N+T | T: 34 J @ 20°C |
| | | | | 60 < t ≤ 100 | --- | 410 | --- | 570-720 | --- | 17 | N+T | T: 34 J @ 20°C |
| JIS G 3119:2013 | Symbol SBV1B | --- | --- | 6 ≤ t ≤ 50 | --- | 345 | --- | 550-690 | --- | 15 | AR, N, A, Q+T or N+A | --- |
| | | | | 50 < t ≤ 150 | --- | 345 | --- | 550-690 | --- | 18 | N or Q+T | --- |
| JIS G 3120:2014 | Symbol SQV1A | --- | --- | --- | --- | 345 | --- | 550-690 T | --- | 18 | AR, A or Q+T | L: 40 J @ BA°C |
| | Symbol SQV1B | --- | --- | --- | --- | 480 | --- | 620-790 T | --- | 16 | AR, A or Q+T | L: 47 J @ BA°C |
| JIS G 3124:2009 | Symbol SEV345 | --- | --- | 6 ≤ t ≤ 50 | --- | 430 | --- | 590-740 T | --- | 14 | AR, N, N+T or A | T: 31 J @ 0°C |
| | | | | 50 < t ≤ 100 | --- | 430 | --- | 590-740 T | --- | 18 | AR, N, N+T or A | T: 31 J @ 0°C |
| | | | | 100 < t ≤ 125 | --- | 420 | --- | 580-730 T | --- | 18 | AR, N, N+T or A | T: 31 J @ 0°C |
| | | | | 125 < t ≤ 150 | --- | 410 | --- | 570-720 T | --- | 18 | AR, N, N+T or A | T: 31 J @ 0°C |

### 4.4 Cr-Mo Alloy Steels for Pressure Vessel Plates

#### 4.4.1A Chemical Composition of ¾Cr-½Mo Alloy Steels for Pressure Vessel Plates

| Specification | Designation | UNS No. | Steel No. | Section Thickness mm | Section Thickness in | Weight, %max, Unless Otherwise Specified C | Mn | Si | P | S | Cr | Ni | Mo | Others |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ASME SA-387/SA-387M* | Grade 2, Class 1 | S50460 | --- | --- | --- | 0.05-0.21 | 0.55-0.80 | 0.15-0.40 | 0.025 | 0.025 | 0.50-0.80 | 0.40 | 0.45-0.60 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| | Grade 2, Class 2 | S50460 | --- | --- | --- | 0.05-0.21 | 0.55-0.80 | 0.15-0.40 | 0.025 | 0.025 | 0.50-0.80 | 0.40 | 0.45-0.60 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| ASTM A387/A387M-11* | Grade 2, Class 1 | S50460 | --- | --- | --- | 0.05-0.21 | 0.55-0.80 | 0.15-0.40 | 0.025 | 0.025 | 0.50-0.80 | 0.40 | 0.45-0.60 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| | Grade 2, Class 2 | S50460 | --- | --- | --- | 0.05-0.21 | 0.55-0.80 | 0.15-0.40 | 0.025 | 0.025 | 0.50-0.80 | 0.40 | 0.45-0.60 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| JIS G 4109:2013 | Symbol SCMV1-1 | --- | --- | 6 ≤ t ≤ 200 | --- | 0.21 | 0.55-0.80 | 0.40 | 0.020 | 0.020 | 0.50-0.80 | 0.40 | 0.45-0.60 | V 0.03; Cu 0.40; Ti 0.03; Nb 0.02; B 0.003 |
| | Symbol SCMV1-2 | --- | --- | 6 ≤ t ≤ 200 | --- | 0.21 | 0.55-0.80 | 0.40 | 0.020 | 0.020 | 0.50-0.80 | 0.40 | 0.45-0.60 | V 0.03; Cu 0.40; Ti 0.03; Nb 0.02; B 0.003 |

*: See ASTM A20/A20M-14 for additional information.

#### 4.4.1B Mechanical Properties of ¾Cr–½Mo Alloy Steels for Pressure Vessel Plates

| Specification | Designation | UNS No. | Steel No. | Section Thickness / Diameter mm | Section Thickness / Diameter in. | Yield Strength, min. MPa | Yield Strength, min. ksi | Tensile Strength, min. MPa | Tensile Strength, min. ksi | Elongation % min. | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ASME SA-387/SA-387M | Grade 2, Class 1 | S50460 | --- | --- | --- | 230 | 33 | 380-550 | 55-80 | 22 | A, N+T or Q+T | --- |
| | Grade 2, Class 2 | S50460 | --- | --- | --- | 310 | 45 | 485-620 | 70-90 | 22 | A, N+T or Q+T | --- |
| ASTM A387/A387M-11 | Grade 2, Class 1 | S50460 | --- | --- | --- | 230 | 33 | 380-550 | 55-80 | 22 | A, N+T or Q+T | --- |
| | Grade 2, Class 2 | S50460 | --- | --- | --- | 310 | 45 | 485-620 | 70-90 | 22 | A, N+T or Q+T | --- |
| JIS G 4109:2013 | Symbol SCMV1-1 | --- | --- | 6 ≤ t ≤ 50 | --- | 225 | --- | 380-550 T | --- | 18 | A or N+T | --- |
| | | | | 50 < t ≤ 200 | --- | 225 | --- | 380-550 T | --- | 22 | A or N+T | --- |
| | Symbol SCMV1-2 | --- | --- | 6 ≤ t ≤ 50 | --- | 315 | --- | 480-620 T | --- | 18 | N+T | --- |
| | | | | 50 < t ≤ 200 | --- | 315 | --- | 480-620 T | --- | 22 | N+T | --- |

### 4.4 Cr-Mo Alloy Steels for Pressure Vessel Plates

#### 4.4.2A Chemical Composition of 1Cr-½Mo Alloy Steels for Pressure Vessel Plates

| Specification | Designation | UNS No. | Steel No. | Section Thickness mm | Section Thickness in | Weight, %max, Unless Otherwise Specified C | Mn | Si | P | S | Cr | Ni | Mo | Others |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ASME SA-387/SA-387M* | Grade 12, Class 1 | K11757 | --- | --- | --- | 0.05-0.17 | 0.40-0.65 | 0.15-0.40 | 0.025 | 0.025 | 0.80-1.15 | 0.40 | 0.45-0.60 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| | Grade 12, Class 2 | K11757 | --- | --- | --- | 0.05-0.17 | 0.40-0.65 | 0.15-0.40 | 0.025 | 0.025 | 0.80-1.15 | 0.40 | 0.45-0.60 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| ASTM A387/A387M-11* | Grade 12, Class 1 | K11757 | --- | --- | --- | 0.05-0.17 | 0.40-0.65 | 0.15-0.40 | 0.025 | 0.025 | 0.80-1.15 | 0.40 | 0.45-0.65 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| | Grade 12, Class 2 | K11757 | --- | --- | --- | 0.05-0.17 | 0.40-0.65 | 0.15-0.40 | 0.025 | 0.025 | 0.80-1.15 | 0.40 | 0.45-0.65 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| EN 10028-2:2009 | 13 CrMo 4-5 | --- | 1.7335 | --- | --- | 0.08-0.18 | 0.40-1.00 | 0.35 | 0.025 | 0.010 | 0.70-1.15 | --- | 0.40-0.60 | Cu 0.30; N 0.012 |
| GB 6654-1996 | Grade 15CrMoR | --- | --- | --- | --- | 0.12-0.18 | 0.40-0.70 | 0.15-0.40 | 0.030 | 0.030 | 0.80-1.20 | 0.30 | 0.45-0.60 | Cu 0.30 |
| GB 713-1997 | Grade 15CrMog | --- | --- | --- | --- | 0.12-0.18 | 0.40-0.70 | 0.15-0.40 | 0.030 | 0.030 | 0.80-1.20 | 0.30 | 0.45-0.60 | V 0.010; Cu 0.30 |
| JIS G 4109:2013 | Symbol SCMV2-1 | --- | --- | 6 ≤ t ≤ 200 | --- | 0.17 | 0.40-0.65 | 0.40 | 0.020 | 0.020 | 0.80-1.15 | 0.40 | 0.45-0.60 | V 0.03; Cu 0.40; Ti 0.03; Nb 0.02; B 0.003 |
| | Symbol SCMV2-2 | --- | --- | 6 ≤ t ≤ 200 | --- | 0.17 | 0.40-0.65 | 0.40 | 0.020 | 0.020 | 0.80-1.15 | 0.40 | 0.45-0.60 | V 0.03; Cu 0.40; Ti 0.03; Nb 0.02; B 0.003 |

*: See ASTM A20/A20M-14 for additional information.

#### 4.4.2B Mechanical Properties of 1Cr-½Mo Alloy Steels for Pressure Vessel Plates

| Specification | Designation | UNS No. | Steel No. | Section Thickness / Diameter mm | Section Thickness / Diameter in. | Yield Strength, min. MPa | Yield Strength, min. ksi | Tensile Strength, min. MPa | Tensile Strength, min. ksi | Elongation % min. | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ASME SA-387/SA-387M | Grade 12, Class 1 | K11757 | --- | --- | --- | 230 | 33 | 380-550 | 55-80 | 22 | A, N+T or Q+T | --- |
| | Grade 12, Class 2 | K11757 | --- | --- | --- | 275 | 40 | 450-585 | 65-85 | 22 | A, N+T or Q+T | --- |
| ASTM A387/A387M-11 | Grade 12, Class 1 | K11757 | --- | --- | --- | 230 | 33 | 380-550 | 55-80 | 22 | A, N+T or Q+T | --- |
| | Grade 12, Class 2 | K11757 | --- | --- | --- | 275 | 40 | 450-585 | 65-85 | 22 | A, N+T or Q+T | --- |
| EN 10028-2:2009 | 13 CrMo 4-5 | --- | 1.7335 | t ≤ 16 | --- | 300 | --- | 450-600 | --- | 19 | N+T | see standard for impact data |
| | | | | 15 < t ≤ 60 | --- | 290 | --- | 450-600 | --- | 19 | N+T | |
| | | | | 60 < t ≤ 100 | --- | 270 | --- | 440-590 | --- | 19 | N+T | |
| | | | | 100 < t ≤ 150 | --- | 255 | --- | 430-580 | --- | 19 | N+T or Q+T | |
| | | | | 150 < t ≤ 250 | --- | 245 | --- | 420-570 | --- | 19 | Q+T | |
| GB 6654-1996 | Grade 15CrMoR | --- | --- | 6 < t ≤ 60 | --- | 295 | --- | 450-590 | --- | 19 | N+T | T: 31 J @ 20°C |
| | | | | 60 < t ≤ 100 | --- | 275 | --- | 450-590 | --- | 18 | N+T | T: 31 J @ 20°C |
| GB 713-1997 | Grade 15CrMog | --- | --- | t ≤ 60 | --- | 295 | --- | 450-590 | --- | 19 | HR, CtR, N or N+T | T: 31 J @ RT |
| | | | | 60 < t ≤ 100 | --- | 275 | --- | 450-590 | --- | 18 | HR, CtR, N or N+T | T: 31 J @ RT |
| JIS G 4109:2013 | Symbol SCMV2-1 | --- | --- | 6 ≤ t ≤ 50 | --- | 225 | --- | 380-550 T | --- | 18 | A or N+T | --- |
| | | | | 50 < t ≤ 200 | --- | 225 | --- | 380-550 T | --- | 22 | A or N+T | --- |
| | Symbol SCMV2-2 | --- | --- | 6 ≤ t ≤ 50 | --- | 275 | --- | 450-590 T | --- | 19 | N+T | --- |
| | | | | 50 < t ≤ 200 | --- | 275 | --- | 450-590 T | --- | 22 | N+T | --- |

**4.4 Cr-Mo Alloy Steels for Pressure Vessel Plates**

**4.4.3A Chemical Composition of 1¼Cr-½Mo Alloy Steels for Pressure Vessel Plates**

| Specification | Designation | UNS No. | Steel No. | Section Thickness mm | Section Thickness in | Weight, %max, Unless Otherwise Specified C | Mn | Si | P | S | Cr | Ni | Mo | Others |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ASME SA-387/SA-387M* | Grade 11, Class 1 | K11789 | --- | --- | --- | 0.05-0.17 | 0.40-0.65 | 0.50-0.80 | 0.025 | 0.025 | 1.00-1.50 | 0.40 | 0.45-0.65 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| | Grade 11, Class 2 | K11789 | --- | --- | --- | 0.05-0.17 | 0.40-0.65 | 0.50-0.80 | 0.025 | 0.025 | 1.00-1.50 | 0.40 | 0.45-0.65 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| ASTM A387/A387M-11* | Grade 11, Class 1 | K11789 | --- | --- | --- | 0.05-0.17 | 0.40-0.65 | 0.50-0.80 | 0.025 | 0.025 | 1.00-1.50 | 0.40 | 0.45-0.65 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| | Grade 11, Class 2 | K11789 | --- | --- | --- | 0.05-0.17 | 0.40-0.65 | 0.50-0.80 | 0.025 | 0.025 | 1.00-1.50 | 0.40 | 0.45-0.65 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| EN 10028-2:2009 | 13CrMoSi5-5 | --- | 1.7336 | --- | --- | 0.17 | 0.40-0.65 | 0.50-0.80 | 0.015 | 0.005 | 1.00-1.50 | 0.30 | 0.45-0.65 | Cu 0.30; N 0.012 |
| JIS G 4109:2013 | Symbol SCMV3-1 | --- | --- | 6 ≤ t ≤ 200 | --- | 0.17 | 0.40-0.65 | 0.50-0.80 | 0.020 | 0.020 | 1.00-1.50 | 0.40 | 0.45-0.60 | V 0.03; Cu 0.40; Ti 0.03; Nb 0.02; B 0.003 |
| | Symbol SCMV3-2 | --- | --- | 6 ≤ t ≤ 200 | --- | 0.17 | 0.40-0.65 | 0.50-0.80 | 0.020 | 0.020 | 1.00-1.50 | 0.40 | 0.45-0.60 | V 0.03; Cu 0.40; Ti 0.03; Nb 0.02; B 0.003 |

*: See ASTM A20/A20M-14 for additional information.

**4.4.3B Mechanical Properties of 1¼Cr–½Mo Alloy Steels for Pressure Vessel Plates**

| Specification | Designation | UNS No. | Steel No. | Section Thickness / Diameter mm | Section Thickness / Diameter in. | Yield Strength, min. MPa | Yield Strength, min. ksi | Tensile Strength, min. MPa | Tensile Strength, min. ksi | Elongation % min. | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ASME SA-387/SA-387M | Grade 11, Class 1 | K11789 | --- | --- | --- | 240 | 35 | 415-585 | 60-85 | 22 | A, N+T or Q+T | --- |
| | Grade 11, Class 2 | K11789 | --- | --- | --- | 310 | 45 | 515-690 | 75-100 | 22 | A, N+T or Q+T | --- |
| ASTM A387/A387M-11 | Grade 11, Class 1 | K11789 | --- | --- | --- | 240 | 35 | 415-585 | 60-85 | 22 | A, N+T or Q+T | --- |
| | Grade 11, Class 2 | K11789 | --- | --- | --- | 310 | 45 | 515-690 | 75-100 | 22 | A, N+T or Q+T | --- |
| EN 10028-2:2009 | 13CrMoSi5-5 | --- | 1.7336 | t ≤ 60 | --- | 310 | --- | 510-690 | --- | 20 | N+T | see standard for impact data |
| | | | | t ≤ 60 | --- | 400 | --- | 510-690 | --- | 20 | Q+T | |
| | | | | 60 < t ≤ 100 | --- | 300 | --- | 480-660 | --- | 20 | N+T | |
| | | | | 60 < t ≤ 100 | --- | 390 | --- | 500-680 | --- | 20 | Q+T | |
| | | | | 100 < t ≤ 250 | --- | 380 | --- | 490-670 | --- | 20 | Q+T | |
| JIS G 4109:2013 | Symbol SCMV3-1 | --- | --- | 6 ≤ t ≤ 50 | --- | 235 | --- | 410-590 T | --- | 19 | A or N+T | --- |
| | | | | 50 < t ≤ 200 | --- | 235 | --- | 410-590 T | --- | 22 | A or N+T | --- |
| | Symbol SCMV3-2 | --- | --- | 6 ≤ t ≤ 50 | --- | 315 | --- | 520-690 T | --- | 18 | N+T | --- |
| | | | | 50 < t ≤ 200 | --- | 315 | --- | 520-690 T | --- | 22 | N+T | --- |

### 4.4 Cr-Mo Alloy Steels for Pressure Vessel Plates

#### 4.4.4A Chemical Composition of 2¼Cr-1Mo Alloy Steels for Pressure Vessel Plates

| Specification | Designation | UNS No. | Steel No. | Section Thickness mm | Section Thickness in | Weight, %max, Unless Otherwise Specified C | Mn | Si | P | S | Cr | Ni | Mo | Others |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ASME SA-387/SA-387M* | Grade 22, Class 1 | K21590 | --- | --- | --- | 0.05-0.15 | 0.30-0.60 | 0.50 | 0.025 | 0.025 | 2.00-2.50 | 0.40 | 0.90-1.10 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| | Grade 22, Class 2 | K21590 | --- | --- | --- | 0.05-0.15 | 0.30-0.60 | 0.50 | 0.025 | 0.025 | 2.00-2.50 | 0.40 | 0.90-1.10 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| | Grade 22L, Class 1 | K21590 | --- | --- | --- | 0.10 | 0.30-0.60 | 0.50 | 0.025 | 0.025 | 2.00-2.50 | 0.40 | 0.90-1.10 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| ASTM A387/A387M-11* | Grade 22, Class 1 | K21590 | --- | --- | --- | 0.05-0.15 | 0.30-0.60 | 0.50 | 0.025 | 0.025 | 2.00-2.50 | 0.40 | 0.90-1.10 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| | Grade 22, Class 2 | K21590 | --- | --- | --- | 0.05-0.15 | 0.30-0.60 | 0.50 | 0.025 | 0.025 | 2.00-2.50 | 0.40 | 0.90-1.10 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| | Grade 22L, Class 1 | K21590 | --- | --- | --- | 0.10 | 0.30-0.60 | 0.50 | 0.025 | 0.025 | 2.00-2.50 | 0.40 | 0.90-1.10 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| EN 10028-2:2009 | 10CrMo9-10 | --- | 1.7380 | --- | --- | 0.08-0.14 | 0.40-0.80 | 0.50 | 0.020 | 0.010 | 2.00-2.50 | --- | 0.90-1.10 | Cu 0.30; N 0.012 |
| JIS G 4109:2013 | Symbol SCMV4-1 | --- | --- | 6 ≤ t ≤ 300 | --- | 0.17 | 0.30-0.60 | 0.50 | 0.020 | 0.020 | 2.00-2.50 | 0.40 | 0.90-1.10 | V 0.03; Cu 0.40; Ti 0.03; Nb 0.02; B 0.003 |
| | Symbol SCMV4-2 | --- | --- | 6 ≤ t ≤ 300 | --- | 0.17 | 0.30-0.60 | 0.50 | 0.020 | 0.020 | 2.00-2.50 | 0.40 | 0.90-1.10 | V 0.03; Cu 0.40; Ti 0.03; Nb 0.02; B 0.003 |
| JIS G 4110:2008 | Symbol SCMQ4E | --- | --- | 6 ≤ t ≤ 300 | --- | 0.17 | 0.30-0.60 | 0.50 | 0.015 | 0.015 | 2.00-2.50 | 0.40 | 0.90-1.10 | V 0.03; Cu 0.40; Nb 0.02 |

* See ASTM A20/A20M-14 for additional information.

#### 4.4.4B Mechanical Properties of 2¼Cr–1Mo Alloy Steels for Pressure Vessel Plates

| Specification | Designation | UNS No. | Steel No. | Section Thickness / Diameter mm | Section Thickness / Diameter in. | Yield Strength, min. MPa | Yield Strength, min. ksi | Tensile Strength, min. MPa | Tensile Strength, min. ksi | Elongation % min. | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ASME SA-387/SA-387M | Grade 22, Class 1 | K21590 | --- | --- | --- | 205 | 30 | 415-585 | 60-85 | 18 | A, SR, N+T or Q+T | --- |
| | Grade 22, Class 2 | K21590 | --- | --- | --- | 310 | 45 | 515-690 | 75-100 | 18 | A, SR, N+T or Q+T | --- |
| | Grade 22L, Class 1 | K21590 | --- | --- | --- | 205 | 30 | 415-585 | 60-85 | 18 | A, SR, N+T or Q+T | --- |
| ASTM A387/A387M-11 | Grade 22, Class 1 | K21590 | --- | --- | --- | 205 | 30 | 415-585 | 60-85 | 18 | A, SR, N+T or Q+T | --- |
| | Grade 22, Class 2 | K21590 | --- | --- | --- | 310 | 45 | 515-690 | 75-100 | 18 | A, SR, N+T or Q+T | --- |
| | Grade 22L, Class 1 | K21590 | --- | --- | --- | 205 | 30 | 415-585 | 60-85 | 18 | A, SR, N+T or Q+T | --- |
| EN 10028-2:2009 | 10CrMo9-10 | --- | 1.7380 | t ≤ 16 | --- | 310 | --- | 480-630 | --- | 18 | N+T | see standard for impact data |
| | | | | 16 < t ≤ 40 | --- | 300 | --- | 480-630 | --- | 18 | N+T | |
| | | | | 40 < t ≤ 60 | --- | 290 | --- | 480-630 | --- | 18 | N+T | |
| | | | | 60 < t ≤ 100 | --- | 280 | --- | 470-620 | --- | 17 | N+T or Q+T | |
| | | | | 100 < t ≤ 150 | --- | 260 | --- | 460-610 | --- | 17 | Q+T | |
| | | | | 150 < t ≤ 250 | --- | 250 | --- | 450-600 | --- | 17 | Q+T | |
| JIS G 4109:2013 | Symbol SCMV4-1 | --- | --- | 6 ≤ t ≤ 300 | --- | 205 | --- | 410-590 T | --- | 18 | A or N+T | --- |
| | Symbol SCMV4-2 | --- | --- | 6 ≤ t ≤ 300 | --- | 315 | --- | 520-690 T | --- | 18 | N+T | --- |
| JIS G 4110:2008 | Symbol SCMQ4E | --- | --- | 6 ≤ t ≤ 300 | --- | 380 | --- | 580-760 T | --- | 18 | Q+T or N+T | T: 54 J @ -18°C |

### 4.4 Cr-Mo Alloy Steels for Pressure Vessel Plates

#### 4.4.5A Chemical Composition of 3Cr-1Mo Alloy Steels for Pressure Vessel Plates

| Specification | Designation | UNS No. | Steel No. | Section Thickness mm | Section Thickness in | Weight, %max, Unless Otherwise Specified C | Mn | Si | P | S | Cr | Ni | Mo | Others |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ASME SA-387/SA-387M* | Grade 21, Class 1 | K31545 | --- | --- | --- | 0.05-0.15 | 0.30-0.60 | 0.50 | 0.025 | 0.025 | 2.75-3.25 | 0.40 | 0.90-1.10 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| | Grade 21, Class 2 | K31545 | --- | --- | --- | 0.05-0.15 | 0.30-0.60 | 0.50 | 0.025 | 0.025 | 2.75-3.25 | 0.40 | 0.90-1.10 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| | Grade 21L, Class 1 | K31545 | --- | --- | --- | 0.10 | 0.30-0.60 | 0.50 | 0.025 | 0.025 | 2.75-3.25 | 0.40 | 0.90-1.10 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| ASTM A387/A387M-11* | Grade 21, Class 1 | K31545 | --- | --- | --- | 0.05-0.15 | 0.30-0.60 | 0.50 | 0.025 | 0.025 | 2.75-3.25 | 0.40 | 0.90-1.10 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| | Grade 21, Class 2 | K31545 | --- | --- | --- | 0.05-0.15 | 0.30-0.60 | 0.50 | 0.025 | 0.025 | 2.75-3.25 | 0.40 | 0.90-1.10 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| | Grade 21L, Class 1 | K31545 | --- | --- | --- | 0.10 | 0.30-0.60 | 0.50 | 0.025 | 0.025 | 2.75-3.25 | 0.40 | 0.90-1.10 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| JIS G 4109:2013 | Symbol SCMV5-1 | --- | --- | 6 ≤ t ≤ 300 | --- | 0.17 | 0.30-0.60 | 0.50 | 0.020 | 0.020 | 2.75-3.25 | 0.40 | 0.90-1.10 | V 0.03; Cu 0.40; Ti 0.03; Nb 0.02; B 0.003 |
| | Symbol SCMV5-2 | --- | --- | 6 ≤ t ≤ 300 | --- | 0.17 | 0.30-0.60 | 0.50 | 0.020 | 0.020 | 2.75-3.25 | 0.40 | 0.90-1.10 | V 0.03; Cu 0.40; Ti 0.03; Nb 0.02; B 0.003 |

* See ASTM A20/A20M-14 for additional information.

#### 4.4.5B Mechanical Properties of 3Cr–1Mo Alloy Steels for Pressure Vessel Plates

| Specification | Designation | UNS No. | Steel No. | Section Thickness / Diameter mm | Section Thickness / Diameter in. | Yield Strength, min. MPa | Yield Strength, min. ksi | Tensile Strength, min. MPa | Tensile Strength, min. ksi | Elongation % min. | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ASME SA-387/SA-387M | Grade 21, Class 1 | K31545 | --- | --- | --- | 205 | 30 | 415-585 | 60-85 | 18 | A, SR, N+T or Q+T | --- |
| | Grade 21, Class 2 | K31545 | --- | --- | --- | 310 | 45 | 515-690 | 75-100 | 18 | A, SR, N+T or Q+T | --- |
| | Grade 21L, Class 1 | K31545 | --- | --- | --- | 205 | 30 | 415-585 | 60-85 | 18 | A, SR, N+T or Q+T | --- |
| ASTM A387/A387M-11 | Grade 21, Class 1 | K31545 | --- | --- | --- | 205 | 30 | 415-585 | 60-85 | 18 | A, SR, N+T or Q+T | --- |
| | Grade 21, Class 2 | K31545 | --- | --- | --- | 310 | 45 | 515-690 | 75-100 | 18 | A, SR, N+T or Q+T | --- |
| | Grade 21L, Class 1 | K31545 | --- | --- | --- | 205 | 30 | 415-585 | 60-85 | 18 | A, SR, N+T or Q+T | --- |
| JIS G 4109:2013 | Symbol SCMV5-1 | --- | --- | 6 ≤ t ≤ 300 | --- | 205 | --- | 410-590 T | --- | 18 | A or N+T | --- |
| | Symbol SCMV5-2 | --- | --- | 6 ≤ t ≤ 300 | --- | 315 | --- | 520-690 T | --- | 18 | N+T | --- |

### 4.4 Cr-Mo Alloy Steels for Pressure Vessel Plates

#### 4.4.6A Chemical Composition of 5Cr-½Mo Alloy Steels for Pressure Vessel Plates

| Specification | Designation | UNS No. | Steel No. | Section Thickness mm | Section Thickness in | Weight, %max, Unless Otherwise Specified C | Mn | Si | P | S | Cr | Ni | Mo | Others |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ASME SA-387/SA-387M* | Grade 5, Class 1 | S50200 | --- | --- | --- | 0.15 | 0.30-0.60 | 0.50 | 0.025 | 0.025 | 4.00-6.00 | 0.40 | 0.45-0.65 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| | Grade 5, Class 2 | S50200 | --- | --- | --- | 0.15 | 0.30-0.60 | 0.50 | 0.025 | 0.025 | 4.00-6.00 | 0.40 | 0.45-0.65 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| ASTM A387/A387M-11* | Grade 5, Class 1 | S50200 | --- | --- | --- | 0.15 | 0.30-0.60 | 0.50 | 0.025 | 0.025 | 4.00-6.00 | 0.40 | 0.45-0.65 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| | Grade 5, Class 2 | S50200 | --- | --- | --- | 0.15 | 0.30-0.60 | 0.50 | 0.025 | 0.025 | 4.00-6.00 | 0.40 | 0.45-0.65 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| EN 10028-2:2009 | X12CrMo5 | --- | 1.7362 | --- | --- | 0.10-0.15 | 0.30-0.60 | 0.50 | 0.020 | 0.005 | 4.0-6.0 | 0.30 | 0.45-0.65 | Cu 0.30; N 0.012 |
| JIS G 4109:2013 | Symbol SCMV6-1 | --- | --- | 6 ≤ t ≤ 300 | --- | 0.15 | 0.30-0.60 | 0.50 | 0.020 | 0.020 | 4.00-6.00 | 0.40 | 0.45-0.65 | V 0.03; Cu 0.40; Ti 0.03; Nb 0.02; B 0.003 |
| | Symbol SCMV6-2 | --- | --- | 6 ≤ t ≤ 300 | --- | 0.15 | 0.30-0.60 | 0.50 | 0.020 | 0.020 | 4.00-6.00 | 0.40 | 0.45-0.65 | V 0.03; Cu 0.40; Ti 0.03; Nb 0.02; B 0.003 |

*: See ASTM A20/A20M-14 for additional information.

#### 4.4.6B Mechanical Properties of 5Cr–½Mo Alloy Steels for Pressure Vessel Plates

| Specification | Designation | UNS No. | Steel No. | Section Thickness / Diameter mm | Section Thickness / Diameter in. | Yield Strength, min. MPa | Yield Strength, min. ksi | Tensile Strength, min. MPa | Tensile Strength, min. ksi | Elongation % min. | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ASME SA-387/SA-387M | Grade 5, Class 1 | S50200 | --- | --- | --- | 205 | 30 | 415-585 | 60-85 | 18 | A, SR, N+T or Q+T | --- |
| | Grade 5, Class 2 | S50200 | --- | --- | --- | 310 | 45 | 515-690 | 75-100 | 18 | A, SR, N+T or Q+T | --- |
| ASTM A387/A387M-11 | Grade 5, Class 1 | S50200 | --- | --- | --- | 205 | 30 | 415-585 | 60-85 | 18 | A, SR, N+T or Q+T | --- |
| | Grade 5, Class 2 | S50200 | --- | --- | --- | 310 | 45 | 515-690 | 75-100 | 18 | A, SR, N+T or Q+T | --- |
| EN 10028-2:2009 | X12CrMo5 | --- | 1.7362 | t ≤ 60 | --- | 320 | --- | 510-690 | --- | 20 | N+T | see standard for impact data |
| | | | | 60 < t ≤ 150 | --- | 300 | --- | 480-660 | --- | 20 | N+T | |
| | | | | 150 < t ≤ 250 | --- | 300 | --- | 450-630 | --- | 20 | Q+T | |
| JIS G 4109:2013 | Symbol SCMV6-1 | --- | --- | 6 ≤ t ≤ 300 | --- | 205 | --- | 410-590 T | --- | 18 | A or N+T | --- |
| | Symbol SCMV6-2 | --- | --- | 6 ≤ t ≤ 300 | --- | 315 | --- | 520-690 T | --- | 18 | N+T | --- |

**4.4 Cr-Mo Alloy Steels for Pressure Vessel Plates**

**4.4.7A Chemical Composition of 9Cr-1Mo Alloy Steels for Pressure Vessel Plates**

| Specification | Designation | UNS No. | Steel No. | Section Thickness mm | Section Thickness in | Weight, %max, Unless Otherwise Specified C | Mn | Si | P | S | Cr | Ni | Mo | Others |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ASME SA-387/SA-387M* | Grade 91, Class 2 | K90901 | --- | --- | --- | 0.08-0.12 | 0.30-0.60 | 0.20-0.50 | 0.020 | 0.010 | 8.00-9.50 | 0.40 | 0.85-1.05 | V 0.18-0.25; Al 0.02; Cu 0.40; Ti 0.01; Cb 0.06-0.10; N 0.030-0.070; Zr 0.01; B 0.0010 |
| ASTM A387/A387M-11* | Grade 91, Class 2 | K91560 | --- | --- | --- | 0.08-0.12 | 0.30-0.60 | 0.20-0.50 | 0.020 | 0.010 | 8.00-9.50 | 0.40 | 0.85-1.05 | V 0.18-0.25; Al 0.02; Cu 0.40; Ti 0.01; Cb 0.06-0.10; N 0.030-0.070; Zr 0.01; B 0.0010 |
| EN 10028-2:2009 | X10CrMoVNb9-1 | --- | 1.4903 | --- | --- | 0.08-0.12 | 0.30-0.60 | 0.50 | 0.020 | 0.005 | 8.0-9.5 | 0.30 | 0.85-1.05 | V 0.18-0.25; Al 0.040; Cu 0.30; Nb 0.06-0.10; N 0.030-0.070 |

*: See ASTM A20/A20M-14 for additional information.

**4.4.7B Mechanical Properties of 9Cr–1Mo Alloy Steels for Pressure Vessel Plates**

| Specification | Designation | UNS No. | Steel No. | Section Thickness / Diameter mm | Section Thickness / Diameter in. | Yield Strength, min. MPa | Yield Strength, min. ksi | Tensile Strength, min. MPa | Tensile Strength, min. ksi | Elongation % min. | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ASME SA-387/SA-387M | Grade 91, Class 2 | K90901 | --- | --- | --- | 415 | 60 | 585-760 | 85-110 | 18 | N+T, A or SR | --- |
| ASTM A387/A387M-11 | Grade 91, Class 2 | K91560 | --- | --- | --- | 415 | 60 | 585-760 | 85-110 | 18 | N+T, A or SR | --- |
| EN 10028-2:2009 | X10CrMoVNb9-1 | --- | 1.4903 | t ≤ 60 | --- | 445 | --- | 580-760 | --- | 18 | N+T | see standard for impact data |
| | | | | 60 < t ≤ 150 | --- | 435 | --- | 550-730 | --- | 18 | N+T | |
| | | | | 150 < t ≤ 250 | --- | 435 | --- | 520-700 | --- | 18 | Q+T | |

### 4.5 Ni Alloy Steels for Pressure Vessel Plates

#### 4.5.1A Chemical Composition of ½Ni Alloy Steels for Pressure Vessel Plates

| Specification | Designation | UNS No. | Steel No. | Section Thickness mm | Section Thickness in | Weight, %max, Unless Otherwise Specified C | Mn | Si | P | S | Cr | Ni | Mo | Others |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| EN 10028-4:2009 | 11MnNi5-3 | --- | 1.6212 | --- | --- | 0.14 | 0.70-1.50 | 0.50 | 0.025 | 0.010 | --- | 0.30-0.80 | --- | V 0.050; Al 0.020 min.; Nb 0.05; (Cr+Cu+Mo) 0.50 |
| | 13MnNi6-3 | --- | 1.6217 | --- | --- | 0.16 | 0.85-1.70 | 0.50 | 0.025 | 0.010 | --- | 0.30-0.85 | --- | V 0.050; Al 0.020 min.; Nb 0.05; (Cr+Cu+Mo) 0.50 |
| GB 3531-1996 | Grade 15MnNiDR | --- | --- | --- | --- | 0.18 | 1.20-1.60 | 0.15-0.50 | 0.030 | 0.025 | 0.25 | 0.20-0.60 | 0.08 | V 0.06; Al 0.020 min.; Cu 0.25 |
| ISO 9328-4:2004 | Grade 11MnNi5-3 | --- | --- | --- | --- | 0.14 | 0.70-1.50 | 0.50 | 0.025 | 0.015 | --- | 0.30-0.80 | --- | V 0.05; Al 0.02-; Nb 0.05; (Cr+Cu+Mo) 0.50 |
| | Grade 13MnNi6-3 | --- | --- | --- | --- | 0.16 | 0.85-1.70 | 0.50 | 0.025 | 0.015 | --- | 0.30-0.80 | --- | V 0.05; Al 0.02-; Nb 0.05; (Cr+Cu+Mo) 0.50 |

#### 4.5.1B Mechanical Properties of ½ Ni Alloy Steels for Pressure Vessel Plates

| Specification | Designation | UNS No. | Steel No. | Section Thickness / Diameter mm | Section Thickness / Diameter in. | Yield Strength, min. MPa | Yield Strength, min. ksi | Tensile Strength, min. MPa | Tensile Strength, min. ksi | Elongation % min. | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| EN 10028-4:2009 | 11MnNi5-3 | --- | 1.6212 | t ≤ 30 | --- | 285 | --- | 420-530 | --- | 24 | N+T | see standard for impact data |
| | | | | 30 < t ≤ 50 | --- | 275 | --- | 420-530 | --- | 24 | N+T | |
| | | | | 50 < t ≤ 80 | --- | 265 | --- | 420-530 | --- | 24 | N+T | |
| | 13MnNi6-3 | --- | 1.6217 | t ≤ 30 | --- | 355 | --- | 490-610 | --- | 22 | N+T | see standard for impact data |
| | | | | 30 < t ≤ 50 | --- | 345 | --- | 490-610 | --- | 22 | N+T | |
| | | | | 50 < t ≤ 80 | --- | 335 | --- | 490-610 | --- | 22 | N+T | |
| GB 3531-1996 | Grade 15MnNiDR | --- | --- | 6 ≤ t ≤ 16 | --- | 325 | --- | 490-630 | --- | 20 | N or N+T | --- |
| | | | | 16 < t ≤ 36 | --- | 305 | --- | 470-610 | --- | 20 | N or N+T | --- |
| | | | | 36 < t ≤ 60 | --- | 290 | --- | 460-600 | --- | 20 | N or N+T | --- |
| ISO 9328-4:2004 | Grade 11MnNi5-3 | --- | --- | t ≤ 30 | --- | 285 | --- | 550, 420-530 T | 80 | 35, 24 T | N or N+T | see standard for impact data |
| | | | | 30 < t ≤ 50 | --- | 275 | --- | 420-530 T | --- | 24 T | N or N+T | |
| | | | | 50 < t ≤ 80 | --- | 265 | --- | 420-530 T | --- | 24 T | N or N+T | |
| | Grade 13MnNi6-3 | --- | --- | t ≤ 30 | --- | 355 | --- | 490-610 T | --- | 22 T | N or N+T | see standard for impact data |
| | | | | 30 < t ≤ 50 | --- | 345 | --- | 490-610 T | --- | 22 T | N or N+T | |
| | | | | 50 < t ≤ 80 | --- | 335 | --- | 490-610 T | --- | 22 T | N or N+T | |

### 4.5 Ni Alloy Steels for Pressure Vessel Plates

#### 4.5.2A Chemical Composition of 1½ Ni Alloy Steels for Pressure Vessel Plates

| Specification | Designation | UNS No. | Steel No. | Section Thickness | | Weight, %max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| EN 10028-4:2009 | 15NiMn6 | --- | 1.6228 | --- | --- | 0.18 | 0.80-1.50 | 0.35 | 0.025 | 0.010 | --- | 1.30-1.70 | --- | V 0.05; (Cr+Cu+Mo) 0.50 |
| ISO 9328-4:2004 | Grade 15NiMn6 | --- | --- | --- | --- | 0.18 | 0.80-1.50 | 0.35 | 0.025 | 0.015 | --- | 1.30-1.70 | --- | V 0.05; (Cr+Cu+Mo) 0.50 |

#### 4.5.2B Mechanical Properties of 1½ Ni Alloy Steels for Pressure Vessel Plates

| Specification | Designation | UNS No. | Steel No. | Section Thickness / Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation % min. | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | | | |
| EN 10028-4:2009 | 15NiMn6 | --- | 1.6228 | t ≤ 30 | --- | 355 | --- | 490-640 | --- | 22 | N or N+T or Q+T | see standard for impact data |
| | | | | 30 < t ≤ 50 | --- | 345 | --- | 490-640 | --- | 22 | N or N+T or Q+T | |
| | | | | 50 < t ≤ 80 | --- | 335 | --- | 490-640 | --- | 22 | N or N+T or Q+T | |
| ISO 9328-4:2004 | Grade 15NiMn6 | --- | --- | t ≤ 30 | --- | 355 | --- | 490-640 T | --- | 22 T | N or N+T or Q+T | see standard for impact data |
| | | | | 30 < t ≤ 50 | --- | 345 | --- | 490-640 T | --- | 22 T | N or N+T or Q+T | |
| | | | | 50 < t ≤ 80 | --- | 335 | --- | 490-640 T | --- | 22 T | N or N+T or Q+T | |

**4.5 Ni Alloy Steels for Pressure Vessel Plates**

**4.5.3A Chemical Composition of 2¼Ni Alloy Steels for Pressure Vessel Plates**

| Specification | Designation | UNS No. | Steel No. | Section Thickness | | Weight, %max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASME SA-203/SA-203M* | Grade A | K21703 | --- | t ≤ 50 | t ≤ 2 | 0.17 | 0.70 | 0.15-0.40 | 0.025 | 0.025 | 0.30 | 2.10-2.50 | 0.12 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| | | | | 50 < t ≤ 100 | 2 < t ≤ 4 | 0.20 | 0.80 | 0.15-0.40 | 0.025 | 0.025 | 0.30 | 2.10-2.50 | 0.12 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| | | | | t > 100 | t > 4 | 0.23 | 0.80 | 0.15-0.40 | 0.025 | 0.025 | 0.30 | 2.10-2.50 | 0.12 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| | Grade B | K22103 | --- | t ≤ 50 | t ≤ 2 | 0.21 | 0.70 | 0.15-0.40 | 0.025 | 0.025 | 0.30 | 2.10-2.50 | 0.12 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| | | | | 50 < t ≤ 100 | 2 < t ≤ 4 | 0.24 | 0.80 | 0.15-0.40 | 0.025 | 0.025 | 0.30 | 2.10-2.50 | 0.12 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| | | | | t > 100 | t > 4 | 0.25 | 0.80 | 0.15-0.40 | 0.025 | 0.025 | 0.30 | 2.10-2.50 | 0.12 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| ASTM A203/A203M-12* | Grade A | K21703 | --- | t ≤ 50 | t ≤ 2 | 0.17 | 0.70 | 0.15-0.40 | 0.025 | 0.025 | 0.30 | 2.10-2.50 | 0.12 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| | | | | 50 < t ≤ 100 | 2 < t ≤ 4 | 0.20 | 0.80 | 0.15-0.40 | 0.025 | 0.025 | 0.30 | 2.10-2.50 | 0.12 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| | | | | t > 100 | t > 4 | 0.23 | 0.80 | 0.15-0.40 | 0.025 | 0.025 | 0.30 | 2.10-2.50 | 0.12 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| | Grade B | K22103 | --- | t ≤ 50 | t ≤ 2 | 0.21 | 0.70 | 0.15-0.40 | 0.025 | 0.025 | 0.30 | 2.10-2.50 | 0.12 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| | | | | 50 < t ≤ 100 | 2 < t ≤ 4 | 0.24 | 0.80 | 0.15-0.40 | 0.025 | 0.025 | 0.30 | 2.10-2.50 | 0.12 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| | | | | t > 100 | t > 4 | 0.25 | 0.80 | 0.15-0.40 | 0.025 | 0.025 | 0.30 | 2.10-2.50 | 0.12 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| JIS G 3127:2013 | Symbol SL2N255 | --- | --- | 6 ≤ t ≤ 50 | --- | 0.17 | 0.70 | 0.30 | 0.015 | 0.015 | --- | 2.10-2.50 | --- | --- |

*: See ASTM A20/A20M-14 for additional information.

**4.5 Ni Alloy Steels for Pressure Vessel Plates**

**4.5.3B Mechanical Properties of 2¼Ni Alloy Steels for Pressure Vessel Plates**

| Specification | Designation | UNS No. | Steel No. | Section Thickness / Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | % min. | | |
| ASME SA-203/SA-203M | Grade A | K21703 | --- | t ≤ 50 | t ≤ 2 | 255 | 37 | 450-585 | 65-85 | 23 | N | 27 J @ BA°C |
| | | | | t > 50 | t > 2 | 255 | 37 | 450-585 | 65-85 | 23 | N | 27 J @ BA°C |
| | Grade B | K22103 | --- | t ≤ 50 | t ≤ 2 | 275 | 40 | 485-620 | 70-90 | 21 | N | 27 J @ BA°C |
| | | | | t > 50 | t > 2 | 275 | 40 | 485-620 | 70-90 | 21 | N | 27 J @ BA°C |
| ASTM A203/A203M-12 | Grade A | K21703 | --- | t ≤ 50 | t ≤ 2 | 255 | 37 | 450-585 | 65-85 | 23 | N | 27 J @ BA°C |
| | | | | t > 50 | t > 2 | 255 | 37 | 450-585 | 65-85 | 23 | N | 27 J @ BA°C |
| | Grade B | K22103 | --- | t ≤ 50 | t ≤ 2 | 275 | 40 | 485-620 | 70-90 | 21 | N | 27 J @ BA°C |
| | | | | t > 50 | t > 2 | 275 | 40 | 485-620 | 70-90 | 21 | N | 27 J @ BA°C |
| JIS G 3127:2013 | Symbol SL2N255 | --- | --- | 6 ≤ t ≤ 16 | --- | 255 | --- | 450-590 T | --- | 24 | N, N+T or TMCP | see standard for impact data |
| | | | | 16 < t ≤ 20 | --- | 255 | --- | 450-590 T | --- | 29 | N, N+T or TMCP | L: 21 J @ -70°C |
| | | | | 20 < t ≤ 50 | --- | 255 | --- | 450-590 T | --- | 24 | N, N+T or TMCP | L: 21 J @ -70°C |

**4.5 Ni Alloy Steels for Pressure Vessel Plates**

**4.5.4A Chemical Composition of 3½Ni Alloy Steels for Pressure Vessel Plates**

| Specification | Designation | UNS No. | Steel No. | Section Thickness | | Weight, %max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASME SA-203/SA-203M* | Grade D | K31718 | --- | t ≤ 50 | t ≤ 2 | 0.17 | 0.70 | 0.15-0.40 | 0.025 | 0.025 | 0.30 | 3.25-3.75 | 0.12 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| | | | | 50 < t ≤ 100 | 2 < t ≤ 4 | 0.20 | 0.80 | 0.15-0.40 | 0.025 | 0.025 | 0.30 | 3.25-3.75 | 0.12 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| | Grade E | K32018 | --- | t ≤ 50 | t ≤ 2 | 0.20 | 0.70 | 0.15-0.40 | 0.025 | 0.025 | 0.30 | 3.25-3.75 | 0.12 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| | | | | 50 < t ≤ 100 | 2 < t ≤ 4 | 0.23 | 0.80 | 0.15-0.40 | 0.025 | 0.025 | 0.30 | 3.25-3.75 | 0.12 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| | Grade F | --- | --- | t ≤ 50 | t ≤ 2 | 0.20 | 0.70 | 0.15-0.40 | 0.025 | 0.025 | 0.30 | 3.25-3.75 | 0.12 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| | | | | 50 < t ≤ 100 | 2 < t ≤ 4 | 0.23 | 0.80 | 0.15-0.40 | 0.025 | 0.025 | 0.30 | 3.25-3.75 | 0.12 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| ASTM A203/A203M-12* | Grade D | K31718 | --- | t ≤ 50 | t ≤ 2 | 0.17 | 0.70 | 0.15-0.40 | 0.025 | 0.025 | 0.30 | 3.25-3.75 | 0.12 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| | | | | 50 < t ≤ 100 | 2 < t ≤ 4 | 0.20 | 0.80 | 0.15-0.40 | 0.025 | 0.025 | 0.30 | 3.25-3.75 | 0.12 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| | Grade E | K32018 | --- | t ≤ 50 | t ≤ 2 | 0.20 | 0.70 | 0.15-0.40 | 0.025 | 0.025 | 0.30 | 3.25-3.75 | 0.12 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| | | | | 50 < t ≤ 100 | 2 < t ≤ 4 | 0.23 | 0.80 | 0.15-0.40 | 0.025 | 0.025 | 0.30 | 3.25-3.75 | 0.12 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| | Grade F | --- | --- | t ≤ 50 | t ≤ 2 | 0.20 | 0.70 | 0.15-0.40 | 0.025 | 0.025 | 0.30 | 3.25-3.75 | 0.12 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| | | | | 50 < t ≤ 100 | 2 < t ≤ 4 | 0.23 | 0.80 | 0.15-0.40 | 0.025 | 0.025 | 0.30 | 3.25-3.75 | 0.12 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| EN 10028-4:2009 | 12Ni14 | --- | 1.5637 | --- | --- | 0.15 | 0.30-0.80 | 0.35 | 0.020 | 0.005 | --- | 3.25-3.75 | --- | V 0.05; (Cr+Cu+Mo) 0.50 |
| JIS G 3127:2013 | Symbol SL3N255 | --- | --- | 6 ≤ t ≤ 50 | --- | 0.15 | 0.70 | 0.30 | 0.015 | 0.015 | --- | 3.25-3.75 | --- | --- |
| | Symbol SL3N275 | --- | --- | 6 ≤ t ≤ 50 | --- | 0.17 | 0.70 | 0.30 | 0.015 | 0.015 | --- | 3.25-3.75 | --- | --- |
| | Symbol SL3N440 | --- | --- | 6 ≤ t ≤ 50 | --- | 0.15 | 0.70 | 0.30 | 0.015 | 0.015 | --- | 3.25-3.75 | --- | --- |

*: See ASTM A20/A20M-14 for additional information.

**4.5 Ni Alloy Steels for Pressure Vessel Plates**

**4.5.4B Mechanical Properties of 3½Ni Alloy Steels for Pressure Vessel Plates**

| Specification | Designation | UNS No. | Steel No. | Section Thickness / Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | % min. | | |
| ASME SA-203/SA-203M | Grade D | K31718 | --- | t ≤ 50 | t ≤ 2 | 255 | 37 | 450-585 | 65-85 | 23 | N | 27 J @ BA°C |
| | | | | t > 50 | t > 2 | 255 | 37 | 450-585 | 65-85 | 23 | N | 27 J @ BA°C |
| | Grade E | K32018 | --- | t ≤ 50 | t ≤ 2 | 275 | 40 | 485-620 | 70-90 | 21 | N | 27 J @ BA°C |
| | | | | t > 50 | t > 2 | 275 | 40 | 485-620 | 70-90 | 21 | N | 27 J @ BA°C |
| | Grade F | --- | --- | t ≤ 50 | t ≤ 2 | 380 | 55 | 550-690 | 80-100 | 20 | Q+T | --- |
| | | | | t > 50 | t > 2 | 345 | 50 | 515-655 | 75-95 | 20 | Q+T | --- |
| ASTM A203/A203M-12 | Grade D | K31718 | --- | t ≤ 50 | t ≤ 2 | 255 | 37 | 450-585 | 65-85 | 23 | N | 27 J @ BA°C |
| | | | | t > 50 | t > 2 | 255 | 37 | 450-585 | 65-85 | 23 | N | 27 J @ BA°C |
| | Grade E | K32018 | --- | t ≤ 50 | t ≤ 2 | 275 | 40 | 485-620 | 70-90 | 21 | N | 27 J @ BA°C |
| | | | | t > 50 | t > 2 | 275 | 40 | 485-620 | 70-90 | 21 | N | 27 J @ BA°C |
| | Grade F | --- | --- | t ≤ 50 | t ≤ 2 | 380 | 55 | 550-690 | 80-100 | 20 | Q+T | --- |
| | | | | t > 50 | t > 2 | 345 | 50 | 515-655 | 75-95 | 20 | Q+T | --- |
| EN 10028-4:2009 | 12Ni14 | --- | 1.5637 | t ≤ 30 | --- | 355 | --- | 490-640 | --- | 22 | N or N+T or Q+T | see standard for impact data |
| | | | | 30 < t ≤ 50 | --- | 345 | --- | 490-640 | --- | 22 | N or N+T or Q+T | |
| | | | | 50 < t ≤ 80 | --- | 335 | --- | 490-640 | --- | 22 | N or N+T or Q+T | |
| JIS G 3127:2013 | Symbol SL3N255 | --- | --- | 6 ≤ t ≤ 16 | --- | 255 | --- | 450-590 T | --- | 24 | N, N+T or TMCP | see standard for impact data |
| | | | | 16 < t ≤ 20 | --- | 255 | --- | 450-590 T | --- | 29 | N, N+T or TMCP | L: 21 J @ -101°C |
| | | | | 20 < t ≤ 50 | --- | 255 | --- | 450-590 T | --- | 24 | N, N+T or TMCP | L: 21 J @ -101°C |
| | Symbol SL3N275 | --- | --- | 6 ≤ t ≤ 16 | --- | 275 | --- | 480-620 T | --- | 22 | N, N+T or TMCP | see standard for impact data |
| | | | | 16 < t ≤ 20 | --- | 275 | --- | 480-620 T | --- | 26 | N, N+T or TMCP | L: 21 J @ -101°C |
| | | | | 20 < t ≤ 50 | --- | 275 | --- | 480-620 T | --- | 22 | N, N+T or TMCP | L: 21 J @ -101°C |
| | Symbol SL3N440 | --- | --- | 6 ≤ t ≤ 16 | --- | 440 | --- | 540-690 T | --- | 21 | Q+T | see standard for impact data |
| | | | | 16 < t ≤ 20 | --- | 440 | --- | 540-690 T | --- | 25 | Q+T | L: 27 J @ -110°C |
| | | | | 20 < t ≤ 50 | --- | 440 | --- | 540-690 T | --- | 21 | Q+T | L: 27 J @ -110°C |

## 4.5 Ni Alloy Steels for Pressure Vessel Plates

### 4.5.5A Chemical Composition of 5Ni Alloy Steels for Pressure Vessel Plates

| Specification | Designation | UNS No. | Steel No. | Section Thickness mm | Section Thickness in | Weight, %max, Unless Otherwise Specified C | Mn | Si | P | S | Cr | Ni | Mo | Others |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| EN 10028-4:2009 | X12Ni5 | --- | 1.5680 | --- | --- | 0.15 | 0.30-0.80 | 0.35 | 0.020 | 0.005 | --- | 4.75-5.25 | --- | V 0.05; (Cr+Cu+Mo) 0.50 |
| JIS G 3127:2013 | Symbol SL5N590 | --- | --- | 6 ≤ t ≤ 50 | --- | 0.13 | 1.50 | 0.30 | 0.015 | 0.015 | --- | 4.75-6.00 | --- | --- |

### 4.5.5B Mechanical Properties of 5Ni Alloy Steels for Pressure Vessel Plates

| Specification | Designation | UNS No. | Steel No. | Section Thickness / Diameter mm | Section Thickness / Diameter in. | Yield Strength, min. MPa | Yield Strength, min. ksi | Tensile Strength, min. MPa | Tensile Strength, min. ksi | Elongation % min. | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| EN 10028-4:2009 | X12Ni5 | --- | 1.5680 | t ≤ 30 | --- | 390 | --- | 530-710 | --- | 20 | N or N+T or Q+T | see standard for impact data |
| | | | | 30 < t ≤ 50 | --- | 380 | --- | 530-710 | --- | 20 | N or N+T or Q+T | |
| JIS G 3127:2013 | Symbol SL5N590 | --- | --- | 6 ≤ t ≤ 16 | --- | 590 | --- | 690-830 T | --- | 21 | Q+T | see standard for impact data |
| | | | | 16 < t ≤ 20 | --- | 590 | --- | 690-830 T | --- | 25 | Q+T | L: 41 J @ -130°C |
| | | | | 20 < t ≤ 50 | --- | 590 | --- | 690-830 T | --- | 21 | Q+T | L: 41 J @ -130°C |

### 4.5.6A Chemical Composition of 9Ni Alloy Steels for Pressure Vessel Plates

| Specification | Designation | UNS No. | Steel No. | Section Thickness mm | Section Thickness in | Weight, %max, Unless Otherwise Specified C | Mn | Si | P | S | Cr | Ni | Mo | Others |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ASME SA-353/SA-353M* | --- | K81340 | --- | --- | --- | 0.13 | 0.90 | 0.15-0.40 | 0.015 | 0.015 | 0.30 | 8.50-9.50 | 0.12 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| ASME SA-553/SA-553M* | Type II | K71340 | --- | --- | --- | 0.13 | 0.90 | 0.15-0.40 | 0.035 | 0.035 | 0.30 | 7.50-8.50 | 0.12 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| | Type I | K81340 | --- | --- | --- | 0.13 | 0.90 | 0.15-0.40 | 0.035 | 0.035 | 0.30 | 8.50-9.50 | 0.12 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| ASTM A353/A353M-09 (2014)* | --- | K81340 | --- | --- | --- | 0.13 | 0.90 | 0.15-0.40 | 0.015 | 0.015 | 0.30 | 8.50-9.50 | 0.12 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| ASTM A553/A553M-14* | Type II | K71340 | --- | --- | --- | 0.13 | 0.90 | 0.15-0.40 | 0.015 | 0.015 | 0.30 | 7.50-8.50 | 0.12 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| | Type I | K81340 | --- | --- | --- | 0.13 | 0.90 | 0.15-0.40 | 0.015 | 0.015 | 0.30 | 8.50-9.50 | 0.12 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| ASTM A844/A844M-09* | --- | K81340 | --- | --- | --- | 0.13 | 0.90 | 0.15-0.40 | 0.015 | 0.015 | 0.30 | 8.50-9.50 | 0.12 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| EN 10028-4:2009 | X8Ni9 | --- | 1.5662 | --- | --- | 0.10 | 0.30-0.80 | 0.35 | 0.020 | 0.005 | --- | 8.5-10.0 | 0.10 | V 0.05; (Cr+Cu+Mo) 0.50 |
| | X7Ni9 | --- | 1.5663 | --- | --- | 0.10 | 0.30-0.80 | 0.35 | 0.015 | 0.005 | --- | 8.5-10.0 | 0.10 | V 0.01; (Cr+Cu+Mo) 0.50 |
| JIS G 3127:2013 | Symbol SL9N520 | --- | --- | 6 ≤ t ≤ 50 | --- | 0.12 | 0.90 | 0.30 | 0.015 | 0.015 | --- | 8.50-9.50 | --- | --- |
| | Symbol SL9N590 | --- | --- | 6 ≤ t ≤ 100 | --- | 0.12 | 0.90 | 0.30 | 0.015 | 0.015 | --- | 8.50-9.50 | --- | --- |

*: See ASTM A20/A20M-14 for additional information.

**4.5 Ni Alloy Steels for Pressure Vessel Plates**

**4.5.6B Mechanical Properties of 9Ni Alloy Steels for Pressure Vessel Plates**

| Specification | Designation | UNS No. | Steel No. | Section Thickness / Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | % min. | | |
| ASME SA-353/SA-353M | --- | K81340 | --- | --- | --- | 515 | 75 | 690-825 | 100-120 | 20.0 | NN+T | --- |
| ASME SA-553/SA-553M | Type II | K71340 | --- | --- | --- | 585 | 85 | 690-825 | 100-120 | 20.0 | Q+T | --- |
| | Type I | K81340 | --- | --- | --- | 585 | 85 | 690-825 | 100-120 | 20.0 | Q+T | --- |
| ASTM A353/A353M-09 (2014) | --- | K81340 | --- | --- | --- | 515 | 75 | 690-825 | 100-120 | 20.0 | NN+T | --- |
| ASTM A553/A553M-14 | Type II | K71340 | --- | --- | --- | 585 | 85 | 690-825 | 100-120 | 20.0 | Q+T | --- |
| | Type I | K81340 | --- | --- | --- | 585 | 85 | 690-825 | 100-120 | 20.0 | Q+T | --- |
| ASTM A844/A844M-09 | --- | K81340 | --- | t ≤ 50 | t ≤ 2 | 585 | 85 | 690-825 | 100-120 | 20.0 | Q+T | --- |
| EN 10028-4:2009 | X8Ni9 | --- | 1.5662 | t ≤ 30 | --- | 490 | --- | 640-840 | --- | 18 | N or N+T | see standard for impact data |
| | | | | t ≤ 30 | --- | 490 | --- | 640-840 | --- | 18 | Q+T | |
| | | | | t ≤ 30 | --- | 585 | --- | 680-820 | --- | 18 | Q+T | |
| | | | | 30 < t ≤ 50 | --- | 480 | --- | 640-840 | --- | 18 | N or N+T | |
| | | | | 30 < t ≤ 50 | --- | 480 | --- | 640-840 | --- | 18 | Q+T | |
| | | | | 30 < t ≤ 50 | --- | 575 | --- | 680-820 | --- | 18 | Q+T | |
| | X7Ni9 | --- | 1.5663 | t ≤ 15 | --- | 585 | --- | 680-820 | --- | 18 | N or N+T or Q+T | see standard for impact data |
| | | | | 15 < t ≤ 30 | --- | 585 | --- | 680-820 | --- | 18 | Q+T | |
| | | | | 30 < t ≤ 50 | --- | 575 | --- | 680-820 | --- | 18 | Q+T | |
| JIS G 3127:2013 | Symbol SL9N520 | --- | --- | 6 ≤ t ≤ 16 | --- | 520 | --- | 690-830 T | --- | 21 | NN+T | see standard for impact data |
| | | | | 16 < t ≤ 20 | --- | 520 | --- | 690-830 T | --- | 25 | NN+T | L: 34 J @ -196°C |
| | | | | 20 < t ≤ 50 | --- | 520 | --- | 690-830 T | --- | 21 | NN+T | L: 34 J @ -196°C |
| | Symbol SL9N590 | --- | --- | 6 ≤ t ≤ 16 | --- | 590 | --- | 690-830 T | --- | 21 | Q+T | see standard for impact data |
| | | | | 16 < t ≤ 20 | --- | 590 | --- | 690-830 T | --- | 25 | Q+T | L: 41 J @ -196°C |
| | | | | 20 < t ≤ 100 | --- | 590 | --- | 690-830 T | --- | 21 | Q+T | L: 41 J @ -196°C |

### 4.6 Ni-Mo Alloy Steels for Pressure Vessel Plates

#### 4.6.1A Chemical Composition of ½Ni-½Mo Alloy Steels for Pressure Vessel Plates

| Specification | Designation | UNS No. | Steel No. | Section Thickness | | Weight, %max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASME SA-302/SA-302M* | Grade C | K12039 | --- | t ≤ 25 | t ≤ 1 | 0.20 | 1.15-1.50 | 0.15-0.40 | 0.025 | 0.025 | 0.30 | 0.40-0.70 | 0.45-0.60 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| | | | | 25 < t ≤ 50 | 1 < t ≤ 2 | 0.23 | 1.15-1.50 | 0.15-0.40 | 0.025 | 0.025 | 0.30 | 0.40-0.70 | 0.45-0.60 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| | | | | t > 50 | t > 2 | 0.25 | 1.15-1.50 | 0.15-0.40 | 0.025 | 0.025 | 0.30 | 0.40-0.70 | 0.45-0.60 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| ASME SA-533/SA-533M* | Type B, Class 1 | K12539 | --- | --- | --- | 0.25 | 1.15-1.50 | 0.15-0.40 | 0.025 | 0.025 | 0.30 | 0.40-0.70 | 0.45-0.60 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| | Type B, Class 2 | K12539 | --- | --- | --- | 0.25 | 1.15-1.50 | 0.15-0.40 | 0.025 | 0.025 | 0.30 | 0.40-0.70 | 0.45-0.60 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| | Type B, Class 3 | K12539 | --- | --- | --- | 0.25 | 1.15-1.50 | 0.15-0.40 | 0.025 | 0.025 | 0.30 | 0.40-0.70 | 0.45-0.60 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| ASTM A302/A302M-12* | Grade C | K12039 | --- | t ≤ 25 | t ≤ 1 | 0.20 | 1.15-1.50 | 0.15-0.40 | 0.025 | 0.025 | 0.30 | 0.40-0.70 | 0.45-0.60 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| | | | | 25 < t ≤ 50 | 1 < t ≤ 2 | 0.23 | 1.15-1.50 | 0.15-0.40 | 0.025 | 0.025 | 0.30 | 0.40-0.70 | 0.45-0.60 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| | | | | t > 50 | t > 2 | 0.25 | 1.15-1.50 | 0.15-0.40 | 0.025 | 0.025 | 0.30 | 0.40-0.70 | 0.45-0.60 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| ASTM A533/A533M- 09 (2014)* | Type B, Class 1 | K12539 | --- | --- | --- | 0.25 | 1.15-1.50 | 0.15-0.40 | 0.025 | 0.025 | 0.30 | 0.40-0.70 | 0.45-0.60 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| | Type B, Class 2 | K12539 | --- | --- | --- | 0.25 | 1.15-1.50 | 0.15-0.40 | 0.025 | 0.025 | 0.30 | 0.40-0.70 | 0.45-0.60 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| | Type B, Class 3 | K12539 | --- | --- | --- | 0.25 | 1.15-1.50 | 0.15-0.40 | 0.025 | 0.025 | 0.30 | 0.40-0.70 | 0.45-0.60 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| EN 10028-2:2009 | 20MnMoNi4-5 | --- | 1.6311 | --- | --- | 0.15-0.23 | 1.00-1.50 | 0.40 | 0.020 | 0.010 | 0.20 | 0.40-0.80 | 0.45-0.60 | V 0.02; Cu 0.20; N 0.012 |
| JIS G 3119:2013 | Symbol SBV2 | --- | --- | 6 ≤ t ≤ 25 | --- | 0.20 | 1.15-1.50 | 0.15-0.40 | 0.020 | 0.020 | 0.30 | 0.40-0.70 | 0.45-0.60 | V 0.03; Cu 0.40; Ti 0.03; Nb 0.02; B 0.0010 |
| | | | | 25 < t ≤ 50 | --- | 0.23 | 1.15-1.50 | 0.15-0.40 | 0.020 | 0.020 | 0.30 | 0.40-0.70 | 0.45-0.60 | V 0.03; Cu 0.40; Ti 0.03; Nb 0.02; B 0.0010 |
| | | | | 50 < t ≤ 150 | --- | 0.25 | 1.15-1.50 | 0.15-0.40 | 0.020 | 0.020 | 0.30 | 0.40-0.70 | 0.45-0.60 | V 0.03; Cu 0.40; Ti 0.03; Nb 0.02; B 0.0010 |
| JIS G 3120:2014 | Symbol SQV2A | --- | --- | --- | --- | 0.25 | 1.15-1.50 | 0.15-0.40 | 0.020 | 0.020 | 0.30 | 0.40-0.70 | 0.45-0.60 | V 0.03; Cu 0.40; Ti 0.03; Nb 0.02; B 0.0010 |
| | Symbol SQV2B | --- | --- | --- | --- | 0.25 | 1.15-1.50 | 0.15-0.40 | 0.020 | 0.020 | 0.30 | 0.40-0.70 | 0.45-0.60 | V 0.03; Cu 0.40; Ti 0.03; Nb 0.02; B 0.0010 |

*: See ASTM A20/A20M-14 for additional information.

**4.6 Ni-Mo Alloy Steels for Pressure Vessel Plates**

**4.6.1B Mechanical Properties of ½Ni-½Mo Alloys Steels for Pressure Vessel Plates**

| Specification | Designation | UNS No. | Steel No. | Section Thickness / Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | % min. | | |
| ASME SA-302/SA-302M | Grade C | K12039 | --- | t ≤ 50 | t ≤ 2 | 345 | 50 | 550-690 | 80-100 | 20 | AR or N or SR or N+SR | --- |
| | | | | t > 50 | t > 2 | 345 | 50 | 550-690 | 80-100 | 20 | N | --- |
| ASME SA-533/SA-533M | Type B, Class 1 | K12539 | --- | t ≥ 6.5 | t ≥ 0.25 | 345 | 50 | 550-690 | 80-100 | 18 | Q+T | --- |
| | Type B, Class 2 | K12539 | --- | t ≥ 6.5 | t ≥ 0.25 | 485 | 70 | 620-795 | 90-115 | 16 | Q+T | --- |
| | Type B, Class 3 | K12539 | --- | 6.5 ≤ t ≤ 65 | 0.25 ≤ t ≤ 2.5 | 570 | 83 | 690-860 | 100-125 | 16 | Q+T | --- |
| ASTM A302/A302M-12 | Grade C | K12039 | --- | t ≤ 50 | t ≤ 2 | 345 | 50 | 550-690 | 80-100 | 20 | AR, N, SR or N+SR | --- |
| | | | | t > 50 | t > 2 | 345 | 50 | 550-690 | 80-100 | 20 | N | --- |
| ASTM A533/A533M-09 (2014) | Type B, Class 1 | K12539 | --- | t ≥ 6.5 | t ≥ 0.25 | 345 | 50 | 550-690 | 80-100 | 18 | Q+T | --- |
| | Type B, Class 2 | K12539 | --- | t ≥ 6.5 | t ≥ 0.25 | 485 | 70 | 620-795 | 90-115 | 16 | Q+T | --- |
| | Type B, Class 3 | K12539 | --- | 6.5 ≤ t ≤ 65 | 0.25 ≤ t ≤ 2.5 | 570 | 83 | 690-860 | 100-125 | 16 | Q+T | --- |
| EN 10028-2:2009 | 20MnMoNi4-5 | --- | 1.6311 | t ≤ 40 | --- | 470 | --- | 590-750 | --- | 18 | Q+T | see standard for impact data |
| | | | | 40 < t ≤ 60 | --- | 460 | --- | 590-730 | --- | 18 | Q+T | |
| | | | | 60 < t ≤ 100 | --- | 450 | --- | 570-710 | --- | 18 | Q+T | |
| | | | | 100 < t ≤ 150 | --- | 440 | --- | 570-710 | --- | 18 | Q+T | |
| | | | | 150 < t ≤ 250 | --- | 400 | --- | 560-700 | --- | 18 | Q+T | |
| JIS G 3119:2013 | Symbol SBV2 | --- | --- | 6 ≤ t ≤ 50 | --- | 345 | --- | 550-690 | --- | 17 | AR, N, A, Q+T or N+A | --- |
| | | | | 50 < t ≤ 150 | --- | 345 | --- | 550-690 | --- | 20 | N or Q+T | --- |
| JIS G 3120:2014 | Symbol SQV2A | --- | --- | --- | --- | 345 | --- | 550-690 T | --- | 18 | AR, A or Q+T | L: 40 J @ BA°C |
| | Symbol SQV2B | --- | --- | --- | --- | 480 | --- | 620-790 T | --- | 16 | AR, A or Q+T | L: 47 J @ BA°C |

**4.6 Ni Alloys Steels for Pressure Plates**

**4.6.2A Chemical Composition of ¾Ni-½Mo Alloy Steels for Pressure Vessel Plates**

| Specification | Designation | UNS No. | Steel No. | Section Thickness | | Weight, %max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASME SA-302/SA-302M* | Grade D | K12054 | --- | t ≤ 25 | t ≤ 1 | 0.20 | 1.15-1.50 | 0.15-0.40 | 0.025 | 0.025 | 0.30 | 0.70-1.00 | 0.45-0.60 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| | | | | 25 < t ≤ 50 | 1 < t ≤ 2 | 0.23 | 1.15-1.50 | 0.15-0.40 | 0.025 | 0.025 | 0.30 | 0.70-1.00 | 0.45-0.60 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| | | | | t > 50 | t > 2 | 0.25 | 1.15-1.50 | 0.15-0.40 | 0.025 | 0.025 | 0.30 | 0.70-1.00 | 0.45-0.60 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| ASME SA-533/SA-533M* | Type C, Class 1 | K12554 | --- | --- | --- | 0.25 | 1.15-1.50 | 0.15-0.40 | 0.025 | 0.025 | 0.30 | 0.70-1.00 | 0.45-0.60 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| | Type C, Class 2 | K12554 | --- | --- | --- | 0.25 | 1.15-1.50 | 0.15-0.40 | 0.025 | 0.025 | 0.30 | 0.70-1.00 | 0.45-0.60 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| | Type C, Class 3 | K12554 | --- | --- | --- | 0.25 | 1.15-1.50 | 0.15-0.40 | 0.025 | 0.025 | 0.30 | 0.70-1.00 | 0.45-0.60 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| ASTM A302/A302M-12* | Grade D | K12054 | --- | t ≤ 25 | t ≤ 1 | 0.20 | 1.15-1.50 | 0.15-0.40 | 0.025 | 0.025 | 0.30 | 0.70-1.00 | 0.45-0.60 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| | | | | 25 < t ≤ 50 | 1 < t ≤ 2 | 0.23 | 1.15-1.50 | 0.15-0.40 | 0.025 | 0.025 | 0.30 | 0.70-1.00 | 0.45-0.60 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| | | | | t > 50 | t > 2 | 0.25 | 1.15-1.50 | 0.15-0.40 | 0.025 | 0.025 | 0.30 | 0.70-1.00 | 0.45-0.60 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| ASTM A533/A533M-09 (2014)* | Type C, Class 1 | K12554 | --- | --- | --- | 0.25 | 1.15-1.50 | 0.15-0.40 | 0.025 | 0.025 | 0.30 | 0.70-1.00 | 0.45-0.60 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| | Type C, Class 2 | K12554 | --- | --- | --- | 0.25 | 1.15-1.50 | 0.15-0.40 | 0.025 | 0.025 | 0.30 | 0.70-1.00 | 0.45-0.60 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| | Type C, Class 3 | K12554 | --- | --- | --- | 0.25 | 1.15-1.50 | 0.15-0.40 | 0.025 | 0.025 | 0.30 | 0.70-1.00 | 0.45-0.60 | V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010 |
| EN 10028-2:2009 | 15NiCuMoNb5-6-4 | --- | 1.6368 | --- | --- | 0.17 | 0.80-1.20 | 0.25-0.50 | 0.025 | 0.010 | 0.30 | 1.00-1.30 | 0.25-0.50 | Al 0.015 min.; Cu 0.50-0.80; Nb 0.015-0.045; N 0.020 |
| GB 6654-1996 | Grade 13MnNiMoNbR | --- | --- | --- | --- | 0.15 | 1.20-1.60 | 0.15-0.50 | 0.025 | 0.025 | 0.20-0.40 | 0.60-1.00 | 0.20-0.40 | Cu 0.30; Nb 0.005-0.020 |
| JIS G 3119:2013 | Symbol SBV3 | --- | --- | 6 ≤ t ≤ 25 | --- | 0.20 | 1.15-1.50 | 0.15-0.40 | 0.020 | 0.020 | 0.30 | 0.70-1.00 | 0.45-0.60 | V 0.03; Cu 0.40; Ti 0.03; Nb 0.02; B 0.0010 |
| | | | | 25 < t ≤ 50 | --- | 0.23 | 1.15-1.50 | 0.15-0.40 | 0.020 | 0.020 | 0.30 | 0.70-1.00 | 0.45-0.60 | V 0.03; Cu 0.40; Ti 0.03; Nb 0.02; B 0.0010 |
| | | | | 50 < t ≤ 150 | --- | 0.25 | 1.15-1.50 | 0.15-0.40 | 0.020 | 0.020 | 0.30 | 0.70-1.00 | 0.45-0.60 | V 0.03; Cu 0.40; Ti 0.03; Nb 0.02; B 0.0010 |
| JIS G 3120:2014 | Symbol SQV3A | --- | --- | --- | --- | 0.25 | 1.15-1.50 | 0.15-0.40 | 0.020 | 0.020 | 0.30 | 0.70-1.00 | 0.45-0.60 | V 0.03; Cu 0.40; Ti 0.03; Nb 0.02; B 0.0010 |
| | Symbol SQV3B | --- | --- | --- | --- | 0.25 | 1.15-1.50 | 0.15-0.40 | 0.020 | 0.020 | 0.30 | 0.70-1.00 | 0.45-0.60 | V 0.03; Cu 0.40; Ti 0.03; Nb 0.02; B 0.0010 |

*: See ASTM A20/A20M-14 for additional information.

**4.6 Ni-Mo Alloy Steels for Pressure Vessel Plates**

**4.6.2B Mechanical Properties of ¾Ni-½Mo Alloy Steels for Pressure Vessel Plates**

| Specification | Designation | UNS No. | Steel No. | Section Thickness / Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | % min. | | |
| ASME SA-302/SA-302M | Grade D | K12054 | --- | t ≤ 50 | t ≤ 2 | 345 | 50 | 550-690 | 80-100 | 20 | AR or N or SR or N+SR | --- |
| | | | | t > 50 | t > 2 | 345 | 50 | 550-690 | 80-100 | 20 | N | --- |
| ASME SA-533/SA-533M | Type C, Class 1 | K12554 | --- | t ≥ 6.5 | t ≥ 0.25 | 345 | 50 | 550-690 | 80-100 | 18 | Q+T | --- |
| | Type C, Class 2 | K12554 | --- | t ≥ 6.5 | t ≥ 0.25 | 485 | 70 | 620-795 | 90-115 | 16 | Q+T | --- |
| | Type C, Class 3 | K12554 | --- | 6.5 ≤ t ≤ 65 | 0.25 ≤ t ≤ 2.5 | 570 | 83 | 690-860 | 100-125 | 16 | Q+T | --- |
| ASTM A302/A302M-12 | Grade D | K12054 | --- | t ≤ 50 | t ≤ 2 | 345 | 50 | 550-690 | 80-100 | 20 | AR, N, SR or N+SR | --- |
| | | | | t > 50 | t > 2 | 345 | 50 | 550-690 | 80-100 | 20 | N | --- |
| ASTM A533/A533M-09 (2014) | Type C, Class 1 | K12554 | --- | t ≥ 6.5 | t ≥ 0.25 | 345 | 50 | 550-690 | 80-100 | 18 | Q+T | --- |
| | Type C, Class 2 | K12554 | --- | t ≥ 6.5 | t ≥ 0.25 | 485 | 70 | 620-795 | 90-115 | 16 | Q+T | --- |
| | Type C, Class 3 | K12554 | --- | 6.5 ≤ t ≤ 65 | 0.25 ≤ t ≤ 2.5 | 570 | 83 | 690-860 | 100-125 | 16 | Q+T | --- |
| EN 10028-2:2009 | 15NiCuMoNb5-6-4 | --- | 1.6368 | t ≤ 40 | --- | 460 | --- | 610-780 | --- | 16 | N+T | see standard for impact data |
| | | | | 40 < t ≤ 60 | --- | 440 | --- | 610-780 | --- | 16 | N+T | |
| | | | | 60 < t ≤ 100 | --- | 430 | --- | 600-760 | --- | 16 | N+T | |
| | | | | 100 < t ≤ 150 | --- | 420 | --- | 590-740 | --- | 16 | N+T or Q+T | |
| | | | | 150 < t ≤ 200 | --- | 410 | --- | 580-740 | --- | 16 | Q+T | |
| GB 6654-1996 | Grade 13MnNiMoNbR | --- | --- | t ≤ 100 | --- | 390 | --- | 570-720 | --- | 18 | N+T | T: 31 J @ 0°C |
| | | | | 100 < t ≤ 120 | --- | 380 | --- | 570-720 | --- | 18 | N+T | T: 31 J @ 0°C |
| JIS G 3119:2013 | Symbol SBV3 | --- | --- | 6 ≤ t ≤ 50 | --- | 345 | --- | 550-690 | --- | 17 | AR, N, A, Q+T or N+A | --- |
| | | | | 50 < t ≤ 150 | --- | 345 | --- | 550-690 | --- | 20 | N or Q+T | --- |
| JIS G 3120:2014 | Symbol SQV3A | --- | --- | --- | --- | 345 | --- | 550-690 T | --- | 18 | AR, A or Q+T | L: 40 J @ BA°C |
| | Symbol SQV3B | --- | --- | --- | --- | 480 | --- | 620-790 T | --- | 16 | AR, A or Q+T | L: 47 J @ BA°C |

### 4.7 Ferritic and Martensitic Stainless Steels for Pressure Vessel Plates

### 4.7A Chemical Composition of Ferritic and Martensitic Stainless Steels for Pressure Vessel Plates

| Specification | Designation | UNS No | Steel No | Weight, %, max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASME SA-240/SA-240M | Type 405 | S40500 | --- | 0.08 | 1.00 | 1.00 | 0.040 | 0.030 | 11.5-14.5 | 0.60 | --- | Al 0.10-0.30 |
| ASTM A240/A240M-15a | Type 405 | S40500 | --- | 0.08 | 1.00 | 1.00 | 0.040 | 0.030 | 11.5-14.5 | 0.60 | --- | Al 0.10-0.30 |
| EN 10088-2:2014 | X6CrAl13 | --- | 1.4002 | 0.08 | 1.00 | 1.00 | 0.040 | 0.015 | 12.0-14.0 | --- | --- | Al 0.10-0.30 |
| GB 3280-92 | Grade 0Cr13Al | --- | --- | 0.08 | 1.00 | 1.00 | 0.035 | 0.030 | 11.50-14.50 | 0.60 | --- | Al 0.10-0.30 |
| GB 4237-92 | Grade 0Cr13Al | --- | --- | 0.08 | 1.00 | 1.00 | 0.035 | 0.030 | 11.50-14.50 | 0.60 | --- | Al 0.10-0.30 |
| GB 4238-92 | Grade 0Cr13Al | --- | --- | 0.08 | 1.00 | 1.00 | 0.035 | 0.030 | 11.50-14.50 | 0.60 | --- | Al 0.10-0.30 |
| JIS G 4304:2012 | Symbol SUS405 | --- | --- | 0.08 | 1.00 | 1.00 | 0.040 | 0.030 | 11.50-14.50 | 0.60 | --- | Al 0.10-0.30 |
| JIS G 4305:2012 | Symbol SUS405 | --- | --- | 0.08 | 1.00 | 1.00 | 0.040 | 0.030 | 11.50-14.50 | 0.60 | --- | Al 0.10-0.30 |
| ASME SA-240/SA-240M | --- | S40977 | --- | 0.030 | 1.50 | 1.00 | 0.040 | 0.015 | 10.5-12.5 | 0.30-1.00 | --- | N 0.030 |
| | | S41050 | --- | 0.04 | 1.00 | 1.00 | 0.045 | 0.030 | 10.5-12.5 | 0.60-1.10 | --- | N 0.10 |
| ASTM A240/A240M-15a | --- | S40977 | --- | 0.030 | 1.50 | 1.00 | 0.040 | 0.015 | 10.5-12.5 | 0.30-1.00 | --- | N 0.030 |
| | | S41050 | --- | 0.04 | 1.00 | 1.00 | 0.045 | 0.030 | 10.5-12.5 | 0.60-1.10 | --- | N 0.10 |
| EN 10028-7:2007 | X2CrNi12 | --- | 1.4003 | 0.030 | 1.50 | 1.00 | 0.040 | 0.015 | 10.5-12.5 | 0.30-1.00 | --- | N 0.030 |
| EN 10088-2:2014 | X2CrNi12 | --- | 1.4003 | 0.030 | 1.50 | 1.00 | 0.040 | 0.015 | 10.5-12.5 | 0.30-1.00 | --- | N 0.030 |
| ISO 9328-7:2004 | Grade X2CrNi12 | --- | --- | 0.030 | 1.50 | 1.00 | 0.040 | 0.015 | 10.5-12.5 | 0.30-1.10 | --- | N 0.030 |
| JIS G 4312:2011 | Symbol SUH409L | --- | --- | 0.030 | 1.00 | 1.00 | 0.040 | 0.030 | 10.50-11.75 | 0.60 | --- | Ti 6xC to 0.75 |
| ASME SA-240/SA-240M | --- | S42035 | --- | 0.08 | 1.00 | 1.00 | 0.045 | 0.030 | 13.5-15.5 | 1.0-2.5 | 0.2-1.2 | Ti 0.30-0.50 |
| ASTM A240/A240M-15a | --- | S42035 | --- | 0.08 | 1.00 | 1.00 | 0.045 | 0.030 | 13.5-15.5 | 1.0-2.5 | 0.2-1.2 | Ti 0.30-0.50 |
| EN 10028-7:2007 | X6CrNiTi12 | --- | 1.4516 | 0.08 | 1.50 | 0.70 | 0.040 | 0.015 | 10.5-12.5 | 0.50-1.50 | --- | Ti 0.05-0.35 |
| EN 10088-2:2014 | X6CrNiTi12 | --- | 1.4516 | 0.08 | 1.50 | 0.70 | 0.040 | 0.015 | 10.5-12.5 | 0.50-1.50 | --- | Ti 0.05-0.35 |
| | X5CrNiMoTi15-2 | --- | 1.4589 | 0.08 | 1.00 | 1.00 | 0.040 | 0.015 | 13.5-15.5 | 1.00-2.50 | 0.20-1.20 | Ti 0.30-0.50 |
| ISO 9328-7:2004 | Grade X6CrNiTi12 | --- | --- | 0.08 | 1.00 | 1.00 | 0.040 | 0.015 | 10.5-12.5 | 0.50-1.50 | --- | Ti 0.05-0.35 |
| ASME SA-240/SA-240M | --- | S41500 | --- | 0.05 | 0.50-1.00 | 0.60 | 0.030 | 0.030 | 11.5-14.0 | 3.5-5.5 | 0.50-1.00 | --- |
| ASTM A240/A240M-15a | --- | S41500 | --- | 0.05 | 0.50-1.00 | 0.60 | 0.030 | 0.030 | 11.5-14.0 | 3.5-5.5 | 0.50-1.00 | --- |
| EN 10028-7:2007 | X3CrNiMo13-4 | --- | 1.4313 | 0.05 | 1.50 | 0.70 | 0.040 | 0.015 | 12.0-14.0 | 3.5-4.5 | 0.30-0.70 | N 0.020 min. |
| ISO 9328-7:2004 | Grade X3CrNiMo13-4 | --- | --- | 0.05 | 0.50-1.00 | 0.70 | 0.040 | 0.015 | 12.0-14.0 | 3.5-4.5 | 0.30-1.00 | --- |

**4.7 Ferritic and Martensitic Stainless Steels for Pressure Vessel Plates**

**4.7A Chemical Composition of Ferritic and Martensitic Stainless Steels for Pressure Vessel Plates (Continued)**

| Specification | Designation | UNS No | Steel No | Weight, %, max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASME SA-240/SA-240M | Type 439 | S43035 | --- | 0.030 | 1.00 | 1.00 | 0.040 | 0.030 | 17.0-19.0 | 0.50 | --- | Al 0.15; N 0.030; Ti [0.20+4(C+N)] to 1.10 |
| | --- | S43932 | --- | 0.030 | 1.00 | 1.00 | 0.040 | 0.030 | 17.0-19.0 | 0.50 | --- | Al 0.15; N 0.030; Ti+Cb [0.20+4(C+N)] to 0.75 |
| | --- | S43940 | --- | 0.030 | 1.00 | 1.00 | 0.040 | 0.015 | 17.5-18.5 | --- | --- | Ti 0.10-0.60; Cb [0.30+(3xC)] min. |
| ASTM A240/A240M-15a | Type 439 | S43035 | --- | 0.030 | 1.00 | 1.00 | 0.040 | 0.030 | 17.0-19.0 | 0.50 | --- | Al 0.15; N 0.030; Ti [0.20+4(C+N)] to 1.10 |
| | --- | S43932 | --- | 0.030 | 1.00 | 1.00 | 0.040 | 0.030 | 17.0-19.0 | 0.50 | --- | Al 0.15; N 0.030; Ti+Cb [0.20+4(C+N)] to 0.75 |
| | --- | S43940 | --- | 0.030 | 1.00 | 1.00 | 0.040 | 0.015 | 17.5-18.5 | --- | --- | Ti 0.10-0.60; Cb [0.30+(3xC)] min. |
| EN 10028-7:2007 | X2CrTiNb18 | --- | 1.4509 | 0.030 | 1.00 | 1.00 | 0.040 | 0.015 | 17.5-18.5 | --- | --- | Ti 0.10-0.60; Nb [3xC+0.30] to 1.00 |
| EN 10088-2:2014 | X2CrTiNb18 | --- | 1.4509 | 0.030 | 1.00 | 1.00 | 0.040 | 0.015 | 17.5-18.5 | --- | --- | Ti 0.10-0.60; Nb [3xC+0.30] to 1.00 |
| ISO 9328-7:2004 | Grade X2CrTiNb18 | --- | --- | 0.030 | 1.00 | 1.00 | 0.040 | 0.015 | 17.5-18.5 | --- | --- | Ti 0.10-0.60; Nb [(3xC)+0.30] to 1.00 |
| EN 10028-7:2007 | X3CrTi17 | --- | 1.4510 | 0.05 | 1.00 | 1.00 | 0.040 | 0.015 | 16.0-18.0 | --- | --- | Ti [4x(C+N)+0.15] to 0.80 |
| | X2CrTi17 | --- | 1.4520 | 0.025 | 0.50 | 0.50 | 0.040 | 0.015 | 16.0-18.0 | --- | --- | Ti 0.30-0.60; N 0.015 |
| EN 10088-2:2014 | X3CrTi17 | --- | 1.4510 | 0.05 | 1.00 | 1.00 | 0.040 | 0.015 | 16.0-18.0 | --- | --- | Ti [4x(C+N)+0.15] to 0.80 |
| | X3CrNb17 | --- | 1.4511 | 0.05 | 1.00 | 1.00 | 0.040 | 0.015 | 16.0-18.0 | --- | --- | Nb 12xC to 1.00 |
| | X2CrTi17 | --- | 1.4520 | 0.025 | 0.50 | 0.50 | 0.040 | 0.015 | 16.0-18.0 | --- | --- | N 0.015; Ti [4x(C+N)+0.15] to 0.80 |
| GB 3280-92 | Grade 00Cr17 | --- | --- | 0.030 | 1.00 | 0.75 | 0.035 | 0.030 | 16.00-19.00 | 0.60 | --- | Ti 0.10-1.00; Nb 0.10-1.00 |
| ISO 9328-7:2004 | Grade X2CrTi17 | --- | --- | 0.025 | 0.50 | 0.50 | 0.040 | 0.015 | 16.0-18.0 | --- | --- | Ti 0.30-0.60; N 0.015 |
| | Grade X3CrTi17 | --- | --- | 0.05 | 1.00 | 1.00 | 0.040 | 0.015 | 16.0-19.0 | --- | --- | Ti [4x(C+N)+0.15] to 0.75 |
| JIS G 4304:2012 | Symbol SUS430LX | --- | --- | 0.030 | 1.00 | 0.75 | 0.040 | 0.030 | 16.00-19.00 | 0.60 | --- | Ti 0.10-1.00; Nb 0.10-1.00 |
| JIS G 4305:2012 | Symbol SUS430LX | --- | --- | 0.030 | 1.00 | 0.75 | 0.040 | 0.030 | 16.00-19.00 | 0.60 | --- | Ti 0.10-1.00; Nb 0.10-1.00 |

**4.7 Ferritic and Martensitic Stainless Steels for Pressure Vessel Plates**

**4.7A Chemical Composition of Ferritic and Martensitic Stainless Steels for Pressure Vessel Plates (Continued)**

| Specification | Designation | UNS No | Steel No | Weight, %, max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASME SA-240/SA-240M | Type 444 | S44400 | --- | 0.025 | 1.00 | 1.00 | 0.040 | 0.030 | 17.5-19.5 | 1.00 | 1.75-2.50 | N 0.035; (Ti+Cb) [0.20+4(C+N)] to 0.80 |
| ASTM A240/A240M-15a | Type 444 | S44400 | --- | 0.025 | 1.00 | 1.00 | 0.040 | 0.030 | 17.5-19.5 | 1.00 | 1.75-2.50 | N 0.035; Ti+Cb [0.20+4(C+N)] to 0.80 |
| EN 10028-7:2007 | X2CrMoTi18-2 | --- | 1.4521 | 0.025 | 1.00 | 1.00 | 0.040 | 0.015 | 17.0-20.0 | --- | 1.80-2.50 | N 0.030; Ti [4x(C+N)+0.15] to 0.80 |
| EN 10088-2:2014 | X2CrMoTi18-2 | --- | 1.4521 | 0.025 | 1.00 | 1.00 | 0.040 | 0.015 | 17.0-20.0 | --- | 1.80-2.50 | N 0.030; Ti [4x(C+N)+0.15] to 0.80 |
| GB 3280-92 | Grade 00Cr18Mo2 | --- | --- | 0.025 | 1.00 | 1.00 | 0.035 | 0.030 | 17.00-20.00 | 0.60 | 1.75-2.50 | Ti 8x(C+N) to 0.80; Nb 8x(C+N) to 0.80; Zr 8x(C+N) to 0.80; (Ti+Nb+Zr) 8x(C+N) to 0.80; N 0.025 |
| GB 4237-92 | Grade 00Cr18Mo2 | --- | --- | 0.025 | 1.00 | 1.00 | 0.035 | 0.030 | 17.00-20.00 | 0.60 | 1.75-2.50 | Ti 8x(C+N) to 0.80; Nb 8x(C+N) to 0.80; Zr 8x(C+N) to 0.80; (Ti+Nb+Zr) 8x(C+N) to 0.80; N 0.025 |
| ISO 9328-7:2004 | Grade X2CrMoTi18-2 | --- | --- | 0.025 | 1.00 | 1.00 | 0.040 | 0.015 | 17.0-20.0 | --- | 1.80-2.50 | N 0.030; Ti [4x(C+N)+0.15] to 0.80 |
| JIS G 4304:2012 | Symbol SUS444 | --- | --- | 0.025 | 1.00 | 1.00 | 0.040 | 0.030 | 17.00-20.00 | 0.60 | 1.75-2.50 | Ti, Nb, Zr or their combination 8x(C + N) to 0.80; N 0.025 |
| JIS G 4305:2012 | Symbol SUS444 | --- | --- | 0.025 | 1.00 | 1.00 | 0.040 | 0.030 | 17.00-20.00 | 0.60 | 1.75-2.50 | Ti, Nb, Zr or their combination 8x(C + N) to 0.80; N 0.025 |

**4.7 Ferritic and Martensitic Stainless Steels for Pressure Vessel Plates**

**4.7B Mechanical Properties of Ferritic and Martensitic Stainless Steels for Pressure Vessel Plates**

| Specification | Designation | UNS No. | Steel No. | Section Thickness / Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | % min. | | |
| ASME SA-240/SA-240M | Type 405 | S40500 | --- | --- | --- | 170 | 25 | 415 | 60 | 20 | see standard | 179 max. HB; 88 max. HRB |
| ASTM A240/A240M-15a | Type 405 | S40500 | --- | --- | --- | 170 | 25 | 415 | 60 | 20 | see standard | 179 max. HB; 88 max. HRBW |
| EN 10088-2:2014 | X6CrAl13 | --- | 1.4002 | t ≤ 8 | --- | 230 | --- | 400-600 | --- | 17 L, 17 T | A | --- |
| | | | | t ≤ 13.5 | --- | 210 | --- | 400-600 | --- | 17 L, 17 T | A | --- |
| | | | | t ≤ 25 | --- | 210 | --- | 400-600 | --- | 17 L, 17 T | A | --- |
| GB 3280-92 | Grade 0Cr13Al | --- | --- | --- | --- | 175 | --- | 410 | --- | 20 | A | 183 max. HB; 88 max. HRB |
| GB 4237-92 | Grade 0Cr13Al | --- | --- | --- | --- | 177 | --- | 410 | --- | 20 | A | 183 max. HB; 88 max. HRB |
| GB 4238-92 | Grade 0Cr13Al | --- | --- | --- | --- | 175 | --- | 410 | --- | 20 | A | 183 max. HB; 88 max. HRB |
| JIS G 4304:2012 | Symbol SUS405 | --- | --- | --- | --- | 175 | --- | 410 | --- | 20 | A | 183 max. HBW; 88 max. HRBW; 200 max. HV |
| JIS G 4305:2012 | Symbol SUS405 | --- | --- | --- | --- | 175 | --- | 410 | --- | 20 | A | 183 max. HBW; 88 max. HRBW; 200 max. HV |
| ASME SA-240/SA-240M | --- | S40977 | --- | --- | --- | 280 | 41 | 450 | 65 | 18 | see standard | 180 max. HB; 88 max. HRB |
| | | S41050 | --- | --- | --- | 205 | 30 | 415 | 60 | 22 | see standard | 183 max. HB; 89 max. HRB |
| ASTM A240/A240M-15a | --- | S40977 | --- | --- | --- | 280 | 41 | 450 | 65 | 18 | see standard | 180 max. HB; 88 max. HRBW |
| | | S41050 | --- | --- | --- | 205 | 30 | 415 | 60 | 22 | see standard | 183 max. HB; 89 max. HRBW |
| EN 10028-7:2007 | X2CrNi12 | --- | 1.4003 | t ≤ 8 | --- | 280 | --- | 450-650 | --- | 20 L, 20 T | A | T: 50 J @ RT |
| | | | | t ≤ 13.5 | --- | 280 | --- | 450-650 | --- | 20 L, 20 T | A | T: 50 J @ RT |
| | | | | t ≤ 25 | --- | 250 | --- | 450-650 | --- | 18 L, 18 T | A | T: 50 J @ RT |
| EN 10088-2:2014 | X2CrNi12 | --- | 1.4003 | t ≤ 8 | --- | 280 | --- | 450-650 | --- | 20 L, 20 T | A | --- |
| | | | | t ≤ 13.5 | --- | 280 | --- | 450-650 | --- | 20 L, 20 T | A | --- |
| | | | | t ≤ 25 | --- | 250 | --- | 450-650 | --- | 18 L, 18 T | A | --- |
| ISO 9328-7:2004 | Grade X2CrNi12 | --- | --- | t ≤ 6 | --- | 280 | --- | 450-650 | --- | 20 L, 20 T | A | T: 50 J @ 20°C |
| | | | | t ≤ 12 | --- | 280 | --- | 450-650 | --- | 20 L, 20 T | A | T: 50 J @ 20°C |
| | | | | t ≤ 25 | --- | 250 | --- | 450-650 | --- | 18 L, 18 T | A | T: 50 J @ 20°C |
| JIS G 4312:2011 | Symbol SUH409L | --- | --- | --- | --- | 175 | --- | 360 | --- | 25 | A | 162 max. HBW; 80 max. HRBW; 175 max. HV |

**4.7 Ferritic and Martensitic Stainless Steels for Pressure Vessel Plates**

**4.7B Mechanical Properties of Ferritic and Martensitic Stainless Steels for Pressure Vessel Plates (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness / Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation % min. | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | | | |
| ASME SA-240/SA-240M | --- | S42035 | --- | --- | --- | 380 | 55 | 550 | 80 | 16 | see standard | 180 max. HB; 88 max. HRB |
| ASTM A240/A240M-15a | --- | S42035 | --- | --- | --- | 380 | 55 | 550 | 80 | 16 | see standard | 180 max. HB; 88 max. HRBW |
| EN 10028-7:2007 | X6CrNiTi12 | --- | 1.4516 | t ≤ 8 | --- | 280 | --- | 450-650 | --- | 23 L, 23 T | A | T: 50 J @ RT |
| | | | | t ≤ 13.5 | --- | 280 | --- | 450-650 | --- | 23 L, 23 T | A | T: 50 J @ RT |
| | | | | t ≤ 25 | --- | 250 | --- | 450-650 | --- | 20 L, 20 T | A | T: 50 J @ RT |
| EN 10088-2:2014 | X6CrNiTi12 | --- | 1.4516 | t ≤ 8 | --- | 280 | --- | 450-650 | --- | 23 L, 23 T | A | --- |
| | | | | t ≤ 13.5 | --- | 280 | --- | 450-650 | --- | 23 L, 23 T | A | --- |
| | | | | t ≤ 25 | --- | 250 | --- | 450-650 | --- | 20 L, 20 T | A | --- |
| | X5CrNiMoTi15-2 | --- | 1.4589 | t ≤ 8 | --- | 400 | --- | 550-750 | --- | 16 L, 16 T | A | --- |
| | | | | t ≤ 13.5 | --- | 360 | --- | 500-750 | --- | 14 L, 14 T | A | --- |
| ISO 9328-7:2004 | Grade X6CrNiTi12 | --- | --- | t ≤ 6 | --- | 280 | --- | 450-650 | --- | 23 L, 23 T | A | T: 50 J @ 20°C |
| | | | | t ≤ 12 | --- | 280 | --- | 450-650 | --- | 23 L, 23 T | A | T: 50 J @ 20°C |
| | | | | t ≤ 25 | --- | 250 | --- | 450-650 | --- | 20 L, 20 T | A | T: 50 J @ 20°C |
| ASME SA-240/SA-240M | --- | S41500 | --- | --- | --- | 620 | 90 | 795 | 115 | 15 | see standard | 302 max. HB; 32 max, HRC |
| ASTM A240/A240M-15a | --- | S41500 | --- | --- | --- | 620 | 90 | 795 | 115 | 15 | see standard | 302 max. HB; 32 max, HRC |
| EN 10028-7:2007 | X3CrNiMo13-4 | --- | 1.4313 | t ≤ 75 | --- | 650 | --- | 780-980 | --- | 14 L, 14 T | Q+T | see standard for impact data |
| ISO 9328-7:2004 | Grade X3CrNiMo13-4 | --- | --- | t ≤ 75 | --- | 650 | --- | 780-980 | --- | 14 L, 14 T | Q+T | see standard for impact data |
| ASME SA-240/SA-240M | Type 439 | S43035 | --- | --- | --- | 205 | 30 | 415 | 60 | 22 | see standard | 183 max. HB; 89 max. HRB |
| | --- | S43932 | --- | --- | --- | 205 | 30 | 415 | 60 | 22 | see standard | 183 max. HB; 89 max. HRB |
| | | S43940 | --- | --- | --- | 250 | 36 | 430 | 62 | 18 | see standard | 180 max. HB; 88 max. HRB |
| ASTM A240/A240M-15a | Type 439 | S43035 | --- | --- | --- | 205 | 30 | 415 | 60 | 22 | see standard | 183 max. HB; 89 max. HRBW |
| | --- | S43932 | --- | --- | --- | 205 | 30 | 415 | 60 | 22 | see standard | 183 max. HB; 89 max. HRBW |
| | | S43940 | --- | --- | --- | 250 | 36 | 430 | 62 | 18 | see standard | 180 max. HB; 88 max. HRBW |
| EN 10028-7:2007 | X2CrTiNb18 | --- | 1.4509 | t ≤ 4 | --- | 230 | --- | 430-630 | --- | 18 L, 18 T | A | --- |
| EN 10088-2:2014 | X2CrTiNb18 | --- | 1.4509 | t ≤ 8 | --- | 230 | --- | 430-630 | --- | 18 L, 18 T | A | --- |
| ISO 9328-7:2004 | Grade X2CrTiNb18 | --- | --- | t ≤ 2.5 | --- | 230 | --- | 430-630 | --- | 18 L, 18 T | A | --- |

**4.7 Ferritic and Martensitic Stainless Steels for Pressure Vessel Plates**

**4.7B Mechanical Properties of Ferritic and Martensitic Stainless Steels for Pressure Vessel Plates (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness / Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation % min. | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | | | |
| EN 10028-7:2007 | X3CrTi17 | --- | 1.4510 | t ≤ 4 | --- | 230 | --- | 420-600 | --- | 23 L, 23 T | A | --- |
| | X2CrTi17 | --- | 1.4520 | t ≤ 4 | --- | 180 | --- | 380-530 | --- | 24 L, 24 T | A | --- |
| EN 10088-2:2014 | X3CrTi17 | --- | 1.4510 | t ≤ 8 | --- | 230 | --- | 420-600 | --- | 23 L, 23 T | A | --- |
| | | | | t ≤ 13.5 | --- | 230 | --- | 420-600 | --- | 23 L, 23 T | A | --- |
| | X3CrNb17 | --- | 1.4511 | t ≤ 8 | --- | 230 | --- | 420-600 | --- | 23 L, 23 T | A | --- |
| | X2CrTi17 | --- | 1.4520 | t ≤ 8 | --- | 180 | --- | 380-530 | --- | 24 L, 24 T | A | --- |
| GB 3280-92 | Grade 00Cr17 | --- | --- | --- | --- | 175 | --- | 365 | --- | 22 | A | 183 max. HB; 88 max. HRB |
| ISO 9328-7:2004 | Grade X2CrTi17 | --- | --- | t ≤ 2.5 | --- | 180 | --- | 380-530 | --- | 24 L, 24 T | A | --- |
| | Grade X3CrTi17 | --- | --- | t ≤ 3 | --- | 230 | --- | 420-600 | --- | 23 L, 23 T | A | --- |
| JIS G 4304:2012 | Symbol SUS430LX | --- | --- | --- | --- | 175 | --- | 360 | --- | 22 | A | 183 max. HBW; 88 max. HRBW; 200 max. HV |
| JIS G 4305:2012 | Symbol SUS430LX | --- | --- | --- | --- | 175 | --- | 360 | --- | 22 | A | 183 max. HBW; 88 max. HRBW; 200 max. HV |
| ASME SA-240/SA-240M | Type 444 | S44400 | --- | --- | --- | 275 | 40 | 415 | 60 | 20 | see standard | 217 max. HB; 96 max. HRB |
| ASTM A240/A240M-15a | Type 444 | S44400 | --- | --- | --- | 275 | 40 | 415 | 60 | 20 | --- | 217 max. HB; 96 max. HRBW |
| EN 10028-7:2007 | X2CrMoTi18-2 | --- | 1.4521 | t ≤ 4 | --- | 300 | --- | 420-640 | --- | 20 L, 20 T | A | --- |
| EN 10088-2:2014 | X2CrMoTi18-2 | --- | 1.4521 | t ≤ 8 | --- | 300 | --- | 420-640 | --- | 20 L, 20 T | A | --- |
| | | | | t ≤ 12 | --- | 280 | --- | 420-620 | --- | 20 L, 20 T | A | --- |
| | | | | t ≤ 13.5 | --- | 280 | --- | 400-600 | --- | 20 L, 20 T | A | --- |
| GB 3280-92 | Grade 00Cr18Mo2 | --- | --- | --- | --- | 245 | --- | 410 | --- | 20 | A | 217 max. HB; 96 max. HRB |
| GB 4237-92 | Grade 00Cr18Mo2 | --- | --- | --- | --- | 245 | --- | 410 | --- | 20 | A | 217 max. HB; 96 max. HRB |
| ISO 9328-7:2004 | Grade X2CrMoTi18-2 | --- | --- | t ≤ 2.5 | --- | 300 | --- | 420-640 | --- | 20 L, 20 T | A | --- |
| JIS G 4304:2012 | Symbol SUS444 | --- | --- | --- | --- | 245 | --- | 410 | --- | 20 | A | 217 max. HBW; 96 max. HRBW; 230 max. HV |
| JIS G 4305:2012 | Symbol SUS444 | --- | --- | --- | --- | 245 | --- | 410 | --- | 20 | A | 217 max. HBW; 96 max. HRBW; 230 max. HV |

## 4.8 Austenitic Stainless Steels for Pressure Vessel Plates

### 4.8A Chemical Composition of Austenitic Stainless Steels for Pressure Vessel Plates

| Specification | Designation | UNS No | Steel No | Weight, %, max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASME SA-240/SA-240M | Type 301LN | S30153 | --- | 0.03 | 2.00 | 1.00 | 0.045 | 0.030 | 16.0-18.0 | 6.0-8.0 | --- | N 0.07-0.20 |
| ASME SA-666 | Type 301LN | S30153 | --- | 0.03 | 2.00 | 1.00 | 0.045 | 0.030 | 16.0-18.0 | 6.0-8.0 | --- | N 0.07-0.20 |
| ASTM A240/A240M-15a | Type 301LN | S30153 | --- | 0.03 | 2.00 | 1.00 | 0.045 | 0.030 | 16.0-18.0 | 6.0-8.0 | --- | N 0.07-0.20 |
| ASTM A666-15 | Type 301LN | S30153 | --- | 0.03 | 2.00 | 1.00 | 0.045 | 0.030 | 16.0-18.0 | 6.0-8.0 | --- | N 0.07-0.20 |
| EN 10028-7:2007 | X2CrNiN18-7 | --- | 1.4318 | 0.030 | 2.00 | 1.00 | 0.045 | 0.015 | 16.5-18.5 | 6.0-8.0 | --- | N 0.10-0.20 |
| EN 10088-2:2014 | X2CrNiN18-7 | --- | 1.4318 | 0.030 | 2.00 | 1.00 | 0.045 | 0.015 | 16.5-18.5 | 6.0-8.0 | --- | N 0.10-0.20 |
| ISO 9328-7:2004 | Grade X2CrNiN18-7 | --- | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.015 | 16.5-18.5 | 6.0-8.0 | --- | N 0.10-0.20 |
| ASME SA-240/SA-240M | Type 304 | S30400 | --- | 0.07 | 2.00 | 0.75 | 0.045 | 0.030 | 17.5-19.5 | 8.0-10.5 | --- | N 0.10 |
| ASME SA-666 | Type 304 | S30400 | --- | 0.08 | 2.00 | 0.75 | 0.045 | 0.030 | 18.0-20.0 | 8.0-10.5 | --- | N 0.10 |
| ASTM A240/A240M-15a | Type 304 | S30400 | --- | 0.07 | 2.00 | 0.75 | 0.045 | 0.030 | 17.5-19.5 | 8.0-10.5 | --- | N 0.10 |
| ASTM A666-15 | Type 304 | S30400 | --- | 0.08 | 2.00 | 0.75 | 0.045 | 0.030 | 18.0-20.0 | 8.0-10.5 | --- | N 0.10 |
| EN 10028-7:2007 | X5CrNi18-10 | --- | 1.4301 | 0.07 | 2.00 | 1.00 | 0.045 | 0.015 | 17.5-19.5 | 8.0-10.5 | --- | N 0.10 |
| EN 10088-2:2014 | X5CrNi18-10 | --- | 1.4301 | 0.07 | 2.00 | 1.00 | 0.045 | 0.015 | 17.5-19.5 | 8.0-10.5 | --- | N 0.10 |
| GB 3280-92 | Grade 0Cr18Ni9 | --- | --- | 0.07 | 2.00 | 1.00 | 0.035 | 0.030 | 17.00-19.00 | 8.00-11.00 | --- | --- |
| GB 4237-92 | Grade 0Cr18Ni9 | --- | --- | 0.07 | 2.00 | 1.00 | 0.035 | 0.030 | 17.00-19.00 | 8.00-11.00 | --- | --- |
| GB 4238-92 | Grade 0Cr18Ni9 | --- | --- | 0.07 | 2.00 | 1.00 | 0.035 | 0.030 | 17.00-19.00 | 8.00-11.00 | --- | --- |
| ISO 9328-7:2004 | Grade X5CrNi18-9 | --- | --- | 0.07 | 2.00 | 1.00 | 0.045 | 0.015 | 17.5-19.5 | 8.0-10.5 | --- | N 0.11 |
| JIS G 4304:2012 | Symbol SUS304 | --- | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 18.00-20.00 | 8.00-10.50 | --- | --- |
| JIS G 4305:2012 | Symbol SUS304 | --- | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 18.00-20.00 | 8.00-10.50 | --- | --- |
| ASME SA-240/SA-240M | Type 304H | S30409 | --- | 0.04-0.10 | 2.00 | 0.75 | 0.045 | 0.030 | 18.0-20.0 | 8.0-10.5 | --- | --- |
| ASTM A240/A240M-15a | Type 304H | S30409 | --- | 0.04-0.10 | 2.00 | 0.75 | 0.045 | 0.030 | 18.0-20.0 | 8.0-10.5 | --- | --- |
| EN 10028-7:2007 | X6CrNi18-10 | --- | 1.4948 | 0.04-0.08 | 2.00 | 1.00 | 0.035 | 0.015 | 17.0-19.0 | 8.0-11.0 | --- | N 0.10 |
| ISO 9328-7:2004 | Grade X6CrNi18-10 | --- | --- | 0.04-0.08 | 2.00 | 1.00 | 0.035 | 0.015 | 17.0-19.0 | 8.0-11.0 | --- | N 0.11 |
| ASME SA-240/SA-240M | Type 304L | S30403 | --- | 0.030 | 2.00 | 0.75 | 0.045 | 0.030 | 17.5-19.5 | 8.0-12.0 | --- | N 0.10 |
| ASME SA-666 | Type 304L | S30403 | --- | 0.030 | 2.00 | 0.75 | 0.045 | 0.030 | 18.0-20.0 | 8.0-12.0 | --- | N 0.10 |
| ASTM A240/A240M-15a | Type 304L | S30403 | --- | 0.030 | 2.00 | 0.75 | 0.045 | 0.030 | 17.5-19.5 | 8.0-12.0 | --- | N 0.10 |
| ASTM A666-15 | Type 304L | S30403 | --- | 0.030 | 2.00 | 0.75 | 0.045 | 0.030 | 18.0-20.0 | 8.0-12.0 | --- | N 0.10 |
| EN 10028-7:2007 | X2CrNi19-11 | --- | 1.4306 | 0.030 | 2.00 | 1.00 | 0.045 | 0.015 | 18.0-20.0 | 10.0-12.0 | --- | N 0.10 |
| | X2CrNi18-9 | --- | 1.4307 | 0.030 | 2.00 | 1.00 | 0.045 | 0.015 | 17.5-19.5 | 8.0-10.5 | --- | N 0.10 |
| EN 10088-2:2014 | X2CrNi19-11 | --- | 1.4306 | 0.030 | 2.00 | 1.00 | 0.045 | 0.015 | 18.0-20.0 | 10.0-12.0 | --- | N 0.10 |
| | X2CrNi18-9 | --- | 1.4307 | 0.030 | 2.00 | 1.00 | 0.045 | 0.015 | 17.5-19.5 | 8.0-10.5 | --- | N 0.10 |
| GB 3280-92 | Grade 00Cr19Ni10 | --- | --- | 0.030 | 2.00 | 1.00 | 0.035 | 0.030 | 18.00-20.00 | 8.00-12.00 | --- | --- |
| | Grade 00Cr19Ni13Mo3 | --- | --- | 0.030 | 2.50 | 1.00 | 0.035 | 0.030 | 18.00-20.00 | 11.00-15.00 | --- | --- |
| GB 4237-92 | Grade 00Cr19Ni10 | --- | --- | 0.030 | 2.00 | 1.00 | 0.035 | 0.030 | 18.00-20.00 | 8.00-12.00 | --- | --- |
| ISO 9328-7:2004 | Grade X2CrNi18-9 | --- | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.015 | 17.5-19.5 | 8.0-10.0 | --- | N 0.11 |
| | Grade X2CrNi19-11 | --- | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.015 | 18.0-20.0 | 10.0-12.0 | --- | N 0.11 |
| JIS G 4304:2012 | Symbol SUS304L | --- | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 18.00-20.00 | 9.00-13.00 | --- | --- |
| JIS G 4305:2012 | Symbol SUS304L | --- | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 18.00-20.00 | 9.00-13.00 | --- | --- |

**4.8 Austenitic Stainless Steels for Pressure Vessel Plates**

**4.8A Chemical Composition of Austenitic Stainless Steels for Pressure Vessel Plates (Continued)**

| Specification | Designation | UNS No | Steel No | Weight, %, max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASME SA-240/SA-240M | Type 304N | S30451 | --- | 0.08 | 2.00 | 0.75 | 0.045 | 0.030 | 18.0-20.0 | 8.0-10.5 | --- | N 0.10-0.16 |
| ASME SA-666 | Type 304N | S30451 | --- | 0.08 | 2.00 | 0.75 | 0.045 | 0.030 | 18.0-20.0 | 8.0-10.5 | --- | N 0.10-0.16 |
| ASTM A240/A240M-15a | Type 304N | S30451 | --- | 0.08 | 2.00 | 0.75 | 0.045 | 0.030 | 18.0-20.0 | 8.0-10.5 | --- | N 0.10-0.16 |
| ASTM A666-15 | Type 304N | S30451 | --- | 0.08 | 2.00 | 0.75 | 0.045 | 0.030 | 18.0-20.0 | 8.0-10.5 | --- | N 0.10-0.16 |
| EN 10028-7:2007 | X5CrNiN19-9 | --- | 1.4315 | 0.06 | 2.00 | 1.00 | 0.045 | 0.015 | 18.0-20.0 | 8.0-11.0 | --- | N 0.12-0.22 |
| EN 10088-2:2014 | X5CrNiN19-9 | --- | 1.4315 | 0.06 | 2.00 | 1.00 | 0.045 | 0.015 | 18.0-20.0 | 8.0-11.0 | --- | N 0.12-0.22 |
| GB 3280-92 | Grade 0Cr19Ni9N | --- | --- | 0.08 | 2.50 | 1.00 | 0.035 | 0.030 | 18.00-20.00 | 7.00-10.50 | --- | N 0.10-0.25 |
| GB 4237-92 | Grade 0Cr19Ni9N | --- | --- | 0.08 | 2.50 | 1.00 | 0.035 | 0.030 | 18.00-20.00 | 7.00-10.50 | --- | N 0.10-0.25 |
| ISO 9328-7:2004 | Grade X5CrNiN18-8 | --- | --- | 0.07 | 2.50 | 1.00 | 0.045 | 0.015 | 18.0-20.0 | 8.0-11.0 | --- | N 0.10-0.16 |
| JIS G 4304:2012 | Symbol SUS304N1 | --- | --- | 0.08 | 2.50 | 1.00 | 0.045 | 0.030 | 18.00-20.00 | 7.00-10.50 | --- | N 0.10-0.25 |
| JIS G 4305:2012 | Symbol SUS304N1 | --- | --- | 0.08 | 2.50 | 1.00 | 0.045 | 0.030 | 18.00-20.00 | 7.00-10.50 | --- | N 0.10-0.25 |
| ASME SA-240/SA-240M | Type 304LN | S30453 | --- | 0.030 | 2.00 | 0.75 | 0.045 | 0.030 | 18.0-20.0 | 8.0-12.0 | --- | N 0.10-0.16 |
| ASME SA-666 | Type 304LN | S30453 | --- | 0.030 | 2.00 | 0.75 | 0.045 | 0.030 | 18.0-20.0 | 8.0-12.0 | --- | N 0.10-0.16 |
| ASTM A240/A240M-15a | Type 304LN | S30453 | --- | 0.030 | 2.00 | 0.75 | 0.045 | 0.030 | 18.0-20.0 | 8.0-12.0 | --- | N 0.10-0.16 |
| ASTM A666-15 | Type 304LN | S30453 | --- | 0.030 | 2.00 | 0.75 | 0.045 | 0.030 | 18.0-20.0 | 8.0-12.0 | --- | N 0.10-0.16 |
| EN 10028-7:2007 | X2CrNiN18-10 | --- | 1.4311 | 0.030 | 2.00 | 1.00 | 0.045 | 0.015 | 17.5-19.5 | 8.5-11.5 | --- | N 0.12-0.22 |
| EN 10088-2:2014 | X2CrNiN18-10 | --- | 1.4311 | 0.030 | 2.00 | 1.00 | 0.045 | 0.015 | 17.5-19.5 | 8.5-11.5 | --- | N 0.12-0.22 |
| GB 3280-92 | Grade 00Cr18Ni10N | --- | --- | 0.030 | 2.00 | 1.00 | 0.035 | 0.030 | 17.00-19.00 | 8.50-11.50 | --- | N 0.12-0.22 |
| GB 4237-92 | Grade 00Cr18Ni10N | --- | --- | 0.030 | 2.00 | 1.00 | 0.035 | 0.030 | 17.00-19.00 | 8.50-11.50 | --- | N 0.12-0.22 |
| ISO 9328-7:2004 | Grade X2CrNiN18-10 | --- | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.015 | 17.5-19.5 | 8.0-11.5 | --- | N 0.12-0.22 |
| JIS G 4304:2012 | Symbol SUS304LN | --- | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 17.00-19.00 | 8.50-11.50 | --- | N 0.12-0.22 |
| JIS G 4305:2012 | Symbol SUS304LN | --- | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 17.00-19.00 | 8.50-11.50 | --- | N 0.12-0.22 |
| ASME SA-240/SA-240M | Type 309H | S30909 | --- | 0.04-0.10 | 2.00 | 0.75 | 0.045 | 0.030 | 22.0-24.0 | 12.0-15.0 | --- | --- |
| ASTM A240/A240M-15a | Type 309H | S30909 | --- | 0.04-0.10 | 2.00 | 0.75 | 0.045 | 0.030 | 22.0-24.0 | 12.0-15.0 | --- | --- |
| EN 10028-7:2007 | X6CrNi23-13 | --- | 1.4950 | 0.04-0.08 | 2.00 | 0.70 | 0.035 | 0.015 | 22.0-24.0 | 12.0-15.0 | --- | N 0.10 |
| ISO 9328-7:2004 | Grade X6CrNi23-13 | --- | --- | 0.04-0.08 | 2.00 | 0.70 | 0.035 | 0.015 | 22.0-24.0 | 12.0-15.0 | --- | N 0.11 |
| ASME SA-240/SA-240M | Type 310H | S31009 | --- | 0.04-0.10 | 2.00 | 0.75 | 0.045 | 0.030 | 24.0-26.0 | 19.0-22.0 | --- | --- |
| ASTM A240/A240M-15a | Type 310H | S31009 | --- | 0.04-0.10 | 2.00 | 0.75 | 0.045 | 0.030 | 24.0-26.0 | 19.0-22.0 | --- | --- |
| EN 10028-7:2007 | X6CrNi25-20 | --- | 1.4951 | 0.04-0.08 | 2.00 | 0.70 | 0.035 | 0.015 | 24.0-26.0 | 19.0-22.0 | --- | N 0.10 |
| ISO 9328-7:2004 | Grade X6CrNi25-20 | --- | --- | 0.04-0.08 | 2.00 | 0.70 | 0.035 | 0.015 | 24.0-26.0 | 19.0-22.0 | --- | N 0.11 |

**4.8 Austenitic Stainless Steels for Pressure Vessel Plates**

**4.8A Chemical Composition of Austenitic Stainless Steels for Pressure Vessel Plates (Continued)**

| Specification | Designation | UNS No | Steel No | Weight, %, max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASME SA-240/SA-240M | Type 316 | S31600 | --- | 0.08 | 2.00 | 0.75 | 0.045 | 0.030 | 16.0-18.0 | 10.0-14.0 | 2.00-3.00 | N 0.10 |
| ASME SA-666 | Type 316 | S31600 | --- | 0.08 | 2.00 | 0.75 | 0.045 | 0.030 | 16.0-18.0 | 10.0-14.0 | 2.00-3.00 | --- |
| ASTM A240/A240M-15a | Type 316 | S31600 | --- | 0.08 | 2.00 | 0.75 | 0.045 | 0.030 | 16.0-18.0 | 10.0-14.0 | 2.00-3.00 | N 0.10 |
| ASTM A666-15 | Type 316 | S31600 | --- | 0.08 | 2.00 | 0.75 | 0.045 | 0.030 | 16.0-18.0 | 10.0-14.0 | 2.00-3.00 | --- |
| EN 10028-7:2007 | X5CrNiMo17-12-2 | --- | 1.4401 | 0.07 | 2.00 | 1.00 | 0.045 | 0.015 | 16.5-18.5 | 10.0-13.0 | 2.00-2.50 | N 0.10 |
| | X3CrNiMo17-13-3 | --- | 1.4436 | 0.05 | 2.00 | 1.00 | 0.045 | 0.015 | 16.5-18.5 | 10.5-13.0 | 2.50-3.00 | N 0.10 |
| EN 10088-2:2014 | X5CrNiMo17-12-2 | --- | 1.4401 | 0.07 | 2.00 | 1.00 | 0.045 | 0.015 | 16.5-18.5 | 10.0-13.0 | 2.00-2.50 | N 0.10 |
| | X3CrNiMo17-13-3 | --- | 1.4436 | 0.05 | 2.00 | 1.00 | 0.045 | 0.015 | 16.5-18.5 | 10.5-13.0 | 2.50-3.00 | N 0.10 |
| GB 3280-92 | Grade 0Cr17Ni12Mo2 | --- | --- | 0.08 | 2.00 | 1.00 | 0.035 | 0.030 | 16.00-18.00 | 10.00-14.00 | 2.00-3.00 | --- |
| GB 4237-92 | Grade 0Cr17Ni12Mo2 | --- | --- | 0.08 | 2.00 | 1.00 | 0.035 | 0.030 | 16.00-18.00 | 10.00-14.00 | 2.00-3.00 | --- |
| GB 4238-92 | Grade 0Cr17Ni12Mo2 | --- | --- | 0.08 | 2.00 | 1.00 | 0.035 | 0.030 | 16.00-18.00 | 10.00-14.00 | 2.00-3.00 | --- |
| ISO 9328-7:2004 | Grade X3CrNiMo17-12-3 | --- | --- | 0.05 | 2.00 | 1.00 | 0.045 | 0.015 | 16.5-18.5 | 10.5-13.0 | 2.50-3.00 | N 0.11 |
| | Grade X5CrNiMo17-12-2 | --- | --- | 0.07 | 2.00 | 1.00 | 0.045 | 0.015 | 16.5-18.5 | 10.0-13.0 | 2.00-3.00 | N 0.11 |
| JIS G 4304:2012 | Symbol SUS316 | --- | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 16.00-18.00 | 10.00-14.00 | 2.00-3.00 | --- |
| JIS G 4305:2012 | Symbol SUS316 | --- | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 16.00-18.00 | 10.00-14.00 | 2.00-3.00 | --- |
| ASME SA-240/SA-240M | Type 316L | S31603 | --- | 0.030 | 2.00 | 0.75 | 0.045 | 0.030 | 16.0-18.0 | 10.0-14.0 | 2.00-3.00 | N 0.10 |
| ASME SA-666 | Type 316L | S31603 | --- | 0.030 | 2.00 | 0.75 | 0.045 | 0.030 | 16.0-18.0 | 10.0-14.0 | 2.00-3.00 | --- |
| ASTM A240/A240M-15a | Type 316L | S31603 | --- | 0.030 | 2.00 | 0.75 | 0.045 | 0.030 | 16.0-18.0 | 10.0-14.0 | 2.00-3.00 | N 0.10 |
| ASTM A666-15 | Type 316L | S31603 | --- | 0.030 | 2.00 | 0.75 | 0.045 | 0.030 | 16.0-18.0 | 10.0-14.0 | 2.00-3.00 | --- |
| EN 10028-7:2007 | X2CrNiMo17-12-2 | --- | 1.4404 | 0.030 | 2.00 | 1.00 | 0.045 | 0.015 | 16.5-18.5 | 10.0-13.0 | 2.00-2.50 | N 0.10 |
| | X2CrNiMo17-12-3 | --- | 1.4432 | 0.030 | 2.00 | 1.00 | 0.045 | 0.015 | 16.5-18.5 | 10.5-13.0 | 2.50-3.00 | N 0.10 |
| | X2CrNiMo18-14-3 | --- | 1.4435 | 0.030 | 2.00 | 1.00 | 0.045 | 0.015 | 17.0-19.0 | 12.5-15.0 | 2.50-3.00 | N 0.10 |
| EN 10088-2:2014 | X2CrNiMo17-12-2 | --- | 1.4404 | 0.030 | 2.00 | 1.00 | 0.045 | 0.015 | 16.5-18.5 | 10.0-13.0 | 2.00-2.50 | N 0.10 |
| | X2CrNiMo17-12-3 | --- | 1.4432 | 0.030 | 2.00 | 1.00 | 0.045 | 0.015 | 16.5-18.5 | 10.5-13.0 | 2.50-3.00 | N 0.10 |
| | X2CrNiMo18-14-3 | --- | 1.4435 | 0.030 | 2.00 | 1.00 | 0.045 | 0.015 | 17.0-19.0 | 12.5-15.0 | 2.50-3.00 | N 0.10 |
| GB 3280-92 | Grade 00Cr17Ni14Mo2 | --- | --- | 0.030 | 2.00 | 1.00 | 0.035 | 0.030 | 16.00-18.00 | 12.00-15.00 | 2.00-3.00 | --- |
| GB 4237-92 | Grade 00Cr17Ni14Mo2 | --- | --- | 0.030 | 2.00 | 1.00 | 0.035 | 0.030 | 16.00-18.00 | 12.00-15.00 | 2.00-3.00 | --- |
| ISO 9328-7:2004 | Grade X2CrNiMo17-12-2 | --- | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.015 | 16.5-18.5 | 10.0-13.0 | 2.00-3.00 | N 0.11 |
| | Grade X2CrNiMo17-12-3 | --- | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.015 | 16.5-18.5 | 10.5-13.0 | 2.50-3.00 | N 0.11 |
| | Grade X2CrNiMo18-14-3 | --- | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.015 | 17.0-19.0 | 12.5-15.0 | 2.50-3.00 | N 0.11 |
| JIS G 4304:2012 | Symbol SUS316L | --- | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 16.00-18.00 | 12.00-15.00 | 2.00-3.00 | --- |
| JIS G 4305:2012 | Symbol SUS316L | --- | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 16.00-18.00 | 12.00-15.00 | 2.00-3.00 | --- |

**4.8 Austenitic Stainless Steels for Pressure Vessel Plates**

**4.8A Chemical Composition of Austenitic Stainless Steels for Pressure Vessel Plates (Continued)**

| Specification | Designation | UNS No | Steel No | Weight, %, max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASME SA-240/SA-240M | Type 316Ti | S31635 | --- | 0.08 | 2.00 | 0.75 | 0.045 | 0.030 | 16.0-18.0 | 10.0-14.0 | 2.00-3.00 | N 0.10; Ti 5x(C+N) to 0.70 |
| ASTM A240/A240M-15a | Type 316Ti | S31635 | --- | 0.08 | 2.00 | 0.75 | 0.045 | 0.030 | 16.0-18.0 | 10.0-14.0 | 2.00-3.00 | N 0.10; Ti 5x(C+N) to 0.70 |
| EN 10028-7:2007 | X6CrNiMoTi17-12-2 | --- | 1.4571 | 0.08 | 2.00 | 1.00 | 0.045 | 0.015 | 16.5-18.5 | 10.5-13.5 | 2.00-2.50 | Ti 5xC to 0.70 |
| EN 10088-2:2014 | X6CrNiMoTi17-12-2 | --- | 1.4571 | 0.08 | 2.00 | 1.00 | 0.045 | 0.015 | 16.5-18.5 | 10.5-13.5 | 2.00-2.50 | Ti 5xC to 0.70 |
| GB 3280-92 | Grade 0Cr18Ni12Mo2Ti | --- | --- | 0.08 | 2.00 | 1.00 | 0.035 | 0.030 | 16.00-19.00 | 11.00-14.00 | 1.80-2.50 | Ti 5xC to 0.70 |
| GB 4237-92 | Grade 0Cr18Ni12Mo2Ti | --- | --- | 0.08 | 2.00 | 1.00 | 0.035 | 0.030 | 16.00-19.00 | 11.00-14.00 | 1.80-2.50 | Ti 5xC to 0.07 |
| ISO 9328-7:2004 | Grade X6CrNiMoTi17-12-2 | --- | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.015 | 16.5-18.5 | 10.5-13.5 | 2.00-2.50 | Ti 5xC to 0.70 |
| JIS G 4304:2012 | Symbol SUS316Ti | --- | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 16.00-18.00 | 10.00-14.00 | 2.00-3.00 | Ti 5xC min |
| JIS G 4305:2012 | Symbol SUS316Ti | --- | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 16.00-18.00 | 10.00-14.00 | 2.00-3.00 | Ti 5xC min |
| ASME SA-240/SA-240M | Type 316Cb | S31640 | --- | 0.08 | 2.00 | 0.75 | 0.045 | 0.030 | 16.0-18.0 | 10.0-14.0 | 2.00-3.00 | N 0.10; Cb 10xC to 1.10 |
| ASTM A240/A240M-15a | Type 316Cb | S31640 | --- | 0.08 | 2.00 | 0.75 | 0.045 | 0.030 | 16.0-18.0 | 10.0-14.0 | 2.00-3.00 | N 0.10; Cb 10xC to 1.10 |
| EN 10028-7:2007 | X6CrNiMoNb17-12-2 | --- | 1.4580 | 0.08 | 2.00 | 1.00 | 0.045 | 0.015 | 16.5-18.5 | 10.5-13.5 | 2.00-2.50 | Nb 10xC to 1.00 |
| EN 10088-2:2014 | X6CrNiMoNb17-12-2 | --- | 1.4580 | 0.08 | 2.00 | 1.00 | 0.045 | 0.015 | 16.5-18.5 | 10.5-13.5 | 2.00-2.50 | Nb 10xC to 1.00 |
| ISO 9328-7:2004 | Grade X6CrNiMoNb17-12-2 | --- | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.015 | 16.5-18.5 | 10.5-13.5 | 2.00-2.50 | Nb 10xC to 1.00 |
| ASME SA-479/SA-479M | Type 316LN | S31653 | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 16.0-18.0 | 10.0-14.0 | 2.00-3.00 | N 0.10-0.16 |
| ASTM A479/A479M-14 | Type 316LN | S31653 | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 16.0-18.0 | 10.0-14.0 | 2.00-3.00 | N 0.10-0.16 |
| EN 10028-7:2007 | X2CrNiMoN17-11-2 | --- | 1.4406 | 0.030 | 2.00 | 1.00 | 0.045 | 0.015 | 16.5-18.5 | 10.0-12.5 | 2.00-2.50 | N 0.12-0.22 |
| | X2CrNiMoN17-13-3 | --- | 1.4429 | 0.030 | 2.00 | 1.00 | 0.045 | 0.015 | 16.5-18.5 | 11.0-14.0 | 2.50-3.00 | N 0.12-0.22 |
| EN 10088-3:2014 | X2CrNiMoN17-11-2 | --- | 1.4406 | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 16.5-18.5 | 10.0-12.5 | 2.00-2.50 | N 0.12-0.22 |
| | X2CrNiMoN17-13-3 | --- | 1.4429 | 0.030 | 2.00 | 1.00 | 0.045 | 0.015 | 16.5-18.5 | 11.0-14.0 | 2.50-3.00 | N 0.12-0.22 |
| GB 3280-92 | Grade 00Cr17Ni13Mo2N | --- | --- | 0.030 | 2.00 | 1.00 | 0.035 | 0.030 | 16.50-18.50 | 10.50-14.50 | 2.00-3.00 | N 0.12-0.22 |
| GB 4237-92 | Grade 00Cr17Ni13Mo2N | --- | --- | 0.030 | 2.00 | 1.00 | 0.035 | 0.030 | 16.50-18.50 | 10.50-14.50 | 2.00-3.00 | N 0.12-0.22 |
| ISO 9328-7:2004 | Grade X2CrNiMoN17-11-2 | --- | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.015 | 16.5-18.5 | 10.0-12.5 | 2.00-3.00 | N 0.12-0.22 |
| | Grade X2CrNiMoN17-13-3 | --- | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.015 | 16.5-18.5 | 11.0-13.0 | 2.50-3.00 | N 0.12-0.22 |
| JIS G 4304:2012 | Symbol SUS316LN | --- | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 16.50-18.50 | 10.50-14.50 | 2.00-3.00 | N 0.12-0.22 |
| JIS G 4305:2012 | Symbol SUS316LN | --- | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 16.50-18.50 | 10.50-14.50 | 2.00-3.00 | N 0.12-0.22 |
| ASME SA-240/SA-240M | Type 317L | S31703 | --- | 0.030 | 2.00 | 0.75 | 0.045 | 0.030 | 18.0-20.0 | 11.0-15.0 | 3.0-4.0 | N 0.10 |
| ASTM A240/A240M-15a | Type 317L | S31703 | --- | 0.030 | 2.00 | 0.75 | 0.045 | 0.030 | 18.0-20.0 | 11.0-15.0 | 3.0-4.0 | N 0.10 |
| EN 10028-7:2007 | X2CrNiMo18-15-4 | --- | 1.4438 | 0.030 | 2.00 | 1.00 | 0.045 | 0.015 | 17.5-19.5 | 13.0-16.0 | 3.0-4.0 | N 0.10 |
| EN 10088-2:2014 | X2CrNiMo18-15-4 | --- | 1.4438 | 0.030 | 2.00 | 1.00 | 0.045 | 0.015 | 17.5-19.5 | 13.0-16.0 | 3.0-4.0 | N 0.10 |
| GB 4237-92 | Grade 00Cr19Ni13Mo3 | --- | --- | 0.030 | 2.00 | 1.00 | 0.035 | 0.030 | 18.00-20.00 | 11.00-15.00 | 3.00-4.00 | --- |
| ISO 9328-7:2004 | Grade X2CrNiMo18-15-4 | --- | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.015 | 17.5-19.5 | 13.0-16.0 | 3.00-4.0 | N 0.11 |
| JIS G 4304:2012 | Symbol SUS317L | --- | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 18.00-20.00 | 11.00-15.00 | 3.00-4.00 | --- |
| JIS G 4305:2012 | Symbol SUS317L | --- | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 18.00-20.00 | 11.00-15.00 | 3.00-4.00 | --- |

**4.8 Austenitic Stainless Steels for Pressure Vessel Plates**

**4.8A Chemical Composition of Austenitic Stainless Steels for Pressure Vessel Plates (Continued)**

| Specification | Designation | UNS No | Steel No | Weight, %, max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASME SA-240/SA-240M | Type 317LN | S31753 | --- | 0.030 | 2.00 | 0.75 | 0.045 | 0.030 | 18.0-20.0 | 11.0-15.0 | 3.0-4.0 | N 0.10-0.22 |
| ASTM A240/A240M-15a | Type 317LN | S31753 | --- | 0.030 | 2.00 | 0.75 | 0.045 | 0.030 | 18.0-20.0 | 11.0-15.0 | 3.0-4.0 | N 0.10-0.22 |
| EN 10028-7:2007 | X2CrNiMoN18-12-4 | --- | 1.4434 | 0.030 | 2.00 | 1.00 | 0.045 | 0.015 | 16.5-19.5 | 10.5-14.0 | 3.0-4.0 | N 0.10-0.20 |
| EN 10088-2:2014 | X2CrNiMoN18-12-4 | --- | 1.4434 | 0.030 | 2.00 | 1.00 | 0.045 | 0.015 | 16.5-19.5 | 10.5-14.0 | 3.0-4.0 | N 0.10-0.20 |
| ISO 9328-7:2004 | Grade X2CrNiMoN18-12-4 | --- | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.015 | 16.5-19.5 | 10.5-14.0 | 3.00-4.0 | N 0.10-0.20 |
| JIS G 4304:2012 | Symbol SUS317LN | --- | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 18.00-20.00 | 11.00-15.00 | 3.00-4.00 | N 0.10-0.22 |
| JIS G 4305:2012 | Symbol SUS317LN | --- | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 18.00-20.00 | 11.00-15.00 | 3.00-4.00 | N 0.10-0.22 |
| ASME SA-240/SA-240M | Type 317LMN | S31726 | --- | 0.030 | 2.00 | 0.75 | 0.045 | 0.030 | 17.0-20.0 | 13.5-17.5 | 4.0-5.0 | N 0.10-0.20 |
| ASTM A240/A240M-15a | Type 317LMN | S31726 | --- | 0.030 | 2.00 | 0.75 | 0.045 | 0.030 | 17.0-20.0 | 13.5-17.5 | 4.0-5.0 | N 0.10-0.20 |
| EN 10028-7:2007 | X2CrNiMoN17-13-5 | --- | 1.4439 | 0.030 | 2.00 | 1.00 | 0.045 | 0.015 | 16.5-18.5 | 12.5-14.5 | 4.0-5.0 | N 0.12-0.22 |
| EN 10088-2:2014 | X2CrNiMoN17-13-5 | --- | 1.4439 | 0.030 | 2.00 | 1.00 | 0.045 | 0.015 | 16.5-18.5 | 12.5-14.5 | 4.0-5.0 | N 0.12-0.22 |
| ISO 9328-7:2004 | Grade X2CrNiMoN17-13-5 | --- | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.015 | 16.5-18.5 | 12.5-14.5 | 4.0-5.0 | N 0.12-0.22 |
| ASME SA-240/SA-240M | Type 321 | S32100 | --- | 0.08 | 2.00 | 0.75 | 0.045 | 0.030 | 17.0-19.0 | 9.0-12.0 | --- | N 0.10; Ti 5x(C+N) to 0.70 |
| ASTM A240/A240M-15a | Type 321 | S32100 | --- | 0.08 | 2.00 | 0.75 | 0.045 | 0.030 | 17.0-19.0 | 9.0-12.0 | --- | N 0.10; Ti 5x(C+N) to 0.70 |
| EN 10028-7:2007 | X6CrNiTi18-10 | --- | 1.4541 | 0.08 | 2.00 | 1.00 | 0.045 | 0.015 | 17.0-19.0 | 9.0-12.0 | --- | Ti 5xC to 0.70 |
| EN 10088-2:2014 | X6CrNiTi18-10 | --- | 1.4541 | 0.08 | 2.00 | 1.00 | 0.045 | 0.015 | 17.0-19.0 | 9.0-12.0 | --- | Ti 5xC to 0.70 |
| GB 3280-92 | Grade 0Cr18Ni10Ti | --- | --- | 0.08 | 2.00 | 1.00 | 0.035 | 0.030 | 17.00-19.00 | 9.00-12.00 | --- | Ti 5xC min. |
| GB 4237-92 | Grade 0Cr18Ni10Ti | --- | --- | 0.08 | 2.00 | 1.00 | 0.035 | 0.030 | 17.00-19.00 | 9.00-12.00 | --- | Ti 5xC min. |
| GB 4238-92 | Grade 0Cr18Ni10Ti | --- | --- | 0.08 | 2.00 | 1.00 | 0.035 | 0.030 | 17.00-19.00 | 9.00-12.00 | --- | Ti 5xC min. |
| ISO 9328-7:2004 | Grade X6CrNiTi18-10 | --- | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.015 | 17.0-19.0 | 9.0-12.0 | --- | Ti 5xC to 0.70 |
| JIS G 4304:2012 | Symbol SUS321 | --- | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 17.00-19.00 | 9.00-13.00 | --- | Ti 5xC min. |
| JIS G 4305:2012 | Symbol SUS321 | --- | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 17.00-19.00 | 9.00-13.00 | --- | Ti 5xC min. |
| ASME SA-240/SA-240M | Type 347 | S34700 | --- | 0.08 | 2.00 | 0.75 | 0.045 | 0.030 | 17.0-19.0 | 9.0-13.0 | --- | Cb 10xC to 1.00 |
| ASTM A240/A240M-15a | Type 347 | S34700 | --- | 0.08 | 2.00 | 0.75 | 0.045 | 0.030 | 17.0-19.0 | 9.0-13.0 | --- | Cb 10xC to 1.00 |
| EN 10028-7:2007 | X6CrNiNb18-10 | --- | 1.4550 | 0.08 | 2.00 | 1.00 | 0.045 | 0.015 | 17.0-19.0 | 9.0-12.0 | --- | Nb 10xC to 1.00 |
| EN 10088-2:2014 | X6CrNiNb18-10 | --- | 1.4550 | 0.08 | 2.00 | 1.00 | 0.045 | 0.015 | 17.0-19.0 | 9.0-12.0 | --- | Nb 10xC to 1.00 |
| GB 3280-92 | Grade 0Cr18Ni11Nb | --- | --- | 0.08 | 2.00 | 1.00 | 0.035 | 0.030 | 17.00-19.00 | 9.00-13.00 | --- | Nb 10xC min. |
| GB 4237-92 | Grade 0Cr18Ni11Nb | --- | --- | 0.08 | 2.00 | 1.00 | 0.035 | 0.030 | 17.00-19.00 | 9.00-13.00 | --- | Nb 10xC min. |
| GB 4238-92 | Grade 0Cr18Ni11Nb | --- | --- | 0.08 | 2.00 | 1.00 | 0.035 | 0.030 | 17.00-19.00 | 9.00-13.00 | --- | Nb 10xC min. |
| ISO 9328-7:2004 | Grade X6CrNiNb18-10 | --- | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.015 | 17.0-19.0 | 9.0-12.0 | --- | Nb 10xC to 1.00 |
| JIS G 4304:2012 | Symbol SUS347 | --- | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 17.00-19.00 | 9.00-13.00 | --- | Nb 10xC min. |
| JIS G 4305:2012 | Symbol SUS347 | --- | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 17.00-19.00 | 9.00-13.00 | --- | Nb 10xC min. |

**4.8 Austenitic Stainless Steels for Pressure Vessel Plates**

**4.8A Chemical Composition of Austenitic Stainless Steels for Pressure Vessel Plates (Continued)**

| Specification | Designation | UNS No | Steel No | Weight, %, max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASME SA-240/SA-240M | Type 904L | N08904 | --- | 0.020 | 2.00 | 1.00 | 0.045 | 0.035 | 19.0-23.0 | 23.0-28.0 | 4.00-5.00 | Cu 1.00-2.00; N 0.10 |
| ASTM A240/A240M-15a | Type 904L | N08904 | --- | 0.020 | 2.00 | 1.00 | 0.045 | 0.035 | 19.0-23.0 | 23.0-28.0 | 4.00-5.00 | Cu 1.00-2.00; N 0.10 |
| EN 10028-7:2007 | X1NiCrMoCu25-20-5 | --- | 1.4539 | 0.020 | 2.00 | 0.70 | 0.030 | 0.010 | 19.0-21.0 | 24.0-26.0 | 4.0-5.0 | Cu 1.20-2.00; N 0.15 |
| EN 10088-2:2014 | X1NiCrMoCu25-20-5 | --- | 1.4539 | 0.020 | 2.00 | 0.70 | 0.030 | 0.010 | 19.0-21.0 | 24.0-26.0 | 4.0-5.0 | Cu 1.20-2.00; N 0.15 |
| ISO 9328-7:2004 | Grade X1NiCrMoCu25-20-5 | --- | --- | 0.020 | 2.00 | 0.70 | 0.030 | 0.010 | 19.0-21.0 | 24.0-26.0 | 4.0-5.0 | Cu 1.20-2.00; N 0.15 |
| JIS G 4304:2012 | Symbol SUS890L | --- | --- | 0.020 | 2.00 | 1.00 | 0.045 | 0.030 | 19.00-23.00 | 23.00-28.00 | 4.00-5.00 | Cu 1.00-2.00 |
| JIS G 4305:2012 | Symbol SUS890L | --- | --- | 0.020 | 2.00 | 1.00 | 0.045 | 0.030 | 19.00-23.00 | 23.00-28.00 | 4.00-5.00 | Cu 1.00-2.00 |
| ASME SA-240/SA-240M | --- | N08367 | --- | 0.030 | 2.00 | 1.00 | 0.040 | 0.030 | 20.0-22.0 | 23.5-25.5 | 6.0-7.0 | Cu 0.75; N 0.18-0.25 |
| | | N08926 | --- | 0.020 | 2.00 | 0.50 | 0.030 | 0.010 | 19.0-21.0 | 24.0-26.0 | 6.00-7.00 | Cu 0.50-1.50; N 0.15-0.25 |
| | | S31277 | --- | 0.020 | 3.00 | 0.50 | 0.030 | 0.010 | 20.5-23.0 | 26.0-28.0 | 6.5-8.0 | Cu 0.50-1.50; N 0.30-0.40 |
| ASTM A240/A240M-15a | --- | N08367 | --- | 0.030 | 2.00 | 1.00 | 0.040 | 0.030 | 20.0-22.0 | 23.5-25.5 | 6.0-7.0 | Cu 0.75; N 0.18-0.25 |
| | | N08926 | --- | 0.020 | 2.00 | 0.50 | 0.030 | 0.010 | 19.0-21.0 | 24.0-26.0 | 6.00-7.00 | Cu 0.50-1.50; N 0.15-0.25 |
| | | S31277 | --- | 0.020 | 3.00 | 0.50 | 0.030 | 0.010 | 20.5-23.0 | 26.0-28.0 | 6.5-8.0 | Cu 0.50-1.50; N 0.30-0.40 |
| EN 10028-7:2007 | X1NiCrMoCuN25-20-7 | --- | 1.4529 | 0.020 | 1.00 | 0.50 | 0.030 | 0.010 | 19.0-21.0 | 24.0-26.0 | 6.0-7.0 | Cu 0.50-1.50; N 0.15-0.25 |
| EN 10088-2:2014 | X1NiCrMoCuN25-20-7 | --- | 1.4529 | 0.020 | 1.00 | 0.50 | 0.030 | 0.010 | 19.0-21.0 | 24.0-26.0 | 6.0-7.0 | Cu 0.50-1.50; N 0.15-0.25 |
| ISO 9328-7:2004 | Grade X1NiCrMoCuN25-20-7 | --- | --- | 0.020 | 2.00 | 0.75 | 0.030 | 0.010 | 19.0-21.0 | 24.0-26.0 | 6.0-7.0 | Cu 0.50-1.50; N 0.15-0.25 |
| JIS G 4304:2012 | Symbol SUS836L | --- | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 19.00-24.00 | 24.00-26.00 | 5.00-7.00 | N 0.25 |
| JIS G 4305:2012 | Symbol SUS836L | --- | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 19.00-24.00 | 24.00-26.00 | 5.00-7.00 | N 0.25 |
| ASME SA-240/SA-240M | Type 800H | N08810 | --- | 0.05-0.10 | 1.50 | 1.00 | 0.045 | 0.015 | 19.0-23.0 | 30.0-35.0 | --- | Al 0.15-0.60; Cu 0.75; Ti 0.15-0.60; Fe 39.5 min. |
| ASTM A240/A240M-15a | Type 800H | N08810 | --- | 0.05-0.10 | 1.50 | 1.00 | 0.045 | 0.015 | 19.0-23.0 | 30.0-35.0 | --- | Al 0.15-0.60; Cu 0.75; Ti 0.15-0.60; Fe 39.5 min. |
| EN 10028-7:2007 | X8NiCrAlTi32-21 | --- | 1.4959 | 0.05-0.10 | 1.50 | 0.70 | 0.015 | 0.010 | 19.0-22.0 | 30.0-34.0 | --- | Al 0.25-0.65; Cu 0.50; Ti 0.25-0.65; Co 0.50; N 0.030; (Ni+Co) 30.0 to 34.0 |
| ISO 9328-7:2004 | Grade X8NiCrAlTi32-21 | --- | --- | 0.05-0.10 | 1.50 | 0.70 | 0.015 | 0.010 | 19.0-22.0 | 30.0-34.0 | --- | Al 0.25-0.65; Cu 0.50; Ti 0.25-0.65; Co 1.00; N 0.11; (Ni+Co) 30.0 to 34.0 |

**4.8 Austenitic Stainless Steels for Pressure Vessel Plates**

**4.8B Mechanical Properties of Austenitic Stainless Steels for Pressure Vessel Plates**

| Specification | Designation | UNS No. | Steel No. | Section Thickness / Diameter mm | Section Thickness / Diameter in. | Yield Strength, min. MPa | Yield Strength, min. ksi | Tensile Strength, min. MPa | Tensile Strength, min. ksi | Elongation % min. | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ASME SA-240/SA-240M | Type 301LN | S30153 | --- | --- | --- | 240 | 35 | 550 | 80 | 45 | Q+SA | 241 max. HB; 100 max. HRB |
| ASME SA-666 | Type 301LN | S30153 | --- | --- | --- | 240 | 35 | 550 L | 80 L | 45 L | A | 241 max. HB; 100 max. HRB |
| ASTM A240/A240M-15a | Type 301LN | S30153 | --- | --- | --- | 240 | 35 | 550 | 80 | 45 | SA | 241 max. HBW; 100 max. HRBW |
| ASTM A666-15 | Type 301LN | S30153 | --- | --- | --- | 240 | 35 | 550 L | 80 L | 45 L | A | 241 max. HB; 100 max. HRB |
| EN 10028-7:2007 | X2CrNiN18-7 | --- | 1.4318 | t ≤ 3 | --- | 350 | --- | 650-850 | --- | 35 T | SA | see standard for impact data |
| | | | | t ≤ 8 | --- | 350 | --- | 650-850 | --- | 40 T | SA | |
| | | | | t ≤ 13.5 | --- | 330 | --- | 650-850 | --- | 40 T | SA | |
| | | | | t ≤ 75 | --- | 330 | --- | 650-850 | --- | 40 T | SA | |
| EN 10088-2:2014 | X2CrNiN18-7 | --- | 1.4318 | t ≤ 8 | --- | 350 | --- | 650-850 | --- | 40 T | SA | see standard for impact data |
| | | | | t ≤ 13.5 | --- | 330 | --- | 650-850 | --- | 40 T | SA | |
| | | | | t ≤ 75 | --- | 330 | --- | 630-830 | --- | 45 T | SA | |
| ISO 9328-7:2004 | Grade X2CrNiN18-7 | --- | --- | t ≤ 6 | --- | 350 | --- | 650-850 | --- | 40 T | SA | --- |
| | | | | t ≤ 12 | --- | 330 | --- | 650-850 | --- | 40 T | SA | see standard for impact data |
| | | | | t ≤ 75 | --- | 330 | --- | 650-850 | --- | 40 T | SA | |
| ASME SA-240/SA-240M | Type 304 | S30400 | --- | --- | --- | 205 | 30 | 515 | 75 | 40 | Q+SA | 201 max. HB; 92 max. HRB |
| ASME SA-666 | Type 304 | S30400 | --- | --- | --- | 205 | 30 | 515 L | 75 L | 40 L | A | 201 max. HB; 92 max. HRB |
| ASTM A240/A240M-15a | Type 304 | S30400 | --- | --- | --- | 205 | 30 | 515 | 75 | 40 | SA | 201 max. HBW; 92 max. HRBW |
| ASTM A666-15 | Type 304 | S30400 | --- | --- | --- | 205 | 30 | 515 L | 75 L | 40 L | A | 201 max. HB; 92 max. HRB |
| EN 10028-7:2007 | X5CrNi18-10 | --- | 1.4301 | t ≤ 8 | --- | 230 | --- | 540-750 | --- | 45 T | SA | see standard for impact data |
| | | | | t ≤ 13.5 | --- | 210 | --- | 520-720 | --- | 45 T | SA | |
| | | | | t ≤ 75 | --- | 210 | --- | 520-720 | --- | 45 T | SA | |
| EN 10088-2:2014 | X5CrNi18-10 | --- | 1.4301 | t ≤ 8 | --- | 230 | --- | 540-750 | --- | 45 T | SA | see standard for impact data |
| | | | | t ≤ 13.5 | --- | 210 | --- | 520-720 | --- | 45 T | SA | |
| | | | | t ≤ 75 | --- | 210 | --- | 520-720 | --- | 45 T | SA | |
| GB 3280-92 | Grade 0Cr18Ni9 | --- | --- | --- | --- | 205 | --- | 520 | --- | 40 | ST | 187 max. HB; 90 max. HRB |
| GB 4237-92 | Grade 0Cr18Ni9 | --- | --- | --- | --- | 205 | --- | 520 | --- | 40 | ST | 187 max. HB; 90 max. HRB |

Note: This section continued on next page.

**4.8 Austenitic Stainless Steels for Pressure Vessel Plates**

**4.8B Mechanical Properties of Austenitic Stainless Steels for Pressure Vessel Plates (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness / Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | % min. | | |
| GB 4238-92 | Grade 0Cr18Ni9 | --- | --- | --- | --- | 205 | --- | 520 | --- | 40 | ST | 187 max. HB; 90 max. HRB |
| ISO 9328-7:2004 | Grade X5CrNi18-9 | --- | --- | t ≤ 6 | --- | 230 | --- | 540-750 | --- | 45 T | SA | --- |
| | | | | t ≤ 12 | --- | 210 | --- | 520-720 | --- | 45 T | SA | see standard for |
| | | | | t ≤ 75 | --- | 210 | --- | 520-720 | --- | 45 T | SA | impact data |
| JIS G 4304:2012 | Symbol SUS304 | --- | --- | --- | --- | 205 | --- | 520 | --- | 40 | ST | 187 max. HBW; 90 max. HRBW; 200 max. HV |
| JIS G 4305:2012 | Symbol SUS304 | --- | --- | --- | --- | 205 | --- | 520 | --- | 40 | ST | 187 max. HBW; 90 max. HRBW; 200 max. HV |
| ASME SA-240/SA-240M | Type 304H | S30409 | --- | --- | --- | 205 | 30 | 515 | 75 | 40 | Q+SA | 201 max. HB; 92 max. HRB |
| ASTM A240/A240M-15a | Type 304H | S30409 | --- | --- | --- | 205 | 30 | 515 | 75 | 40 | SA | 201 max. HBW; 92 max. HRBW |
| EN 10028-7:2007 | X6CrNi18-10 | --- | 1.4948 | t ≤ 8 | --- | 230 | --- | 530-740 | --- | 45 T | SA | see standard for |
| | | | | t ≤ 13.5 | --- | 210 | --- | 510-710 | --- | 45 T | SA | impact data |
| | | | | t ≤ 75 | --- | 190 | --- | 510-710 | --- | 45 T | SA | |
| ISO 9328-7:2004 | Grade X6CrNi18-10 | --- | --- | t ≤ 6 | --- | 230 | --- | 530-740 | --- | 45 T | SA | --- |
| | | | | t ≤ 12 | --- | 210 | --- | 510-710 | --- | 45 T | SA | see standard for |
| | | | | t ≤ 75 | --- | 190 | --- | 510-710 | --- | 45 T | SA | impact data |

**4.8 Austenitic Stainless Steels for Pressure Vessel Plates**

**4.8B Mechanical Properties of Austenitic Stainless Steels for Pressure Vessel Plates (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness / Diameter mm | Section Thickness / Diameter in. | Yield Strength, min. MPa | Yield Strength, min. ksi | Tensile Strength, min. MPa | Tensile Strength, min. ksi | Elongation % min. | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ASME SA-240/SA-240M | Type 304L | S30403 | --- | --- | --- | 170 | 25 | 485 | 70 | 40 | Q+SA | 201 max. HB; 92 max. HRB |
| ASME SA-666 | Type 304L | S30403 | --- | --- | --- | 170 | 25 | 485 L | 70 L | 40 L | A | 201 max. HB; 92 max. HRB |
| ASTM A240/A240M-15a | Type 304L | S30403 | --- | --- | --- | 170 | 25 | 485 | 70 | 40 | SA | 201 max. HBW; 92 max. HRBW |
| ASTM A666-15 | Type 304L | S30403 | --- | --- | --- | 170 | 25 | 485 L | 70 L | 40 L | A | 201 max. HB; 92 max. HRB |
| EN 10028-7:2007 | X2CrNi19-11 | --- | 1.4306 | t ≤ 8 | --- | 220 | --- | 520-700 | --- | 45 T | SA | see standard for impact data |
| | | | | t ≤ 13.5 | --- | 200 | --- | 520-700 | --- | 45 T | SA | |
| | | | | t ≤ 75 | --- | 200 | --- | 500-700 | --- | 45 T | SA | |
| | X2CrNi18-9 | --- | 1.4307 | t ≤ 8 | --- | 220 | --- | 520-700 | --- | 45 T | SA | see standard for impact data |
| | | | | t ≤ 13.5 | --- | 200 | --- | 520-700 | --- | 45 T | SA | |
| | | | | t ≤ 75 | --- | 200 | --- | 500-700 | --- | 45 T | SA | |
| EN 10088-2:2014 | X2CrNi19-11 | --- | 1.4306 | t ≤ 8 | --- | 220 | --- | 520-700 | --- | 45 T | SA | see standard for impact data |
| | | | | t ≤ 13.5 | --- | 200 | --- | 520-700 | --- | 45 T | SA | |
| | | | | t ≤ 75 | --- | 200 | --- | 500-700 | --- | 45 T | SA | |
| | X2CrNi18-9 | --- | 1.4307 | t ≤ 8 | --- | 220 | --- | 520-700 | --- | 45 T | SA | see standard for impact data |
| | | | | t ≤ 13.5 | --- | 200 | --- | 520-700 | --- | 45 T | SA | |
| | | | | t ≤ 75 | --- | 200 | --- | 500-700 | --- | 45 T | SA | |
| GB 3280-92 | Grade 00Cr19Ni10 | --- | --- | --- | --- | 177 | --- | 480 | --- | 40 | ST | 187 max. HB; 90 max. HRB |
| | Grade 00Cr19Ni13Mo3 | --- | --- | --- | --- | 177 | --- | 480 | --- | 40 | ST | 187 max. HB; 90 max. HRB |
| GB 4237-92 | Grade 00Cr19Ni10 | --- | --- | --- | --- | 177 | --- | 480 | --- | 40 | ST | 187 min. HB; 90 max. HRB |
| ISO 9328-7:2004 | Grade X2CrNi18-9 | --- | --- | t ≤ 6 | --- | 220 | --- | 520-670 | --- | 45 T | SA | --- |
| | | | | t ≤ 12 | --- | 200 | --- | 520-670 | --- | 45 T | SA | see standard for impact data |
| | | | | t ≤ 75 | --- | 200 | --- | 500-650 | --- | 45 T | SA | |
| | Grade X2CrNi19-11 | --- | --- | t ≤ 6 | --- | 220 | --- | 520-670 | --- | 45 T | SA | --- |
| | | | | t ≤ 12 | --- | 200 | --- | 520-670 | --- | 45 T | SA | see standard for impact data |
| | | | | t ≤ 75 | --- | 200 | --- | 500-650 | --- | 45 T | SA | |
| JIS G 4304:2012 | Symbol SUS304L | --- | --- | --- | --- | 175 | --- | 480 | --- | 40 | ST | 187 max. HBW; 90 max. HRBW; 200 max. HV |
| JIS G 4305:2012 | Symbol SUS304L | --- | --- | --- | --- | 175 | --- | 480 | --- | 40 | ST | 187 max. HBW; 90 max. HRBW; 200 max. HV |

**4.8 Austenitic Stainless Steels for Pressure Vessel Plates**

**4.8B Mechanical Properties of Austenitic Stainless Steels for Pressure Vessel Plates (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness / Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation % min. | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | | | |
| ASME SA-240/SA-240M | Type 304N | S30451 | --- | --- | --- | 240 | 35 | 550 | 80 | 30 | Q+SA | 217 max. HB; 95 max. HRB |
| ASME SA-666 | Type 304N | S30451 | --- | --- | --- | 240 | 35 | 550 L | 80 L | 30 L | A | 217 max. HB; 95 max. HRB |
| ASTM A240/A240M-15a | Type 304N | S30451 | --- | --- | --- | 240 | 35 | 550 | 80 | 30 | SA | 217 max. HBW; 95 max. HRBW |
| ASTM A666-15 | Type 304N | S30451 | --- | --- | --- | 240 | 35 | 550 L | 80 L | 30 L | A | 217 max. HB; 95 max. HRB |
| EN 10028-7:2007 | X5CrNiN19-9 | --- | 1.4315 | t ≤ 8 | --- | 290 | --- | 550-750 | --- | 40 T | SA | see standard for impact data |
| | | | | t ≤ 13.5 | --- | 270 | --- | 550-750 | --- | 40 T | SA | |
| | | | | t ≤ 75 | --- | 270 | --- | 550-750 | --- | 40 T | SA | |
| EN 10088-2:2014 | X5CrNiN19-9 | --- | 1.4315 | t ≤ 8 | --- | 290 | --- | 500-750 | --- | 40 T | SA | see standard for impact data |
| | | | | t ≤ 13.5 | --- | 270 | --- | 500-750 | --- | 40 T | SA | |
| | | | | t ≤ 75 | --- | 270 | --- | 500-750 | --- | 40 T | SA | |
| GB 3280-92 | Grade 0Cr19Ni9N | --- | --- | --- | --- | 275 | --- | 550 | --- | 35 | ST | 217 max. HB; 95 max. HRB |
| GB 4237-92 | Grade 0Cr19Ni9N | --- | --- | --- | --- | 275 | --- | 550 | --- | 35 | ST | 217 max. HB; 95 max. HRB |
| ISO 9328-7:2004 | Grade X5CrNiN18-8 | --- | --- | t ≤ 6 | --- | 290 | --- | 550-750 | --- | 40 T | SA | --- |
| | | | | t ≤ 12 | --- | 270 | --- | 550-750 | --- | 40 T | SA | see standard for impact data |
| | | | | t ≤ 75 | --- | 270 | --- | 550-750 | --- | 40 T | SA | |
| JIS G 4304:2012 | Symbol SUS304N1 | --- | --- | --- | --- | 275 | --- | 550 | --- | 35 | ST | 217 max. HBW; 95 max. HRBW; 220 max. HV |
| JIS G 4305:2012 | Symbol SUS304N1 | --- | --- | --- | --- | 275 | --- | 550 | --- | 35 | ST | 217 max. HBW; 95 max. HRBW; 220 max. HV |

**4.8 Austenitic Stainless Steels for Pressure Vessel Plates**

**4.8B Mechanical Properties of Austenitic Stainless Steels for Pressure Vessel Plates (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness / Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation % min. | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | | | |
| ASME SA-240/SA-240M | Type 304LN | S30453 | --- | --- | --- | 205 | 30 | 515 | 75 | 40 | Q+SA | 217 max. HB; 95 max. HRB |
| ASME SA-666 | Type 304LN | S30453 | --- | --- | --- | 205 | 30 | 515 L | 75 L | 40 L | A | 217 max. HB; 95 max. HRB |
| ASTM A240/A240M-15a | Type 304LN | S30453 | --- | --- | --- | 205 | 30 | 515 | 75 | 40 | SA | 217 max. HBW; 95 max. HRBW |
| ASTM A666-15 | Type 304LN | S30453 | --- | --- | --- | 205 | 30 | 515 L | 75 L | 40 L | A | 217 max. HB; 95 max. HRB |
| EN 10028-7:2007 | X2CrNiN18-10 | --- | 1.4311 | t ≤ 8 | --- | 290 | --- | 550-750 | --- | 40 T | SA | see standard for impact data |
| | | | | t ≤ 13.5 | --- | 270 | --- | 550-750 | --- | 40 T | SA | |
| | | | | t ≤ 75 | --- | 270 | --- | 550-750 | --- | 40 T | SA | |
| EN 10088-2:2014 | X2CrNiN18-10 | --- | 1.4311 | t ≤ 8 | --- | 290 | --- | 550-750 | --- | 40 T | SA | see standard for impact data |
| | | | | t ≤ 13.5 | --- | 270 | --- | 550-750 | --- | 40 T | SA | |
| | | | | t ≤ 75 | --- | 270 | --- | 550-750 | --- | 40 T | SA | |
| GB 3280-92 | Grade 00Cr18Ni10N | --- | --- | --- | --- | 245 | --- | 550 | --- | 40 | ST | 217 max. HB; 95 max. HRB |
| GB 4237-92 | Grade 00Cr18Ni10N | --- | --- | --- | --- | 245 | --- | 550 | --- | 40 | ST | 217 max. HB; 95 max. HRB |
| ISO 9328-7:2004 | Grade X2CrNiN18-10 | --- | --- | t ≤ 6 | --- | 290 | --- | 550-750 | --- | 40 T | SA | --- |
| | | | | t ≤ 12 | --- | 270 | --- | 550-750 | --- | 40 T | SA | see standard for impact data |
| | | | | t ≤ 75 | --- | 270 | --- | 550-750 | --- | 40 T | SA | |
| JIS G 4304:2012 | Symbol SUS304LN | --- | --- | --- | --- | 245 | --- | 550 | --- | 40 | ST | 217 max. HBW; 95 max. HRBW; 220 max. HV |
| JIS G 4305:2012 | Symbol SUS304LN | --- | --- | --- | --- | 245 | --- | 550 | --- | 40 | ST | 217 max. HBW; 95 max. HRBW; 220 max. HV |

**4.8 Austenitic Stainless Steels for Pressure Vessel Plates**

**4.8B Mechanical Properties of Austenitic Stainless Steels for Pressure Vessel Plates (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness / Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | % min. | | |
| ASME SA-240/SA-240M | Type 309H | S30909 | --- | --- | --- | 205 | 30 | 515 | 75 | 40 | Q+SA | 217 max. HB; 95 max. HRB |
| ASTM A240/A240M-15a | Type 309H | S30909 | --- | --- | --- | 205 | 30 | 515 | 75 | 40 | SA | 217 max. HBW; 95 max. HRBW |
| EN 10028-7:2007 | X6CrNi23-13 | --- | 1.4950 | t ≤ 8 | --- | 220 | --- | 530-730 | --- | 35 T | SA | see standard for impact data |
| | | | | t ≤ 13.5 | --- | 200 | --- | 510-710 | --- | 35 T | SA | |
| | | | | t ≤ 75 | --- | 200 | --- | 510-710 | --- | 35 T | SA | |
| ISO 9328-7:2004 | Grade X6CrNi23-13 | --- | --- | t ≤ 6 | --- | 220 | --- | 530-730 | --- | 35 T | SA | --- |
| | | | | t ≤ 12 | --- | 200 | --- | 510-710 | --- | 35 T | SA | see standard for impact data |
| | | | | t ≤ 75 | --- | 200 | --- | 510-710 | --- | 35 T | SA | |
| ASME SA-240/SA-240M | Type 310H | S31009 | --- | --- | --- | 205 | 30 | 515 | 75 | 40 | Q+SA | 217 max. HB; 95 max. HRB |
| ASTM A240/A240M-15a | Type 310H | S31009 | --- | --- | --- | 205 | 30 | 515 | 75 | 40 | SA | 217 max. HBW; 95 max. HRBW |
| EN 10028-7:2007 | X6CrNi25-20 | --- | 1.4951 | t ≤ 8 | --- | 220 | --- | 530-730 | --- | 35 T | SA | see standard for impact data |
| | | | | t ≤ 13.5 | --- | 200 | --- | 510-710 | --- | 35 T | SA | |
| | | | | t ≤ 75 | --- | 200 | --- | 510-710 | --- | 35 T | SA | |
| ISO 9328-7:2004 | Grade X6CrNi25-20 | --- | --- | t ≤ 6 | --- | 220 | --- | 530-730 | --- | 35 T | SA | --- |
| | | | | t ≤ 12 | --- | 200 | --- | 510-710 | --- | 35 T | SA | see standard for impact data |
| | | | | t ≤ 75 | --- | 200 | --- | 510-710 | --- | 35 T | SA | |

**4.8 Austenitic Stainless Steels for Pressure Vessel Plates**

**4.8B Mechanical Properties of Austenitic Stainless Steels for Pressure Vessel Plates (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness / Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation % min. | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | | | |
| ASME SA-240/SA-240M | Type 316 | S31600 | --- | --- | --- | 205 | 30 | 515 | 75 | 40 | Q+SA | 217 max. HB; 95 max. HRB |
| ASME SA-666 | Type 316 | S31600 | --- | --- | --- | 205 | 30 | 515 L | 75 L | 40 L | A | 217 max. HB; 95 max. HRB |
| ASTM A240/A240M-15a | Type 316 | S31600 | --- | --- | --- | 205 | 30 | 515 | 75 | 40 | SA | 217 max. HBW; 95 max. HRBW |
| ASTM A666-15 | Type 316 | S31600 | --- | --- | --- | 205 | 30 | 515 L | 75 L | 40 L | A | 217 max. HB; 95 max. HRB |
| EN 10028-7:2007 | X5CrNiMo17-12-2 | --- | 1.4401 | t ≤ 8 | --- | 240 | --- | 530-680 | --- | 40 T | SA | see standard for impact data |
| | | | | t ≤ 13.5 | --- | 220 | --- | 530-680 | --- | 40 T | SA | |
| | | | | t ≤ 75 | --- | 220 | --- | 520-670 | --- | 45 T | SA | |
| | X3CrNiMo17-13-3 | --- | 1.4436 | t ≤ 8 | --- | 240 | --- | 550-700 | --- | 40 T | SA | see standard for impact data |
| | | | | t ≤ 13.5 | --- | 220 | --- | 550-700 | --- | 40 T | SA | |
| | | | | t ≤ 75 | --- | 220 | --- | 530-730 | --- | 40 T | SA | |
| EN 10088-2:2014 | X5CrNiMo17-12-2 | --- | 1.4401 | t ≤ 8 | --- | 240 | --- | 530-680 | --- | 40 T | SA | see standard for impact data |
| | | | | t ≤ 13.5 | --- | 220 | --- | 530-680 | --- | 40 T | SA | |
| | | | | t ≤ 75 | --- | 220 | --- | 520-670 | --- | 45 T | SA | |
| | X3CrNiMo17-13-3 | --- | 1.4436 | t ≤ 8 | --- | 240 | --- | 550-700 | --- | 40 T | SA | see standard for impact data |
| | | | | t ≤ 13.5 | --- | 220 | --- | 550-700 | --- | 40 T | SA | |
| | | | | t ≤ 75 | --- | 220 | --- | 530-730 | --- | 40 T | SA | |
| GB 3280-92 | Grade 0Cr17Ni12Mo2 | --- | --- | --- | --- | 205 | --- | 520 | --- | 40 | ST | 187 max. HB; 90 max. HRB |
| GB 4237-92 | Grade 0Cr17Ni12Mo2 | --- | --- | --- | --- | 205 | --- | 520 | --- | 40 | ST | 187 max. HB; 90 max. HRB |
| GB 4238-92 | Grade 0Cr17Ni12Mo2 | --- | --- | --- | --- | 205 | --- | 520 | --- | 40 | ST | 187 max. HB; 90 max. HRB |
| ISO 9328-7:2004 | Grade X3CrNiMo17-12-3 | --- | --- | t ≤ 6 | --- | 240 | --- | 550-700 | --- | 40 T | SA | --- |
| | | | | t ≤ 12 | --- | 220 | --- | 550-700 | --- | 40 T | SA | see standard for impact data |
| | | | | t ≤ 75 | --- | 220 | --- | 530-730 | --- | 40 T | SA | |
| | Grade X5CrNiMo17-12-2 | --- | --- | t ≤ 6 | --- | 240 | --- | 530-680 | --- | 40 T | SA | --- |
| | | | | t ≤ 12 | --- | 220 | --- | 530-680 | --- | 40 T | SA | see standard for impact data |
| | | | | t ≤ 75 | --- | 220 | --- | 520-670 | --- | 45 T | SA | |
| JIS G 4304:2012 | Symbol SUS316 | --- | --- | --- | --- | 205 | --- | 520 | --- | 40 | ST | 187 max. HBW; 90 max. HRBW; 200 max. HV |
| JIS G 4305:2012 | Symbol SUS316 | --- | --- | --- | --- | 205 | --- | 520 | --- | 40 | ST | 187 max. HBW; 90 max. HRBW; 200 max. HV |

**4.8 Austenitic Stainless Steels for Pressure Vessel Plates**

**4.8B Mechanical Properties of Austenitic Stainless Steels for Pressure Vessel Plates (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness / Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation % min. | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | | | |
| ASME SA-240/SA-240M | Type 316L | S31603 | --- | --- | --- | 170 | 25 | 485 | 70 | 40 | Q+SA | 217 max. HB; 95 max. HRB |
| ASME SA-666 | Type 316L | S31603 | --- | --- | --- | 170 | 25 | 485 L | 70 L | 40 L | A | 217 max. HB; 95 max. HRB |
| ASTM A240/A240M-15a | Type 316L | S31603 | --- | --- | --- | 170 | 25 | 485 | 70 | 40 | SA | 217 max. HBW; 95 max. HRBW |
| ASTM A666-15 | Type 316L | S31603 | --- | --- | --- | 170 | 25 | 485 L | 70 L | 40 L | A | 217 max. HB; 95 max. HRB |
| EN 10028-7:2007 | X2CrNiMo17-12-2 | --- | 1.4404 | t ≤ 8 | --- | 240 | --- | 530-680 | --- | 40 T | SA | see standard for impact data |
| | | | | t ≤ 13.5 | --- | 220 | --- | 530-680 | --- | 40 T | SA | |
| | | | | t ≤ 75 | --- | 220 | --- | 520-670 | --- | 45 T | SA | |
| | X2CrNiMo17-12-3 | --- | 1.4432 | t ≤ 8 | --- | 240 | --- | 550-700 | --- | 40 T | SA | see standard for impact data |
| | | | | t ≤ 13.5 | --- | 220 | --- | 550-700 | --- | 40 T | SA | |
| | | | | t ≤ 75 | --- | 220 | --- | 520-670 | --- | 45 T | SA | |
| | X2CrNiMo18-14-3 | --- | 1.4435 | t ≤ 8 | --- | 240 | --- | 550-700 | --- | 40 T | SA | see standard for impact data |
| | | | | t ≤ 13.5 | --- | 220 | --- | 550-700 | --- | 40 T | SA | |
| | | | | t ≤ 75 | --- | 220 | --- | 520-670 | --- | 45 T | SA | |
| EN 10088-2:2014 | X2CrNiMo17-12-2 | --- | 1.4404 | t ≤ 8 | --- | 240 | --- | 530-680 | --- | 40 T | SA | see standard for impact data |
| | | | | t ≤ 13.5 | --- | 220 | --- | 530-680 | --- | 40 T | SA | |
| | | | | t ≤ 75 | --- | 220 | --- | 520-670 | --- | 45 T | SA | |
| | X2CrNiMo17-12-3 | --- | 1.4432 | t ≤ 8 | --- | 240 | --- | 550-700 | --- | 40 T | SA | see standard for impact data |
| | | | | t ≤ 13.5 | --- | 220 | --- | 550-700 | --- | 40 T | SA | |
| | | | | t ≤ 75 | --- | 220 | --- | 520-670 | --- | 45 T | SA | |
| | X2CrNiMo18-14-3 | --- | 1.4435 | t ≤ 8 | --- | 240 | --- | 550-700 | --- | 40 T | SA | see standard for impact data |
| | | | | t ≤ 13.5 | --- | 220 | --- | 550-700 | --- | 40 T | SA | |
| | | | | t ≤ 75 | --- | 220 | --- | 520-670 | --- | 45 T | SA | |
| GB 3280-92 | Grade 00Cr17Ni14Mo2 | --- | --- | --- | --- | 177 | --- | 480 | --- | 40 | ST | 187 max. HB; 90 max. HRB |
| GB 4237-92 | Grade 00Cr17Ni14Mo2 | --- | --- | --- | --- | 177 | --- | 480 | --- | 40 | ST | 187 max. HB; 90 max. HRB |

Note: This section continued on next page.

**4.8 Austenitic Stainless Steels for Pressure Vessel Plates**

**4.8B Mechanical Properties of Austenitic Stainless Steels for Pressure Vessel Plates (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness / Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | % min. | | |
| ISO 9328-7:2004 | Grade X2CrNiMo17-12-2 | --- | --- | t ≤ 6 | --- | 240 | --- | 530-680 | --- | 40 T | SA | --- |
| | | | | t ≤ 12 | --- | 220 | --- | 530-680 | --- | 40 T | SA | see standard for impact data |
| | | | | t ≤ 75 | --- | 220 | --- | 520-670 | --- | 45 T | SA | |
| | Grade X2CrNiMo17-12-3 | --- | --- | t ≤ 6 | --- | 240 | --- | 550-700 | --- | 40 T | SA | --- |
| | | | | t ≤ 12 | --- | 220 | --- | 550-700 | --- | 40 T | SA | see standard for impact data |
| | | | | t ≤ 75 | --- | 220 | --- | 520-670 | --- | 45 T | SA | |
| | Grade X2CrNiMo18-14-3 | --- | --- | t ≤ 6 | --- | 240 | --- | 550-700 | --- | 40 T | SA | --- |
| | | | | t ≤ 12 | --- | 220 | --- | 550-700 | --- | 40 T | SA | see standard for impact data |
| | | | | t ≤ 75 | --- | 220 | --- | 520-670 | --- | 45 T | SA | |
| JIS G 4304:2012 | Symbol SUS316L | --- | --- | --- | --- | 175 | --- | 480 | --- | 40 | ST | 187 max. HBW; 90 max. HRBW; 200 max. HV |
| JIS G 4305:2012 | Symbol SUS316L | --- | --- | --- | --- | 175 | --- | 480 | --- | 40 | ST | 187 max. HBW; 90 max. HRBW; 200 max. HV |
| ASME SA-240/SA-240M | Type 316Ti | S31635 | --- | --- | --- | 205 | 30 | 515 | 75 | 40 | Q+SA | 217 max. HB; 95 max. HRB |
| ASTM A240/A240M-15a | Type 316Ti | S31635 | --- | --- | --- | 205 | 30 | 515 | 75 | 40 | SA | 217 max. HBW; 95 max. HRBW |
| EN 10028-7:2007 | X6CrNiMoTi17-12-2 | --- | 1.4571 | t ≤ 8 | --- | 240 | --- | 540-690 | --- | 40 T | SA | see standard for impact data |
| | | | | t ≤ 13.5 | --- | 220 | --- | 540-690 | --- | 40 T | SA | |
| | | | | t ≤ 75 | --- | 220 | --- | 520-670 | --- | 40 T | SA | |
| EN 10088-2:2014 | X6CrNiMoTi17-12-2 | --- | 1.4571 | t ≤ 8 | --- | 240 | --- | 540-690 | --- | 40 T | SA | see standard for impact data |
| | | | | t ≤ 13.5 | --- | 220 | --- | 540-690 | --- | 40 T | SA | |
| | | | | t ≤ 75 | --- | 220 | --- | 520-670 | --- | 40 T | SA | |
| GB 3280-92 | Grade 0Cr18Ni12Mo2Ti | --- | --- | --- | --- | 205 | --- | 530 | --- | 35 | ST | 187 max. HB; 90 max. HRB |
| GB 4237-92 | Grade 0Cr18Ni12Mo2Ti | --- | --- | --- | --- | 205 | --- | 530 | --- | 37 | ST | 187 max. HB; 90 max. HRB |
| ISO 9328-7:2004 | Grade X6CrNiMoTi17-12-2 | --- | --- | t ≤ 6 | --- | 240 | --- | 540-690 | --- | 40 T | SA | --- |
| | | | | t ≤ 12 | --- | 220 | --- | 540-690 | --- | 40 T | SA | see standard for impact data |
| | | | | t ≤ 75 | --- | 220 | --- | 520-670 | --- | 40 T | SA | |
| JIS G 4304:2012 | Symbol SUS316Ti | --- | --- | --- | --- | 205 | --- | 520 | --- | 40 | ST | 187 max. HBW; 90 max. HRBW; 200 max. HV |
| JIS G 4305:2012 | Symbol SUS316Ti | --- | --- | --- | --- | 205 | --- | 520 | --- | 40 | ST | 187 max. HBW; 90 max. HRBW; 200 max. HV |

**4.8 Austenitic Stainless Steels for Pressure Vessel Plates**

**4.8B Mechanical Properties of Austenitic Stainless Steels for Pressure Vessel Plates (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness / Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation % min. | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | | | |
| ASME SA-240/SA-240M | Type 316Cb | S31640 | --- | --- | --- | 205 | 30 | 515 | 75 | 30 | Q+SA | 217 max. HB; 95 max. HRB |
| ASTM A240/A240M-15a | Type 316Cb | S31640 | --- | --- | --- | 205 | 30 | 515 | 75 | 30 | SA | 217 max. HBW; 95 max. HRBW |
| EN 10028-7:2007 | X6CrNiMoNb17-12-2 | --- | 1.4580 | t ≤ 75 | --- | 220 | --- | 520-720 | --- | 40 T | SA | see standard for impact data |
| EN 10088-2:2014 | X6CrNiMoNb17-12-2 | --- | 1.4580 | t ≤ 75 | --- | 220 | --- | 520-720 | --- | 40 T | SA | see standard for impact data |
| ISO 9328-7:2004 | Grade X6CrNiMoNb17-12-2 | --- | --- | t ≤ 75 | --- | 220 | --- | 520-720 | --- | 40 T | SA | see standard for impact data |
| ASME SA-479/SA-479M | Type 316LN | S31653 | --- | --- | --- | 205 | 30 | 515 | 75 | 30 | A | --- |
| ASTM A479/A479M-14 | Type 316LN | S31653 | --- | --- | --- | 205 | 30 | 515 | 75 | 30 | SA | --- |
| EN 10028-7:2007 | X2CrNiMoN17-11-2 | --- | 1.4406 | t ≤ 8 | --- | 300 | --- | 580-780 | --- | 40 T | SA | see standard for impact data |
| | | | | t ≤ 13.5 | --- | 280 | --- | 580-780 | --- | 40 T | SA | |
| | | | | t ≤ 75 | --- | 280 | --- | 580-780 | --- | 40 T | SA | |
| | X2CrNiMoN17-13-3 | --- | 1.4429 | t ≤ 8 | --- | 300 | --- | 580-780 | --- | 35 T | SA | see standard for impact data |
| | | | | t ≤ 13.5 | --- | 280 | --- | 580-780 | --- | 35 T | SA | |
| | | | | t ≤ 75 | --- | 280 | --- | 580-780 | --- | 40 T | SA | |
| EN 10088-3:2014 | X2CrNiMoN17-11-2 | --- | 1.4406 | t ≤ 160 | --- | 280 | --- | 580-800 | --- | 40 L | SA | 250 max. HBW |
| | | | | 160 < t ≤ 250 | --- | 280 | --- | 580-800 | --- | 30 T | SA | 250 max. HBW |
| GB 3280-92 | Grade 00Cr17Ni13Mo2N | --- | --- | --- | --- | 245 | --- | 550 | --- | 40 | ST | 217 max. HB; 95 max. HRB |
| GB 4237-92 | Grade 00Cr17Ni13Mo2N | --- | --- | --- | --- | 245 | --- | 550 | --- | 40 | ST | 217 max. HB; 95 max. HRB |
| ISO 9328-7:2004 | Grade X2CrNiMoN17-11-2 | --- | --- | t ≤ 6 | --- | 300 | --- | 580-780 | --- | 40 T | SA | --- |
| | | | | t ≤ 12 | --- | 280 | --- | 580-780 | --- | 40 T | SA | see standard for impact data |
| | | | | t ≤ 75 | --- | 280 | --- | 580-780 | --- | 40 T | SA | |
| | Grade X2CrNiMoN17-13-3 | --- | --- | t ≤ 6 | --- | 300 | --- | 580-780 | --- | 35 T | SA | --- |
| | | | | t ≤ 12 | --- | 280 | --- | 580-780 | --- | 35 T | SA | see standard for impact data |
| | | | | t ≤ 75 | --- | 280 | --- | 580-780 | --- | 40 T | SA | |
| JIS G 4304:2012 | Symbol SUS316LN | --- | --- | --- | --- | 245 | --- | 550 | --- | 40 | ST | 217 max. HBW; 95 max. HRBW; 220 max. HV |
| JIS G 4305:2012 | Symbol SUS316LN | --- | --- | --- | --- | 245 | --- | 550 | --- | 40 | ST | 217 max. HBW; 95 max. HRBW; 220 max. HV |

**4.8 Austenitic Stainless Steels for Pressure Vessel Plates**

**4.8B Mechanical Properties of Austenitic Stainless Steels for Pressure Vessel Plates (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness / Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation % min. | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | | | |
| ASME SA-240/SA-240M | Type 317L | S31703 | --- | --- | --- | 205 | 30 | 515 | 75 | 40 | Q+SA | 217 max. HB; 95 max. HRB |
| ASTM A240/A240M-15a | Type 317L | S31703 | --- | --- | --- | 205 | 30 | 515 | 75 | 40 | SA | 217 max. HBW; 95 max. HRBW |
| EN 10028-7:2007 | X2CrNiMo18-15-4 | --- | 1.4438 | t ≤ 8 | --- | 240 | --- | 550-700 | --- | 35 T | SA | see standard for impact data |
| | | | | t ≤ 13.5 | --- | 220 | --- | 550-700 | --- | 35 T | SA | |
| | | | | t ≤ 75 | --- | 220 | --- | 520-720 | --- | 40 T | SA | |
| EN 10088-2:2014 | X2CrNiMo18-15-4 | --- | 1.4438 | t ≤ 8 | --- | 240 | --- | 550-700 | --- | 35 T | SA | see standard for impact data |
| | | | | t ≤ 13.5 | --- | 220 | --- | 550-700 | --- | 35 T | SA | |
| | | | | t ≤ 75 | --- | 220 | --- | 520-720 | --- | 40 T | SA | |
| GB 4237-92 | Grade 00Cr19Ni13Mo3 | --- | --- | --- | --- | 177 | --- | 480 | --- | 35 | ST | 187 max. HB; 90 max. HRB |
| ISO 9328-7:2004 | Grade X2CrNiMo18-15-4 | --- | --- | t ≤ 6 | --- | 240 | --- | 550-700 | --- | 35 T | SA | --- |
| | | | | t ≤ 12 | --- | 220 | --- | 550-700 | --- | 35 T | SA | see standard for impact data |
| | | | | t ≤ 75 | --- | 220 | --- | 520-720 | --- | 40 T | SA | |
| JIS G 4304:2012 | Symbol SUS317L | --- | --- | --- | --- | 175 | --- | 480 | --- | 40 | ST | 187 max. HBW; 90 max. HRBW; 200 max. HV |
| JIS G 4305:2012 | Symbol SUS317L | --- | --- | --- | --- | 175 | --- | 480 | --- | 40 | ST | 187 max. HBW; 90 max. HRBW; 200 max. HV |
| ASME SA-240/SA-240M | Type 317LN | S31753 | --- | --- | --- | 240 | 35 | 550 | 80 | 40 | Q+SA | 217 max. HB; 95 max. HRB |
| ASTM A240/A240M-15a | Type 317LN | S31753 | --- | --- | --- | 240 | 35 | 550 | 80 | 40 | SA | 217 max. HBW; 95 max. HRBW |
| EN 10028-7:2007 | X2CrNiMoN18-12-4 | --- | 1.4434 | t ≤ 8 | --- | 290 | --- | 570-770 | --- | 35 T | SA | see standard for impact data |
| | | | | t ≤ 13.5 | --- | 270 | --- | 570-770 | --- | 35 T | SA | |
| | | | | t ≤ 75 | --- | 270 | --- | 540-740 | --- | 40 T | SA | |
| EN 10088-2:2014 | X2CrNiMoN18-12-4 | --- | 1.4434 | t ≤ 8 | --- | 290 | --- | 570-770 | --- | 35 T | SA | see standard for impact data |
| | | | | t ≤ 13.5 | --- | 270 | --- | 570-770 | --- | 35 T | SA | |
| | | | | t ≤ 75 | --- | 270 | --- | 540-740 | --- | 40 T | SA | |
| ISO 9328-7:2004 | Grade X2CrNiMoN18-12-4 | --- | --- | t ≤ 6 | --- | 290 | --- | 570-770 | --- | 35 T | SA | --- |
| | | | | t ≤ 12 | --- | 270 | --- | 570-770 | --- | 35 T | SA | see standard for impact data |
| | | | | t ≤ 75 | --- | 270 | --- | 540-740 | --- | 40 T | SA | |
| JIS G 4304:2012 | Symbol SUS317LN | --- | --- | --- | --- | 245 | --- | 550 | --- | 40 | ST | 217 max. HBW; 95 max. HRBW; 220 max. HV |
| JIS G 4305:2012 | Symbol SUS317LN | --- | --- | --- | --- | 245 | --- | 550 | --- | 40 | ST | 217 max. HBW; 95 max. HRBW; 220 max. HV |

**4.8 Austenitic Stainless Steels for Pressure Vessel Plates**

**4.8B Mechanical Properties of Austenitic Stainless Steels for Pressure Vessel Plates (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness / Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation % min. | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | | | |
| ASME SA-240/SA-240M | Type 317LMN | S31726 | --- | --- | --- | 240 | 35 | 550 | 80 | 40 | Q+SA | 223 max. HB; 96 max. HRB |
| ASTM A240/A240M-15a | Type 317LMN | S31726 | --- | --- | --- | 240 | 35 | 550 | 80 | 40 | SA | 223 max. HBW; 96 max. HRBW |
| EN 10028-7:2007 | X2CrNiMoN17-13-5 | --- | 1.4439 | t ≤ 8 | --- | 290 | --- | 580-780 | --- | 35 T | SA | see standard for impact data |
| | | | | t ≤ 13.5 | --- | 270 | --- | 580-780 | --- | 35 T | SA | |
| | | | | t ≤ 75 | --- | 270 | --- | 580-780 | --- | 40 T | SA | |
| EN 10088-2:2014 | X2CrNiMoN17-13-5 | --- | 1.4439 | t ≤ 8 | --- | 290 | --- | 580-780 | --- | 35 T | SA | see standard for impact data |
| | | | | t ≤ 13.5 | --- | 270 | --- | 580-780 | --- | 35 T | SA | |
| | | | | t ≤ 75 | --- | 270 | --- | 580-780 | --- | 40 T | SA | |
| ISO 9328-7:2004 | Grade X2CrNiMoN17-13-5 | --- | --- | t ≤ 6 | --- | 290 | --- | 580-780 | --- | 35 T | SA | --- |
| | | | | t ≤ 12 | --- | 270 | --- | 580-780 | --- | 35 T | SA | see standard for impact data |
| | | | | t ≤ 75 | --- | 270 | --- | 580-780 | --- | 40 T | SA | |
| ASME SA-240/SA-240M | Type 321 | S32100 | --- | --- | --- | 205 | 30 | 515 | 75 | 40 | Q+SA | 217 max. HB; 95 max. HRB |
| ASTM A240/A240M-15a | Type 321 | S32100 | --- | --- | --- | 205 | 30 | 515 | 75 | 40 | SA | 217 max. HBW; 95 max. HRBW |
| EN 10028-7:2007 | X6CrNiTi18-10 | --- | 1.4541 | t ≤ 8 | --- | 220 | --- | 520-720 | --- | 40 T | SA | see standard for impact data |
| | | | | t ≤ 13.5 | --- | 200 | --- | 520-720 | --- | 40 T | SA | |
| | | | | t ≤ 75 | --- | 200 | --- | 500-700 | --- | 40 T | SA | |
| EN 10088-2:2014 | X6CrNiTi18-10 | --- | 1.4541 | t ≤ 8 | --- | 220 | --- | 520-720 | --- | 40 T | SA | --- |
| | | | | t ≤ 13.5 | --- | 200 | --- | 520-720 | --- | 40 T | SA | see standard for impact data |
| | | | | t ≤ 75 | --- | 200 | --- | 500-700 | --- | 40 T | SA | |
| GB 3280-92 | Grade 0Cr18Ni10Ti | --- | --- | --- | --- | 205 | --- | 520 | --- | 40 | ST | 187 max. HB; 90 max. HRB |
| GB 4237-92 | Grade 0Cr18Ni10Ti | --- | --- | --- | --- | 205 | --- | 520 | --- | 40 | ST | 187 max. HB; 90 max. HRB |
| GB 4238-92 | Grade 0Cr18Ni10Ti | --- | --- | --- | --- | 205 max. | --- | 520 | --- | 40 | ST | 187 max. HB; 90 max. HRB |
| ISO 9328-7:2004 | Grade X6CrNiTi18-10 | --- | --- | t ≤ 6 | --- | 220 | --- | 520-720 | --- | 40 T | SA | --- |
| | | | | t ≤ 12 | --- | 200 | --- | 520-720 | --- | 40 T | SA | see standard for impact data |
| | | | | t ≤ 75 | --- | 200 | --- | 500-700 | --- | 40 T | SA | |
| JIS G 4304:2012 | Symbol SUS321 | --- | --- | --- | --- | 205 | --- | 520 | --- | 40 | ST | 187 max. HBW; 90 max. HRBW; 200 max. HV |
| JIS G 4305:2012 | Symbol SUS321 | --- | --- | --- | --- | 205 | --- | 520 | --- | 40 | ST | 187 max. HBW; 90 max. HRBW; 200 max. HV |

**4.8 Austenitic Stainless Steels for Pressure Vessel Plates**

**4.8B Mechanical Properties of Austenitic Stainless Steels for Pressure Vessel Plates (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness / Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | % min. | | |
| ASME SA-240/SA-240M | Type 347 | S34700 | --- | --- | --- | 205 | 30 | 515 | 75 | 40 | Q+SA | 201 max. HB; 92 max. HRB |
| ASTM A240/A240M-15a | Type 347 | S34700 | --- | --- | --- | 205 | 30 | 515 | 75 | 40 | SA | 201 max. HBW; 92 max. HRBW |
| EN 10028-7:2007 | X6CrNiNb18-10 | --- | 1.4550 | t ≤ 13.5 | --- | 200 | --- | 520-720 | --- | 40 T | SA | see standard for |
| | | | | t ≤ 75 | --- | 200 | --- | 500-700 | --- | 40 T | SA | impact data |
| EN 10088-2:2014 | X6CrNiNb18-10 | --- | 1.4550 | t ≤ 8 | --- | 220 | --- | 520-720 | --- | 40 T | SA | see standard for |
| | | | | t ≤ 13.5 | --- | 200 | --- | 520-720 | --- | 40 T | SA | impact data |
| | | | | t ≤ 75 | --- | 200 | --- | 500-700 | --- | 40 T | SA | |
| GB 3280-92 | Grade 0Cr18Ni11Nb | --- | --- | --- | --- | 205 | --- | 520 | --- | 40 | ST | 187 max. HB; 90 max. HRB |
| GB 4237-92 | Grade 0Cr18Ni11Nb | --- | --- | --- | --- | 205 | --- | 520 | --- | 40 | ST | 187 max. HB; 90 max. HRB |
| GB 4238-92 | Grade 0Cr18Ni11Nb | --- | --- | --- | --- | 205 | --- | 520 | --- | 40 | ST | 187 max. HB; 90 max. HRB |
| ISO 9328-7:2004 | Grade X6CrNiNb18-10 | --- | --- | t ≤ 75 | --- | 200 | --- | 500-700 | --- | 40 T | SA | see standard for impact data |
| JIS G 4304:2012 | Symbol SUS347 | --- | --- | --- | --- | 205 | --- | 520 | --- | 40 | ST | 187 max. HBW; 90 max. HRBW; 200 max. HV |
| JIS G 4305:2012 | Symbol SUS347 | --- | --- | --- | --- | 205 | --- | 520 | --- | 40 | ST | 187 max. HBW; 90 max. HRBW; 200 max. HV |
| ASME SA-240/SA-240M | Type 904L | N08904 | --- | --- | --- | 220 | 31 | 490 | 71 | 35 | Q+SA | 90 max. HRB |
| ASTM A240/A240M-15a | Type 904L | N08904 | --- | --- | --- | 220 | 31 | 490 | 71 | 35 | SA | 90 max. HRBW |
| EN 10028-7:2007 | X1NiCrMoCu25-20-5 | --- | 1.4539 | t ≤ 8 | --- | 240 | --- | 530-730 | --- | 35 T | SA | see standard for |
| | | | | t ≤ 13.5 | --- | 220 | --- | 530-730 | --- | 35 T | SA | impact data |
| | | | | t ≤ 75 | --- | 220 | --- | 520-720 | --- | 35 T | SA | |
| EN 10088-2:2014 | X1NiCrMoCu25-20-5 | --- | 1.4539 | t ≤ 8 | --- | 240 | --- | 530-730 | --- | 35 T | SA | see standard for |
| | | | | t ≤ 13.5 | --- | 220 | --- | 530-730 | --- | 35 T | SA | impact data |
| | | | | t ≤ 75 | --- | 220 | --- | 520-720 | --- | 35 T | SA | |
| ISO 9328-7:2004 | Grade X1NiCrMoCu25-20-5 | --- | --- | t ≤ 6 | --- | 240 | --- | 530-730 | --- | 35 T | SA | --- |
| | | | | t ≤ 12 | --- | 220 | --- | 530-730 | --- | 35 T | SA | see standard for |
| | | | | t ≤ 75 | --- | 220 | --- | 520-720 | --- | 35 T | SA | impact data |
| JIS G 4304:2012 | Symbol SUS890L | --- | --- | --- | --- | 215 | --- | 490 | --- | 35 | ST | 187 max. HBW; 90 max. HRBW; 200 max. HV |
| JIS G 4305:2012 | Symbol SUS890L | --- | --- | --- | --- | 215 | --- | 490 | --- | 35 | ST | 187 max. HBW; 90 max. HRBW; 200 max. HV |

**4.8 Austenitic Stainless Steels for Pressure Vessel Plates**

**4.8B Mechanical Properties of Austenitic Stainless Steels for Pressure Vessel Plates (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness / Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation % min. | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | | | |
| ASME SA-240/SA-240M | --- | N08367 | --- | --- | --- | 310 | 45 | 655 | 95 | 30 | Q+SA | 241 max. HB |
| | | | | --- | --- | 310 | 45 | 690 | 100 | 30 | Q+SA | 100 max. HRB |
| | | N08926 | --- | --- | --- | 295 | 43 | 650 | 94 | 35 | Q+SA | --- |
| | | S31277 | --- | --- | --- | 360 | 52 | 770 | 112 | 40 | Q+SA | --- |
| ASTM A240/A240M-15a | --- | N08367 | --- | --- | --- | 310 | 45 | 655 | 95 | 30 | SA | 241 max. HBW |
| | | | | --- | --- | 310 | 45 | 690 | 100 | 30 | SA | 100 max. HRBW |
| | | N08926 | --- | --- | --- | 295 | 43 | 650 | 94 | 35 | SA | --- |
| | | S31277 | --- | --- | --- | 360 | 52 | 770 | 112 | 40 | SA | --- |
| EN 10028-7:2007 | X1NiCrMoCuN25-20-7 | --- | 1.4529 | t ≤ 75 | --- | 300 | --- | 650-850 | --- | 40 T | SA | see standard for impact data |
| EN 10088-2:2014 | X1NiCrMoCuN25-20-7 | --- | 1.4529 | t ≤ 75 | --- | 300 | --- | 650-850 | --- | 40 T | SA | see standard for impact data |
| ISO 9328-7:2004 | Grade X1NiCrMoCuN25-20-7 | --- | --- | t ≤ 75 | --- | 300 | --- | 650-850 | --- | 40 T | SA | see standard for impact data |
| JIS G 4304:2012 | Symbol SUS836L | --- | --- | --- | --- | 275 | --- | 640 | --- | 40 | ST | 217 max. HBW; 96 max. HRBW; 230 max. HV |
| JIS G 4305:2012 | Symbol SUS836L | --- | --- | --- | --- | 275 | --- | 640 | --- | 40 | ST | 217 max. HBW; 96 max. HRBW; 230 max. HV |
| ASME SA-240/SA-240M | Type 800H | N08810 | --- | --- | --- | 170 | 25 | 450 | 65 | 30 | Q+SA | --- |
| ASTM A240/A240M-15a | Type 800H | N08810 | --- | --- | --- | 170 | 25 | 450 | 65 | 30 | SA | --- |
| EN 10028-7:2007 | X8NiCrAlTi32-21 | --- | 1.4959 | t ≤ 75 | --- | 170 | --- | 500-750 | --- | 30 T | SA | see standard for impact data |
| ISO 9328-7:2004 | Grade X8NiCrAlTi32-21 | --- | --- | t ≤ 75 | --- | 170 | --- | 500-750 | --- | 30 T | SA | see standard for impact data |

### 4.9 Duplex (Ferritic-Austenitic) Stainless Steels for Pressure Vessel Plates

### 4.9A Chemical Composition of Duplex (Ferritic-Austenitic) Stainless Steels for Pressure Vessel Plates

| Specification | Designation | UNS No | Steel No | Weight, %, max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASME SA-240/SA-240M | Type 2205 | S32205 | --- | 0.030 | 2.00 | 1.00 | 0.030 | 0.020 | 22.0-23.0 | 4.5-6.5 | 3.0-3.5 | N 0.14-0.20 |
| ASTM A240/A240M-15a | --- | S31803 | --- | 0.030 | 2.00 | 1.00 | 0.030 | 0.020 | 21.0-23.0 | 4.5-6.5 | 2.5-3.5 | N 0.08-0.20 |
| | Type 2205 | S32205 | --- | 0.030 | 2.00 | 1.00 | 0.030 | 0.020 | 22.0-23.0 | 4.5-6.5 | 3.0-3.5 | N 0.14-0.20 |
| EN 10028-7:2007 | X2CrNiMoN22-5-3 | --- | 1.4462 | 0.030 | 2.00 | 1.00 | 0.035 | 0.015 | 21.0-23.0 | 4.5-6.5 | 2.50-3.5 | N 0.10-0.22 |
| EN 10088-2:2014 | X2CrNiMoN22-5-3 | --- | 1.4462 | 0.030 | 2.00 | 1.00 | 0.035 | 0.015 | 21.0-23.0 | 4.5-6.5 | 2.50-3.5 | N 0.10-0.22 |
| ISO 9328-7:2004 | Grade X2CrNiMoN22-5-3 | --- | --- | 0.030 | 2.00 | 1.00 | 0.035 | 0.015 | 21.0-23.0 | 4.5-6.5 | 2.5-3.5 | N 0.10-0.22 |
| JIS G 4304:2012 | Symbol SUS329J3L | --- | --- | 0.030 | 2.00 | 1.00 | 0.040 | 0.030 | 21.00-24.00 | 4.50-6.50 | 2.50-3.50 | N 0.08-0.20 |
| JIS G 4305:2012 | Symbol SUS329J3L | --- | --- | 0.030 | 2.00 | 1.00 | 0.040 | 0.030 | 21.00-24.00 | 4.50-6.50 | 2.50-3.50 | N 0.08-0.20 |
| ASME SA-240/SA-240M | Type 2304 | S32304 | --- | 0.030 | 2.50 | 1.00 | 0.040 | 0.030 | 21.5-24.5 | 3.0-5.5 | 0.05-0.60 | Cu 0.05-0.60; N 0.05-0.20 |
| ASTM A240/A240M-15a | Type 2304 | S32304 | --- | 0.030 | 2.50 | 1.00 | 0.040 | 0.030 | 21.5-24.5 | 3.0-5.5 | 0.05-0.60 | Cu 0.05-0.60; N 0.05-0.20 |
| EN 10028-7:2007 | X2CrNiN23-4 | --- | 1.4362 | 0.030 | 2.00 | 1.00 | 0.035 | 0.015 | 22.0-24.0 | 3.5-5.5 | 0.10-0.60 | Cu 0.10-0.60; N 0.05-0.20 |
| EN 10088-2:2014 | X2CrNiN23-4 | --- | 1.4362 | 0.030 | 2.00 | 1.00 | 0.035 | 0.015 | 22.0-24.5 | 3.5-5.5 | 0.10-0.60 | Cu 0.10-0.60; N 0.05-0.20 |
| ISO 9328-7:2004 | Grade X2CrNiN23-4 | --- | --- | 0.030 | 2.00 | 1.00 | 0.035 | 0.015 | 22.0-24.0 | 3.5-5.5 | 0.10-0.60 | Cu 0.10-0.60; N 0.05-0.20 |
| ASME SA-240/SA-240M | --- | S32520 | --- | 0.030 | 1.50 | 0.80 | 0.035 | 0.020 | 24.0-26.0 | 5.5-8.0 | 3.0-4.0 | Cu 0.50-2.00; N 0.20-0.35 |
| ASTM A240/A240M-15a | --- | S32520 | --- | 0.030 | 1.50 | 0.80 | 0.035 | 0.020 | 24.0-26.0 | 5.5-8.0 | 3.0-4.0 | Cu 0.50-2.00; N 0.20-0.35 |
| EN 10028-7:2007 | X2CrNiMoCuN25-6-3 | --- | 1.4507 | 0.030 | 2.00 | 0.70 | 0.035 | 0.015 | 24.0-26.0 | 6.0-8.0 | 3.0-4.0 | Cu 1.00-2.50; N 0.20-0.30 |
| EN 10088-2:2014 | X2CrNiMoCuN25-6-3 | --- | 1.4507 | 0.030 | 2.00 | 0.70 | 0.035 | 0.015 | 24.0-26.0 | 6.0-8.0 | 3.0-4.0 | Cu 1.00-2.50; N 0.20-0.30 |
| ISO 9328-7:2004 | Grade X2CrNiMoCuN25-6-3 | --- | --- | 0.030 | 2.00 | 0.70 | 0.035 | 0.015 | 24.0-26.0 | 5.0-7.5 | 2.5-4.0 | Cu 1.00-2.50; N 0.15-0.30 |
| ASME SA-240/SA-240M | Type 2507 | S32750 | --- | 0.030 | 1.20 | 0.80 | 0.035 | 0.020 | 24.0-26.0 | 6.0-8.0 | 3.0-5.0 | Cu 0.50; N 0.24-0.32 |
| ASTM A240/A240M-15a | Type 2507 | S32750 | --- | 0.030 | 1.20 | 0.80 | 0.035 | 0.020 | 24.0-26.0 | 6.0-8.0 | 3.0-5.0 | Cu 0.50; N 0.24-0.32 |
| EN 10028-7:2007 | X2CrNiMoN25-7-4 | --- | 1.4410 | 0.030 | 2.00 | 1.00 | 0.035 | 0.015 | 24.0-26.0 | 6.0-8.0 | 3.0-4.5 | N 0.24-0.35 |
| EN 10088-2:2014 | X2CrNiMoN25-7-4 | --- | 1.4410 | 0.030 | 2.00 | 1.00 | 0.035 | 0.015 | 24.0-26.0 | 6.0-8.0 | 3.0-4.5 | N 0.24-0.35 |
| ISO 9328-7:2004 | Grade X2CrNiMoN25-7-4 | --- | --- | 0.030 | 2.00 | 1.00 | 0.035 | 0.015 | 24.0-26.0 | 6.0-8.0 | 3.0-4.5 | N 0.24-0.35 |
| ASME SA-240/SA-240M | --- | S32760 | --- | 0.030 | 1.00 | 1.00 | 0.030 | 0.010 | 24.0-26.0 | 6.0-8.0 | 3.0-4.0 | Cu 0.50-1.00; W 0.50-1.00; N 0.20-0.30; [Cr+(3.3xMo)+(16xN)] = 40 min. |
| ASTM A240/A240M-15a | --- | S32760 | --- | 0.030 | 1.00 | 1.00 | 0.030 | 0.010 | 24.0-26.0 | 6.0-8.0 | 3.0-4.0 | Cu 0.50-1.00; W 0.50-1.00; N 0.20-0.30; [Cr+(3.3xMo)+(16xN)] = 40 min. |
| EN 10028-7:2007 | X2CrNiMoCuWN25-7-4 | --- | 1.4501 | 0.030 | 1.00 | 1.00 | 0.035 | 0.015 | 24.0-26.0 | 6.0-8.0 | 3.0-4.0 | Cu 0.50-1.00; W 0.50-1.00; N 0.20-0.30 |
| EN 10088-2:2014 | X2CrNiMoCuWN25-7-4 | --- | 1.4501 | 0.030 | 1.00 | 1.00 | 0.035 | 0.015 | 24.0-26.0 | 6.0-8.0 | 3.0-4.0 | Cu 0.50-1.00; W 0.50-1.00; N 0.20-0.30 |
| ISO 9328-7:2004 | Grade X2CrNiMoCuWN25-7-4 | --- | --- | 0.030 | 1.00 | 1.00 | 0.035 | 0.015 | 24.0-26.0 | 6.0-8.0 | 3.0-4.0 | Cu 0.50-1.00; W 0.50-1.00; N 0.20-0.30 |

**4.9 Duplex Stainless Steels for Pressure Vessel Plates**

**4.9B Mechanical Properties of Duplex (Ferritic-Austenitic) Stainless Steels for Pressure Vessel Plates**

| Specification | Designation | UNS No. | Steel No. | Section Thickness / Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | % min. | | |
| ASME SA-240/SA-240M | Type 2205 | S32205 | --- | --- | --- | 450 | 65 | 655 | 95 | 25 | Q+SA | 293 max. HB; 31 max. HRC |
| ASTM A240/A240M-15a | --- | S31803 | --- | --- | --- | 450 | 65 | 620 | 90 | 25 | SA | 293 max. HBW; 31 max. HRC |
| | Type 2205 | S32205 | --- | --- | --- | 450 | 65 | 655 | 95 | 25 | SA | 293 max. HBW; 31 max. HRC |
| EN 10028-7:2007 | X2CrNiMoN22-5-3 | --- | 1.4462 | t ≤ 8 | --- | 485 | --- | 700-950 | --- | 20 L, 20 T | SA | see standard for impact data |
| | | | | t ≤ 13.5 | --- | 445 | --- | 700-950 | --- | 25 L, 25 T | SA | |
| | | | | t ≤ 75 | --- | 445 | --- | 640-480 | --- | 25 L, 25 T | SA | |
| EN 10088-2:2014 | X2CrNiMoN22-5-3 | --- | 1.4462 | t ≤ 8 | --- | 500 | --- | 700-950 | --- | 20 L, 20 T | SA | see standard for impact data |
| | | | | t ≤ 13.5 | --- | 460 | --- | 700-950 | --- | 25 L, 25 T | SA | |
| | | | | t ≤ 75 | --- | 460 | --- | 640-840 | --- | 25 L, 25 T | SA | |
| ISO 9328-7:2004 | Grade X2CrNiMoN22-5-3 | --- | --- | t ≤ 6 | --- | 465 | --- | 660-950 | --- | 20 L, 20 T | SA | --- |
| | | | | t ≤ 12 | --- | 445 | --- | 660-950 | --- | 25 L, 25 T | SA | see standard for impact data |
| | | | | t ≤ 75 | --- | 445 | --- | 640-840 | --- | 25 L, 25 T | SA | |
| JIS G 4304:2012 | Symbol SUS329J3L | --- | --- | --- | --- | 450 | --- | 620 | --- | 18 | ST | 302 max. HBW; 32 max. HRC; 320 max. HV |
| JIS G 4305:2012 | Symbol SUS329J3L | --- | --- | --- | --- | 450 | --- | 620 | --- | 18 | ST | 302 max. HBW; 32 max. HRC; 320 max. HV |
| ASME SA-240/SA-240M | Type 2304 | S32304 | --- | --- | --- | 400 | 58 | 600 | 87 | 25 | Q+SA | 290 max. HB; 32 max. HRC |
| ASTM A240/A240M-15a | Type 2304 | S32304 | --- | --- | --- | 400 | 58 | 600 | 87 | 25 | SA | 290 max. HBW; 32 max. HRC |
| EN 10028-7:2007 | X2CrNiN23-4 | --- | 1.4362 | t ≤ 8 | --- | 405 | --- | 600-850 | --- | 20 L, 20 T | SA | see standard for impact data |
| | | | | t ≤ 13.5 | --- | 385 | --- | 600-850 | --- | 20 L, 20 T | SA | |
| | | | | t ≤ 50 | --- | 385 | --- | 630-800 | --- | 25 L, 25 T | SA | |
| EN 10088-2:2014 | X2CrNiN23-4 | --- | 1.4362 | t ≤ 8 | --- | 450 | --- | 650-850 | --- | 20 L, 20 T | SA | see standard for impact data |
| | | | | t ≤ 13.5 | --- | 400 | --- | 650-850 | --- | 20 L, 20 T | SA | |
| | | | | t ≤ 75 | --- | 400 | --- | 630-800 | --- | 25 L, 25 T | SA | |
| ISO 9328-7:2004 | Grade X2CrNiN23-4 | --- | --- | t ≤ 6 | --- | 405 | --- | 600-850 | --- | 20 L, 20 T | SA | --- |
| | | | | t ≤ 12 | --- | 385 | --- | 600-850 | --- | 20 L, 20 T | SA | see standard for impact data |
| | | | | t ≤ 75 | --- | 385 | --- | 630-800 | --- | 25 L, 25 T | SA | |

**4.9 Duplex Stainless Steels for Pressure Vessel Plates**

**4.9B Mechanical Properties of Duplex (Ferritic-Austenitic) Stainless Steels for Pressure Vessel Plates (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness / Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | % min. | | |
| ASME SA-240/SA-240M | --- | S32520 | --- | --- | --- | 550 | 80 | 770 | 112 | 25 | Q+SA | 310 max. HB |
| ASTM A240/A240M-15a | --- | S32520 | --- | --- | --- | 550 | 80 | 770 | 112 | 25 | SA | 310 max. HBW; 32 max. HRC |
| EN 10028-7:2007 | X2CrNiMoCuN25-6-3 | --- | 1.4507 | t ≤ 8 | --- | 495 | --- | 690-940 | --- | 20 L, 20 T | SA | see standard for impact data |
| | | | | t ≤ 13.5 | --- | 475 | --- | 690-940 | --- | 20 L, 20 T | SA | |
| | | | | t ≤ 50 | --- | 475 | --- | 690-890 | --- | 25 L, 25 T | SA | |
| EN 10088-2:2014 | X2CrNiMoCuN25-6-3 | --- | 1.4507 | t ≤ 8 | --- | 550 | --- | 750-1000 | --- | 20 L, 20 T | SA | see standard for impact data |
| | | | | t ≤ 13.5 | --- | 530 | --- | 750-1000 | --- | 20 L, 20 T | SA | |
| | | | | t ≤ 75 | --- | 530 | --- | 730-930 | --- | 25 L, 25 T | SA | |
| ISO 9328-7:2004 | Grade X2CrNiMoCuN25-6-3 | --- | --- | t ≤ 6 | --- | 495 | --- | 690-940 | --- | 20 L, 20 T | SA | --- |
| | | | | t ≤ 12 | --- | 475 | --- | 690-940 | --- | 20 L, 20 T | SA | see standard for impact data |
| | | | | t ≤ 75 | --- | 475 | --- | 690-890 | --- | 25 L, 25 T | SA | |
| ASME SA-240/SA-240M | Type 2507 | S32750 | --- | --- | --- | 550 | 80 | 795 | 116 | 15 | Q+SA | 310 max. HB; 32 max. HRC |
| ASTM A240/A240M-15a | Type 2507 | S32750 | --- | --- | --- | 550 | 80 | 795 | 116 | 15 | SA | 310 max. HBW; 32 max. HRC |
| EN 10028-7:2007 | X2CrNiMoN25-7-4 | --- | 1.4410 | t ≤ 8 | --- | 535 | --- | 750-1000 | --- | 20 L, 20 T | SA | see standard for impact data |
| | | | | t ≤ 13.5 | --- | 515 | --- | 750-1000 | --- | 20 L, 20 T | SA | |
| | | | | t ≤ 50 | --- | 515 | --- | 730-930 | --- | 20 L, 20 T | SA | |
| EN 10088-2:2014 | X2CrNiMoN25-7-4 | --- | 1.4410 | t ≤ 8 | --- | 550 | --- | 750-1000 | --- | 20 L, 20 T | SA | see standard for impact data |
| | | | | t ≤ 13.5 | --- | 530 | --- | 750-1000 | --- | 20 L, 20 T | SA | |
| | | | | t ≤ 75 | --- | 530 | --- | 730-930 | --- | 20 L, 20 T | SA | |
| ISO 9328-7:2004 | Grade X2CrNiMoN25-7-4 | --- | --- | t ≤ 6 | --- | 535 | --- | 750-1000 | --- | 20 L, 20 T | SA | --- |
| | | | | t ≤ 12 | --- | 515 | --- | 750-1000 | --- | 20 L, 20 T | SA | see standard for impact data |
| | | | | t ≤ 75 | --- | 515 | --- | 730-930 | --- | 20 L, 20 T | SA | |
| ASME SA-240/SA-240M | --- | S32760 | --- | --- | --- | 550 | 80 | 750 | 108 | 25 | Q+SA | 270 max. HB |
| ASTM A240/A240M-15a | --- | S32760 | --- | --- | --- | 550 | 80 | 750 | 108 | 25 | SA | 270 max. HBW; 28 max. HRC |
| EN 10028-7:2007 | X2CrNiMoCuWN25-7-4 | --- | 1.4501 | t ≤ 50 | --- | 515 | --- | 730-930 | --- | 25 L, 25 T | SA | see standard for impact data |
| EN 10088-2:2014 | X2CrNiMoCuWN25-7-4 | --- | 1.4501 | t ≤ 75 | --- | 530 | --- | 730-930 | --- | 25 L, 25 T | SA | see standard for impact data |
| ISO 9328-7:2004 | Grade X2CrNiMoCuWN25-7-4 | --- | --- | t ≤ 75 | --- | 515 | --- | 730-930 | --- | 25 L, 25 T | SA | see standard for impact data |

# Chapter 5

# *STEEL TUBES AND PIPES*

### AFNOR Standards

| | |
|---|---|
| AFNOR NF A 49-220:1990 | Grooved Seamless Steel Tubes for Use at High Temperature - Dimensions - Technical Delivery Conditions |
| AFNOR NF A 49-647:1979 | Structural Welded Tubes, Circular, Square, Rectangular or Oval, in Ferritic or Austenitic Stainless Steels Dimensions - Technical Delivery Conditions |

### API Standard

| | |
|---|---|
| API 5L - 2012 | Specification for Line Pipe |

### ASME Standards

| | |
|---|---|
| ASME SA-53/SA-53M | Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless |
| ASME SA-106/SA-106M | Seamless Carbon Steel Pipe for High-Temperature Service |
| ASME SA-135 | Electric-Resistance-Welded Steel Pipe |
| ASME SA-178/SA-178M | Electric-Resistance-Welded Carbon Steel and Carbon-Manganese Steel Boiler and Superheater Tubes<br>*Note: Mechanical properties data are supplementary requirements, provided for information only.* |
| ASME SA-179/SA-179M | Seamless Cold-Drawn Low-Carbon Steel Heat-Exchanger and Condenser Tubes<br>*Note: Mechanical properties data are supplementary requirements, provided for information only.* |
| ASME SA-192/SA-192M | Seamless Carbon Steel Boiler Tubes for High-Pressure Service<br>*Note: Mechanical properties data are supplementary requirements, provided for information only.* |
| ASME SA-209/SA-209M | Seamless Carbon-Molybdenum Alloy-Steel Boiler and Superheater Tubes |
| ASME SA-210/SA-210M | Seamless Medium-Carbon Steel Boiler and Superheater Tubes |
| ASME SA-213/SA-213M | Seamless Ferritic and Austenitic Alloy-Steel Boiler, Superheater, and Heat-Exchanger Tubes |
| ASME SA-214/SA-214M | Electric-Resistance-Welded Carbon Steel Heat-Exchanger and Condenser Tubes |
| ASME SA-249/SA-249M | Welded Austenitic Steel Boiler, Superheater, Heat-Exchanger, and Condenser Tubes |
| ASME SA-250/SA-250M | Electric-Resistance-Welded Ferritic Alloy-Steel Boiler and Superheater Tubes |
| ASME SA-268/SA-268M | Seamless and Welded Ferritic and Martensitic Stainless Steel Tubing for General Service |
| ASME SA-312/SA-312M | Seamless and Welded Austenitic Stainless Steel Pipes |
| ASME SA-333/SA-333M | Seamless and Welded Steel Pipe for Low-Temperature Service |
| ASME SA-334/SA-334M | Seamless and Welded Carbon and Alloy-Steel Tubes for Low-Temperature Service |
| ASME SA-335/SA-335M | Seamless Ferritic Alloy-Steel Pipe for High-Temperature Service |
| ASME SA-358/SA-358M | Electric-Fusion–Welded Austenitic Chromium-Nickel Alloy Steel Pipe for High-Temperature Service<br>*Note: The listed tensile requirements conform to ASTM A240/A240M plate material that is used to make the pipe. See the applicable AWS filler metal specifications listed in ASTM A240/A240M for the weld tensile property requirements.* |
| ASME SA-376/SA-376M | Seamless Austenitic Steel Pipe for High-Temperature Central-Station Service |
| ASME SA-409/SA-409M | Welded Large Diameter Austenitic Steel Pipe for Corrosive or High-Temperature Service |
| ASME SA-513 | Electric-Resistance-Welded Carbon and Alloy Steel Mechanical Tubing<br>*Note: Mechanical properties data are supplementary requirements, provided for information only.* |
| ASME SA-556/SA-556M | Seamless Cold-Drawn Carbon Steel Feedwater Heater Tubes |
| ASME SA-688/SA-688M | Welded Austenitic Stainless Steel Feedwater Heater Tubes |
| ASME SA-789/SA-789M | Seamless and Welded Ferritic/Austenitic Stainless Steel Tubing for General Service |
| ASME SA-803/SA-803M | Welded Ferritic Stainless Steel Feedwater Heater Tubes |

### ASTM Standards

| | |
|---|---|
| ASTM A53/A53M-12 | Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless |
| ASTM A106/A106M-14 | Seamless Carbon Steel Pipe for High-Temperature Service |
| ASTM A135/A135M-09 (2014) | Electric-Resistance-Welded Steel Pipe |
| ASTM A139/A139M-04 (2010) | Electric-Fusion (Arc)-Welded Steel Pipe (NPS 4 and Over) |
| ASTM A178/A178M-02 (2012) | Electric-Resistance-Welded Carbon Steel and Carbon-Manganese Steel Boiler and Superheater Tubes<br>*Note: Mechanical properties data are supplementary requirements, provided for information only.* |
| ASTM A179/A179M-90a (2012) | Seamless Cold-Drawn Low-Carbon Steel Heat-Exchanger and Condenser Tubes<br>*Note: Mechanical properties data are supplementary requirements, provided for information only.* |
| ASTM A192/A192-02 (2012) | Seamless Carbon Steel Boiler Tubes for High-Pressure Service<br>*Note: Mechanical properties data are supplementary requirements, provided for information only.* |
| ASTM A209/A209-03 (2012) | Seamless Carbon-Molybdenum Alloy-Steel Boiler and Superheater Tubes |
| ASTM A210/A210M-02 (2012) | Seamless Medium-Carbon Steel Boiler and Superheater Tubes |
| ASTM A213/A213M-15a | Seamless Ferritic and Austenitic Alloy-Steel Boiler, Superheater, and Heat-Exchanger Tubes |
| ASTM A214/A214M-96 (2012) | Electric-Resistance-Welded Carbon Steel Heat-Exchanger and Condenser Tubes |
| ASTM A249/A249M-14a | Welded Austenitic Steel Boiler, Superheater, Heat-Exchanger, and Condenser Tubes |
| ASTM A250/A250M-05 (2014) | Electric-Resistance-Welded Ferritic Alloy-Steel Boiler and Superheater Tubes |
| ASTM A268/A268M-10 | Seamless and Welded Ferritic and Martensitic Stainless Steel Tubing for General Service |
| ASTM A269/A269M-14e1 | Seamless and Welded Austenitic Stainless Steel Tubing for General Service |
| ASTM A270/A270M-15 | Seamless and Welded Austenitic and Ferritic/Austenitic Stainless Steel Sanitary Tubing<br>*Note: Mechanical properties data are supplementary requirements, provided for information only.* |
| ASTM A312/A312M-15 | Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes |
| ASTM A333/A333M-13 | Seamless and Welded Steel Pipe for Low-Temperature Service and Other Applications with Required Notch Toughness |
| ASTM A334/A334M-04a (2010) | Seamless and Welded Carbon and Alloy-Steel Tubes for Low-Temperature Service |
| ASTM A335/A335M-15 | Seamless Ferritic Alloy-Steel Pipe for High-Temperature Service |
| ASTM A358/A358M-14a | Electric-Fusion–Welded Austenitic Chromium-Nickel Stainless Steel Pipe for High-Temperature Service and General Applications<br>*Note: The listed tensile requirements conform to ASTM A240/A240M plate material that is used to make the pipe. See the applicable AWS filler metal specifications listed in ASTM A240/A240M for the weld tensile property requirements.* |
| ASTM A376/A376M-14 | Seamless Austenitic Steel Pipe for High-Temperature Service |
| ASTM A409/A409M-15 | Welded Large Diameter Austenitic Steel Pipe for Corrosive or High-Temperature Service |
| ASTM A500/A500M-13 | Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes |
| ASTM A501/A501M-14 | Hot-Formed Welded and Seamless Carbon Steel Structural Tubing |
| ASTM A511/A511M-15a | Seamless Stainless Steel Mechanical Tubing<br>*Note: Mechanical properties data are supplementary requirements, provided for information only.* |
| ASTM A512-06 (2012) | Cold-Drawn Buttweld Carbon Steel Mechanical Tubing<br>*Note: Mechanical properties data are supplementary requirements, provided for information only.* |
| ASTM A513/A513M-15 | Electric-Resistance-Welded Carbon and Alloy Steel Mechanical Tubing<br>*Note: Mechanical properties data are supplementary requirements, provided for information only.* |
| ASTM A519-06 (2012) | Seamless Carbon and Alloy Steel Mechanical Tubing<br>*Note: Mechanical properties data are supplementary requirements, provided for information only. Data are "typical" values.* |
| ASTM A554-15 | Welded Stainless Steel Mechanical Tubing<br>*Note: Mechanical properties data are supplementary requirements, provided for information only.* |
| ASTM A556/A556M-96 (2012) | Seamless Cold-Drawn Carbon Steel Feedwater Heater Tubes |
| ASTM A595/A595M-14 | Steel Tubes, Low-Carbon or High-Strength Low-Alloy, Tapered for Structural Use |
| ASTM A632-04 (2014) | Seamless and Welded Austenitic Stainless Steel Tubing (Small-Diameter) for General Service |
| ASTM A688/A688M-15 | Seamless and Welded Austenitic Stainless Steel Feedwater Heater Tubes |
| ASTM A778-01 (2009)e1 | Welded, Unannealed Austenitic Stainless Steel Tubular Products |
| ASTM A789/A789M-14 | Seamless and Welded Ferritic/Austenitic Stainless Steel Tubing for General Service |
| ASTM A803/A803M-12 | Seamless and Welded Ferritic Stainless Steel Feedwater Heater Tubes |
| ASTM A908-03 (2013) | Stainless Steel Needle Tubing |

### BSI Standards

| | |
|---|---|
| BS 3604-2:1991 | Steel Pipes and Tubes for Pressure Purposes: Ferritic Alloy Steel with Specified Elevated Temperature Properties – Part 2: Specification for Longitudinally Arc Welded Tubes |

### CSA Standard

| | |
|---|---|
| CSA Z245.1-14 | Steel Pipe |

### EN Standards

| | |
|---|---|
| EN 10216-1:2013 | Seamless steel tubes for pressure purposes – Technical delivery conditions – Part 1: Non-alloy steel tubes with specified room temperature properties |
| EN 10216-2:2013 | Seamless steel tubes for pressure purposes – Technical delivery conditions – Part 2: Non-alloy and alloy steel tubes with specified elevated temperature properties |
| EN 10216-3:2013 | Seamless steel tubes for pressure purposes – Technical delivery conditions – Part 3: Alloy fine grain steel tubes |
| EN 10216-4:2013 | Seamless steel tubes for pressure purposes – Technical delivery conditions – Part 4: Non-alloy and alloy steel tubes with specified low temperature properties |
| EN 10216-5:2013 | Seamless steel tubes for pressure purposes – Technical delivery conditions – Part 5: Stainless steel tubes |
| EN 10217-1:2002 A1:2005 | Welded steel tubes for pressure purposes – Technical delivery conditions – Part 1: Non-alloy steel tubes with specified room temperature properties |
| EN 10217-2:2002 A1:2005 | Welded steel tubes for pressure purposes – Technical delivery conditions – Part 2: Electric welded non-alloy and alloy steel tubes with specified elevated temperature properties |
| EN 10217-4:2002 A1:2005 | Welded steel tubes for pressure purposes – Technical delivery conditions – Part 4: Electric welded non-alloy steel tubes with specified low temperature properties |
| EN 10217-5:2002 A1:2005 | Welded steel tubes for pressure purposes – Technical delivery conditions – Part 5: Submerged arc welded non-alloy and alloy steel tubes with specified elevated temperature properties |
| EN 10217-6:2002 A1:2005 | Welded steel tubes for pressure purposes – Technical delivery conditions – Part 6: Submerged arc welded non-alloy steel tubes with specified low temperature properties |
| EN 10217-7:2014 | Welded steel tubes for pressure purposes – Technical delivery conditions – Part 7: Stainless steel tubes |
| EN 10296-1:2003 | Welded circular steel tubes for mechanical and general engineering purposes – Technical delivery conditions – Part 1: Non-alloy and alloy steel tubes |
| EN 10296-2:2005 C2:2007 | Welded circular steel tubes for mechanical and general engineering purposes – Technical delivery conditions – Part 2: Stainless steel |
| EN 10297-1:2003 | Seamless circular steel tubes for mechanical and general engineering purposes – Technical delivery conditions – Part 1: Non-alloy and alloy steel tubes |
| EN 10297-2:2005 C1:2007 | Seamless circular steel tubes for mechanical and general engineering purposes – Technical delivery conditions – Part 2: Stainless steel |
| EN 10305-1:2010 | Steel tubes for precision applications – Technical delivery conditions – Part 1: Seamless cold drawn tubes |
| EN 10305-2:2010 | Steel tubes for precision applications – Technical delivery conditions – Part 2: Welded cold drawn tubes |
| EN 10305-3:2010 | Steel tubes for precision applications – Technical delivery conditions – Part 3: Welded cold sized tubes |

### ISO Standards

| | |
|---|---|
| ISO 2937:1974 | Plain End Seamless Steel Tubes for Mechanical Application |
| ISO 3304:1985 | Plain End Seamless Precision Steel Tubes - Technical Conditions for Delivery |
| ISO 3305:1985 | Plain End Welded Precision Steel Tubes - Technical Conditions for Delivery |
| ISO 3306:1985 | Plain End As-Welded and Sized Precision Steel Tubes - Technical Conditions for Delivery |
| ISO 9329-2:1997 | Seamless Steel Tubes for Pressure Purposes - Technical Delivery Conditions - Part 2: Unalloyed and Alloyed Steels with Specified Elevated Temperature Properties |
| ISO 9329-3:1997 | Seamless Steel Tubes for Pressure Purposes. Technical Delivery Conditions<br>Part 3: Unalloyed and Alloyed Steels with Specified Low Temperature Properties |
| ISO 9330-3:1997 | Welded Steel Tubes for Pressure Purposes. Technical Delivery Conditions. Part 3: Electric Resistance and Induction Welded Unalloyed and Alloyed Steel Tubes with Specified Low Temperature Properties |
| ISO 9330-5:2000 | Welded Steel Tubes for Pressure Purposes - Technical Delivery Conditions<br>Part 5: Submerged Arc-Welded Unalloyed and Alloyed Steel Tubes with Specified Low Temperature Properties |

### EN ISO Standard

| | |
|---|---|
| EN ISO 3183:2013 | Petroleum and natural gas industries – Steel pipe for pipeline transportation systems |

### GB Standards

| | |
|---|---|
| GB 3087-1999 | Seamless Steel Tubes for Low and Medium Pressure |
| GB 5310-1995 | Seamless Steel Tubes and Pipes for High Pressure Boiler |
| GB 6479-2000 | Seamless Steel Tubes for High-Pressure for Chemical Fertilizer Equipments |
| GB/T 12770-2002 | Welded Stainless Steel Tubes for Machine Structures |
| GB/T 14164:2005 | Hot-Rolled Wide Strips for Line Pipe of Petroleum and Natural Gas |
| GB/T 14975-2002 | Stainless Steel Seamless Tubes for Structures |
| GB/T 17396-1998 | Seamless Hot-Rolled Steel Tubes for Hydraulic Pillar Service |
| GB 18248-2000 | Seamless Steel Tubes for Gas Cylinder |
| GB/T 18984-2003 | Seamless Steel Tubes for Low-Temperature-Service Piping |

### JIS Standards

| | |
|---|---|
| JIS G 3441:2012 | Alloy steel tubes for machine purposes |
| JIS G 3444:2010 | Carbon steel tubes for general structure |
| JIS G 3445:2010 | Carbon steel tubes for machine structure |
| JIS G 3446:2012 | Stainless steel pipes for machine and structural purposes |
| JIS G 3452:2014 | Carbon steel pipes for ordinary piping |
| JIS G 3454:2012 | Carbon steel tubes for pressure service |
| JIS G 3455:2012 | Carbon steel pipes for high pressure service |
| JIS G 3456:2014 | Carbon steel pipes for high temperature service |
| JIS G 3457:2012 | Arc welded carbon steel pipes |
| JIS G 3458:2013 | Alloy steel pipes |
| JIS G 3459:2012 | Stainless steel pipes |
| JIS G 3460:2013 | Steel tubes for low temperature service |
| JIS G 3461:2012 | Carbon steel boiler and heat exchanger tubes |
| JIS G 3462:2014 | Alloy steel tubes for boiler and heat exchanger |
| JIS G 3463:2012 | Stainless steel boiler and heat exchanger tubes |
| JIS G 3464:2013 | Steel heat exchanger tubes for low temperature service |
| JIS G 3467:2013 | Steel tubes for fired heater |
| JIS G 3468:2011 | Large diameter welded stainless steel pipes |
| JIS G 3472:2013 | Electric resistance welded carbon steel tubes for automobile |
| JIS G 3473:2013 | Carbon steel tubes for cylinder barrels |
| JIS G 3474:2014 | High strength steel tubes for steel tower |

### SAE Standard

| | |
|---|---|
| SAE J526 NOV10 | Welded Low-Carbon Steel Tubing Suitable for Bending, Flaring, Beading, Forming and Brazing |

## Heat Treatment Terms Applicable to this Chapter

### 5.1 Tubes for General and Structural Applications

| Standard | Heat Treatment Terms |
|---|---|
| AFNOR NF A 49-647:1979 | AM: as manufactured |
| ASME SA-268/SA-268M | HT: heat treated |
| ASME SA-513 | N: normalized; AW: as-welded; SD: sink-drawn; MD: mandrel-drawn; MD SR: mandrel-drawn stress-relieved |
| ASME SA-789/SA-789M | ST+Q: solution treated and quenched |
| ASTM A268/A268M-10 | HT: heat treated |
| ASTM A269/A269M-14e1 | HT: heat treated |
| ASTM A270/A270M-15 | HT+Q: heat treated then quenched with water; RC: rapidly cooled |
| ASTM A500/A500M-13 | CF: cold formed; SR: stress relieved; A: annealed; HT: heat treated |
| ASTM A501/A501M-14 | HF: hot formed |
| ASTM A511/A511M-15a | A: annealed; A+Q: annealed then water quenched; RC: cooled rapidly |
| ASTM A512-06 (2012) | SA: soft-annealed; SR A: stress relief annealed |
| ASTM A513/A513M-15 | AW: as-welded; N: normalized; SD: sink-drawn; MD: mandrel-drawn; MD SR: mandrel-drawn stress-relieved |
| ASTM A519-06 (2012) | HR: hot rolled; CW: cold worked; SR: stress relieved; A: annealed; N: normalized; AM: as manufactured |
| ASTM A554-15 | A: annealed; none: not thermally treated |
| ASTM A595/A595M-14 | RCCM: roll compressed cold on a mandrel |
| ASTM A632-04 (2014) | HT: heat treated; HT+Q: heat treated then water quenched; RC: cooled rapidly |
| ASTM A778-01 (2009)e1 | AM: as manufactured |
| ASTM A789/A789M-14 | ST+Q: solution treated and quenched |
| EN 10296-1:2003 | CR: cold rolled; A: annealed; N: full tube normalized; NW: normalized weld zone; U: see standard |
| EN 10296-2:2005 C2:2007 | AW: as welded; A: annealed; SA: solution annealed |
| EN 10297-1:2003 | AR: as rolled; N: normalized; QT: quenched and tempered; A: annealed |
| EN 10297-2:2005 C1:2007 | A: annealed; SA: solution annealed; Q+T: quenched and tempered; CF: cold finished; HF: hot finished |
| EN 10305-1:2010 | A: annealed; C: cold drawn, hard; LC: cold drawn, soft; N: normalized; SR: cold drawn and stress relieved |
| EN 10305-2:2010 | A: annealed; C: cold drawn, hard; LC: cold drawn, soft; N: normalized; SR: cold drawn and stress relieved |
| EN 10305-3:2010 | A: annealed; N: normalized; CR1: welded and cold sized, suitable for final annealing;<br>CR2: welded and cold sized, not intended for heat treatment after welding and resizing |
| GB/T 12770-2002 | A: annealed; W: as-welded; ST: solution treated |
| GB/T 14975-2002 | BA: by agreement |
| GB/T 17396-1998 | HR: hot-rolled; A: annealed; H+T: hardened and tempered |
| GB 18248-2000 | Q+T: quenched and tempered |
| ISO 2937:1974 | HF: hot finished |
| ISO 3304:1985 | BK: cold-finished, as drawn; BKW: lightly cold-worked condition; GBK and GZF (A): annealed;<br>NBK and NZF (N): normalized |
| ISO 3305:1985 | BK: cold-finished, as drawn; BKW: lightly cold-worked condition; GBK and GZF (A): annealed;<br>NBK and NZF (N): normalized |
| ISO 3306:1985 | KM: as-welded and sized; GKM and GZF (A): annealed; NKM and NZF (N): normalized |
| JIS G 3441:2012 | AM: as manufactured; CF: cold finished; A: annealed |
| JIS G 3444:2010 | AM: as manufactured |
| JIS G 3445:2010 | AM: as manufactured; CF: cold formed; AHT: appropriately heat treated |
| JIS G 3446:2012 | ST: solution treated; AM: as manufactured; A: annealed |
| JIS G 3472:2013 | See standard |
| JIS G 3473:2013 | AM: as manufactured; CF: cold finished; SR: stress relieved annealed |
| JIS G 3474:2014 | AM: as manufactured |
| SAE J526 NOV10 | See standard |

**Heat Treatment Terms Applicable to this Chapter (Continued)**

### 5.2 Tubes for Heat Transfer Applications

| Standard | Heat Treatment Terms |
|---|---|
| ASME SA-178/SA-178M | See standard |
| ASME SA-179/SA-179M | HT: heat treated after final cold draw pass at 1200°F (650°C) or higher |
| ASME SA-192/SA-192M | CF: cold finished |
| ASME SA-209/SA-209M | HF: hot finished; CF+IA: cold finished and isothermally annealed; FA: fully annealed; N+T: normalized and tempered |
| ASME SA-210/SA-210M | HF: hot finished; CF+A: cold finished and subcritically annealed; CF+N: cold finished and normalized heat treatment |
| ASME SA-213/SA-213M | A+N+T+SCA: fully or isothermally annealed, normalized and tempered, and subcritically annealed; A+N+T: fully or isothermally annealed and normalized and tempered; N+T: normalized and tempered; ST+Q: solution treated then water quenched; RC: cooled rapidly |
| ASME SA-214/SA-214M | See standard |
| ASME SA-249/SA-249M | ST+Q: solution treated then water quenched; RC: cooled rapidly |
| ASME SA-250/SA-250M | FA: fully annealed; IA: isothermally annealed; N: normalized; N+T: normalized and tempered |
| ASME SA-556/SA-556M | HT: heat treated |
| ASME SA-688/SA-688M | SA+RC: solution annealed then cooled rapidly; SA+Q: solution annealed then quenched rapidly |
| ASME SA-803/SA-803M | SA: solution-annealed |
| ASTM A178/A178M-02 (2012) | See standard |
| ASTM A179/A179M-90a (2012) | CD + 1200°F min: cold drawn + heat treated at 1200°F or higher |
| ASTM A192/A192M-02 (2012) | HF: hot finished; CF + 1200°F min: cold finished + heat treated at 1200°F or higher |
| ASTM A209/A209M-03 (2012) | See standard |
| ASTM A210/A210M-02 (2012) | HF: hot finished; CF+SA: cold finished and subcritically annealed; A: fully annealed; N: normalized |
| ASTM A213/A213M-15a | A: annealed; IA: isothermally annealed; NT: normalized and tempered; SA: subcritically annealed; ST+Q: solution treated then water quenched; RC: cooled rapidly |
| ASTM A214/A214M-96 (2012) | See standard |
| ASTM A249/A249M-14a | ST+Q: solution treated then water quenched; RC: rapidly cooled; SA: solution annealed |
| ASTM A250/A250M-05 (2014) | A: fully annealed; IA: isothermally annealed; N: normalized; NT: normalized and tempered |
| ASTM A556/A556M-96 (2012) | CD + 1200°F min: cold drawn + heat treated to 1200°F or higher |
| ASTM A688/A688M-15 | SA+RC: solution-annealed then rapidly cooled; SA+Q: solution-annealed then quenched in water |
| ASTM A803/A803M-12 | SA: solution-annealed |
| EN 10216-1:2013 | HF: hot formed; HFCF: hot formed cold finished; AF: as formed; N: normalized; NF: normalizing formed; |
| EN 10216-2:2013 | I: isothermally annealed; N: normalized; NT: normalized and tempered; QT: quenched and tempered; NF: normalizing formed |
| EN 10217-1:2002 A1:2005 | See standard |
| EN 10217-2:2002 A1:2005 | See standard |
| EN 10217-7:2014 | SA: solution annealed |
| JIS G 3461:2012 | See standard; N: normalized |
| JIS G 3462:2014 | LTA: low temperature annealed; IA: isothermally annealed; A: fully annealed; N: normalized; NT: normalized and tempered |
| JIS G 3463:2012 | A: annealed; ST: solution treated |
| JIS G 3467:2013 | HFS: hot finished seamless; CFS: cold finished seamless; AM: as manufactured; LTA: low temperature annealed; IA: isothermally annealed; A: fully annealed; N: normalized; NT: normalized and tempered; ST: solution treated |

### 5.3 Tubes for Low Temperature Service

| Standard | Heat Treatment Terms |
|---|---|
| ASME SA-334/SA-334M | N: normalized; N+T: normalized and tempered; Q+T: quenched and tempered; NN+T: double normalized and tempered |
| ASTM A334/A334M-04a (2010) | N: normalized; NT: normalized and tempered; QT: quenched and tempered; NNT: double normalized and tempered |
| EN 10216-4:2013 | N: normalized; NT: normalized and tempered; QT: quenched and tempered |
| EN 10217-4:2002 A1:2005 | See standard |
| GB/T 18984-2003 | N: normalized |
| ISO 9329-3:1997 | N: normalized; QT: quenched and tempered |
| ISO 9330-3:1997 | N: normalized; QT: quenched and tempered |
| ISO 9330-5:2000 | N: normalized; QT: quenched and tempered |
| JIS G 3464:2013 | N: normalized; NT: normalized and tempered; NNT: double normalized and tempered; QT: quenched and tempered |

**Heat Treatment Terms Applicable to this Chapter (Continued)**

### 5.4 Tubes and Pipes for Pressure Service

| Standard | Heat Treatment Terms |
|---|---|
| AFNOR NF A 49-220:1990 | See standard; N: normalized; T: tempered |
| ASME SA-53/SA-53M | --- |
| ASME SA-106 | CF+HT: cold finished and heat treated; HF: hot finished |
| ASME SA-135 | --- |
| ASME SA-312/SA-312M | A+Q: annealed then water quenched; RC: cooled rapidly |
| ASME SA-333/SA-333M | N: normalized; N+T: normalized and tempered; Q+T: quenched and tempered;<br>NN+T: double normalized and tempered |
| ASME SA-335/SA-335M | A: fully or isothermally annealed; N+T: normalized and tempered; SA: subcritically annealed;<br>Q+T: quenched and tempered |
| ASME SA-358/SA-358M | H: heated at specified temperature and water quenched or rapidly cooled;<br>HT: a final heat treatment temperature under 1900°F;<br>A+Q: annealed and quenched; ST: solution treated |
| ASME SA-376/SA-376M | HT+Q: heat treated then water quenched; RC: cooled rapidly; SA+Q: solution annealed then water quenched;<br>SA+RC: solution annealed then cooled rapidly |
| ASME SA-409/SA-409M | HT+Q: heat treated then water quenched; RC: cooled rapidly |
| ASTM A53/A53M-12 | AM: as manufactured; T: tempered |
| ASTM A106/A106M-14 | HF: hot finished; CD + 1200°F min: cold drawn + heat treated at 1200°F or higher |
| ASTM A135/A135M-09 (2012) | AM: as manufactured; T: tempered |
| ASTM A139/A139M-04 (2010) | See standard |
| ASTM A312/A312M-15 | A+Q: annealed then water quenched; RC: cooled rapidly |
| ASTM A333/A333M-13 | QT: quenched and tempered; NNT: double normalized and tempered; N: normalized;<br>NT: normalized and tempered |
| ASTM A335/A335M-15 | FA: fully annealed; IA: isothermally annealed; NT: normalized and tempered;<br>QT: liquid quenched and tempered; SA: subcritically annealed |
| ASTM A358/A358M-14a | H: heated at specified temperature and water quenched or rapidly cooled;<br>HT: a final heat treatment temperature under 1900°F;<br>HT-O: no final heat treatment of pipe fabricated of plate that has been solution treated at temperatures required by this specification;<br>HT-SO: No final heat treatment of pipe fabricated of plate that has not been heat treated |
| ASTM A376/A376M-14 | See standard; HT: heat treated |
| ASTM A409/A409M-15 | H: heated at specified temperature and water quenched or rapidly cooled;<br>HT: a final heat treatment temperature under 1900°F;<br>HT-O: no final heat treatment of pipe fabricated of plate that has been solution treated at temperatures required by this specification;<br>HT-SO: No final heat treatment of pipe fabricated of plate that has not been heat treated |
| ASTM A908-03 (2013) | --- |
| BS 3604-2:1991 | See standard |
| EN 10216-1:2013 | HF: hot formed; HFCF: hot formed cold finished; AF: as formed; N: normalized; NF: normalizing formed; |
| EN 10216-2:2013 | I: isothermally annealed; N: normalized; NT: normalized and tempered; QT: quenched and tempered;<br>NF: normalizing formed |
| EN 10216-3:2013 | N: normalized |
| EN 10216-4:2013 | N: normalized; NT: normalized and tempered; QT: quenched and tempered |
| EN 10216-5:2013 | SA: solution annealed; SA+CF: solution annealed and cold finished; SA+HF: solution annealed and hot finished |
| EN 10217-1:2002 A1:2005 | See standard |
| EN 10217-2:2002 A1:2005 | See standard |
| EN 10217-4:2002 A1:2005 | See standard |
| EN 10217-7:2014 | SA: solution annealed |
| GB 3087-1999 | HF: hot finished; CF: cold finished; HT: heat treated |
| GB 5310-1995 | N+T: normalized and tempered; N: normalized; ST: solution treated |
| GB 6479-2000 | N: normalized; N+T: normalized and tempered; A: annealed |

## Heat Treatment Terms Applicable to this Chapter (Continued)

### 5.4 Tubes and Pipes for Pressure Service (Continued)

| Standard | Heat Treatment Terms |
|---|---|
| JIS G 3452:2014 | See Standard |
| JIS G 3454:2012 | AM: as manufactured; CF + A: cold finished and annealed |
| JIS G 3455:2012 | See standard |
| JIS G 3456:2014 | See standard |
| JIS G 3457:2012 | AW: as welded; ACE: as cold expanded |
| JIS G 3458:2013 | LTA: low temperature annealed; IA: isothermally annealed; FA: fully annealed; N: normalized; NT: normalized and tempered |
| JIS G 3459:2012 | ST: solution treated |
| JIS G 3460:2013 | N: normalized; NT: normalized and tempered; QT: quenched and tempered; NNT: double normalized and tempered |
| JIS G 3468:2011 | ST: solution treated |

### 5.5 Line Pipe Steels

| Standard | Heat Treatment Terms |
|---|---|
| API 5L - 2012 | See standard |
| CSA Z245.1-14 | See standard |
| EN ISO 3183:2013 | See standard |
| GB/T 14164-2005 | HR: hot-rolled; CtR: control-rolled |

## Impact Testing Notes Applicable to this Chapter

see standard for impact data: impact testing requirements are listed in the standard for multiple test temperatures.

### 5.1 Carbon Steel Tubes for General and Structural Applications

### 5.1A Mechanical Properties of Carbon Steel Tubes for General and Structural Applications

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation % min. | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | | | |
| EN 10296-1:2003 | E155 | --- | 1.0033 | --- | --- | --- | --- | 260 | --- | 28 | A | --- |
| EN 10305-3:2010 | E155 | --- | 1.0033 | --- | --- | --- | --- | 260 | --- | 28 | A | see standard |
| EN 10305-2:2010 | E155 | --- | 1.0033 | --- | --- | --- | --- | 260 | --- | 28 | A | see standard |
| ASTM A513-15* | Grade 1008 | G10080 | --- | --- | --- | 160 | 23 | 260 | 38 | 30 | N | 65 max HRB |
| ASME SA-513* | Grade 1008 | G10080 | --- | --- | --- | 159 | 23 | 262 | 38 | 30 | N | 65 max HRB |
| ISO 3304:1985 | R28 | --- | --- | --- | --- | --- | --- | 270 | --- | 30 | GBK & GZF | --- |
| ISO 3305:1985 | R28 | --- | --- | --- | --- | --- | --- | 270 | --- | 30 | GBK & GZF | --- |
| ISO 3306:1985 | R28 | --- | --- | --- | --- | --- | --- | 270 | --- | 30 | GKM & GZF | --- |
| EN 10305-2:2010 | E155 | --- | 1.0033 | --- | --- | 155 | --- | 270-410 | --- | 28 | N | see standard |
| EN 10305-3:2010 | E155 | --- | 1.0033 | --- | --- | 155 | --- | 270-410 | --- | 28 | N | see standard |
| EN 10296-1:2003 | E155 | --- | 1.0033 | --- | --- | 155 | --- | 270 | --- | 28 | N | --- |
| | E190 | --- | 1.0031 | --- | --- | 190 | --- | 270 | --- | 26 L; 24 T | CR | --- |
| EN 10305-3:2010 | E190 | --- | 1.0031 | --- | --- | 190 | --- | 270 | --- | 26 | CR2 | see standard |
| ASTM A513-15* | Grade 1010 | G10100 | --- | --- | --- | 170 | 25 | 275 | 40 | 30 | N | 65 max HRB |
| ASTM A512-06 (2012)* | Grade MT 1010 | G10100 | --- | --- | --- | 138 | 20 | 276 | 40 | 35 | SA | 40-65 HRB |
| ASME SA-513* | Grade 1010 | G10100 | --- | --- | --- | 172 | 25 | 276 | 40 | 30 | N | 65 max HRB |
| EN 10305-1:2010 | E215 | --- | 1.0212 | --- | --- | 140 | --- | 280 | --- | 30 | A | see standard |
| ISO 3304:1985 | R28 | --- | --- | --- | --- | 155 | --- | 280 | --- | 28 | NBK & NZF | --- |
| ISO 3305:1985 | R28 | --- | --- | --- | --- | 155 | --- | 280 | --- | 28 | NBK & NZF | --- |
| ISO 3306:1985 | R28 | --- | --- | --- | --- | 155 | --- | 280 | --- | 28 | NKM & NZF | --- |
| JIS G 3444:2010 | Symbol STK290 | --- | --- | d < 40 | --- | --- | --- | 290 | --- | 30 L | AM | --- |
| | | | | 40 < d ≤350 | --- | --- | --- | 290 | --- | 30 L | AM | --- |
| | | | | d > 350 | --- | --- | --- | 290 | --- | 25 T | AM | --- |
| JIS G 3445:2010 | Symbol STKM11A | --- | --- | d > 40 | --- | --- | --- | 290 | --- | 35 L; 30 T | AM, CF, or AHT | --- |
| JIS G 3452:2014 | Symbol SGP | --- | --- | 3 < t ≤ 4 | --- | --- | --- | 290 | --- | 24 L; 19 T | see standard | --- |
| | | | | 4 < t ≤ 5 | --- | --- | --- | 290 | --- | 26 L; 20 T | see standard | --- |
| | | | | 5 < t ≤ 6 | --- | --- | --- | 290 | --- | 27 L; 22 T | see standard | --- |
| | | | | 6 < t ≤ 7 | --- | --- | --- | 290 | --- | 28 L; 24 T | see standard | --- |
| | | | | 7 < t < 8 | --- | --- | --- | 290 | --- | 30 L; 25 T | see standard | --- |
| | | | | t ≥ 8 | --- | --- | --- | 290 | --- | 30 L; 25 T | see standard | --- |
| EN 10305-3:2010 | E155 | --- | 1.0033 | --- | --- | 203 | --- | 290 | --- | 15 | CR1 | see standard |
| | E195 | --- | 1.0034 | --- | --- | --- | --- | 290 | --- | 28 | A | see standard |
| EN 10305-2:2010 | E195 | --- | 1.0034 | --- | --- | 145 | --- | 290 | --- | 28 | A | see standard |

*: See "List of Standards" at the beginning of the chapter.

Note: This section continued on next page

**5.1 Carbon Steel Tubes for General and Structural Applications**

**5.1A Mechanical Properties of Carbon Steel Tubes for General and Structural Applications (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter mm | Section Thickness/Diameter in. | Yield Strength, min. MPa | Yield Strength, min. ksi | Tensile Strength, min. MPa | Tensile Strength, min. ksi | Elongation % min. | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SAE J526 NOV10 | --- | --- | --- | --- | --- | 170 | --- | 290 | --- | 14 | see standard | 65 max HR30T |
| EN 10296-1:2003 | E155 | --- | 1.0033 | --- | --- | 175 | --- | 290 | --- | 15 | U, NW | --- |
| JIS G 3472:2013 | Symbol STAM290GA | --- | --- | --- | --- | 175 | --- | 290 | --- | 40 | see standard | --- |
| | Symbol STAM290GB | --- | --- | --- | --- | 175 | --- | 290 | --- | 35 | see standard | --- |
| ASTM A513-15* | Grade 1008 | G10080 | --- | --- | --- | 205 | 30 | 290 | 42 | 15 | AW | 50 min HRB |
| ASME SA-513* | Grade 1008 | G10080 | --- | --- | --- | 207 | 30 | 290 | 42 | 15 | AW | 50 min HRB |
| EN 10305-1:2010 | E215 | --- | 1.0212 | --- | --- | 215 | --- | 290-430 | --- | 30 | N | see standard |
| ASTM A512-06 (2012)* | Grade MT 1015 | G10150 | --- | --- | --- | 172 | 25 | 296 | 43 | 34 | SA | 40 min HRB |
| EN 10305-2:2010 | E195 | --- | 1.0034 | --- | --- | 195 | --- | 300-440 | --- | 28 | N | see standard |
| EN 10305-3:2010 | E195 | --- | 1.0034 | --- | --- | 195 | --- | 300-440 | --- | 28 | N | see standard |
| EN 10296-1:2003 | E195 | --- | 1.0034 | --- | --- | --- | --- | 300 | --- | 28 | A | --- |
| | | | | --- | --- | 195 | --- | 300 | --- | 28 | N | --- |
| ISO 3306:1985 | R28 | --- | --- | --- | --- | --- | --- | 300 | --- | 10 | KM | --- |
| ASTM A513-15* | Grade 1015 | G10150 | --- | --- | --- | 205 | 30 | 310 | 45 | 30 | N | 70 max HRB |
| ASME SA-513* | Grade 1015 | G10150 | --- | --- | --- | 207 | 30 | 310 | 45 | 30 | N | 70 max HRB |
| EN 10305-3:2010 | E220 | --- | 1.0215 | --- | --- | 220 | --- | 310 | --- | 23 | CR2 | see standard |
| ASTM A513-15* | Grade 1010 | G10100 | --- | --- | --- | 220 | 32 | 310 | 45 | 15 | AW | 55 min HRB |
| ASME SA-513* | Grade 1010 | G10100 | --- | --- | --- | 221 | 32 | 310 | 45 | 15 | AW | 55 min HRB |
| ASTM A500-13 | Grade A | K03000 | --- | d ≤ 22 | d ≤ 0.875 | 230 | 33 | 310 L | 45 L | 25 L | CF, SR, A | --- |
| | | | | d ≤ 22 | d ≤ 0.875 | 270 | 39 | 310 L | 45 L | 25 L | CF, SR, A | --- |
| EN 10296-1:2003 | E220 | --- | 1.0215 | --- | --- | 220 | --- | 310 | --- | 23 L; 21 T | CR | --- |
| | E235 | --- | 1.0308 | --- | --- | --- | --- | 315 | --- | 25 | A | --- |
| EN 10305-3:2010 | E235 | --- | 1.0308 | --- | --- | --- | --- | 315 | --- | 25 | A | see standard |
| EN 10305-1:2010 | E235 | --- | 1.0308 | --- | --- | 158 | --- | 315 | --- | 25 | A | see standard |
| EN 10305-2:2010 | E235 | --- | 1.0308 | --- | --- | 158 | --- | 315 | --- | 25 | A | see standard |
| ISO 3304:1985 | R33 | --- | --- | --- | --- | --- | --- | 320 | --- | 27 | GBK & GZF | --- |
| ISO 3305:1985 | R33 | --- | --- | --- | --- | --- | --- | 320 | --- | 27 | GBK & GZF | --- |
| ISO 3306:1985 | R33 | --- | --- | --- | --- | --- | --- | 320 | --- | 27 | GKM & GZF | --- |
| ISO 3304:1985 | R33 | --- | --- | --- | --- | 195 | --- | 320 | --- | 25 | NBK & NZF | --- |
| ISO 3305:1985 | R33 | --- | --- | --- | --- | 195 | --- | 320 | --- | 25 | NBK & NZF | --- |
| ISO 3306:1985 | R33 | --- | --- | --- | --- | 195 | --- | 320 | --- | 25 | NKM & NZF | --- |
| ISO 2937:1974 | TS 1 | --- | --- | --- | --- | 195 | --- | 320-440 | --- | 25 | HF | --- |

*: See "List of Standards" at the beginning of the chapter.

Note: This section continued on next page

**5.1 Carbon Steel Tubes for General and Structural Applications**

**5.1A Mechanical Properties of Carbon Steel Tubes for General and Structural Applications (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation % min. | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | | | |
| ISO 3306:1985 | R33 | --- | --- | --- | --- | --- | --- | 330 | --- | 8 | KM | --- |
| EN 10305-3:2010 | E195 | --- | 1.0034 | --- | --- | 231 | --- | 330 | --- | 8 | CR1 | see standard |
| EN 10296-1:2003 | E195 | --- | 1.0034 | --- | --- | 250 | --- | 330 | --- | 8 | U, NW | --- |
| ASTM A513-15* | Grade 1015 | G10150 | --- | --- | --- | 240 | 35 | 330 | 48 | 15 | AW | 58 min HRB |
| | Grade 1008 | G10080 | --- | --- | --- | 260 | 38 | 330 | 48 | 8 | SD | 65 min HRB |
| ASTM A519-06 (2012)* | Grade 1020 | G10200 | --- | O.D. ≤ 323.8 | O.D. ≤ 12.75 | 193 | 28 | 331 | 48 | 30 | A | 50 HRB |
| ASME SA-513* | Grade 1015 | G10150 | --- | --- | --- | 241 | 35 | 331 | 48 | 15 | AW | 58 min HRB |
| | Grade 1008 | G10080 | --- | --- | --- | 262 | 38 | 331 | 48 | 8 | SD | 65 min HRB |
| ISO 3304:1985 | R37 | --- | --- | --- | --- | --- | --- | 340 | --- | 26 | GBK & GZF | --- |
| ISO 3305:1985 | R37 | --- | --- | --- | --- | --- | --- | 340 | --- | 26 | GBK & GZF | --- |
| ISO 3306:1985 | R37 | --- | --- | --- | --- | --- | --- | 340 | --- | 26 | GKM & GZF | --- |
| JIS G 3445:2010 | Symbol STKM12A | --- | --- | d > 40 | --- | 175 | --- | 340 | --- | 35 L; 30 T | AM, CF, or AHT | --- |
| JIS G 3472:2013 | Symbol STAM340G | --- | --- | --- | --- | 195 | --- | 340 | --- | 35 | see standard | --- |
| EN 10305-1:2010 | E235 | --- | 1.0308 | --- | --- | 235 | --- | 340-480 | --- | 25 | N | see standard |
| EN 10305-2:2010 | E235 | --- | 1.0308 | --- | --- | 235 | --- | 340-480 | --- | 25 | N | see standard |
| EN 10305-3:2010 | E235 | --- | 1.0308 | --- | --- | 235 | --- | 340-480 | --- | 25 | N | see standard |
| EN 10296-1:2003 | E235 | --- | 1.0308 | --- | --- | 235 | --- | 340 | --- | 25 | N | --- |
| | E260 | --- | 1.0220 | --- | --- | 260 | --- | 340 | --- | 21 L; 19 T | CR | --- |
| EN 10305-3:2010 | E260 | --- | 1.0220 | --- | --- | 260 | --- | 340 | --- | 21 | CR2 | see standard |
| ASTM A512-06 (2012)* | Grade MT 1020 | G10200 | --- | --- | --- | 207 | 30 | 345 | 50 | 32 | SA | 50 min HRB |
| ASTM A519-06 (2012)* | Grade 1020 | G10200 | --- | --- | --- | 221 | 32 | 345 | 50 | 25 | HR | 55 HRB |
| ASTM A513-15* | Grade 1020 | G10200 | --- | --- | --- | 240 | 35 | 345 | 50 | 25 | N | 75 max HRB |
| | Grade 1021 | G10210 | --- | --- | --- | 240 | 35 | 345 | 50 | 25 | N | 78 max HRB |
| | Grade 1010 | G10100 | --- | --- | --- | 275 | 40 | 345 | 50 | 8 | SD | 65 min HRB |
| ASME SA-513* | Grade 1020 | G10200 | --- | --- | --- | 241 | 35 | 345 | 50 | 25 | N | 75 max HRB |
| | Grade 1021 | G10210 | --- | --- | --- | 241 | 35 | 345 | 50 | 25 | N | 78 max HRB |
| | Grade 1010 | G10100 | --- | --- | --- | 276 | 40 | 345 | 50 | 8 | SD | 65 min HRB |

*: See "List of Standards" at the beginning of the chapter.

**5.1 Carbon Steel Tubes for General and Structural Applications**

**5.1A Mechanical Properties of Carbon Steel Tubes for General and Structural Applications (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter mm | Section Thickness/Diameter in. | Yield Strength, min. MPa | Yield Strength, min. ksi | Tensile Strength, min. MPa | Tensile Strength, min. ksi | Elongation % min. | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ISO 3304:1985 | R28 | --- | --- | --- | --- | --- | --- | 350 | --- | 10 | BKW | --- |
| ISO 3305:1985 | R28 | --- | --- | --- | --- | --- | --- | 350 | --- | 10 | BKW | --- |
| EN 10305-2:2010 | E155 | --- | 1.0033 | --- | --- | 245 | --- | 350 | --- | 10 | LC | see standard |
| | | | | --- | --- | 245 | --- | 350 | --- | 18 | SR | --- |
| ASME SA-513* | Grade 1020 | G10200 | --- | --- | --- | 262 | 38 | 359 | 52 | 12 | AW | 62 min HRB |
| ISO 2937:1974 | TS 4 | --- | --- | --- | --- | 215 | --- | 360-480 | --- | 24 | HF | --- |
| ISO 3304:1985 | R37 | --- | --- | --- | --- | 215 | --- | 360 | --- | 24 | NBK & NZF | --- |
| ISO 3305:1985 | R37 | --- | --- | --- | --- | 215 | --- | 360 | --- | 24 | NBK & NZF | --- |
| ISO 3306:1985 | R37 | --- | --- | --- | --- | 215 | --- | 360 | --- | 24 | NKM & NZF | --- |
| EN 10297-1:2003 | E235 | --- | 1.0308 | t ≤ 16 | --- | 235 | --- | 360 | --- | 25 L; 23 T | AR, N | --- |
| | | | | 16 < t ≤ 40 | --- | 225 | --- | 360 | --- | 25 L; 23 T | AR, N | --- |
| | | | | 40 < t ≤ 65 | --- | 215 | --- | 360 | --- | 25 L; 23 T | AR, N | --- |
| | | | | 65 < t ≤ 80 | --- | 205 | --- | 340 | --- | 25 L; 23 T | AR, N | --- |
| | | | | 80 < t ≤ 100 | --- | 195 | --- | 340 | --- | 25 L; 23 T | AR, N | --- |
| ASTM A513-15* | Grade 1020 | G10200 | --- | --- | --- | 260 | 38 | 360 | 52 | 12 | AW | 62 min HRB |
| ASTM A519-06 (2012)* | Grade 1025 | G10250 | --- | O.D. ≤ 323.8 | O.D. ≤ 12.75 | 207 | 30 | 365 | 53 | 25 | A | 57 HRB |
| ISO 3304:1985 | R33 | --- | --- | --- | --- | --- | --- | 370 | --- | 10 | BKW | --- |
| ISO 3305:1985 | R33 | --- | --- | --- | --- | --- | --- | 370 | --- | 10 | BKW | --- |
| JIS G 3473:2013 | Symbol STC370 | --- | --- | --- | --- | 215 | --- | 370 | --- | 30 | AM | --- |
| JIS G 3445:2010 | Symbol STKM13A | --- | --- | d > 40 | --- | 215 | --- | 370 | --- | 30 L; 25 T | AM, CF, or AHT | --- |
| EN 10305-2:2010 | E195 | --- | 1.0034 | --- | --- | 259 | --- | 370 | --- | 10 | LC | see standard |
| | | | | --- | --- | 260 | --- | 370 | --- | 18 | SR | see standard |
| EN 10296-1:2003 | E275K2 | --- | 1.0456 | t ≤ 16 | --- | 275 | --- | 370 | --- | 24 L; 22 T | --- | 40 J at -20°C |
| | | | | t >16 | --- | 265 | --- | 370 | --- | 24 L; 22 T | --- | 40 J at -20°C |
| ASTM A513-15* | Grade 1021 | G10210 | --- | --- | --- | 275 | 40 | 370 | 54 | 12 | AW | 62 min HRB |
| ASME SA-513* | Grade 1021 | G10210 | --- | --- | --- | 276 | 40 | 372 | 54 | 12 | AW | 62 min HRB |
| ASTM A519-06 (2012)* | Grade 1020 | G10200 | --- | O.D. ≤ 323.8 | O.D. ≤ 12.75 | 234 | 34 | 379 | 55 | 22 | N | 60 HRB |
| ASTM A512-06 (2012)* | Grade MT 1025 | G10250 | --- | --- | --- | 241 | 35 | 379 | 55 | 32 | SA | 55 min HRB |
| ASTM A519-06 (2012)* | Grade 1025 | G10250 | --- | O.D. ≤ 323.8 | O.D. ≤ 12.75 | 241 | 35 | 379 | 55 | 25 | HR | 60 HRB |
| | | | | O.D. ≤ 323.8 | O.D. ≤ 12.75 | 248 | 36 | 379 | 55 | 22 | N | 60 HRB |

*: See "List of Standards" at the beginning of the chapter.

Note: This section continued on next page

**5.1 Carbon Steel Tubes for General and Structural Applications**

**5.1A Mechanical Properties of Carbon Steel Tubes for General and Structural Applications (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter mm | Section Thickness/Diameter in. | Yield Strength, min. MPa | Yield Strength, min. ksi | Tensile Strength, min. MPa | Tensile Strength, min. ksi | Elongation % min. | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ASME SA-513* | Grade 1025 | G10250 | --- | --- | --- | 255 | 37 | 379 | 55 | 25 | N | 80 max HRB |
| | Grade 1008 | G10080 | --- | --- | --- | 310 | 45 | 379 | 55 | 12 | MD SR | 68 min HRB |
| | Grade 1010 | G10100 | --- | --- | --- | 310 | 45 | 379 | 55 | 12 | MD SR | 68 min HRB |
| | Grade 1015 | G10150 | --- | --- | --- | 310 | 45 | 379 | 55 | 8 | SD | 67 min HRB |
| ASTM A513-15* | Grade 1025 | G10250 | --- | --- | --- | 255 | 37 | 379 | 55 | 25 | N | 80 max HRB |
| | Grade 1008 | G10080 | --- | --- | --- | 310 | 45 | 380 | 55 | 12 | MD SR | 68 min HRB |
| | Grade 1010 | G10100 | --- | --- | --- | 310 | 45 | 380 | 55 | 12 | MD SR | 68 min HRB |
| | Grade 1015 | G10150 | --- | --- | --- | 310 | 45 | 380 | 55 | 8 | SD | 67 min HRB |
| EN 10305-1:2010 | E215 | --- | 1.0212 | --- | --- | 266 | --- | 380 | --- | 12 | LC | see standard |
| | | | | | | 280 | --- | 380 | --- | 16 | SR | see standard |
| ASTM A513-15* | Grade 1025 | G10250 | --- | --- | --- | 275 | 40 | 385 | 56 | 12 | AW | 65 min HRB |
| ASME SA-513* | Grade 1025 | G10250 | --- | --- | --- | 276 | 40 | 386 | 56 | 12 | AW | 65 min HRB |
| EN 10296-1:2003 | E275 | --- | 1.0225 | --- | --- | --- | --- | 390 | --- | 21 | A | --- |
| EN 10305-1:2010 | E255 | --- | 1.0408 | --- | --- | --- | --- | 390 | --- | 21 | A | see standard |
| EN 10305-3:2010 | E275 | --- | 1.0225 | --- | --- | --- | --- | 390 | --- | 22 | A | see standard |
| | E235 | --- | 1.0308 | --- | --- | 273 | --- | 390 | --- | 7 | CR1 | see standard |
| EN 10305-2:2010 | E275 | --- | 1.0225 | --- | --- | 195 | --- | 390 | --- | 22 | A | see standard |
| EN 10296-1:2003 | E235 | --- | 1.0308 | --- | --- | 300 | --- | 390 | --- | 7 | U, NW | --- |
| JIS G 3472:2013 | Symbol STAM390G | --- | --- | --- | --- | 235 | --- | 390 | --- | 30 | see standard | --- |
| JIS G 3445:2010 | Symbol STKM12B | --- | --- | --- | --- | 275 | --- | 390 | --- | 25 L; 20 T | AM, CF, or AHT | --- |
| ISO 3304:1985 | R28 | --- | --- | --- | --- | --- | --- | 400 | --- | 8 | BK | --- |
| | R37 | --- | --- | --- | --- | --- | --- | 400 | --- | 9 | BKW | --- |
| | R44 | --- | --- | --- | --- | --- | --- | 400 | --- | 24 | GBK & GZF | --- |
| ISO 3305:1985 | R28 | --- | --- | --- | --- | --- | --- | 400 | --- | 8 | BK | --- |
| | R37 | --- | --- | --- | --- | --- | --- | 400 | --- | 9 | BKW | --- |
| | R44 | --- | --- | --- | --- | --- | --- | 400 | --- | 24 | GBK & GZF | --- |
| ISO 3306:1985 | R37 | --- | --- | --- | --- | --- | --- | 400 | --- | 7 | KM | --- |
| | R44 | --- | --- | --- | --- | --- | --- | 400 | --- | 24 | GKM & GZF | --- |
| EN 10305-2:2010 | E155 | --- | 1.0033 | --- | --- | 320 | --- | 400 | --- | 6 | C | see standard |
| JIS G 3444:2010 | Symbol STK400 | --- | --- | d < 40 | --- | 235 | --- | 400 | --- | 23 L | AM | --- |
| | | | | 40 < d ≤350 | --- | 235 | --- | 400 | --- | 23 L | AM | --- |
| | | | | d > 350 | --- | 235 | --- | 400 | --- | 18 T | AM | --- |

*: See "List of Standards" at the beginning of the chapter.

Note: This section continued on next page

**5.1 Carbon Steel Tubes for General and Structural Applications**

**5.1A Mechanical Properties of Carbon Steel Tubes for General and Structural Applications (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | % min. | | |
| ASTM A500-13 | Grade D | --- | --- | d ≤ 22 | d ≤ 0.875 | 250 | 36 | 400 L | 58 L | 23 L | HT | --- |
| GB/T 17396-1998 | Grade 20 | --- | --- | --- | --- | 245 | --- | 400 | --- | 20 | HR, A or H+T | --- |
| ASTM A501-14 | Grade A | K03000 | --- | --- | --- | 250 | 36 | 400 L | 58 L | 23 L | HF | --- |
| ASTM A500-13 | Grade B | K03000 | --- | d ≤ 22 | d ≤ 0.875 | 290 | 42 | 400 L | 58 L | 23 L | CF, SR, A | --- |
| | | | | d ≤ 22 | d ≤ 0.875 | 315 | 46 | 400 L | 58 L | 23 L | CF, SR, A | --- |
| EN 10296-1:2003 | E275 | --- | 1.0225 | --- | --- | 275 | --- | 410 | --- | 21 | N | --- |
| EN 10297-1:2003 | E275 | --- | 1.0225 | t ≤ 16 | --- | 275 | --- | 410 | --- | 22 L; 20 T | AR, N | --- |
| | | | | 16 < t ≤ 40 | --- | 265 | --- | 410 | --- | 22 L; 20 T | AR, N | --- |
| | | | | 40 < t ≤ 65 | --- | 255 | --- | 410 | --- | 22 L; 20 T | AR, N | --- |
| | | | | 65 < t ≤ 80 | --- | 245 | --- | 380 | --- | 22 L; 20 T | AR, N | --- |
| | | | | 80 < t ≤ 100 | --- | 235 | --- | 380 | --- | 22 L; 20 T | AR, N | --- |
| EN 10305-2:2010 | E275 | --- | 1.0225 | --- | --- | 275 | --- | 410-550 | --- | 22 | N | see standard |
| EN 10305-3:2010 | E275 | --- | 1.0225 | --- | --- | 275 | --- | 410-550 | --- | 22 | N | see standard |
| EN 10296-1:2003 | E320 | --- | 1.0237 | --- | --- | 320 | --- | 410 | --- | 19 L; 17 T | CR | --- |
| EN 10305-3:2010 | E320 | --- | 1.0237 | --- | --- | 320 | --- | 410 | --- | 19 | CR2 | see standard |
| EN 10297-1:2003 | E275K2 | --- | 1.0456 | ≤ 16 | --- | 275 | --- | 410 | --- | 22 L; 20 T | N | L: 40 J at -20°C<br>T: 27 J at -20°C |
| | | | | 16 < t ≤ 40 | --- | 265 | --- | 410 | --- | 22 L; 20 T | N | L: 40 J at -20°C<br>T: 27 J at -20°C |
| | | | | 40 < t ≤ 65 | --- | 255 | --- | 410 | --- | 22 L; 20 T | N | L: 40 J at -20°C<br>T: 27 J at -20°C |
| | | | | 65 < t ≤ 80 | --- | 245 | --- | 380 | --- | 22 L; 20 T | N | L: 40 J at -20°C<br>T: 27 J at -20°C |
| | | | | 80 < t ≤ 100 | --- | 235 | --- | 380 | --- | 22 L; 20 T | N | L: 40 J at -20°C<br>T: 27 J at -20°C |

Note: This section continued on next page

**5.1 Carbon Steel Tubes for General and Structural Applications**

**5.1A Mechanical Properties of Carbon Steel Tubes for General and Structural Applications (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation % min. | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | | | |
| ISO 2937:1974 | TS 9 | --- | --- | --- | --- | 235 | --- | 410-530 | --- | 22 | HF | --- |
| JIS G 3445:2010 | Symbol STKM14A | --- | --- | --- | --- | 245 | --- | 410 | --- | 25 L; 20 T | AM, CF, or AHT | --- |
| ASTM A519-06 (2012)* | Grade 1035 | G10350 | --- | O.D. ≤ 323.8 | O.D. ≤ 12.75 | 228 | 33 | 414 | 60 | 25 | A | 67 HRB |
| ASME SA-513* | Grade 1026 | G10260 | --- | --- | --- | 276 | 40 | 414 | 60 | 25 | N | 85 max HRB |
| | Grade 1030 | G10300 | --- | --- | --- | 276 | 40 | 414 | 60 | 25 | N | 85 max HRB |
| | Grade 1008 | G10080 | --- | --- | --- | 345 | 50 | 414 | 60 | 5 | MD | 73 min HRB |
| | Grade 1010 | G10100 | --- | --- | --- | 345 | 50 | 414 | 60 | 5 | MD | 73 min HRB |
| | Grade 1015 | G10150 | --- | --- | --- | 345 | 50 | 414 | 60 | 12 | MD SR | 72 min HRB |
| | Grade 1020 | G10200 | --- | --- | --- | 345 | 50 | 414 | 60 | 8 | SD | 70 min HRB |
| ASTM A513-15* | Grade 1026 | G10260 | --- | --- | --- | 275 | 40 | 414 | 60 | 25 | N | 85 max HRB |
| | Grade 1030 | G10300 | --- | --- | --- | 275 | 40 | 415 | 60 | 25 | N | 85 max HRB |
| | Grade 1008 | G10080 | --- | --- | --- | 345 | 50 | 415 | 60 | 5 | MD | 73 min HRB |
| | Grade 1010 | G10100 | --- | --- | --- | 345 | 50 | 415 | 60 | 5 | MD | 73 min HRB |
| | Grade 1015 | G10150 | --- | --- | --- | 345 | 50 | 415 | 60 | 12 | MD SR | 72 min HRB |
| | Grade 1020 | G10200 | --- | --- | --- | 345 | 50 | 415 | 60 | 8 | SD | 70 min HRB |
| ISO 3304:1985 | R33 | --- | --- | --- | --- | --- | --- | 420 | --- | 6 | BK | --- |
| ISO 3305:1985 | R33 | --- | --- | --- | --- | --- | --- | 420 | --- | 6 | BK | --- |
| EN 10305-1:2010 | E235 | --- | 1.0308 | --- | --- | 294 | --- | 420 | --- | 10 | LC | see standard |
| EN 10305-2:2010 | E195 | --- | 1.0034 | --- | --- | 336 | --- | 420 | --- | 6 | C | see standard |
| EN 10305-1:2010 | E235 | --- | 1.0308 | --- | --- | 350 | --- | 420 | --- | 16 | SR | --- |
| ASTM A513-15* | Grade 1026 | G10260 | --- | --- | --- | 310 | 45 | 425 | 62 | 12 | AW | 68 min HRB |
| | Grade 1030 | G10300 | --- | --- | --- | 310 | 45 | 425 | 62 | 10 | AW | 70 min HRB |
| ASTM A500-13 | Grade C | K02705 | --- | d ≤ 22 | d ≤ 0.875 | 315 | 46 | 425 L | 62 L | 21 L | CF, SR, A | --- |
| | | | | d ≤ 22 | d ≤ 0.875 | 345 | 50 | 425 L | 62 L | 21 L | CF, SR, A | --- |
| ASTM A513-15* | Grade 1021 | G10210 | --- | --- | --- | 360 | 52 | 425 | 62 | 7 | SD | 70 min HRB |
| ASME SA-513* | Grade 1026 | G10260 | --- | --- | --- | 310 | 45 | 427 | 62 | 12 | AW | 68 min HRB |
| | Grade 1030 | G10300 | --- | --- | --- | 310 | 45 | 427 | 62 | 10 | AW | 70 min HRB |
| | Grade 1021 | G10210 | --- | --- | --- | 359 | 52 | 428 | 62 | 7 | SD | 70 min HRB |
| EN 10297-1:2003 | C22E | --- | 1.1151 | t ≤ 16 | --- | 240 | --- | 430 | --- | 24 L; 22 T | N | see standard |
| | | | | 16 < t ≤ 40 | --- | 210 | --- | 410 | --- | 25 L; 23 T | N | see standard |
| | | | | 40 < t ≤ 80 | --- | 210 | --- | 410 | --- | 25 L; 23 T | N | see standard |
| ISO 3306:1985 | R44 | --- | --- | --- | --- | --- | --- | 430 | --- | 6 | KM | --- |
| ISO 3304:1985 | R44 | --- | --- | --- | --- | 255 | --- | 430 | --- | 22 | NBK & NZF | --- |
| ISO 3305:1985 | R44 | --- | --- | --- | --- | 255 | --- | 430 | --- | 22 | NBK & NZF | --- |

*: See "List of Standards" at the beginning of the chapter.

Note: This section continued on next page

**5.1 Carbon Steel Tubes for General and Structural Applications**

**5.1A Mechanical Properties of Carbon Steel Tubes for General and Structural Applications (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation % min. | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | | | |
| ISO 3306:1985 | R44 | --- | --- | --- | --- | 255 | --- | 430 | --- | 22 | NKM & NZF | --- |
| EN 10305-1:2010 | E215 | --- | 1.0212 | --- | --- | 344 | --- | 430 | --- | 8 | C | see standard |
| ASTM A512-06 (2012)* | Grade MT 1010 | G10100 | --- | --- | --- | 400 | 58 | 434-689 | 63-100 | 15 | SR A | 70-90 HRB |
| EN 10305-1:2010 | C35E | --- | 1.1181 | --- | --- | --- | --- | 440 | --- | 22 | A | see standard |
| | E255 | --- | 1.0408 | --- | --- | 255 | --- | 440-570 | --- | 21 | N | see standard |
| EN 10305-3:2010 | E275 | --- | 1.0225 | --- | --- | 308 | --- | 440 | --- | 6 | CR1 | see standard |
| EN 10305-2:2010 | E235 | --- | 1.0308 | --- | --- | 308 | --- | 440 | --- | 10 | LC | see standard |
| | | | | --- | --- | 325 | --- | 440 | --- | 14 | SR | see standard |
| EN 10296-1:2003 | E275 | --- | 1.0225 | --- | --- | 340 | --- | 440 | --- | 6 | U, NW | --- |
| JIS G 3445:2010 | Symbol STKM18A | --- | --- | d > 40 | --- | 275 | --- | 440 | --- | 25 L; 20 T | AM, CF, or AHT | --- |
| | Symbol STKM13B | --- | --- | d > 40 | --- | 305 | --- | 440 | --- | 20 L; 15 T | AM, CF, or AHT | --- |
| JIS G 3472:2013 | Symbol STAM440G | --- | --- | --- | --- | 305 | --- | 440 | --- | 25 | see standard | --- |
| JIS G 3473:2013 | Symbol STC440 | --- | --- | --- | --- | 305 | --- | 440 | --- | 10 | CF and SR | --- |
| JIS G 3472:2013 | Symbol STAM440H | --- | --- | --- | --- | 355 | --- | 440 | --- | 20 | see standard | --- |
| ASTM A519-06 (2012)* | Grade 1045 | G10450 | --- | O.D. ≤ 323.8 | O.D. ≤ 12.75 | 241 | 35 | 448 | 65 | 20 | A | 72 HRB |
| | Grade 1035 | G10350 | --- | O.D. ≤ 323.8 | O.D. ≤ 12.75 | 276 | 40 | 448 | 65 | 20 | HR | 72 HRB |
| | Grade 1035 | G10350 | --- | O.D. ≤ 323.8 | O.D. ≤ 12.75 | 276 | 40 | 448 | 65 | 20 | N | 72 HRB |
| ASME SA-513* | Grade 1035 | G10350 | --- | --- | --- | 310 | 45 | 448 | 65 | 20 | N | 88 max HRB |
| | Grade 1040 | G10400 | --- | --- | --- | 310 | 45 | 448 | 65 | 20 | N | 90 max HRB |
| ASTM A519-06 (2012)* | Grade 1020 | G10200 | --- | O.D. ≤ 323.8 | O.D. ≤ 12.75 | 345 | 50 | 448 | 65 | 10 | SR | 72 HRB |
| ASME SA-513* | Grade 1015 | G10150 | --- | --- | --- | 379 | 55 | 448 | 65 | 5 | MD | 77 min HRB |
| | Grade 1020 | G10200 | --- | --- | --- | 379 | 55 | 448 | 65 | 10 | MD SR | 75 min HRB |
| | Grade 1025 | G10250 | --- | --- | --- | 379 | 55 | 448 | 65 | 7 | SD | 72 min HRB |
| ASTM A512-06 (2012)* | Grade MT 1030 | G10300 | --- | --- | --- | 276 | 40 | 448 | 65 | 30 | SA | 60 min HRB |
| | Grade 1110 | G11100 | --- | --- | --- | 400 | 58 | 434-689 | 63-100 | 15 | SR A | 70-100 HRB |
| | Grade 1011 | G10110 | --- | --- | --- | 407 | 59 | 448-689 | 65-100 | 13 | SR A | 70-100 HRB |
| ASTM A513-15* | Grade 1035 | G10350 | --- | --- | --- | 310 | 45 | 450 | 65 | 20 | N | 88 max HRB |
| | Grade 1040 | G10400 | --- | --- | --- | 310 | 45 | 450 | 65 | 20 | N | 90 max HRB |
| ASTM A513-15* | Grade 1015 | G10150 | --- | --- | --- | 380 | 55 | 450 | 65 | 5 | MD | 77 min HRB |
| | Grade 1020 | G10200 | --- | --- | --- | 380 | 55 | 450 | 65 | 10 | MD SR | 75 min HRB |
| | Grade 1025 | G10250 | --- | --- | --- | 380 | 55 | 450 | 65 | 7 | SD | 72 min HRB |
| ISO 3304:1985 | R37 | --- | --- | --- | --- | --- | --- | 450 | --- | 6 | BK | --- |
| | R44 | --- | --- | --- | --- | --- | --- | 450 | --- | 8 | BKW | --- |
| ISO 3305:1985 | R37 | --- | --- | --- | --- | --- | --- | 450 | --- | 6 | BK | --- |
| | R44 | --- | --- | --- | --- | --- | --- | 450 | --- | 8 | BKW | --- |

*: See "List of Standards" at the beginning of the chapter.

Note: This section continued on next page

**5.1 Carbon Steel Tubes for General and Structural Applications**

**5.1A Mechanical Properties of Carbon Steel Tubes for General and Structural Applications (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter mm | Section Thickness/Diameter in. | Yield Strength, min. MPa | Yield Strength, min. ksi | Tensile Strength, min. MPa | Tensile Strength, min. ksi | Elongation % min. | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| EN 10305-3:2010 | E355 | --- | 1.0580 | --- | --- | --- | --- | 450 | --- | 22 | A | see standard |
| EN 10305-1:2010 | E355 | --- | 1.0580 | --- | --- | 225 | --- | 450 | --- | 22 | A | see standard |
| EN 10305-2:2010 | E355 | --- | 1.0580 | --- | --- | 225 | --- | 450 | --- | 22 | A | see standard |
| EN 10297-1:2003 | E315 | --- | 1.0236 | t ≤ 16 | --- | 315 | --- | 450 | --- | 21 L; 19 T | AR, N | --- |
| | | | | 16 < t ≤ 40 | --- | 305 | --- | 450 | --- | 21 L; 19 T | AR, N | --- |
| | | | | 40 < t ≤ 65 | --- | 295 | --- | 450 | --- | 21 L; 19 T | AR, N | --- |
| | | | | 65 < t ≤ 80 | --- | 280 | --- | 420 | --- | 21 L; 19 T | AR, N | --- |
| | | | | 80 < t ≤ 100 | --- | 270 | --- | 420 | --- | 21 L; 19 T | AR, N | --- |
| EN 10305-3:2010 | E370 | --- | 1.0261 | --- | --- | 370 | --- | 450 | --- | 15 | CR2 | see standard |
| EN 10296-1:2003 | E370 | --- | 1.0261 | --- | --- | 370 | --- | 450 | --- | 15 L; 13 T | CR | --- |
| ASTM A595/A595M-14 | Grade A | K02004 | --- | --- | --- | 380 | 55 | 450 | 65 | 23 | RCCM | --- |
| ASTM A513-15* | Grade 1035 | G10350 | --- | --- | --- | 345 | 50 | 455 | 66 | 10 | AW | 75 min HRB |
| | Grade 1524 | G15240 | --- | --- | --- | 345 | 50 | 455 | 66 | 10 | AW | 75 min HRB |
| | Grade 1040 | G10400 | --- | --- | --- | 345 | 50 | 455 | 66 | 10 | AW | 75 min HRB |
| ASME SA-513* | Grade 1035 | G10350 | --- | --- | --- | 345 | 50 | 455 | 66 | 10 | AW | 75 min HRB |
| | Grade 1524 | G15240 | --- | --- | --- | 345 | 50 | 455 | 66 | 10 | AW | 75 min HRB |
| | Grade 1040 | G10400 | --- | --- | --- | 345 | 50 | 455 | 66 | 10 | AW | 75 min HRB |
| ASTM A512-06 (2012)* | Grade MT 1015 | G10150 | --- | --- | --- | 414 | 60 | 455-689 | 66-100 | 14 | SR A | 70-100 HRB |
| EN 10305-1:2010 | C35E | --- | 1.1181 | --- | --- | 280 | --- | 460 | --- | 21 | N | see standard |
| ASTM A512-06 (2012)* | Grade 1016 | G10160 | --- | --- | --- | 421 | 61 | 462-689 | 67-100 | 13 | SR A | 70-100 HRB |
| | Grade MT 1017 | G10170 | --- | --- | --- | 427 | 62 | 462-689 | 67-100 | 13 | SR A | 72-100 HRB |
| ASTM A519-06 (2012)* | Grade 1050 | G10500 | --- | O.D. ≤ 323.8 | O.D. ≤ 12.75 | 262 | 38 | 469 | 68 | 18 | A | 74 HRB |
| ASME SA-513* | Grade 1021 | G10210 | --- | --- | --- | 400 | 58 | 469 | 68 | 10 | MD SR | 75 min HRB |
| ASTM A512-06 (2012)* | Grade 1018 | G10180 | --- | --- | --- | 427 | 62 | 469-689 | 68-100 | 13 | SR A | 73-100 HRB |
| JIS G 3445:2010 | Symbol STKM15A | --- | --- | d > 40 | --- | 275 | --- | 470 | --- | 22 L; 17 T | AM, CF, or AHT | --- |
| JIS G 3472:2013 | Symbol STAM470G | --- | --- | --- | --- | 325 | --- | 470 | --- | 22 | see standard | --- |
| JIS G 3445:2010 | Symbol STKM12C | --- | --- | d > 40 | --- | 355 | --- | 470 | --- | 20 L; 15 T | AM, CF, or AHT | --- |
| ASTM A513-15* | Grade 1021 | G10210 | --- | --- | --- | 400 | 58 | 470 | 68 | 10 | MD SR | 75 min HRB |
| JIS G 3472:2013 | Symbol STAM470H | --- | --- | --- | --- | 410 | --- | 470 | --- | 18 | see standard | --- |
| ISO 3304:1985 | R50 | --- | --- | --- | --- | --- | --- | 480 | --- | 23 | GBK & GZF | --- |
| ISO 3305:1985 | R50 | --- | --- | --- | --- | --- | --- | 480 | --- | 23 | GBK & GZF | --- |
| ISO 3306:1985 | R50 | --- | --- | --- | --- | --- | --- | 480 | --- | 23 | GKM & GZF | --- |
| EN 10305-1:2010 | E235 | --- | 1.0308 | --- | --- | 384 | --- | 480 | --- | 6 | C | see standard |
| ASTM A595/A595M-14 | Grade B | K02005 | --- | --- | --- | 410 | 60 | 480 | 70 | 21 | RCCM | --- |

*: See "List of Standards" at the beginning of the chapter.

Note: This section continued on next page

**5.1 Carbon Steel Tubes for General and Structural Applications**

**5.1A Mechanical Properties of Carbon Steel Tubes for General and Structural Applications (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation % min. | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | | | |
| ASTM A513-15* | Grade 1026 | G10260 | --- | --- | --- | 380 | 55 | 480 | 70 | 7 | SD | 77 min HRB |
| | Grade 1020 | G10200 | --- | --- | --- | 415 | 60 | 480 | 70 | 5 | MD | 80 min HRB |
| | Grade 1025 | G10250 | --- | --- | --- | 415 | 60 | 480 | 70 | 10 | MD SR | 77 min HRB |
| | Grade 1030 | G10300 | --- | --- | --- | 425 | 62 | 480 | 70 | 7 | SD | 78 min HRB |
| ASTM A519-06 (2012)* | Grade 1025 | G10250 | --- | O.D. ≤ 323.8 | O.D. ≤ 12.75 | 379 | 55 | 483 | 70 | 8 | SR | 75 HRB |
| ASTM A519-06 (2012)* | Grade 1020 | G10200 | --- | O.D. ≤ 323.8 | O.D. ≤ 12.75 | 414 | 60 | 483 | 70 | 5 | CW | 75 HRB |
| ASME SA-513* | Grade 1026 | G10260 | --- | --- | --- | 379 | 55 | 483 | 70 | 7 | SD | 77 min HRB |
| | Grade 1020 | G10200 | --- | --- | --- | 414 | 60 | 483 | 70 | 5 | MD | 80 min HRB |
| | Grade 1025 | G10250 | --- | --- | --- | 414 | 60 | 483 | 70 | 10 | MD SR | 77 min HRB |
| | Grade 1030 | G10300 | --- | --- | --- | 427 | 62 | 483 | 70 | 7 | SD | 78 min HRB |
| EN 10297-1:2003 | E355 | --- | 1.0580 | t ≤ 16 | --- | 355 | --- | 490 | --- | 20 L; 18 T | AR, N | --- |
| | | | | 16 < t ≤ 40 | --- | 345 | --- | 490 | --- | 20 L; 18 T | AR, N | --- |
| | | | | 40 < t ≤ 65 | --- | 335 | --- | 490 | --- | 20 L; 18 T | AR, N | --- |
| | | | | 65 < t ≤ 80 | --- | 315 | --- | 470 | --- | 20 L; 18 T | AR, N | --- |
| | | | | 80 < t ≤ 100 | --- | 295 | --- | 470 | --- | 20 L; 18 T | AR, N | --- |
| EN 10296-1:2003 | E355 | --- | 1.0580 | --- | --- | --- | --- | 490 | --- | 22 | A | --- |
| ISO 3304:1985 | R50 | --- | --- | --- | --- | 285 | --- | 490 | --- | 21 | NBK & NZF | --- |
| ISO 3305:1985 | R50 | --- | --- | --- | --- | 285 | --- | 490 | --- | 21 | NBK & NZF | --- |
| ISO 3306:1985 | R50 | --- | --- | --- | --- | 285 | --- | 490 | --- | 21 | NKM & NZF | --- |
| JIS G 3444:2010 | Symbol STK490 | --- | --- | d < 40 | --- | 315 | --- | 490 | --- | 23 L | AM | --- |
| | | | | 40 < d ≤350 | --- | 315 | --- | 490 | --- | 23 L | AM | --- |
| | | | | d > 350 | --- | 315 | --- | 490 | --- | 18 T | AM | --- |
| JIS G 3445:2010 | Symbol STKM18B | --- | --- | --- | --- | 315 | --- | 490 | --- | 23 L; 18 T | AM, CF, or AHT | --- |
| | Symbol STKM19A | --- | --- | --- | --- | 315 | --- | 490 | --- | 23 L; 18 T | AM, CF, or AHT | --- |
| ISO 2937:1974 | TS 18 | --- | --- | --- | --- | 285 | --- | 490-610 | --- | 21 | HF | --- |
| EN 10296-1:2003 | E355 | --- | 1.0580 | --- | --- | 355 | --- | 490 | --- | 22 | N | --- |
| EN 10305-1:2010 | E355 | --- | 1.0580 | --- | --- | 355 | --- | 490-630 | --- | 22 | N | see standard |
| EN 10305-2:2010 | E355 | --- | 1.0580 | --- | --- | 355 | --- | 490-630 | --- | 22 | N | see standard |
| EN 10305-3:2010 | E355 | --- | 1.0580 | --- | --- | 355 | --- | 490-630 | --- | 22 | N | see standard |
| EN 10305-2:2010 | E235 | --- | 1.0308 | --- | --- | 392 | --- | 490 | --- | 6 | C | see standard |
| EN 10305-3:2010 | E420 | --- | 1.0575 | --- | --- | 420 | --- | 490 | --- | 12 | CR2 | see standard |
| ASTM A512-06 (2012)* | Grade MT 1020 | G10200 | --- | --- | --- | 448 | 65 | 490-896 | 71-130 | 11 | SR A | 75 HRB-20 HRC |
| ASTM A513-15* | Grade 1021 | G10210 | --- | --- | --- | 425 | 62 | 495 | 72 | 5 | MD | 80 min HRB |
| ASME SA-513* | Grade 1021 | G10210 | --- | --- | --- | 427 | 62 | 496 | 72 | 5 | MD | 80 min HRB |
| ASTM A512-06 (2012)* | Grade 1025 | G10250 | --- | --- | --- | 462 | 67 | 496-896 | 72-130 | 11 | SR A | 78 HRB-20 HRC |

*: See "List of Standards" at the beginning of the chapter.

**5.1 Carbon Steel Tubes for General and Structural Applications**

**5.1A Mechanical Properties of Carbon Steel Tubes for General and Structural Applications (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation % min. | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | | | |
| EN 10297-1:2003 | C22E | --- | 1.1151 | t ≤ 8 | --- | 340 | --- | 500 | --- | 20 L; 18 T | QT | --- |
| | | | | 8 < t ≤ 20 | --- | 290 | --- | 470 | --- | 22 L; 20 T | QT | --- |
| | | | | 20 < t ≤ 50 | --- | 270 | --- | 440 | --- | 22 L; 20 T | QT | --- |
| | | | | 50 < t ≤ 80 | --- | 260 | --- | 420 | --- | 22 L; 20 | QT | --- |
| JIS G 3444:2010 | Symbol STK500 | --- | --- | d < 40 | --- | 355 | --- | 500 | --- | 15 L | AM | --- |
| | | | | 40 < d ≤350 | --- | 355 | --- | 500 | --- | 15 L | AM | --- |
| | | | | d > 350 | --- | 355 | --- | 500 | --- | 10 T | AM | --- |
| JIS G 3472:2013 | Symbol STAM500G | --- | --- | --- | --- | 355 | --- | 500 | --- | 18 | see standard | --- |
| JIS G 3445:2010 | Symbol STKM14B | --- | --- | --- | --- | 355 | --- | 500 | --- | 15 L; 10 T | AM, CF, or AHT | --- |
| JIS G 3472:2013 | Symbol STAM500H | --- | --- | --- | --- | 430 | --- | 500 | --- | 16 | see standard | --- |
| EN 10305-1:2010 | C45E | --- | 1.1191 | --- | --- | --- | --- | 510 | --- | 20 | A | see standard |
| GB/T 17396-1998 | Grade 35 | --- | --- | --- | --- | 305 | --- | 510 | --- | 17 | HR, A or H+T | --- |
| JIS G 3445:2010 | Symbol STKM16A | --- | --- | d > 40 | --- | 325 | --- | 510 | --- | 20 L; 15 T | AM, CF, or AHT | --- |
| EN 10305-2:2010 | E275 | --- | 1.0225 | --- | --- | 357 | --- | 510 | --- | 8 | LC | see standard |
| | | | | --- | --- | 375 | --- | 510 | --- | 12 | SR | see standard |
| JIS G 3445:2010 | Symbol STKM13C | --- | --- | d > 40 | --- | 380 | --- | 510 | --- | 15 L; 10 T | AM, CF, or AHT | --- |
| | Symbol STKM18C | --- | --- | d > 40 | --- | 380 | --- | 510 | --- | 15 L; 10 T | AM, CF, or AHT | --- |
| JIS G 3473:2013 | Symbol STC510A | --- | --- | --- | --- | 380 | --- | 510 | --- | 10 | CF or SR | --- |
| | Symbol STC510B | --- | --- | --- | --- | 380 | --- | 510 | --- | 15 | SR | --- |
| ASTM A513-15* | Grade 1025 | G10250 | --- | --- | --- | 450 | 65 | 515 | 75 | 5 | MD | 82 min HRB |
| | Grade 1026 | G10260 | --- | --- | --- | 450 | 65 | 515 | 75 | 10 | MD SR | 80 min HRB |
| ASTM A519-06 (2012)* | Grade 1045 | G10450 | --- | O.D. ≤ 323.8 | O.D. ≤ 12.75 | 310 | 45 | 517 | 75 | 15 | HR | 80 HRB |
| | | | | O.D. ≤ 323.8 | O.D. ≤ 12.75 | 331 | 48 | 517 | 75 | 15 | N | 80 HRB |
| ASME SA-513* | Grade 1025 | G10250 | --- | --- | --- | 448 | 65 | 517 | 75 | 5 | MD | 82 min HRB |
| | Grade 1026 | G10260 | --- | --- | --- | 448 | 65 | 517 | 75 | 10 | MD SR | 80 min HRB |
| ASTM A519-06 (2012)* | Grade 1025 | G10250 | --- | O.D. ≤ 323.8 | O.D. ≤ 12.75 | 448 | 65 | 517 | 75 | 5 | CW | 80 HRB |
| | Grade 1035 | G10350 | --- | O.D. ≤ 323.8 | O.D. ≤ 12.75 | 448 | 65 | 517 | 75 | 8 | SR | 80 HRB |
| EN 10305-1:2010 | E255 | --- | 1.0408 | --- | --- | --- | --- | 520 | --- | 8 | LC | see standard |
| | E410 | --- | 1.0509 | --- | --- | --- | --- | 520 | --- | 22 | A | see standard |
| ISO 3304:1985 | R44 | --- | --- | --- | --- | --- | --- | 520 | --- | 5 | BK | --- |
| ISO 3305:1985 | R44 | --- | --- | --- | --- | --- | --- | 520 | --- | 5 | BK | --- |
| ISO 3306:1985 | R50 | --- | --- | --- | --- | --- | --- | 520 | --- | 5 | KM | --- |
| EN 10305-1:2010 | E255 | --- | 1.0408 | --- | --- | 375 | --- | 520 | --- | 12 | SR | see standard |
| ASTM A519-06 (2012)* | Grade 1050 | G10500 | --- | O.D. ≤ 323.8 | O.D. ≤ 12.75 | 345 | 50 | 538 | 78 | 12 | N | 82 HRB |
| EN 10305-1:2010 | C35E | --- | 1.1181 | --- | --- | --- | --- | 540 | --- | 7 | LC | see standard |

*: See "List of Standards" at the beginning of the chapter.

Note: This section continued on next page

**5.1 Carbon Steel Tubes for General and Structural Applications**

**5.1A Mechanical Properties of Carbon Steel Tubes for General and Structural Applications (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation % min. | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | | | |
| ISO 2937:1974 | C 35 | --- | --- | --- | --- | 275 | --- | 540-660 | --- | 20 | HF | --- |
| EN 10305-1:2010 | C45E | --- | 1.1191 | --- | --- | 340 | --- | 540 | --- | 18 | N | see standard |
| EN 10305-3:2010 | E355 | --- | 1.0580 | --- | --- | 378 | --- | 540 | --- | 5 | CR1 | see standard |
| JIS G 3444:2010 | Symbol STK540 | --- | --- | d < 40 | --- | 390 | --- | 540 | --- | 20 L | AM | --- |
| | | | | 40 < d ≤350 | --- | 390 | --- | 540 | --- | 20 L | AM | --- |
| | | | | d > 350 | --- | 390 | --- | 540 | --- | 16 T | AM | --- |
| JIS G 3445:2010 | Symbol STKM20A | --- | --- | d > 40 | --- | 390 | --- | 540 | --- | 23 L; 18 T | AM, CF, or AHT | --- |
| JIS G 3473:2013 | Symbol STC540 | --- | --- | --- | --- | 390 | --- | 540 | --- | 20 | AM | --- |
| EN 10296-1:2003 | E355 | --- | 1.0580 | --- | --- | 400 | --- | 540 | --- | 5 | U, NW | --- |
| JIS G 3472:2013 | Symbol STAM540H | --- | --- | --- | --- | 480 | --- | 540 | --- | 13 | see standard | --- |
| ISO 3304:1985 | R50 | --- | --- | --- | --- | --- | --- | 550 | --- | 7 | BKW | --- |
| ISO 3305:1985 | R50 | --- | --- | --- | --- | --- | --- | 550 | --- | 7 | BKW | --- |
| EN 10297-1:2003 | C35E | --- | 1.1181 | t ≤ 16 | --- | 300 | --- | 550 | --- | 18 L; 16 T | N | see standard |
| | | | | 16 < t ≤ 40 | --- | 270 | --- | 520 | --- | 19 L; 17 T | N | see standard |
| | | | | 40 < t ≤ 80 | --- | 270 | --- | 520 | --- | 19 L; 17 T | N | see standard |
| JIS G 3445:2010 | Symbol STKM17A | --- | --- | d > 40 | --- | 345 | --- | 550 | --- | 20 L; 15 T | AM, CF, or AHT | --- |
| EN 10305-1:2010 | E410 | --- | 1.0509 | --- | --- | 410 | --- | 550-700 | --- | 22 | N | see standard |
| JIS G 3445:2010 | Symbol STKM14C | --- | --- | d > 40 | --- | 410 | --- | 550 | --- | 15 L; 10 T | AM, CF, or AHT | --- |
| | Symbol STKM19C | --- | --- | d > 40 | --- | 410 | --- | 550 | --- | 15 L; 10 T | AM, CF, or AHT | --- |
| ASTM A513-15* | Grade 1026 | G10260 | --- | --- | --- | 480 | 70 | 550 | 80 | 5 | MD | 85 min HRB |
| | Grade 1030 | G10300 | --- | --- | --- | 480 | 70 | 550 | 80 | 10 | MD SR | 81 min HRB |
| | Grade 1035 | G10350 | --- | --- | --- | 480 | 70 | 550 | 80 | 7 | SD | 82 min HRB |
| ASTM A519-06 (2012)* | Grade 1050 | G10500 | --- | O.D. ≤ 323.8 | O.D. ≤ 12.75 | 345 | 50 | 552 | 80 | 10 | HR | 85 HRB |
| ASTM A512-06 (2012)* | Grade 1030 | G10300 | --- | --- | --- | 483 | 70 | 552-896 | 80-130 | 10 | SR A | 80 HRB-20 HRC |
| ASTM A519-06 (2012)* | Grade 1045 | G10450 | --- | O.D. ≤ 323.8 | O.D. ≤ 12.75 | 483 | 70 | 552 | 80 | 8 | SR | 85 HRB |
| ASME SA-513* | Grade 1026 | G10260 | --- | --- | --- | 483 | 70 | 552 | 80 | 5 | MD | 85 min HRB |
| | Grade 1030 | G10300 | --- | --- | --- | 483 | 70 | 552 | 80 | 10 | MD SR | 81 min HRB |
| | Grade 1035 | G10350 | --- | --- | --- | 483 | 70 | 552 | 80 | 7 | SD | 82 min HRB |
| EN 10305-2:2010 | E275 | --- | 1.0225 | --- | --- | 448 | --- | 560 | --- | 5 | C | see standard |
| ASTM A519-06 (2012)* | Grade 1050 | G10500 | --- | O.D. ≤ 323.8 | O.D. ≤ 12.75 | 483 | 70 | 565 | 82 | 6 | SR | 86 HRB |
| EN 10305-1:2010 | E255 | --- | 1.0408 | --- | --- | --- | --- | 580 | --- | 5 | C | see standard |
| | E355 | --- | 1.0580 | --- | --- | 406 | --- | 580 | --- | 7 | LC | see standard |
| | | | | --- | --- | 450 | --- | 580 | --- | 10 | SR | see standard |
| JIS G 3445:2010 | Symbol STKM15C | --- | --- | d > 40 | --- | 430 | --- | 580 | --- | 12 L; 7 T | AM, CF, or AHT | --- |

*: See "List of Standards" at the beginning of the chapter.

Note: This section continued on next page

**5.1 Carbon Steel Tubes for General and Structural Applications**

**5.1A Mechanical Properties of Carbon Steel Tubes for General and Structural Applications (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation % min. | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | | | |
| ASTM A513-15* | Grade 1030 | G10300 | --- | --- | --- | 515 | 75 | 585 | 85 | 5 | MD | 87 min HRB |
| | Grade 1035 | G10350 | --- | --- | --- | 515 | 75 | 585 | 85 | 10 | MD SR | 85 min HRB |
| | Grade 1040 | G10400 | --- | --- | --- | 515 | 75 | 585 | 85 | 10 | MD SR | 85 min HRB |
| | Grade 1524 | G15240 | --- | --- | --- | 515 | 75 | 585 | 85 | 10 | MD SR | 85 min HRB |
| ASME SA-513* | Grade 1030 | G10300 | --- | --- | --- | 517 | 75 | 586 | 85 | 5 | MD | 87 min HRB |
| | Grade 1035 | G10350 | --- | --- | --- | 517 | 75 | 586 | 85 | 10 | MD SR | 85 min HRB |
| | Grade 1040 | G10400 | --- | --- | --- | 517 | 75 | 586 | 85 | 10 | MD SR | 85 min HRB |
| | Grade 1524 | G15240 | --- | --- | --- | 517 | 75 | 586 | 85 | 10 | MD SR | 85 min HRB |
| ASTM A519-06 (2012)* | Grade 1035 | G10350 | --- | O.D. ≤ 323.8 | O.D. ≤ 12.75 | 517 | 75 | 586 | 85 | 5 | CW | 88 HRB |
| EN 10305-1:2010 | C35E | --- | 1.1181 | --- | --- | --- | --- | 590 | --- | 5 | C | see standard |
| GB/T 17396-1998 | Grade 45 | --- | --- | --- | --- | 335 | --- | 590 | --- | 14 | HR, A or H+T | --- |
| EN 10305-2:2010 | E355 | --- | 1.0580 | --- | --- | 413 | --- | 590 | --- | 6 | LC | see standard |
| | | | | --- | --- | 435 | --- | 590 | --- | 10 | SR | see standard |
| JIS G 3474:2014 | Symbol STKT590 | --- | --- | --- | --- | 440 | --- | 590-740 | --- | 20 L; 16 T | AM | --- |
| JIS G 3473:2013 | Symbol STC590A | --- | --- | --- | --- | 490 | --- | 590 | --- | 10 | CF or SR | --- |
| | Symbol STC590B | --- | --- | --- | --- | 490 | --- | 590 | --- | 15 | SR | --- |
| EN 10297-1:2003 | E420J2 | --- | 1.0599 | t ≤ 16 | --- | 420 | --- | 600 | --- | 19 L; 17 T | N | L: 27J at -20°C<br>T: 20 J at -20°C |
| | | | | 16 < t ≤ 40 | --- | 400 | --- | 560 | --- | 19 L; 17 T | N | L: 27J at -20°C<br>T: 20 J at -20°C |
| | | | | 40 < t ≤ 65 | --- | 390 | --- | 530 | --- | 19 L; 17 T | N | L: 27J at -20°C<br>T: 20 J at -20°C |
| | | | | 65 < t ≤ 80 | --- | 370 | --- | 500 | --- | 19 L; 17 T | N | L: 27J at -20°C<br>T: 20 J at -20°C |
| | | | | 80 < t ≤ 100 | --- | 360 | --- | 500 | --- | 19 L; 17 T | N | L: 27J at -20°C<br>T: 20 J at -20°C |
| ISO 3304:1985 | R50 | --- | --- | --- | --- | --- | --- | 600 | --- | 4 | BK | --- |
| ISO 3305:1985 | R50 | --- | --- | --- | --- | --- | --- | 600 | --- | 4 | BK | --- |
| EN 10305-1:2010 | E410 | --- | 1.0509 | --- | --- | --- | --- | 620 | --- | 8 | LC | see standard |
| EN 10297-1:2003 | C45E | --- | 1.1181 | t ≤ 16 | --- | 340 | --- | 620 | --- | 14 L; 12 T | N | see standard |
| | | | | 16 < t ≤ 40 | --- | 305 | --- | 580 | --- | 16 L; 14 T | N | see standard |
| | | | | 40 < t ≤ 80 | --- | 305 | --- | 580 | --- | 16 L; 14 T | N | see standard |
| JIS G 3445:2010 | Symbol STKM16C | --- | --- | d > 40 | --- | 460 | --- | 620 | --- | 12 L; 7 T | AM, CF, or AHT | --- |
| ASTM A513-15* | Grade 1035 | G10350 | --- | --- | --- | 550 | 80 | 620 | 90 | 5 | MD | 90 min HRB |
| | Grade 1040 | G10400 | --- | --- | --- | 550 | 80 | 620 | 90 | 5 | MD | 90 min HRB |
| | Grade 1524 | G15240 | --- | --- | --- | 550 | 80 | 620 | 90 | 5 | MD | 90 min HRB |
| ASTM A519-06 (2012)* | Grade 1045 | G10450 | --- | O.D. ≤ 323.8 | O.D. ≤ 12.75 | 552 | 80 | 621 | 90 | 5 | CW | 90 HRB |

*: See "List of Standards" at the beginning of the chapter.

Note: This section continued on next page

**5.1 Carbon Steel Tubes for General and Structural Applications**

**5.1A Mechanical Properties of Carbon Steel Tubes for General and Structural Applications (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation % min. | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | | | |
| ASME SA-513* | Grade 1035 | G10350 | --- | --- | --- | 552 | 80 | 621 | 90 | 5 | MD | 90 min HRB |
| | Grade 1040 | G10400 | --- | --- | --- | 552 | 80 | 621 | 90 | 5 | MD | 90 min HRB |
| | Grade 1524 | G15240 | --- | --- | --- | 552 | 80 | 621 | 90 | 5 | MD | 90 min HRB |
| EN 10297-1:2003 | C35E | --- | 1.1181 | t ≤ 8 | --- | 430 | --- | 630 | --- | 17 L; 15 T | QT | --- |
| | | | | 8 < t ≤ 20 | --- | 380 | --- | 600 | --- | 19 L; 17 T | QT | --- |
| | | | | 20 < t ≤ 50 | --- | 320 | --- | 550 | --- | 20 L; 18 T | QT | --- |
| | | | | 50 < t ≤ 80 | --- | 290 | --- | 500 | --- | 20 L; 18 T | QT | --- |
| EN 10305-1:2010 | E355 | --- | 1.0580 | --- | --- | 512 | --- | 640 | --- | 4 | C | see standard |
| EN 10305-2:2010 | E355 | --- | 1.0580 | --- | --- | 512 | --- | 640 | --- | 4 | C | see standard |
| EN 10305-1:2010 | 26Mn5 | --- | 1.1161 | --- | --- | --- | --- | 650 | --- | 7 | LC | see standard |
| EN 10297-1:2003 | E470 | --- | 1.0536 | t ≤ 16 | --- | 470 | --- | 650 | --- | 17 L; 15 T | AR | --- |
| | | | | 16 < t ≤ 40 | --- | 430 | --- | 600 | --- | 17 L; 15 T | AR | --- |
| | | | | 40 < t ≤ 65 | --- | --- | --- | --- | --- | 17 L; 15 T | AR | --- |
| | | | | 65 < t ≤ 80 | --- | --- | --- | --- | --- | 17 L; 15 T | AR | --- |
| | | | | 80 < t ≤ 100 | --- | --- | --- | --- | --- | 17 L; 15 T | AR | --- |
| JIS G 3445:2010 | Symbol STKM17C | --- | --- | d > 40 | --- | 480 | --- | 650 | --- | 10 L; 5 T | AM, CF, or AHT | --- |
| EN 10305-1:2010 | C45E | --- | 1.1191 | --- | --- | --- | --- | 670 | --- | 6 | LC | see standard |
| EN 10297-1:2003 | 38Mn6 | --- | 1.1127 | t ≤ 16 | --- | 400 | --- | 670 | --- | 14 L; 12 T | N | --- |
| | | | | 16 < t ≤ 40 | --- | 380 | --- | 620 | --- | 15 L; 13 T | N | --- |
| | | | | 40 < t ≤ 80 | --- | 360 | --- | 570 | --- | 16 L; 14 T | N | --- |
| EN 10305-1:2010 | E410 | --- | 1.0509 | --- | --- | 590 | --- | 690 | --- | 12 | SR | see standard |

*: See "List of Standards" at the beginning of the chapter.

**5.1 Carbon Steel Tubes for General and Structural Applications**

**5.1A Mechanical Properties of Carbon Steel Tubes for General and Structural Applications (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | % min. | | |
| EN 10305-1:2010 | 26Mn5 | --- | 1.1161 | --- | --- | --- | --- | 700 | --- | 4 | C | see standard |
| EN 10297-1:2003 | C45E | --- | 1.1181 | t ≤ 8 | --- | 490 | --- | 700 | --- | 14 L; 12 T | QT | --- |
| | | | | 8 < t ≤ 20 | --- | 430 | --- | 650 | --- | 16 L; 14 T | QT | --- |
| | | | | 20 < t ≤ 50 | --- | 370 | --- | 630 | --- | 17 L; 15 T | QT | --- |
| | | | | 50 < t ≤ 80 | --- | 340 | --- | 600 | --- | 17 L; 15 T | QT | --- |
| | E590K2 | --- | 1.0644 | t ≤ 16 | --- | 590 | --- | 700 | --- | 16 L; 14 T | QT | L: 40 J at -20°C<br>T: 27 J at -20°C |
| | | | | 16 < t ≤ 40 | --- | 540 | --- | 650 | --- | 16 L; 14 T | QT | L: 40 J at -20°C<br>T: 27 J at -20°C |
| | | | | 40 < t ≤ 65 | --- | 480 | --- | 570 | --- | 16 L; 14 T | QT | L: 40 J at -20°C<br>T: 27 J at -20°C |
| | | | | 65 < t ≤ 80 | --- | 455 | --- | 520 | --- | 16 L; 14 T | QT | L: 40 J at -20°C<br>T: 27 J at -20°C |
| | | | | 80 < t ≤ 100 | --- | 420 | --- | 520 | --- | 16 L; 14 T | QT | L: 40 J at -20°C<br>T: 27 J at -20°C |
| EN 10305-1:2010 | C45E | --- | 1.1191 | --- | --- | --- | --- | 720 | --- | 4 | C | see standard |
| | E410 | --- | 1.0509 | --- | --- | --- | --- | 750 | --- | 4 | C | see standard |
| GB 18248-2000 | Grade 37Mn | --- | --- | --- | --- | 630 | --- | 750 L | --- | 16 L | Q+T | L: 55 J @ RT |

**5.1 Carbon Steel Tubes for General and Structural Applications**

**5.1B Chemical Composition of Carbon Steel Tubes for General and Structural Applications**

| Specification | Designation | UNS No. | Steel No. | Weight, % max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| EN 10296-1:2003 | E155 | --- | 1.0033 | 0.11 | 0.70 | 0.35 | 0.045 | 0.045 | --- | --- | --- | --- |
| EN 10305-3:2010 | E155 | --- | 1.0033 | 0.11 | 0.70 | 0.35 | 0.025 | 0.025 | --- | --- | --- | Al 0.015 min. |
| EN 10305-2:2010 | E155 | --- | 1.0033 | 0.11 | 0.70 | 0.35 | 0.025 | 0.025 | --- | --- | --- | Al 0.015 min. |
| ASTM A513-15* | Grade 1008 | G10080 | --- | 0.10 | 0.50 | --- | 0.035 | 0.035 | --- | --- | --- | --- |
| ASME SA-513* | Grade 1008 | G10080 | --- | 0.10 | 0.50 | --- | 0.035 | 0.035 | --- | --- | --- | --- |
| ISO 3304:1985 | R28 | --- | --- | 0.10 | 0.30 | --- | 0.040 | 0.040 | --- | --- | --- | --- |
| ISO 3305:1985 | R28 | --- | --- | 0.13 | 0.60 | --- | 0.050 | 0.050 | --- | --- | --- | --- |
| ISO 3306:1985 | R28 | --- | --- | 0.13 | 0.60 | --- | 0.050 | 0.050 | --- | --- | --- | --- |
| EN 10296-1:2003 | E190 | --- | 1.0031 | 0.10 | 0.70 | 0.35 | 0.045 | 0.045 | --- | --- | --- | --- |
| EN 10305-3:2010 | E190 | --- | 1.0031 | 0.10 | 0.70 | 0.35 | 0.025 | 0.025 | --- | --- | --- | Al 0.015 min. |
| ASTM A513-15* | Grade 1010 | G10100 | --- | 0.08-0.13 | 0.30-0.60 | --- | 0.035 | 0.035 | --- | --- | --- | --- |
| ASTM A512-06 (2012)* | Grade MT 1010 | G10100 | --- | 0.05-0.15 | 0.30-0.60 | --- | 0.04 | 0.045 | --- | --- | --- | --- |
| ASME SA-513* | Grade 1010 | G10100 | --- | 0.08-0.13 | 0.30-0.60 | --- | 0.035 | 0.035 | --- | --- | --- | --- |
| EN 10305-1:2010 | E215 | --- | 1.0212 | 0.10 | 0.70 | 0.05 | 0.025 | 0.025 | --- | --- | --- | Al 0.025 min |
| JIS G 3444:2010 | Symbol STK290 | --- | --- | --- | --- | --- | 0.050 | 0.050 | --- | --- | --- | --- |
| JIS G 3445:2010 | Symbol STKM11A | --- | --- | 0.12 | 0.60 | 0.35 | 0.040 | 0.040 | --- | --- | --- | --- |
| JIS G 3452:2014 | Symbol SGP | --- | --- | --- | --- | --- | 0.040 | 0.040 | --- | --- | --- | --- |
| EN 10305-3:2010 | E195 | --- | 1.0034 | 0.15 | 0.70 | 0.35 | 0.025 | 0.025 | --- | --- | --- | Al 0.015 min. |
| EN 10305-2:2010 | E195 | --- | 1.0034 | 0.15 | 0.70 | 0.35 | 0.025 | 0.025 | --- | --- | --- | Al 0.015 min. |
| SAE J526 NOV10 | --- | --- | --- | 0.18 | 0.60 | --- | 0.035 | 0.035 | --- | --- | --- | --- |
| EN 10296-1:2003 | E155 | --- | 1.0033 | 0.11 | 0.70 | 0.35 | 0.045 | 0.045 | --- | --- | --- | --- |
| JIS G 3472:2013 | Symbol STAM290GA | --- | --- | 0.12 | 0.60 | 0.35 | 0.035 | 0.035 | --- | --- | --- | --- |
| | Symbol STAM290GB | --- | --- | 0.12 | 0.60 | 0.35 | 0.035 | 0.035 | --- | --- | --- | --- |
| ASTM A513-15* | Grade 1008 | G10080 | --- | 0.10 | 0.50 | --- | 0.035 | 0.035 | --- | --- | --- | --- |
| ASME SA-513* | Grade 1008 | G10080 | --- | 0.10 | 0.50 | --- | 0.035 | 0.035 | --- | --- | --- | --- |
| ASTM A512-06 (2012)* | Grade MT 1015 | G10150 | --- | 0.10-0.20 | 0.30-0.60 | --- | 0.04 | 0.045 | --- | --- | --- | --- |

*: See "List of Standards" at the beginning of the chapter.

**5.1 Carbon Steel Tubes for General and Structural Applications**

**5.1B Chemical Composition of Carbon Steel Tubes for General and Structural Applications (Continued)**

| Specification | Designation | UNS No. | Steel No. | Weight, % max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| EN 10305-3:2010 | E195 | --- | 1.0034 | 0.15 | 0.70 | 0.35 | 0.025 | 0.025 | --- | --- | --- | Al 0.015 min. |
| ISO 3306:1985 | R28 | --- | --- | 0.13 | 0.60 | --- | 0.050 | 0.050 | --- | --- | --- | --- |
| ASTM A513-15* | Grade 1015 | G10150 | --- | 0.13-0.18 | 0.30-0.60 | --- | 0.035 | 0.035 | --- | --- | --- | --- |
| ASME SA-513* | Grade 1015 | G10150 | --- | 0.12-0.18 | 0.30-0.60 | --- | 0.035 | 0.035 | --- | --- | --- | --- |
| EN 10305-3:2010 | E220 | --- | 1.0215 | 0.14 | 0.70 | 0.35 | 0.025 | 0.025 | --- | --- | --- | Al 0.015 min. |
| ASTM A513-15* | Grade 1010 | G10100 | --- | 0.08-0.13 | 0.30-0.60 | --- | 0.035 | 0.035 | --- | --- | --- | --- |
| ASME SA-513* | Grade 1010 | G10100 | --- | 0.08-0.13 | 0.30-0.60 | --- | 0.035 | 0.035 | --- | --- | --- | --- |
| ASTM A500-13 | Grade A | K03000 | --- | 0.26 | 1.35 | --- | 0.035 | 0.035 | --- | --- | --- | Cu 0.20 min |
| EN 10296-1:2003 | E220 | --- | 1.0215 | 0.14 | 0.70 | 0.35 | 0.045 | 0.045 | --- | --- | --- | --- |
| EN 10305-3:2010 | E235 | --- | 1.0308 | 0.17 | 1.20 | 0.35 | 0.025 | 0.025 | --- | --- | --- | Al 0.015 min. |
| EN 10305-1:2010 | E235 | --- | 1.0308 | 0.17 | 1.20 | 0.35 | 0.025 | 0.025 | --- | --- | --- | Al 0.015 min. |
| EN 10305-2:2010 | E235 | --- | 1.0308 | 0.17 | 1.20 | 0.35 | 0.025 | 0.025 | --- | --- | --- | Al 0.015 min. |
| ISO 3304:1985 | R33 | --- | --- | 0.16 | 0.70 | --- | 0.050 | 0.050 | --- | --- | --- | --- |
| ISO 3305:1985 | R33 | --- | --- | 0.16 | 0.70 | --- | 0.050 | 0.050 | --- | --- | --- | --- |
| ISO 3306:1985 | R33 | --- | --- | 0.16 | 0.70 | --- | 0.050 | 0.050 | --- | --- | --- | --- |
| ISO 2937:1974 | TS 1 | --- | --- | 0.16 | 0.30-0.70 | --- | 0.050 | 0.050 | --- | --- | --- | --- |
| ASTM A513-15* | Grade 1015 | G10150 | --- | 0.13-0.18 | 0.30-0.60 | --- | 0.035 | 0.035 | --- | --- | --- | --- |
| | Grade 1008 | G10080 | --- | 0.10 | 0.50 | --- | 0.035 | 0.035 | --- | --- | --- | --- |
| ASTM A519-06 (2012)* | Grade 1020 | G10200 | --- | 0.18-0.23 | 0.30-0.60 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| ASME SA-513* | Grade 1015 | G10150 | --- | 0.12-0.18 | 0.30-0.60 | --- | 0.035 | 0.035 | --- | --- | --- | --- |
| | Grade 1008 | G10080 | --- | 0.10 | 0.50 | --- | 0.035 | 0.035 | --- | --- | --- | --- |
| ISO 3304:1985 | R37 | --- | --- | 0.17 | 0.8 | 0.35 | 0.050 | 0.050 | --- | --- | --- | --- |
| ISO 3305:1985 | R37 | --- | --- | 0.17 | 0.8 | 0.35 | 0.050 | 0.050 | --- | --- | --- | --- |
| ISO 3306:1985 | R37 | --- | --- | 0.17 | 0.8 | 0.35 | 0.050 | 0.050 | --- | --- | --- | --- |
| JIS G 3445:2010 | Symbol STKM12A | --- | --- | 0.20 | 0.60 | 0.35 | 0.040 | 0.040 | --- | --- | --- | --- |
| JIS G 3472:2013 | Symbol STAM340G | --- | --- | 0.20 | 0.60 | 0.35 | 0.035 | 0.035 | --- | --- | --- | --- |
| EN 10296-1:2003 | E235 | --- | 1.0308 | 0.17 | 1.20 | 0.35 | 0.045 | 0.045 | --- | --- | --- | --- |
| | E260 | --- | 1.0220 | 0.16 | 1.20 | 0.35 | 0.045 | 0.045 | --- | --- | --- | --- |
| EN 10305-3:2010 | E260 | --- | 1.0220 | 0.16 | 1.20 | 0.35 | 0.025 | 0.025 | --- | --- | --- | Al 0.015 min. |
| ASTM A512-06 (2012)* | Grade MT 1020 | G10200 | --- | 0.15-0.25 | 0.30-0.60 | --- | 0.04 | 0.045 | --- | -- | --- | --- |
| ASTM A513-15* | Grade 1020 | G10200 | --- | 0.18-0.23 | 0.30-0.60 | --- | 0.035 | 0.035 | --- | --- | --- | --- |
| | Grade 1021 | G10210 | --- | 0.18-0.23 | 0.60-0.90 | --- | 0.035 | 0.035 | --- | --- | --- | --- |
| ASME SA-513* | Grade 1020 | G10200 | --- | 0.17-0.23 | 0.30-0.60 | --- | 0.035 | 0.035 | --- | --- | --- | --- |
| | Grade 1021 | G10210 | --- | 0.17-0.23 | 0.60-0.90 | --- | 0.035 | 0.035 | --- | --- | --- | --- |

*: See "List of Standards" at the beginning of the chapter.

**5.1 Carbon Steel Tubes for General and Structural Applications**

**5.1B Chemical Composition of Carbon Steel Tubes for General and Structural Applications (Continued)**

| Specification | Designation | UNS No. | Steel No. | Weight, % max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ISO 3304:1985 | R28 | --- | --- | 0.10 | 0.30 | --- | 0.040 | 0.040 | --- | --- | --- | --- |
| ISO 3305:1985 | R28 | --- | --- | 0.13 | 0.60 | --- | 0.050 | 0.050 | --- | --- | --- | --- |
| EN 10305-2:2010 | E155 | --- | 1.0033 | 0.11 | 0.70 | 0.35 | 0.025 | 0.025 | --- | --- | --- | Al 0.015 min. |
| ASME SA-513* | Grade 1020 | G10200 | --- | 0.17-0.23 | 0.30-0.60 | --- | 0.035 | 0.035 | --- | --- | --- | --- |
| ISO 2937:1974 | TS 4 | --- | --- | 0.17 | 0.40-0.80 | 0.35 | 0.045 | 0.045 | --- | --- | --- | --- |
| ISO 3304:1985 | R37 | --- | --- | 0.17 | 0.8 | 0.35 | 0.050 | 0.050 | --- | --- | --- | --- |
| ISO 3305:1985 | R37 | --- | --- | 0.17 | 0.8 | 0.35 | 0.050 | 0.050 | --- | --- | --- | --- |
| ISO 3306:1985 | R37 | --- | --- | 0.17 | 0.8 | 0.35 | 0.050 | 0.050 | --- | --- | --- | --- |
| EN 10297-1:2003 | E235 | --- | 1.0308 | 0.17 | 1.20 | 0.35 | 0.030 | 0.035 | --- | --- | --- | --- |
| ASTM A513-15* | Grade 1020 | G10200 | --- | 0.18-0.23 | 0.30-0.60 | --- | 0.035 | 0.035 | --- | --- | --- | --- |
| ASTM A519-06 (2012)* | Grade 1025 | G10250 | --- | 0.22-0.28 | 0.30-0.60 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| ISO 3304:1985 | R33 | --- | --- | 0.16 | 0.70 | --- | 0.050 | 0.050 | --- | --- | --- | --- |
| ISO 3305:1985 | R33 | --- | --- | 0.16 | 0.70 | --- | 0.050 | 0.050 | --- | --- | --- | --- |
| JIS G 3473:2013 | Symbol STC370 | --- | --- | 0.25 | 0.30-0.90 | 0.35 | 0.040 | 0.040 | --- | --- | --- | --- |
| JIS G 3445:2010 | Symbol STKM13A | --- | --- | 0.25 | 0.30-0.90 | 0.35 | 0.040 | 0.040 | --- | --- | --- | --- |
| EN 10305-2:2010 | E195 | --- | 1.0034 | 0.15 | 0.70 | 0.35 | 0.025 | 0.025 | --- | --- | --- | Al 0.015 min. |
| EN 10296-1:2003 | E275K2 | --- | 1.0456 | 0.20 | 0.50-1.40 | 0.40 | 0.035 | 0.030 | 0.30 | 0.30 | 0.10 | Al 0.020 min; Cu 0.35; N 0.015; Nb 0.050; Ti 0.03; V 0.05 |
| ASTM A513-15* | Grade 1021 | G10210 | --- | 0.18-0.23 | 0.60-0.90 | --- | 0.035 | 0.035 | --- | --- | --- | --- |
| ASME SA-513* | Grade 1021 | G10210 | --- | 0.17-0.23 | 0.60-0.90 | --- | 0.035 | 0.035 | --- | --- | --- | --- |
| ASTM A519-06 (2012)* | Grade 1020 | G10200 | --- | 0.18-0.23 | 0.30-0.60 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| ASTM A512-06 (2012)* | Grade MT 1025 | G10250 | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| ASTM A519-06 (2012)* | Grade 1025 | G10250 | --- | 0.22-0.28 | 0.30-0.60 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| ASME SA-513* | Grade 1025 | G10250 | --- | 0.22-0.28 | 0.30-0.60 | --- | 0.035 | 0.035 | --- | --- | --- | --- |
| | Grade 1008 | G10080 | --- | 0.10 | 0.50 | --- | 0.035 | 0.035 | --- | --- | --- | --- |
| | Grade 1010 | G10100 | --- | 0.08-0.13 | 0.30-0.60 | --- | 0.035 | 0.035 | --- | --- | --- | --- |
| | Grade 1015 | G10150 | --- | 0.12-0.18 | 0.30-0.60 | --- | 0.035 | 0.035 | --- | --- | --- | --- |
| ASTM A513-15* | Grade 1025 | G10250 | --- | 0.22-0.28 | 0.30-0.60 | --- | 0.035 | 0.035 | --- | --- | --- | --- |
| | Grade 1008 | G10080 | --- | 0.10 | 0.50 | --- | 0.035 | 0.035 | --- | --- | --- | --- |
| | Grade 1010 | G10100 | --- | 0.08-0.13 | 0.30-0.60 | --- | 0.035 | 0.035 | --- | --- | --- | --- |
| | Grade 1015 | G10150 | --- | 0.13-0.18 | 0.30-0.60 | --- | 0.035 | 0.035 | --- | --- | --- | --- |

*: See "List of Standards" at the beginning of the chapter.

Note: This section continued on next page

**5.1 Carbon Steel Tubes for General and Structural Applications**

**5.1B Chemical Composition of Carbon Steel Tubes for General and Structural Applications (Continued)**

| Specification | Designation | UNS No. | Steel No. | Weight, % max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| EN 10305-1:2010 | E215 | --- | 1.0212 | 0.10 | 0.70 | 0.05 | 0.025 | 0.025 | --- | --- | --- | Al 0.025 min |
| EN 10296-1:2003 | E275 | --- | 1.0225 | 0.21 | 1.40 | 0.35 | 0.045 | 0.045 | --- | --- | --- | --- |
| EN 10305-1:2010 | E255 | --- | 1.0408 | 0.21 | 0.40-1.10 | 0.35 | 0.025 | 0.025 | --- | --- | --- | -- |
| EN 10305-3:2010 | E275 | --- | 1.0225 | 0.21 | 1.40 | 0.35 | 0.025 | 0.025 | --- | --- | --- | Al 0.015 min. |
| | E235 | --- | 1.0308 | 0.17 | 1.20 | 0.35 | 0.025 | 0.025 | --- | --- | --- | Al 0.015 min. |
| EN 10305-2:2010 | E275 | --- | 1.0225 | 0.21 | 1.40 | 0.35 | 0.025 | 0.025 | --- | --- | --- | Al 0.015 min. |
| EN 10296-1:2003 | E235 | --- | 1.0308 | 0.17 | 1.20 | 0.35 | 0.045 | 0.045 | --- | --- | --- | --- |
| JIS G 3472:2013 | Symbol STAM390G | --- | --- | 0.25 | 0.30-0.90 | 0.35 | 0.035 | 0.035 | --- | --- | --- | --- |
| JIS G 3445:2010 | Symbol STKM12B | --- | --- | 0.20 | 0.60 | 0.35 | 0.040 | 0.040 | --- | --- | --- | --- |

**5.1 Carbon Steel Tubes for General and Structural Applications**

**5.1B Chemical Composition of Carbon Steel Tubes for General and Structural Applications (Continued)**

| Specification | Designation | UNS No. | Steel No. | Weight, % max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ISO 3304:1985 | R28 | --- | --- | 0.10 | 0.30 | --- | 0.040 | 0.040 | --- | --- | --- | --- |
| | R37 | --- | --- | 0.17 | 0.8 | 0.35 | 0.050 | 0.050 | --- | --- | --- | --- |
| | R44 | --- | --- | 0.21 | 1.2 | 0.35 | 0.050 | 0.050 | --- | --- | --- | --- |
| ISO 3305:1985 | R28 | --- | --- | 0.13 | 0.60 | --- | 0.050 | 0.050 | --- | --- | --- | --- |
| | R37 | --- | --- | 0.17 | 0.8 | 0.35 | 0.050 | 0.050 | --- | --- | --- | --- |
| | R44 | --- | --- | 0.21 | 1.2 | 0.35 | 0.050 | 0.050 | --- | --- | --- | --- |
| ISO 3306:1985 | R37 | --- | --- | 0.17 | 0.8 | 0.35 | 0.050 | 0.050 | --- | --- | --- | --- |
| | R44 | --- | --- | 0.21 | 1.2 | 0.35 | 0.050 | 0.050 | --- | --- | --- | --- |
| EN 10305-2:2010 | E155 | --- | 1.0033 | 0.11 | 0.70 | 0.35 | 0.025 | 0.025 | --- | --- | --- | Al 0.015 min. |
| JIS G 3444:2010 | Symbol STK400 | --- | --- | 0.25 | --- | --- | 0.040 | 0.040 | --- | --- | --- | --- |
| ASTM A500-13 | Grade D | --- | --- | 0.26 | 1.35 | --- | 0.035 | 0.035 | --- | --- | --- | Cu 0.20 min |
| GB/T 17396-1998 | Grade 20 | --- | --- | 0.17-0.24 | 0.35-0.65 | 0.17-0.37 | 0.035 | 0.035 | 0.25 | 0.25 | --- | Cu 0.20 |
| ASTM A501-14 | Grade A | K03000 | --- | 0.26 | --- | --- | 0.035 | 0.035 | --- | --- | --- | Cu 0.20 min |
| ASTM A500-13 | Grade B | K03000 | --- | 0.26 | 1.35 | --- | 0.035 | 0.035 | --- | --- | --- | Cu 0.20 min |
| EN 10296-1:2003 | E275 | --- | 1.0225 | 0.21 | 1.40 | 0.35 | 0.045 | 0.045 | --- | --- | --- | --- |
| EN 10297-1:2003 | E275 | --- | 1.0225 | 0.21 | 1.40 | 0.35 | 0.030 | 0.035 | --- | --- | --- | --- |
| EN 10305-2:2010 | E275 | --- | 1.0225 | 0.21 | 1.40 | 0.35 | 0.025 | 0.025 | --- | --- | --- | Al 0.015 min. |
| EN 10305-3:2010 | E275 | --- | 1.0225 | 0.21 | 1.40 | 0.35 | 0.025 | 0.025 | --- | --- | --- | Al 0.015 min. |
| EN 10296-1:2003 | E320 | --- | 1.0237 | 0.20 | 1.40 | 0.35 | 0.045 | 0.045 | --- | --- | --- | --- |
| EN 10305-3:2010 | E320 | --- | 1.0237 | 0.20 | 1.40 | 0.35 | 0.025 | 0.025 | --- | --- | --- | Al 0.015 min. |
| EN 10297-1:2003 | E275K2 | --- | 1.0456 | 0.20 | 0.50-1.40 | 0.40 | 0.030 | 0.030 | 0.30 | 0.30 | 0.10 | Al 0.020 min; Cu 0.35; N 0.015; Nb 0.05; Ti 0.03; V 0.05 |
| ISO 2937:1974 | TS 9 | --- | --- | 0.21 | 0.40-1.20 | 0.35 | 0.045 | 0.045 | --- | --- | --- | --- |
| JIS G 3445:2010 | Symbol STKM14A | --- | --- | 0.30 | 0.30-1.00 | 0.35 | 0.040 | 0.040 | --- | --- | --- | --- |
| ASTM A519-06 (2012)* | Grade 1035 | G10350 | --- | 0.32-0.38 | 0.60-0.90 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| ASME SA-513* | Grade 1026 | G10260 | --- | 0.22-0.28 | 0.60-0.90 | --- | 0.035 | 0.035 | --- | --- | --- | --- |
| | Grade 1030 | G10300 | --- | 0.27-0.34 | 0.60-0.90 | --- | 0.035 | 0.035 | --- | --- | --- | --- |
| | Grade 1008 | G10080 | --- | 0.10 | 0.50 | --- | 0.035 | 0.035 | --- | --- | --- | --- |
| | Grade 1010 | G10100 | --- | 0.08-0.13 | 0.30-0.60 | --- | 0.035 | 0.035 | --- | --- | --- | --- |
| | Grade 1015 | G10150 | --- | 0.12-0.18 | 0.30-0.60 | --- | 0.035 | 0.035 | --- | --- | --- | --- |
| | Grade 1020 | G10200 | --- | 0.17-0.23 | 0.30-0.60 | --- | 0.035 | 0.035 | --- | --- | --- | --- |

*: See "List of Standards" at the beginning of the chapter.

Note: This section continued on next page.

**5.1 Carbon Steel Tubes for General and Structural Applications**

**5.1B Chemical Composition of Carbon Steel Tubes for General and Structural Applications (Continued)**

| Specification | Designation | UNS No. | Steel No. | Weight, % max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASTM A513-15* | Grade 1026 | G10260 | --- | 0.22-0.28 | 0.60-0.90 | --- | 0.035 | 0.035 | --- | --- | --- | --- |
| | Grade 1030 | G10300 | --- | 0.28-0.34 | 0.60-0.90 | --- | 0.035 | 0.035 | --- | --- | --- | --- |
| | Grade 1008 | G10080 | --- | 0.10 | 0.50 | --- | 0.035 | 0.035 | --- | --- | --- | --- |
| | Grade 1010 | G10100 | --- | 0.08-0.13 | 0.30-0.60 | --- | 0.035 | 0.035 | --- | --- | --- | --- |
| | Grade 1015 | G10150 | --- | 0.13-0.18 | 0.30-0.60 | --- | 0.035 | 0.035 | --- | --- | --- | --- |
| | Grade 1020 | G10200 | --- | 0.18-0.23 | 0.30-0.60 | --- | 0.035 | 0.035 | --- | --- | --- | --- |
| ISO 3304:1985 | R33 | --- | --- | 0.16 | 0.70 | --- | 0.050 | 0.050 | --- | --- | --- | --- |
| ISO 3305:1985 | R33 | --- | --- | 0.16 | 0.70 | --- | 0.050 | 0.050 | --- | --- | --- | --- |
| EN 10305-1:2010 | E235 | --- | 1.0308 | 0.17 | 1.20 | 0.35 | 0.025 | 0.025 | --- | --- | --- | Al 0.015 min. |

*: See "List of Standards" at the beginning of the chapter.

Note: This section continued on next page.

**5.1 Carbon Steel Tubes for General and Structural Applications**

**5.1B Chemical Composition of Carbon Steel Tubes for General and Structural Applications (Continued)**

| Specification | Designation | UNS No. | Steel No. | Weight, % max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| EN 10305-2:2010 | E195 | --- | 1.0034 | 0.15 | 0.70 | 0.35 | 0.025 | 0.025 | --- | --- | --- | Al 0.015 min. |
| ASTM A500-13 | Grade C | K02705 | --- | 0.23 | 1.35 | --- | 0.035 | 0.035 | --- | --- | --- | Cu 0.20 min |
| ASTM A513-15* | Grade 1021 | G10210 | --- | 0.18-0.23 | 0.60-0.90 | --- | 0.035 | 0.035 | --- | --- | --- | --- |
| ASME SA-513* | Grade 1021 | G10210 | --- | 0.17-0.23 | 0.60-0.90 | --- | 0.035 | 0.035 | --- | --- | --- | --- |
| EN 10297-1:2003 | C22E | --- | 1.1151 | 0.17-0.24 | 0.40-0.70 | 0.40 | 0.035 | 0.035 | 0.40 | 0.40 | 0.10 | Cr+Mo+Ni 0.63 |
| EN 10305-1:2010 | E215 | --- | 1.0212 | 0.10 | 0.70 | 0.05 | 0.025 | 0.025 | --- | --- | --- | Al 0.025 min |
| ASTM A512-06 (2012)* | Grade MT 1010 | G10100 | --- | 0.05-0.15 | 0.30-0.60 | --- | 0.04 | 0.045 | --- | --- | --- | --- |
| EN 10305-1:2010 | C35E | --- | 1.1181 | 0.32-0.39 | 0.50-0.80 | 0.40 | 0.030 | 0.035 | 0.40 | --- | 0.10 | Cr+Mo+Ni 0.63 |
| | E255 | --- | 1.0408 | 0.21 | 0.40-1.10 | 0.35 | 0.025 | 0.025 | --- | --- | --- | --- |
| EN 10305-2:2010 | E235 | --- | 1.0308 | 0.17 | 1.20 | 0.35 | 0.025 | 0.025 | --- | --- | --- | Al 0.015 min. |
| JIS G 3445:2010 | Symbol STKM18A | --- | --- | 0.18 | 1.50 | 0.55 | 0.040 | 0.040 | --- | --- | --- | --- |
| | Symbol STKM13B | --- | --- | 0.25 | 0.30-0.90 | 0.35 | 0.040 | 0.040 | --- | --- | --- | --- |
| JIS G 3472:2013 | Symbol STAM440G | --- | --- | 0.25 | 0.30-0.90 | 0.35 | 0.035 | 0.035 | --- | --- | --- | --- |
| JIS G 3473:2013 | Symbol STC440 | --- | --- | 0.25 | 0.30-0.90 | 0.35 | 0.040 | 0.040 | --- | --- | --- | --- |
| JIS G 3472:2013 | Symbol STAM440H | --- | --- | 0.25 | 0.30-0.90 | 0.35 | 0.035 | 0.035 | --- | --- | --- | --- |
| ASTM A519-06 (2012)* | Grade 1045 | G10450 | --- | 0.43-0.50 | 0.60-0.90 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| | Grade 1035 | G10350 | --- | 0.32-0.38 | 0.60-0.90 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| ASME SA-513* | Grade 1035 | G10350 | --- | 0.31-0.38 | 0.60-0.90 | --- | 0.035 | 0.035 | --- | --- | --- | --- |
| | Grade 1040 | G10400 | --- | 0.36-0.44 | 0.60-0.90 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| ASTM A519-06 (2012)* | Grade 1020 | G10200 | --- | 0.18-0.23 | 0.30-0.60 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| ASME SA-513* | Grade 1025 | G10250 | --- | 0.22-0.28 | 0.30-0.60 | --- | 0.035 | 0.035 | --- | --- | --- | --- |
| ASTM A512-06 (2012)* | Grade MT 1030 | G10300 | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| | Grade 1011 | G10110 | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| | Grade 1110 | G11100 | --- | 0.08-0.13 | 0.30-0.60 | --- | 0.040 | 0.08-0.130 | --- | --- | --- | --- |
| ASTM A513-15* | Grade 1035 | G10350 | --- | 0.32-0.38 | 0.60-0.90 | --- | 0.035 | 0.035 | --- | --- | --- | --- |
| | Grade 1040 | G10400 | --- | 0.37-0.44 | 0.60-0.90 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| ASTM A513-15* | Grade 1025 | G10250 | --- | 0.22-0.28 | 0.30-0.60 | --- | 0.035 | 0.035 | --- | --- | --- | --- |
| ISO 3304:1985 | R37 | --- | --- | 0.17 | 0.8 | 0.35 | 0.050 | 0.050 | --- | --- | --- | --- |
| | R44 | --- | --- | 0.21 | 1.2 | 0.35 | 0.050 | 0.050 | --- | --- | --- | --- |
| ISO 3305:1985 | R37 | --- | --- | 0.17 | 0.8 | 0.35 | 0.050 | 0.050 | --- | --- | --- | --- |
| | R44 | --- | --- | 0.21 | 1.2 | 0.35 | 0.050 | 0.050 | --- | --- | --- | --- |
| EN 10305-3:2010 | E355 | --- | 1.0580 | 0.22 | 1.60 | 0.55 | 0.025 | 0.025 | --- | --- | --- | Al 0.020 min. |
| EN 10305-1:2010 | E355 | --- | 1.0580 | 0.22 | 1.60 | 0.55 | 0.025 | 0.025 | --- | --- | --- | Al 0.020 min. |
| EN 10305-2:2010 | E355 | --- | 1.0580 | 0.22 | 1.60 | 0.55 | 0.025 | 0.025 | --- | --- | --- | Al 0.020 min. |
| EN 10297-1:2003 | E315 | --- | 1.0236 | 0.21 | 1.50 | 0.30 | 0.030 | 0.035 | --- | --- | --- | --- |
| EN 10305-3:2010 | E370 | --- | 1.0261 | 0.21 | 1.60 | 0.55 | 0.025 | 0.025 | --- | --- | --- | Al 0.020 min. |

*: See "List of Standards" at the beginning of the chapter.

Note: This section continued on next page.

**5.1 Carbon Steel Tubes for General and Structural Applications**

**5.1B Chemical Composition of Carbon Steel Tubes for General and Structural Applications (Continued)**

| Specification | Designation | UNS No. | Steel No. | Weight, % max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| EN 10296-1:2003 | E370 | --- | 1.0261 | 0.21 | 1.60 | 0.55 | 0.045 | 0.045 | --- | --- | --- | --- |
| ASTM A595/A595M-14 | Grade A | K02004 | --- | 0.15-0.25 | 0.30-0.90 | 0.060 | 0.035 | 0.035 | --- | --- | --- | (Si+Al) 0.020 min |
| ASTM A513-15* | Grade 1035 | G10350 | --- | 0.32-0.38 | 0.60-0.90 | --- | 0.035 | 0.035 | --- | --- | --- | --- |
| | Grade 1524 | G15240 | --- | 0.19-0.25 | 1.35-1.65 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| | Grade 1040 | G10400 | --- | 0.37-0.44 | 0.60-0.90 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| ASME SA-513* | Grade 1035 | G10350 | --- | 0.31-0.38 | 0.60-0.90 | --- | 0.035 | 0.035 | --- | --- | --- | --- |
| | Grade 1524 | G15240 | --- | 0.18-0.25 | 1.35-1.65 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| | Grade 1040 | G10400 | --- | 0.36-0.44 | 0.60-0.90 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| ASTM A512-06 (2012)* | Grade MT 1015 | G10150 | --- | 0.10-0.20 | 0.30-0.60 | --- | 0.04 | 0.045 | --- | --- | --- | --- |
| EN 10305-1:2010 | C35E | --- | 1.1181 | 0.32-0.39 | 0.50-0.80 | 0.40 | 0.030 | 0.035 | 0.40 | --- | 0.10 | Cr+Mo+Ni 0.63 |
| ASTM A512-06 (2012)* | Grade 1016 | G10160 | --- | 0.13-0.18 | 0.60-0.90 | --- | 0.040 | 0.045 | --- | --- | --- | --- |
| | Grade MT 1017 | G10170 | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| ASTM A519-06 (2012)* | Grade 1050 | G10500 | --- | 0.48-0.55 | 0.60-0.90 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| ASME SA-513* | Grade 1021 | G10210 | --- | 0.17-0.23 | 0.60-0.90 | --- | 0.035 | 0.035 | --- | --- | --- | --- |
| ASTM A512-06 (2012)* | Grade 1018 | G10180 | --- | 0.15-0.20 | 0.60-0.90 | --- | 0.040 | 0.045 | --- | --- | --- | --- |
| JIS G 3445:2010 | Symbol STKM15A | --- | --- | 0.25-0.35 | 0.30-1.00 | 0.35 | 0.040 | 0.040 | --- | --- | --- | --- |
| JIS G 3472:2013 | Symbol STAM470G | --- | --- | 0.25 | 0.30-0.90 | 0.35 | 0.035 | 0.035 | --- | --- | --- | --- |
| JIS G 3445:2010 | Symbol STKM12C | --- | --- | 0.20 | 0.60 | 0.35 | 0.040 | 0.040 | --- | --- | --- | --- |
| ASTM A513-15* | Grade 1021 | G10210 | --- | 0.18-0.23 | 0.60-0.90 | --- | 0.035 | 0.035 | --- | --- | --- | --- |
| JIS G 3472:2013 | Symbol STAM470H | --- | --- | 0.25 | 0.30-0.90 | 0.35 | 0.035 | 0.035 | --- | --- | --- | --- |
| ISO 3304:1985 | R50 | --- | --- | 0.23 | 1.6 | 0.55 | 0.050 | 0.050 | --- | --- | --- | --- |
| ISO 3305:1985 | R50 | --- | --- | 0.23 | 1.6 | 0.55 | 0.050 | 0.050 | --- | --- | --- | --- |
| ISO 3306:1985 | R50 | --- | --- | 0.23 | 1.6 | 0.55 | 0.050 | 0.050 | --- | --- | --- | --- |
| EN 10305-1:2010 | E235 | --- | 1.0308 | 0.17 | 1.20 | 0.35 | 0.025 | 0.025 | --- | --- | --- | Al 0.015 min. |
| ASTM A595/A595M-14 | Grade B | K02005 | --- | 0.15-0.25 | 0.40-1.35 | 0.060 | 0.035 | 0.035 | --- | --- | --- | (Si+Al) 0.020 min |
| ASTM A513-15* | Grade 1026 | G10260 | --- | 0.22-0.28 | 0.60-0.90 | --- | 0.035 | 0.035 | --- | --- | --- | --- |
| | Grade 1020 | G10200 | --- | 0.18-0.23 | 0.30-0.60 | --- | 0.035 | 0.035 | --- | --- | --- | --- |
| | Grade 1025 | G10250 | --- | 0.22-0.28 | 0.30-0.60 | --- | 0.035 | 0.035 | --- | --- | --- | --- |
| | Grade 1030 | G10300 | --- | 0.28-0.34 | 0.60-0.90 | --- | 0.035 | 0.035 | --- | --- | --- | --- |
| ASTM A519-06 (2012)* | Grade 1025 | G10250 | --- | 0.22-0.28 | 0.30-0.60 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| ASTM A519-06 (2012)* | Grade 1020 | G10200 | --- | 0.18-0.23 | 0.30-0.60 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| ASME SA-513* | Grade 1026 | G10260 | --- | 0.22-0.28 | 0.60-0.90 | --- | 0.035 | 0.035 | --- | --- | --- | --- |
| | Grade 1020 | G10200 | --- | 0.17-0.23 | 0.30-0.60 | --- | 0.035 | 0.035 | --- | --- | --- | --- |
| | Grade 1025 | G10250 | --- | 0.22-0.28 | 0.30-0.60 | --- | 0.035 | 0.035 | --- | --- | --- | --- |
| | Grade 1030 | G10300 | --- | 0.27-0.34 | 0.60-0.90 | --- | 0.035 | 0.035 | --- | --- | --- | --- |

*: See "List of Standards" at the beginning of the chapter.

Note: This section continued on next page.

**5.1 Carbon Steel Tubes for General and Structural Applications**

**5.1B Chemical Composition of Carbon Steel Tubes for General and Structural Applications (Continued)**

| Specification | Designation | UNS No. | Steel No. | Weight, % max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| EN 10297-1:2003 | E355 | --- | 1.0580 | 0.22 | 1.60 | 0.55 | 0.030 | 0.035 | --- | --- | --- | --- |
| EN 10296-1:2003 | E355 | --- | 1.0580 | 0.22 | 1.60 | 0.55 | 0.045 | 0.045 | --- | --- | --- | --- |
| JIS G 3444:2010 | Symbol STK490 | --- | --- | 0.18 | 1.65 | 0.55 | 0.035 | 0.035 | --- | --- | --- | --- |
| JIS G 3445:2010 | Symbol STKM18B | --- | --- | 0.18 | 1.50 | 0.55 | 0.040 | 0.040 | --- | --- | --- | --- |
| | Symbol STKM19A | --- | --- | 0.25 | 1.50 | 0.55 | 0.040 | 0.040 | --- | --- | --- | --- |
| ISO 2937:1974 | TS 18 | --- | --- | 0.23 | 0.80-1.50 | 0.35 | 0.045 | 0.045 | --- | --- | --- | --- |
| EN 10305-2:2010 | E235 | --- | 1.0308 | 0.17 | 1.20 | 0.35 | 0.025 | 0.025 | --- | --- | --- | Al 0.015 min. |
| EN 10305-3:2010 | E420 | --- | 1.0575 | 0.16 | 1.70 | 0.50 | 0.025 | 0.025 | --- | --- | --- | Al 0.020 min. |
| ASTM A512-06 (2012)* | Grade MT 1020 | G10200 | --- | 0.15-0.25 | 0.30-0.60 | --- | 0.04 | 0.045 | --- | --- | --- | --- |
| ASTM A513-15* | Grade 1021 | G10210 | --- | 0.18-0.23 | 0.60-0.90 | --- | 0.035 | 0.035 | --- | --- | --- | --- |
| ASME SA-513* | Grade 1021 | G10210 | --- | 0.17-0.23 | 0.60-0.90 | --- | 0.035 | 0.035 | --- | --- | --- | --- |
| ASTM A512-06 (2012)* | Grade 1025 | G10250 | --- | 0.22-0.28 | 0.30-0.60 | --- | 0.040 | 0.045 | --- | --- | --- | --- |
| EN 10297-1:2003 | C22E | --- | 1.1151 | 0.17-0.24 | 0.40-0.70 | 0.40 | 0.035 | 0.035 | 0.40 | 0.40 | 0.10 | Cr+Mo+Ni 0.63 |
| JIS G 3444:2010 | Symbol STK500 | --- | --- | 0.24 | 0.30-1.30 | 0.35 | 0.040 | 0.040 | --- | --- | --- | --- |
| JIS G 3472:2013 | Symbol STAM500G | --- | --- | 0.30 | 0.30-1.00 | 0.35 | 0.035 | 0.035 | --- | --- | --- | --- |
| JIS G 3445:2010 | Symbol STKM14B | --- | --- | 0.30 | 0.30-1.00 | 0.35 | 0.040 | 0.040 | --- | --- | --- | --- |
| JIS G 3472:2013 | Symbol STAM500H | --- | --- | 0.30 | 0.30-1.00 | 0.35 | 0.035 | 0.035 | --- | --- | --- | --- |
| EN 10305-1:2010 | C45E | --- | 1.1191 | 0.42-0.55 | 0.50-0.80 | 0.40 | 0.030 | 0.035 | 0.40 | --- | 0.10 | Cr+Mo+Ni 0.63 |
| GB/T 17396-1998 | Grade 35 | --- | --- | 0.32-0.40 | 0.50-0.80 | 0.17-0.37 | 0.035 | 0.035 | 0.25 | 0.25 | --- | Cu 0.20 |
| JIS G 3445:2010 | Symbol STKM16A | --- | --- | 0.35-0.45 | 0.40-1.00 | 0.40 | 0.040 | 0.040 | --- | --- | --- | --- |
| EN 10305-2:2010 | E275 | --- | 1.0225 | 0.21 | 1.40 | 0.35 | 0.025 | 0.025 | --- | --- | --- | Al 0.015 min. |
| JIS G 3445:2010 | Symbol STKM13C | --- | --- | 0.25 | 0.30-0.90 | 0.35 | 0.040 | 0.040 | --- | --- | --- | --- |
| | Symbol STKM18C | --- | --- | 0.18 | 1.50 | 0.55 | 0.040 | 0.040 | --- | --- | --- | --- |
| JIS G 3473:2013 | Symbol STC510A | --- | --- | 0.25 | 0.30-0.90 | 0.35 | 0.040 | 0.040 | --- | --- | --- | --- |
| | Symbol STC510B | --- | --- | 0.18 | 1.50 | 0.55 | 0.040 | 0.040 | --- | --- | --- | --- |
| ASTM A513-15* | Grade 1025 | G10250 | --- | 0.22-0.28 | 0.30-0.60 | --- | 0.035 | 0.035 | --- | --- | --- | --- |
| | Grade 1026 | G10260 | --- | 0.22-0.28 | 0.60-0.90 | --- | 0.035 | 0.035 | --- | --- | --- | --- |
| ASTM A519-06 (2012)* | Grade 1045 | G10450 | --- | 0.43-0.50 | 0.60-0.90 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| ASME SA-513* | Grade 1025 | G10250 | --- | 0.22-0.28 | 0.30-0.60 | --- | 0.035 | 0.035 | --- | --- | --- | --- |
| | Grade 1026 | G10260 | --- | 0.22-0.28 | 0.60-0.90 | --- | 0.035 | 0.035 | --- | --- | --- | --- |
| ASTM A519-06 (2012)* | Grade 1025 | G10250 | --- | 0.22-0.28 | 0.30-0.60 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| | Grade 1035 | G10350 | --- | 0.32-0.38 | 0.60-0.90 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| EN 10305-1:2010 | E255 | --- | 1.0408 | 0.21 | 0.40-1.10 | 0.35 | 0.025 | 0.025 | --- | --- | --- | --- |
| | E410 | --- | 1.0509 | 0.16-0.22 | 1.30-1.70 | 0.10-0.50 | 0.030 | 0.035 | --- | --- | --- | V 0.08-0.15; Al 0.010-0.060; Nb 0.07; Ti 0.05; (Nb+V) 0.20 |
| ISO 3304:1985 | R44 | --- | --- | 0.21 | 1.2 | 0.35 | 0.050 | 0.050 | --- | --- | --- | --- |
| ISO 3305:1985 | R44 | --- | --- | 0.21 | 1.2 | 0.35 | 0.050 | 0.050 | --- | --- | --- | --- |

*: See "List of Standards" at the beginning of the chapter.

Note: This section continued on next page.

**5.1 Carbon Steel Tubes for General and Structural Applications**

**5.1B Chemical Composition of Carbon Steel Tubes for General and Structural Applications (Continued)**

| Specification | Designation | UNS No. | Steel No. | Weight, % max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ISO 3306:1985 | R50 | --- | --- | 0.23 | 1.6 | 0.55 | 0.050 | 0.050 | --- | --- | --- | --- |
| ASTM A519-06 (2012)* | Grade 1050 | G10500 | --- | 0.48-0.55 | 0.60-0.90 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| EN 10305-1:2010 | C35E | --- | 1.1181 | 0.32-0.39 | 0.50-0.80 | 0.40 | 0.030 | 0.035 | 0.40 | --- | 0.10 | Cr+Mo+Ni 0.63 |
| EN 10305-3:2010 | E355 | --- | 1.0580 | 0.22 | 1.60 | 0.55 | 0.025 | 0.025 | --- | --- | --- | Al 0.020 min. |
| ISO 2937:1974 | C 35 | --- | --- | 0.32-0.39 | 0.50-0.80 | 0.15-0.40 | 0.035 | 0.035 | --- | --- | --- | --- |
| JIS G 3444:2010 | Symbol STK540 | --- | --- | 0.23 | 1.50 | 0.55 | 0.040 | 0.040 | --- | --- | --- | --- |
| JIS G 3445:2010 | Symbol STKM20A | --- | --- | 0.25 | 1.60 | 0.55 | 0.040 | 0.040 | --- | --- | --- | Nb or V 0.15 |
| JIS G 3473:2013 | Symbol STC540 | --- | --- | 0.25 | 1.60 | 0.55 | 0.040 | 0.040 | --- | --- | --- | Nb or V 0.15 |
| EN 10296-1:2003 | E355 | --- | 1.0580 | 0.22 | 1.60 | 0.55 | 0.045 | 0.045 | --- | --- | --- | --- |
| JIS G 3472:2013 | Symbol STAM540H | --- | --- | 0.30 | 0.30-1.00 | 0.35 | 0.035 | 0.035 | --- | --- | --- | --- |
| ISO 3304:1985 | R50 | --- | --- | 0.23 | 1.6 | 0.55 | 0.050 | 0.050 | --- | --- | --- | --- |
| ISO 3305:1985 | R50 | --- | --- | 0.23 | 1.6 | 0.55 | 0.050 | 0.050 | --- | --- | --- | --- |
| EN 10297-1:2003 | C35E | --- | 1.1181 | 0.32-0.39 | 0.50-0.80 | 0.40 | 0.035 | 0.035 | 0.40 | 0.40 | 0.10 | Cr+Mo+Ni 0.63 |
| JIS G 3445:2010 | Symbol STKM17A | --- | --- | 0.45-0.55 | 0.40-1.00 | 0.40 | 0.040 | 0.040 | --- | --- | --- | --- |
| EN 10305-1:2010 | E410 | --- | 1.0509 | 0.16-0.22 | 1.30-1.70 | 0.10-0.50 | 0.030 | 0.035 | --- | --- | --- | V 0.08-0.15; Al 0.010-0.060; Nb 0.07; Ti 0.05; (Nb+V) 0.20 |
| JIS G 3445:2010 | Symbol STKM14C | --- | --- | 0.30 | 0.30-1.00 | 0.35 | 0.040 | 0.040 | --- | --- | --- | --- |
| | Symbol STKM19C | --- | --- | 0.25 | 1.50 | 0.55 | 0.040 | 0.040 | --- | --- | --- | --- |
| ASTM A513-15* | Grade 1026 | G10260 | --- | 0.22-0.28 | 0.60-0.90 | --- | 0.035 | 0.035 | --- | --- | --- | --- |
| | Grade 1030 | G10300 | --- | 0.28-0.34 | 0.60-0.90 | --- | 0.035 | 0.035 | --- | --- | --- | --- |
| | Grade 1035 | G10350 | --- | 0.32-0.38 | 0.60-0.90 | --- | 0.035 | 0.035 | --- | --- | --- | --- |
| ASTM A519-06 (2012)* | Grade 1050 | G10500 | --- | 0.48-0.55 | 0.60-0.90 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| ASTM A512-06 (2012)* | Grade 1030 | G10300 | --- | 0.28-0.34 | 0.60-0.90 | --- | 0.040 | 0.045 | --- | --- | --- | --- |
| ASTM A519-06 (2012)* | Grade 1045 | G10450 | --- | 0.43-0.50 | 0.60-0.90 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| ASME SA-513* | Grade 1026 | G10260 | --- | 0.22-0.28 | 0.60-0.90 | --- | 0.035 | 0.035 | --- | --- | --- | --- |
| | Grade 1030 | G10300 | --- | 0.27-0.34 | 0.60-0.90 | --- | 0.035 | 0.035 | --- | --- | --- | --- |
| | Grade 1035 | G10350 | --- | 0.31-0.38 | 0.60-0.90 | --- | 0.035 | 0.035 | --- | --- | --- | --- |
| EN 10305-2:2010 | E275 | --- | 1.0225 | 0.21 | 1.40 | 0.35 | 0.025 | 0.025 | --- | --- | --- | Al 0.015 min. |
| ASTM A519-06 (2012)* | Grade 1050 | G10500 | --- | 0.48-0.55 | 0.60-0.90 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| EN 10305-1:2010 | E255 | --- | 1.0408 | 0.21 | 0.40-1.10 | 0.35 | 0.025 | 0.025 | --- | --- | --- | --- |
| | E355 | --- | 1.0580 | 0.22 | 1.60 | 0.55 | 0.025 | 0.025 | --- | --- | --- | Al 0.020 min. |
| ASTM A513-15* | Grade 1030 | G10300 | --- | 0.28-0.34 | 0.60-0.90 | --- | 0.035 | 0.035 | --- | --- | --- | --- |
| | Grade 1035 | G10350 | --- | 0.32-0.38 | 0.60-0.90 | --- | 0.035 | 0.035 | --- | --- | --- | --- |
| | Grade 1040 | G10400 | --- | 0.37-0.44 | 0.60-0.90 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| | Grade 1524 | G15240 | --- | 0.19-0.25 | 1.35-1.65 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| JIS G 3445:2010 | Symbol STKM15C | --- | --- | 0.25-0.35 | 0.30-1.00 | 0.35 | 0.040 | 0.040 | --- | --- | --- | --- |

*: See "List of Standards" at the beginning of the chapter.

Note: This section continued on next page.

**5.1 Carbon Steel Tubes for General and Structural Applications**

**5.1B Chemical Composition of Carbon Steel Tubes for General and Structural Applications (Continued)**

| Specification | Designation | UNS No. | Steel No. | Weight, % max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASME SA-513* | Grade 1030 | G10300 | --- | 0.27-0.34 | 0.60-0.90 | --- | 0.035 | 0.035 | --- | --- | --- | --- |
| | Grade 1035 | G10350 | --- | 0.31-0.38 | 0.60-0.90 | --- | 0.035 | 0.035 | --- | --- | --- | --- |
| | Grade 1040 | G10400 | --- | 0.36-0.44 | 0.60-0.90 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| | Grade 1524 | G15240 | --- | 0.18-0.25 | 1.35-1.65 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| ASTM A519-06 (2012)* | Grade 1035 | G10350 | --- | 0.32-0.38 | 0.60-0.90 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| EN 10305-1:2010 | C35E | --- | 1.1181 | 0.32-0.39 | 0.50-0.80 | 0.40 | 0.030 | 0.035 | 0.40 | --- | 0.10 | Cr+Mo+Ni 0.63 |
| GB/T 17396-1998 | Grade 45 | --- | --- | 0.42-0.50 | 0.50-0.80 | 0.17-0.37 | 0.035 | 0.035 | 0.25 | 0.25 | --- | Cu 0.20 |
| EN 10305-2:2010 | E355 | --- | 1.0580 | 0.22 | 1.60 | 0.55 | 0.025 | 0.025 | --- | --- | --- | Al 0.020 min. |
| JIS G 3474:2014 | Symbol STKT590 | --- | --- | 0.12 | 2.00 | 0.40 | 0.030 | 0.030 | --- | --- | --- | (Nb+V) 0.15; B 0.0002 |
| JIS G 3473:2013 | Symbol STC590A | --- | --- | 0.25 | 0.30-0.90 | 0.35 | 0.040 | 0.040 | --- | --- | --- | --- |
| | Symbol STC590B | --- | --- | 0.25 | 1.50 | 0.55 | 0.040 | 0.040 | --- | --- | --- | --- |
| EN 10297-1:2003 | E420J2 | --- | 1.0599 | 0.16-0.22 | 1.30-1.70 | 0.10-0.50 | 0.030 | 0.035 | 0.30 | 0.40 | 0.08 | Al 0.010 min; Cu 0.30; N 0.020; Nb 0.07; Ti 0.05; V 0.08-0.15; (Nb+V) 0.20 |
| ISO 3304:1985 | R50 | --- | --- | 0.23 | 1.6 | 0.55 | 0.050 | 0.050 | --- | --- | --- | --- |
| ISO 3305:1985 | R50 | --- | --- | 0.23 | 1.6 | 0.55 | 0.050 | 0.050 | --- | --- | --- | --- |
| EN 10305-1:2010 | E410 | --- | 1.0509 | 0.16-0.22 | 1.30-1.70 | 0.10-0.50 | 0.030 | 0.035 | --- | --- | --- | V 0.08-0.15; Al 0.010-0.060; Nb 0.07; Ti 0.05; (Nb+V) 0.20 |
| EN 10297-1:2003 | C45E | --- | 1.1191 | 0.42-0.50 | 0.50-0.80 | 0.40 | 0.035 | 0.035 | 0.40 | 0.40 | 0.10 | Cr+Mo+Ni 0.63 |
| JIS G 3445:2010 | Symbol STKM16C | --- | --- | 0.35-0.45 | 0.40-1.00 | 0.40 | 0.040 | 0.040 | --- | --- | --- | --- |
| ASTM A513-15* | Grade 1035 | G10350 | --- | 0.32-0.38 | 0.60-0.90 | --- | 0.035 | 0.035 | --- | --- | --- | --- |
| | Grade 1040 | G10400 | --- | 0.37-0.44 | 0.60-0.90 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| | Grade 1524 | G15240 | --- | 0.19-0.25 | 1.35-1.65 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| ASTM A519-06 (2012)* | Grade 1045 | G10450 | --- | 0.43-0.50 | 0.60-0.90 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| ASME SA-513* | Grade 1035 | G10350 | --- | 0.31-0.38 | 0.60-0.90 | --- | 0.035 | 0.035 | --- | --- | --- | --- |
| | Grade 1040 | G10400 | --- | 0.36-0.44 | 0.60-0.90 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| | Grade 1524 | G15240 | --- | 0.18-0.25 | 1.35-1.65 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| EN 10297-1:2003 | C35E | --- | 1.1181 | 0.32-0.39 | 0.50-0.80 | 0.40 | 0.035 | 0.035 | 0.40 | 0.40 | 0.10 | Cr+Mo+Ni 0.63 |
| EN 10305-1:2010 | E355 | --- | 1.0580 | 0.22 | 1.60 | 0.55 | 0.025 | 0.025 | --- | --- | --- | Al 0.020 min. |
| EN 10305-2:2010 | E355 | --- | 1.0580 | 0.22 | 1.60 | 0.55 | 0.025 | 0.025 | --- | --- | --- | Al 0.020 min. |
| EN 10305-1:2010 | 26Mn5 | --- | 1.1161 | 0.20-0.30 | 1.20-1.50 | 0.40 | 0.030 | 0.035 | --- | --- | --- | --- |
| EN 10297-1:2003 | E470 | --- | 1.0536 | 0.16-0.22 | 1.30-1.70 | 0.10-0.50 | 0.030 | 0.035 | --- | --- | --- | Al 0.010 min; N 0.020; Nb 0.07; V 0.08-0.15 |
| JIS G 3445:2010 | Symbol STKM17C | --- | --- | 0.45-0.55 | 0.40-1.00 | 0.40 | 0.040 | 0.040 | --- | --- | --- | --- |
| EN 10305-1:2010 | C45E | --- | 1.1191 | 0.42-0.55 | 0.50-0.80 | 0.40 | 0.030 | 0.035 | 0.40 | --- | 0.10 | Cr+Mo+Ni 0.63 |
| EN 10297-1:2003 | 38Mn6 | --- | 1.1127 | 0.34-0.42 | 1.40-1.65 | 0.15-0.35 | 0.035 | 0.035 | 0.40 | 0.40 | 0.10 | Cr+Mo+Ni 0.63 |
| EN 10305-1:2010 | E410 | --- | 1.0509 | 0.16-0.22 | 1.30-1.70 | 0.10-0.50 | 0.030 | 0.035 | --- | --- | --- | V 0.08-0.15; Al 0.010-0.060; Nb 0.07; Ti 0.05; (Nb+V) 0.20 |

*: See "List of Standards" at the beginning of the chapter.

**5.1 Carbon Steel Tubes for General and Structural Applications**

**5.1B Chemical Composition of Carbon Steel Tubes for General and Structural Applications (Continued)**

| Specification | Designation | UNS No. | Steel No. | Weight, % max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| EN 10305-1:2010 | 26Mn5 | --- | 1.1161 | 0.20-0.30 | 1.20-1.50 | 0.40 | 0.030 | 0.035 | --- | --- | --- | --- |
| EN 10297-1:2003 | C45E | --- | 1.1181 | 0.42-0.50 | 0.50-0.80 | 0.40 | 0.035 | 0.035 | 0.40 | 0.40 | 0.10 | Cr+Mo+Ni 0.63 |
| | E590K2 | --- | 1.0644 | 0.16-0.22 | 1.30-1.70 | 0.10-0.50 | 0.030 | 0.035 | 0.30 | 0.40 | 0.08 | Al 0.010 min; Cu 0.30; N 0.020; Nb 0.07; Ti 0.05; V 0.08-0.15; (Nb+V) 0.20 |
| GB 18248-2000 | Grade 37Mn | --- | --- | 0.34-0.40 | 1.35-1.65 | 0.10-0.30 | 0.03 | 0.03 | 0.3 | 0.3 | --- | Cu 0.20; (P+S) 0.055 |

**5.2 Alloy Steel Tubes for General and Structural Applications**

**5.2A Chemical Composition of Alloy Steel Tubes for General and Structural Applications**

| Specification | Designation | UNS No. | Steel No. | Weight, % max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASTM A519-06 (2012)* | Grade 4028 | G40280 | --- | 0.25-0.30 | 0.70-0.90 | 0.15-0.35 | 0.040 | 0.035-0.050 | 0.20 | 0.25 | 0.20-0.30 | Cu 0.35 |
| EN 10305-1:2010 | 26Mo2 | --- | 1.5417 | 0.22-0.29 | 1.50 | 0.40 | 0.025 | 0.035 | --- | 0.40 | 0.15-0.25 | --- |
| ASME SA-513* | Grade 4130 | G41300 | --- | 0.28-0.33 | 0.40-0.60 | 0.15-0.35 | 0.035 | 0.040 | 0.80-1.10 | --- | 0.15-0.25 | --- |
| ASTM A513-15* | Grade 4130 | G41300 | --- | 0.28-0.33 | 0.40-0.60 | 0.15-0.35 | 0.035 | 0.040 | 0.80-1.10 | --- | 0.15-0.25 | --- |
| ASTM A519-06 (2012)* | Grade 4130 | G41300 | --- | 0.28-0.33 | 0.40-0.60 | 0.15-0.35 | 0.040 | 0.040 | 0.80-1.10 | --- | 0.15-0.25 | --- |
| EN 10297-1:2003 | 25CrMo4 | --- | 1.7218 | 0.22-0.29 | 0.60-0.90 | 0.40 | 0.035 | 0.035 | 0.90-1.20 | --- | 0.15-0.30 | --- |
| | 30CrMo4 | --- | 1.7216 | 0.27-0.34 | 0.35-0.60 | 0.35 | 0.035 | 0.035 | 0.80-1.15 | --- | 0.15-0.30 | --- |
| EN 10305-1:2010 | 25CrMo4 | --- | 1.7218 | 0.22-0.29 | 0.60-0.90 | 0.40 | 0.025 | 0.035 | 0.90-1.20 | --- | 0.15-0.30 | --- |
| JIS G 3441:2012 | Symbol SCM418TK | --- | --- | 0.16-0.21 | 0.60-0.85 | 0.15-0.35 | 0.030 | 0.030 | 0.90-1.20 | 0.25 | 0.15-0.30 | Cu 0.30 |
| | Symbol SCM420TK | --- | --- | 0.18-0.23 | 0.60-0.85 | 0.15-0.35 | 0.030 | 0.030 | 0.90-1.20 | 0.25 | 0.15-0.30 | Cu 0.30 |
| | Symbol SCM430TK | --- | --- | 0.28-0.33 | 0.60-0.85 | 0.15-0.35 | 0.030 | 0.030 | 0.90-1.20 | 0.25 | 0.15-0.30 | Cu 0.30 |
| ASTM A519-06 (2012)* | Grade 4135 | G41350 | --- | 0.32-0.39 | 0.65-0.95 | 0.15-0.35 | 0.040 | 0.040 | 0.80-1.10 | --- | 0.15-0.25 | --- |
| | Grade 4137 | G41370 | --- | 0.35-0.40 | 0.70-0.90 | 0.15-0.35 | 0.040 | 0.040 | 0.80-1.10 | --- | 0.15-0.25 | --- |
| EN 10297-1:2003 | 34CrMo4 | --- | 1.7220 | 0.30-0.37 | 0.60-0.90 | 0.40 | 0.035 | 0.035 | 0.90-1.20 | --- | 0.15-0.30 | --- |
| JIS G 3441:2012 | Symbol SCM435TK | --- | --- | 0.33-0.38 | 0.60-0.85 | 0.15-0.35 | 0.030 | 0.030 | 0.90-1.20 | 0.25 | 0.15-0.30 | Cu 0.30 |
| ASME SA-513* | Grade 4140 | G41400 | --- | 0.38-0.43 | 0.75-1.00 | 0.15-0.35 | 0.035 | 0.040 | 0.80-1.10 | --- | 0.15-0.25 | --- |
| ASTM A513-15* | Grade 4140 | G41400 | --- | 0.38-0.43 | 0.75-1.00 | 0.15-0.35 | 0.035 | 0.040 | 0.80-1.10 | --- | 0.15-0.25 | --- |
| ASTM A519-06 (2012)* | Grade 4140 | G41400 | --- | 0.38-0.43 | 0.75-1.00 | 0.15-0.35 | 0.040 | 0.040 | 0.80-1.10 | --- | 0.15-0.25 | --- |
| | Grade 4142 | G41420 | --- | 0.40-0.45 | 0.75-1.00 | 0.15-0.35 | 0.040 | 0.040 | 0.80-1.10 | --- | 0.15-0.25 | --- |
| EN 10297-1:2003 | 42CrMo4 | --- | 1.7225 | 0.38-0.45 | 0.60-0.90 | 0.40 | 0.035 | 0.035 | 0.90-1.20 | --- | 0.15-0.30 | --- |
| EN 10305-1:2010 | 42CrMo4 | --- | 1.7225 | 0.38-0.45 | 0.60-0.90 | 0.40 | 0.025 | 0.035 | 0.90-1.20 | --- | 0.15-0.30 | --- |
| JIS G 3441:2012 | Symbol SCM440TK | --- | --- | 0.38-0.43 | 0.60-0.85 | 0.15-0.35 | 0.030 | 0.030 | 0.90-1.20 | 0.25 | 0.15-0.30 | Cu 0.30 |

*: See "List of Standards" at the beginning of the chapter.

**5.2 Alloy Steel Tubes for General and Structural Applications**

**5.2B Mechanical Properties of Alloy Steel Tubes for General and Structural Applications**

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter mm | Section Thickness/Diameter in. | Yield Strength MPa | Yield Strength ksi | Tensile Strength MPa | Tensile Strength ksi | Elongation %, min. | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ASTM A519-06 (2012)* | Grade 4028 | G40280 | --- | --- | --- | --- | --- | --- | --- | --- | A, N, SR, QT, or none | --- |
| EN 10305-1:2010 | 26Mo2 | --- | 1.5417 | --- | --- | --- | --- | 720 | --- | 4 | C | --- |
| | | | | | | --- | --- | 670 | --- | 6 | LC | --- |
| | | | | | | --- | --- | --- | --- | --- | SR, or A, or N | --- |
| ASME SA-513* | Grade 4130 | G41300 | --- | --- | --- | 345 | 50 | 483 | 70 | 20 | N | 100 max HRB |
| | | | | --- | --- | 379 | 55 | 496 | 72 | 10 | AW | 80 min HRB |
| | | | | --- | --- | 552 | 80 | 621 | 90 | 10 | MD SR | 87 min HRB |
| | | | | --- | --- | 586 | 85 | 655 | 95 | 5 | MD | 90 min HRB |
| ASTM A513-15* | Grade 4130 | G41300 | --- | --- | --- | 345 | 50 | 480 | 70 | 20 | N | 100 max HRB |
| | | | | --- | --- | 380 | 55 | 495 | 72 | 10 | AW | 80 min HRB |
| | | | | --- | --- | 550 | 80 | 620 | 90 | 10 | MD SR | 87 min HRB |
| | | | | --- | --- | 585 | 85 | 655 | 95 | 5 | MD | 90 min HRB |
| ASTM A519-06 (2012)* | Grade 4130 | G41300 | --- | --- | --- | 379 | 55 | 517 | 75 | 30 | A | 81 HRB |
| | | | | --- | --- | 414 | 60 | 621 | 90 | 20 | N | 89 HRB |
| | | | | --- | --- | 483 | 70 | 621 | 90 | 20 | HR | 89 HRB |
| | | | | --- | --- | 586 | 85 | 724 | 105 | 10 | SR | 95 HRB |
| EN 10297-1:2003 | 25CrMo4 | --- | 1.7218 | --- | --- | --- | --- | --- | --- | --- | A | 212 HB |
| | | | | $t \le 8$ | --- | 700 | --- | 900 | --- | 12 L; 10 T | QT | L: 45 J @ 20°C |
| | | | | $8 < t \le 20$ | --- | 600 | --- | 800 | --- | 14 L; 12 T | | L: 50 J @ 20°C<br>T: 32 J @ 20°C |
| | | | | $20 < t \le 50$ | --- | 450 | --- | 700 | --- | 15 L; 13 T | | see standard for impact data |
| | | | | $50 < t \le 80$ | --- | 400 | --- | 650 | --- | 16 L; 14 T | | see standard for impact data |
| | 30CrMo4 | --- | 1.7216 | $t \le 8$ | --- | 750 | --- | 950 | --- | 9 L; 7 T | QT | L: 40 J @ 20°C |
| | | | | $8 < t \le 20$ | --- | 630 | --- | 850 | --- | 9 L; 7 T | | L: 45 J @ 20°C<br>T: 27 J @ 20°C |
| | | | | $20 < t \le 50$ | --- | 520 | --- | 750 | --- | 10 L; 8 T | | see standard for impact data |
| | | | | $50 < t \le 80$ | --- | 480 | --- | 700 | --- | 11 L; 9 T | | see standard for impact data |
| | | | | --- | --- | --- | --- | --- | --- | --- | A | 223 HB |
| EN 10305-1:2010 | 25CrMo4 | --- | 1.7218 | --- | --- | --- | --- | 720 | --- | 4 | C | --- |
| | | | | | | --- | --- | 670 | --- | 6 | LC | --- |
| | | | | | | --- | --- | --- | --- | --- | SR, or A, or N | --- |
| JIS G 3441:2012 | Symbol SCM418TK | --- | --- | --- | --- | --- | --- | --- | --- | --- | AM, CF or A | --- |
| | Symbol SCM420TK | --- | --- | --- | --- | --- | --- | --- | --- | --- | AM, CF or A | --- |
| | Symbol SCM430TK | --- | --- | --- | --- | --- | --- | --- | --- | --- | AM, CF or A | --- |

*: See "List of Standards" at the beginning of the chapter.

**5.2 Alloy Steel Tubes for General and Structural Applications**

**5.2B Mechanical Properties of Alloy Steel Tubes for General and Structural Applications (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter | | Yield Strength | | Tensile Strength | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | %, min. | | |
| ASTM A519-06 (2012)* | Grade 4135 | G41350 | --- | --- | --- | --- | --- | --- | --- | --- | AM | --- |
| | Grade 4137 | G41370 | --- | --- | --- | --- | --- | --- | --- | --- | AM | --- |
| EN 10297-1:2003 | 34CrMo4 | --- | 1.7220 | t ≤ 8 | --- | 800 | --- | 1000 | --- | 11 L; 9 T | QT | see standard for impact data |
| | | | | 8 < t ≤ 20 | --- | 650 | --- | 900 | --- | 12 L; 10 T | | |
| | | | | 20 < t ≤ 50 | --- | 550 | --- | 800 | --- | 14 L; 12 T | | |
| | | | | 50 < t ≤ 80 | --- | 500 | --- | 750 | --- | 15 L; 13 T | | |
| | | | | --- | --- | --- | --- | --- | --- | --- | A | 223 HB |
| JIS G 3441:2012 | Symbol SCM435TK | --- | --- | --- | --- | --- | --- | --- | --- | --- | AM, CF or A | --- |
| ASME SA-513* | Grade 4140 | G41400 | --- | --- | --- | 448 | 65 | 621 | 90 | 20 | N | 105 max HRB |
| | | | | --- | --- | 485 | 70 | 621 | 90 | 10 | AW | 85 min HRB |
| | | | | --- | --- | 655 | 95 | 724 | 105 | 10 | MD SR | 90 min HRB |
| | | | | --- | --- | 690 | 100 | 758 | 110 | 5 | MD | 90 min HRB |
| ASTM A513-15* | Grade 4140 | G41400 | --- | --- | --- | 450 | 65 | 620 | 90 | 20 | N | 105 max HRB |
| | | | | --- | --- | 485 | 70 | 620 | 90 | 10 | AW | 85 min HRB |
| | | | | --- | --- | 655 | 95 | 725 | 105 | 10 | MD SR | 90 min HRB |
| | | | | --- | --- | 690 | 100 | 760 | 110 | 5 | MD | 90 min HRB |
| ASTM A519-06 (2012)* | Grade 4140 | G41400 | --- | --- | --- | 414 | 60 | 552 | 80 | 25 | A | 85 HRB |
| | | | | --- | --- | 621 | 90 | 855 | 120 | 15 | HR | 100 HRB |
| | | | | --- | --- | 621 | 90 | 855 | 120 | 20 | N | 100 HRB |
| | | | | --- | --- | 689 | 100 | 855 | 120 | 10 | SR | 100 HRB |
| | Grade 4142 | G41420 | --- | --- | --- | --- | --- | --- | --- | --- | A, N, SR, QT, or none | --- |
| EN 10297-1:2003 | 42CrMo4 | --- | 1.7225 | t ≤ 8 | --- | 900 | --- | 1100 | --- | 10 L; 8 T | QT | see standard for impact data |
| | | | | 8 < t ≤ 20 | --- | 750 | --- | 1000 | --- | 11 L; 9 T | | |
| | | | | 20 < t ≤ 50 | --- | 650 | --- | 900 | --- | 12 L; 10 T | | |
| | | | | 50 < t ≤ 80 | --- | 550 | --- | 800 | --- | 13 L; 11 T | | |
| | | | | --- | --- | --- | --- | --- | --- | --- | A | 241 HB |
| EN 10305-1:2010 | 42CrMo4 | --- | 1.7225 | --- | --- | --- | --- | 720 | --- | 4 | C | --- |
| | | | | --- | --- | --- | --- | 670 | --- | 6 | LC | --- |
| | | | | --- | --- | --- | --- | --- | --- | --- | SR, or A, or N | --- |
| JIS G 3441:2012 | Symbol SCM440TK | --- | --- | --- | --- | --- | --- | --- | --- | --- | AM, CF or A | --- |

*: See "List of Standards" at the beginning of the chapter.

## 5.3 Stainless Steel Tubes for General and Structural Applications

### 5.3.1A Chemical Composition of Ferritic and Martensitic Stainless Steel Tubes for General and Structural Applications

| Specification | Designation | UNS No. | Steel No. | Weight, % max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASME SA-268/SA-268M | Grade TP405 | S40500 | --- | 0.08 | 1.00 | 1.00 | 0.040 | 0.030 | 11.5-14.5 | 0.50 | --- | Al 0.10-0.30 |
| ASTM A268/A268M-10 | Grade TP405 | S40500 | --- | 0.08 | 1.00 | 1.00 | 0.040 | 0.030 | 11.5-14.5 | 0.50 | --- | Al 0.10-0.30 |
| ASTM A511/A511M-15a | Grade MT 405 | S40500 | --- | 0.08 | 1.00 | 1.00 | 0.040 | 0.030 | 11.5-14.5 | 0.50 | --- | Al 0.10-0.30 |
| EN 10297-2:2005 C1:2007 | Grade X6CrAl13 | --- | 1.4002 | 0.08 | 1.00 | 1.00 | 0.040 | 0.015 | 12.0-14.0 | --- | --- | Al 0.10-0.30 |
| ASME SA-268/SA-268M | Grade TP409 | S40900 | --- | 0.08 | 1.00 | 1.00 | 0.045 | 0.030 | 10.5-11.7 | 0.50 | --- | Ti 6xC to 0.75 |
| ASTM A268/A268M-10 | Grade TP409 | S40900 | --- | 0.08 | 1.00 | 1.00 | 0.045 | 0.030 | 10.5-11.7 | 0.50 | --- | Ti 6xC to 0.75 |
| EN 10296-2:2005 C2:2007 | Grade X2CrTi12 | --- | 1.4512 | 0.030 | 1.00 | 1.00 | 0.040 | 0.015 | 10.5-12.5 | --- | --- | Ti 6x(C+N) to 0.65; N 0.030 |
| EN 10297-2:2005 C1:2007 | Grade X2CrTi12 | --- | 1.4512 | 0.030 | 1.00 | 1.00 | 0.040 | 0.015 | 10.5-12.5 | --- | --- | Ti 6x(C+N) to 0.65 |
| GB/T 12770-2002 | Grade 00Cr12Ti | --- | --- | 0.025 | 0.80 | 0.80 | 0.035 | 0.02 | 10.5-12.5 | --- | --- | Ti 6xC to 0.75 |
| ASME SA-268/SA-268M | Grade TP410 | S41000 | --- | 0.15 | 1.00 | 1.00 | 0.040 | 0.030 | 11.5-13.5 | --- | --- | --- |
| ASTM A268/A268M-10 | Grade TP410 | S41000 | --- | 0.15 | 1.00 | 1.00 | 0.040 | 0.030 | 11.5-13.5 | --- | --- | --- |
| ASTM A511/A511M-15a | Grade MT 410 | S41000 | --- | 0.15 | 1.00 | 1.00 | 0.040 | 0.030 | 11.5-13.5 | 0.50 | --- | --- |
| EN 10297-2:2005 C1:2007 | Grade X12Cr13 | --- | 1.4006 | 0.08-0.15 | 1.50 | 1.00 | 0.040 | 0.015 | 11.5-13.5 | 0.75 | --- | --- |
| GB/T 12770-2002 | Grade 0Cr13 | --- | --- | 0.08 | 1.00 | 1.00 | 0.035 | 0.03 | 11.50-13.50 | 0.6 | --- | --- |
| | Grade 1Cr13 | --- | --- | 0.15 | 1.00 | 1.00 | 0.035 | 0.03 | 11.50-13.50 | 0.6 | --- | --- |
| GB/T 14975-2002 | Grade 0Cr13 | --- | --- | 0.08 | 1.00 | 1.00 | 0.035 | 0.03 | 11.50-13.50 | 0.6 | --- | --- |
| | Grade 1Cr13 | --- | --- | 0.15 | 1.00 | 1.00 | 0.035 | 0.03 | 11.50-13.50 | 0.6 | --- | --- |
| JIS G 3446:2012 | Symbol SUS410TKA | --- | --- | 0.15 | 1.00 | 1.00 | 0.040 | 0.030 | 11.50-13.50 | 0.60 | --- | --- |
| | Symbol SUS410TKC | --- | --- | 0.15 | 1.00 | 1.00 | 0.040 | 0.030 | 11.50-13.50 | 0.60 | --- | --- |
| GB/T 14975-2002 | Grade 2Cr13 | --- | --- | 0.16-0.25 | 1.00 | 1.00 | 0.035 | 0.03 | 12.00-14.00 | 0.6 | --- | --- |
| JIS G 3446:2012 | Symbol SUS420J1TKA | --- | --- | 0.16-0.25 | 1.00 | 1.00 | 0.040 | 0.030 | 12.00-14.00 | 0.60 | --- | --- |
| AFNOR NF A 49-647:1979 | TS Z 8 C 17 | --- | --- | 0.10 | 1.0 | 1.00 | 0.040 | 0.030 | 16-18 | 0.50 | --- | --- |
| ASME SA-268/SA-268M | Grade TP430 | S43000 | --- | 0.12 | 1.00 | 1.00 | 0.040 | 0.030 | 16.0-18.0 | --- | --- | --- |
| ASTM A268/A268M-10 | Grade TP430 | S43000 | --- | 0.12 | 1.00 | 1.00 | 0.040 | 0.030 | 16.0-18.0 | --- | --- | --- |
| ASTM A554-15 | Grade MT-430 | --- | --- | 0.12 | 1.00 | 1.00 | 0.040 | 0.030 | 16.0-18.0 | 0.50 | --- | --- |
| ASTM A511/A511M-15a | Grade MT 430 | --- | --- | 0.12 | 1.00 | 1.00 | 0.040 | 0.030 | 16.0-18.0 | 0.50 | --- | --- |
| EN 10296-2:2005 C2:2007 | Grade X6Cr17 | --- | 1.4016 | 0.08 | 1.00 | 1.00 | 0.040 | 0.015 | 16.0-18.0 | --- | --- | --- |
| EN 10297-2:2005 C1:2007 | Grade X6Cr17 | --- | 1.4016 | 0.08 | 1.00 | 1.00 | 0.040 | 0.015 | 16.0-18.0 | --- | --- | --- |
| GB/T 12770-2002 | Grade 1Cr17 | --- | --- | 0.12 | 1.00 | 0.75 | 0.035 | 0.03 | 16.00-18.00 | 0.6 | --- | --- |
| GB/T 14975-2002 | Grade 1Cr17 | --- | --- | 0.12 | 1.00 | 0.75 | 0.035 | 0.03 | 16.00-18.00 | 0.6 | --- | --- |
| JIS G 3446:2012 | Symbol SUS430TKA | --- | --- | 0.12 | 1.00 | 0.75 | 0.040 | 0.030 | 16.00-18.00 | 0.60 | --- | --- |
| | Symbol SUS430TKC | --- | --- | 0.12 | 1.00 | 0.75 | 0.040 | 0.030 | 16.00-18.00 | 0.60 | --- | --- |
| ASME SA-268/SA-268M | Grade TP439 | S43035 | --- | 0.07 | 1.00 | 1.00 | 0.040 | 0.030 | 17.00-19.00 | 0.50 | --- | Al 0.15; N 0.04; Ti 0.20+4x(C+N) to 1.10 |
| ASTM A268/A268M-10 | Grade TP439 | S43035 | --- | 0.07 | 1.00 | 1.00 | 0.040 | 0.030 | 17.00-19.00 | 0.50 | --- | Al 0.15; N 0.04; Ti 0.20+4x(C+N) to 1.10 |
| EN 10296-2:2005 C2:2007 | Grade X3CrTi17 | --- | 1.4510 | 0.05 | 1.00 | 1.00 | 0.040 | 0.015 | 16.0-18.0 | --- | --- | Ti 4x(C+N)+0.15 to 0.80 |
| EN 10297-2:2005 C1:2007 | Grade X3CrTi17 | --- | 1.4510 | 0.05 | 1.00 | 1.00 | 0.040 | 0.015 | 16.0-18.0 | --- | --- | Ti 4x(C+N)+0.15 to 0.80 |

**5.3 Stainless Steel Tubes for General and Structural Applications**

**5.3.1B Mechanical Properties of Ferritic and Martensitic Stainless Steel Tubes for General and Structural Applications**

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter | | Yield Strength | | Tensile Strength | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | %, min. | | |
| ASME SA-268/SA-268M | Grade TP405 | S40500 | --- | t ≥ 0.4 | t ≥ 0.015 | 205 | 30 | 415 | 60 | 20 | HT | 207 max HB; 95 max HRB |
| ASTM A268/A268M-10 | Grade TP405 | S40500 | --- | t ≥ 0.4 | t ≥ 0.015 | 205 | 30 | 415 | 60 | 20 | HT | 207 HB; 95 max HRB |
| ASTM A511/A511M-15a* | Grade MT 405 | S40500 | --- | --- | --- | 210 | 30 | 415 | 60 | 20 | A | 207 max HBW; 95 max HRB |
| EN 10297-2:2005 C1:2007 | Grade X6CrAl13 | --- | 1.4002 | --- | --- | 210 | --- | 400 | --- | 17 L, 17 T | A | --- |
| ASME SA-268/SA-268M | Grade TP409 | S40900 | --- | t ≥ 0.4 | t ≥ 0.015 | 170 | 25 | 380 | 55 | 20 | HT | 207 max HB; 95 max HRB |
| ASTM A268/A268M-10 | Grade TP409 | S40900 | --- | t ≥ 0.4 | t ≥ 0.015 | 170 | 25 | 380 | 55 | 20 | HT | 207 max HB; 95 max HRB |
| EN 10296-2:2005 C2:2007 | Grade X2CrTi12 | --- | 1.4512 | t ≤ 30 | --- | 210 | --- | 380 | --- | 25 L, 23 T | AW or A | --- |
| EN 10297-2:2005 C1:2007 | Grade X2CrTi12 | --- | 1.4512 | --- | --- | 210 | --- | 380 | --- | 25 L, 25 T | A | --- |
| GB/T 12770-2002 | Grade 00Cr12Ti | --- | --- | --- | --- | --- | --- | 365-460 | --- | --- | A | --- |
| | | | | --- | --- | --- | --- | 365-460 | --- | 35 | W | --- |

*: See "List of Standards" at the beginning of the chapter.

**5.3 Stainless Steel Tubes for General and Structural Applications**

**5.3.1B Mechanical Properties of Ferritic and Martensitic Stainless Steel Tubes for General and Structural Applications (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter | | Yield Strength | | Tensile Strength | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | %, min. | | |
| ASME SA-268/SA-268M | Grade TP410 | S41000 | --- | t ≥ 0.4 | t ≥ 0.015 | 205 | 30 | 415 | 60 | 20 | HT | 207 max HB; 95 max HRB |
| ASTM A268/A268M-10 | Grade TP410 | S41000 | --- | t ≥ 0.4 | t ≥ 0.015 | 205 | 30 | 415 | 60 | 20 | HT | 207 max HB; 95 max HRB |
| ASTM A511/A511M-15a* | Grade MT 410 | S41000 | --- | --- | --- | 210 | 30 | 415 | 60 | 20 | A | 207 max HBW; 95 max HRB |
| EN 10297-2:2005 C1:2007 | Grade X12Cr13 | --- | 1.4006 | --- | --- | 400 | --- | 550 | --- | 15 L, 15 T | Q+T (QT 550) | --- |
| | | | | --- | --- | 450 | --- | 650 | --- | 12 L, 12 T | Q+T (QT 650) | --- |
| GB/T 12770-2002 | Grade 0Cr13 | --- | --- | --- | --- | --- | --- | 410 | --- | --- | A | --- |
| | | | | --- | --- | --- | --- | 410 | --- | 20 | W | --- |
| | Grade 1Cr13 | --- | --- | --- | --- | --- | --- | 410 | --- | --- | A | --- |
| | | | | --- | --- | --- | --- | 410 | --- | 20 | W | --- |
| GB/T 14975-2002 | Grade 0Cr13 | --- | --- | --- | --- | 180 | --- | 370 T | --- | 22 T | BA | --- |
| | Grade 1Cr13 | --- | --- | --- | --- | 205 | --- | 410 T | --- | 20 T | BA | --- |
| JIS G 3446:2012 | Symbol SUS410TKA | --- | --- | 1 < t ≤ 2 | --- | 205 | --- | 410 | --- | 11 | A | --- |
| | | | | 2 < t ≤ 3 | --- | 205 | --- | 410 | --- | 12 | A | --- |
| | | | | 3 < t ≤ 4 | --- | 205 | --- | 410 | --- | 14 | A | --- |
| | | | | 4 < t ≤ 5 | --- | 205 | --- | 410 | --- | 16 | A | --- |
| | | | | 5 < t ≤ 6 | --- | 205 | --- | 410 | --- | 17 | A | --- |
| | | | | 6 < t ≤ 7 | --- | 205 | --- | 410 | --- | 18 | A | --- |
| | | | | 7 < t < 8 | --- | 205 | --- | 410 | --- | 20 | A | --- |
| | | | | t ≥ 8 | --- | 205 | --- | 410 | --- | 20 | A | --- |
| | Symbol SUS410TKC | --- | --- | 1 < t ≤ 2 | --- | 205 | --- | 410 | --- | 11 | AM | --- |
| | | | | 2 < t ≤ 3 | --- | 205 | --- | 410 | --- | 12 | AM | --- |
| | | | | 3 < t ≤ 4 | --- | 205 | --- | 410 | --- | 14 | AM | --- |
| | | | | 4 < t ≤ 5 | --- | 205 | --- | 410 | --- | 16 | AM | --- |
| | | | | 5 < t ≤ 6 | --- | 205 | --- | 410 | --- | 17 | AM | --- |
| | | | | 6 < t ≤ 7 | --- | 205 | --- | 410 | --- | 18 | AM | --- |
| | | | | 7 < t < 8 | --- | 205 | --- | 410 | --- | 20 | AM | --- |
| | | | | t ≥ 8 | --- | 205 | --- | 410 | --- | 20 | AM | --- |

*: See "List of Standards" at the beginning of the chapter.

**5.3 Stainless Steel Tubes for General and Structural Applications**

**5.3.1B Mechanical Properties of Ferritic and Martensitic Stainless Steel Tubes for General and Structural Applications (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter | | Yield Strength | | Tensile Strength | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | %, min. | | |
| GB/T 14975-2002 | Grade 2Cr13 | --- | --- | --- | --- | 215 | --- | 470 T | --- | 19 T | BA | --- |
| JIS G 3446:2012 | Symbol SUS420J1TKA | --- | --- | 1 < t ≤ 2 | --- | 215 | --- | 470 | --- | 10 | A | --- |
| | | | | 2 < t ≤ 3 | --- | 215 | --- | 470 | --- | 12 | A | --- |
| | | | | 3 < t ≤ 4 | --- | 215 | --- | 470 | --- | 13 | A | --- |
| | | | | 4 < t ≤ 5 | --- | 215 | --- | 470 | --- | 14 | A | --- |
| | | | | 5 < t ≤ 6 | --- | 215 | --- | 470 | --- | 16 | A | --- |
| | | | | 6 < t ≤ 7 | --- | 215 | --- | 470 | --- | 18 | A | --- |
| | | | | 7 < t < 8 | --- | 215 | --- | 470 | --- | 19 | A | --- |
| | | | | t ≥ 8 | --- | 215 | --- | 470 | --- | 19 | A | --- |
| AFNOR NF A 49-647:1979 | TS Z 8 C 17 | --- | --- | --- | --- | 300 | --- | 450 | --- | 16 | AM | --- |
| ASME SA-268/SA-268M | Grade TP430 | S43000 | --- | t ≥ 0.4 | t ≥ 0.015 | 240 | 35 | 415 | 60 | 20 | HT | 190 max HB; 90 max HRB |
| ASTM A268/A268M-10 | Grade TP430 | S43000 | --- | t ≥ 0.4 | t ≥ 0.015 | 240 | 35 | 415 | 60 | 20 | HT | 190 max HB; 90 max HRB |
| ASTM A554-15* | Grade MT 430 | S43000 | --- | --- | --- | 241 | 35 | 414 | 60 | 20 | A | 190 max HB; 90 max HRB |
| ASTM A511/A511M-15a* | Grade MT 430 | S43000 | --- | --- | --- | 240 | 35 | 415 | 60 | 20 | A | 190 max HBW; 90 max HRB |
| EN 10296-2:2005 C2:2007 | Grade X6Cr17 | --- | 1.4016 | t ≤ 30 | --- | 240 | --- | 430 | --- | 20 L, 18 T | AW or A | --- |
| EN 10297-2:2005 C1:2007 | Grade X6Cr17 | --- | 1.4016 | --- | --- | 240 | --- | 430 | --- | 20 L, 20 T | A | --- |
| GB/T 12770-2002 | Grade 1Cr17 | --- | --- | --- | --- | --- | --- | 410 | --- | --- | A | --- |
| | | | | --- | --- | --- | --- | 410 | --- | 20 | W | --- |
| GB/T 14975-2002 | Grade 1Cr17 | --- | --- | --- | --- | 245 | --- | 410 T | --- | 20 T | BA | --- |

*: See "List of Standards" at the beginning of the chapter.

Note: This section continued on next page.

**5.3 Stainless Steel Tubes for General and Structural Applications**

**5.3.1B Mechanical Properties of Ferritic and Martensitic Stainless Steel Tubes for General and Structural Applications (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter | | Yield Strength | | Tensile Strength | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | %, min. | | |
| JIS G 3446:2012 | Symbol SUS430TKA | --- | --- | 1 < t ≤ 2 | --- | 245 | --- | 410 | --- | 11 | A | --- |
| | | | | 2 < t ≤ 3 | --- | 245 | --- | 410 | --- | 12 | A | --- |
| | | | | 3 < t ≤ 4 | --- | 245 | --- | 410 | --- | 14 | A | --- |
| | | | | 4 < t ≤ 5 | --- | 245 | --- | 410 | --- | 16 | A | --- |
| | | | | 5 < t ≤ 6 | --- | 245 | --- | 410 | --- | 17 | A | --- |
| | | | | 6 < t ≤ 7 | --- | 245 | --- | 410 | --- | 18 | A | --- |
| | | | | 7 < t < 8 | --- | 245 | --- | 410 | --- | 20 | A | --- |
| | | | | t ≥ 8 | --- | 245 | --- | 410 | --- | 20 | A | --- |
| | Symbol SUS430TKC | --- | --- | 1 < t ≤ 2 | --- | 245 | --- | 410 | --- | 11 | AM | --- |
| | | | | 2 < t ≤ 3 | --- | 245 | --- | 410 | --- | 12 | AM | --- |
| | | | | 3 < t ≤ 4 | --- | 245 | --- | 410 | --- | 14 | AM | --- |
| | | | | 4 < t ≤ 5 | --- | 245 | --- | 410 | --- | 16 | AM | --- |
| | | | | 5 < t ≤ 6 | --- | 245 | --- | 410 | --- | 17 | AM | --- |
| | | | | 6 < t ≤ 7 | --- | 245 | --- | 410 | --- | 18 | AM | --- |
| | | | | 7 < t < 8 | --- | 245 | --- | 410 | --- | 20 | AM | --- |
| | | | | t ≥ 8 | --- | 245 | --- | 410 | --- | 20 | AM | --- |
| ASME SA-268/SA-268M | Grade TP439 | S43035 | --- | t ≥ 0.4 | t ≥ 0.015 | 205 | 30 | 415 | 60 | 20 | HT | 190 max HB; 90 max HRB |
| ASTM A268/A268M-10 | Grade TP439 | S43035 | --- | t ≥ 0.4 | t ≥ 0.015 | 205 | 30 | 415 | 60 | 20 | HT | 190 max HB; 90 max HRB |
| EN 10296-2:2005 C2:2007 | Grade X3CrTi17 | --- | 1.4510 | t ≤ 30 | --- | 230 | --- | 420 | --- | 23 L, 21 T | AW or A | --- |
| EN 10297-2:2005 C1:2007 | Grade X3CrTi17 | --- | 1.4510 | --- | --- | 230 | --- | 420 | --- | 23 L, 23 T | A | --- |

### 5.3 Stainless Steel Tubes for General and Structural Applications

#### 5.3.2A Chemical Composition of Austenitic Stainless Steel Tubes for General and Structural Applications

| Specification | Designation | UNS No. | Steel No. | Weight, % max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| AFNOR NF A 49-647:1979 | TS Z 6 CN 18-09 | --- | --- | 0.07 | 2.0 | 1.0 | 0.040 | 0.030 | 18-20 | 8-12 | --- | --- |
| ASME SA-249/SA-249M | Grade TP304 | S30400 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 18.0-20.0 | 8.0-11.0 | --- | --- |
| ASME SA-409/SA-409M | Grade TP304 | S30400 | --- | 0.08 | 2.00 | 0.75 | 0.045 | 0.030 | 18.0-20.0 | 8.00-11.0 | --- | --- |
| ASME SA-688/SA-688M | Grade TP 304 | S30400 | --- | 0.08 | 2.00 | 0.75 | 0.040 | 0.030 | 18.00-20.00 | 8.00-11.00 | --- | --- |
| ASTM A269/A269M-14e1 | Grade TP304 | S30400 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 18.0-20.0 | 8.0-11.0 | --- | --- |
| ASTM A511/A511M-15a | Grade MT 304 | S30400 | --- | 0.08 | 2.00 | 1.00 | 0.040 | 0.030 | 18.0-20.0 | 8.0-11.0 | --- | --- |
| ASTM A554-15 | Grade MT-304 | S30400 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 18.0-20.0 | 8.0-11.0 | --- | --- |
| ASTM A632-04 (2014) | Grade TP 304 | S30400 | --- | 0.08 | 2.00 | 0.75 | 0.045 | 0.030 | 18.0-20.0 | 8.0-11.0 | --- | --- |
| ASTM A908-03 (2013) | Type 304 | S30400 | --- | 0.08 | 2.00 | 0.75 | 0.040 | 0.030 | 18.0-20.0 | 8.0-11.0 | --- | --- |
| JIS G 3446:2012 | Symbol SUS304TKA | --- | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 18.00-20.00 | 8.00-10.50 | --- | --- |
| | Symbol SUS304TKC | --- | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 18.00-20.00 | 8.00-10.50 | --- | --- |
| AFNOR NF A 49-647:1979 | TS Z 2 CN 18-10 | --- | --- | 0.030 | 2.0 | 1.0 | 0.040 | 0.030 | 18-20 | 8-12 | --- | --- |
| ASTM A269/A269M-14e1 | Grade TP304L | S30403 | --- | 0.035 | 2.00 | 1.00 | 0.045 | 0.030 | 18.0-20.0 | 8.0-12.0 | --- | --- |
| ASTM A511/A511M-15a | Grade MT 304L | S30403 | --- | 0.035 | 2.00 | 1.00 | 0.040 | 0.030 | 18.0-20.0 | 8.0-13.0 | --- | --- |
| ASTM A554-15 | Grade MT-304L | S30403 | --- | 0.035 | 2.00 | 1.00 | 0.045 | 0.030 | 18.0-20.0 | 8.0-13.0 | --- | --- |
| ASTM A632-04 (2014) | Grade TP 304L | S30403 | --- | 0.030 | 2.00 | 0.75 | 0.045 | 0.030 | 18.0-20.0 | 8.0-13.0 | --- | --- |
| ASTM A778-01 (2009)e1 | Grade TP 304L | S30403 | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 18.0-20.0 | 8.0-13.0 | --- | N 0.10 |
| EN 10296-2:2005 C2:2007 | Grade X2CrNi19-11 | --- | 1.4306 | 0.030 | 2.00 | 1.00 | 0.045 | 0.015 | 18.0-20.0 | 10.0-12.0 | --- | N 0.11 |
| EN 10297-2:2005 C1:2007 | Grade X2CrNi19-11 | --- | 1.4306 | 0.030 | 2.00 | 1.00 | 0.045 | 0.015 | 18.0-20.0 | 10.0-12.0 | --- | N 0.11 |
| GB/T 12770-2002 | Grade 00Cr19Ni10 | --- | --- | 0.03 | 2.00 | 1.00 | 0.035 | 0.03 | 18.00-20.00 | 8.00-12.00 | --- | --- |
| GB/T 14975-2002 | Grade 00Cr19Ni10 | --- | --- | 0.030 | 2.00 | 1.00 | 0.035 | 0.03 | 18.00-20.00 | 8.00-12.00 | --- | --- |
| AFNOR NF A 49-647:1979 | TS Z 6 CND 17-11 | --- | --- | 0.08 | 2.0 | 1.0 | 0.040 | 0.030 | 16-18 | 10-12.5 | 2-2.5 | --- |
| ASTM A269/A269M-14e1 | Grade TP316 | S31600 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 16.0-18.0 | 10.0-14.0 | 2.00-3.00 | --- |
| ASTM A511/A511M-15a | Grade MT 316 | S31600 | --- | 0.08 | 2.00 | 1.00 | 0.040 | 0.030 | 16.0-18.0 | 11.0-14.0 | 2.0-3.0 | --- |
| ASTM A554-15 | Grade MT-316 | --- | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 16.0-18.0 | 10.0-14.0 | 2.0-3.0 | --- |
| ASTM A632-04 (2014) | Grade TP 316 | S31600 | --- | 0.08 | 2.00 | 0.75 | 0.045 | 0.030 | 16.0-18.0 | 11.0-14.0 | 2.00-3.00 | --- |
| JIS G 3446:2012 | Symbol SUS316TKA | --- | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 16.00-18.00 | 10.00-14.00 | 2.00-3.00 | --- |
| | Symbol SUS316TKC | --- | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 16.00-18.00 | 10.00-14.00 | 2.00-3.00 | --- |
| ASTM A269/A269M-14e1 | Grade TP316L | S31603 | --- | 0.035 | 2.00 | 1.00 | 0.045 | 0.030 | 16.0-18.0 | 10.0-15.0 | 2.00-3.00 | --- |
| ASTM A511/A511M-15a | Grade MT 316L | --- | --- | 0.035 | 2.00 | 1.00 | 0.040 | 0.030 | 16.0-18.0 | 10.0-15.0 | 2.0-3.0 | --- |
| ASTM A554-15 | Grade MT-316L | S31603 | --- | 0.035 | 2.00 | 1.00 | 0.045 | 0.030 | 16.0-18.0 | 10.0-15.0 | 2.0-3.0 | --- |
| ASTM A632-04 (2014) | Grade TP 316L | S31603 | --- | 0.030 | 2.00 | 0.75 | 0.045 | 0.030 | 16.0-18.0 | 10.0-15.0 | 2.00-3.00 | --- |
| ASTM A778-01 (2009)e1 | Grade TP 316L | S31603 | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 16.0-18.0 | 10.0-14.0 | 2.00-3.00 | N 0.10 |

Note: This section continued on next page.

**5.3 Stainless Steel Tubes for General and Structural Applications**

**5.3.2A Chemical Composition of Austenitic Stainless Steel Tubes for General and Structural Applications (Continued)**

| Specification | Designation | UNS No. | Steel No. | Weight, % max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| EN 10296-2:2005 C2:2007 | Grade X2CrNiMo17-12-2 | --- | 1.4404 | 0.030 | 2.00 | 1.00 | 0.045 | 0.015 | 16.5-18.5 | 10.0-13.0 | 2.00-2.50 | N 0.11 |
| | Grade X2CrNiMo17-12-3 | --- | 1.4432 | 0.030 | 2.00 | 1.00 | 0.045 | 0.015 | 16.5-18.5 | 10.5-13.0 | 2.50-3.00 | N 0.11 |
| | Grade X2CrNiMo18-14-3 | --- | 1.4435 | 0.030 | 2.00 | 1.00 | 0.045 | 0.015 | 17.0-19.0 | 12.5-15.0 | 2.50-3.00 | N 0.11 |
| EN 10297-2:2005 C1:2007 | Grade X2CrNiMo17-12-2 | --- | 1.4404 | 0.030 | 2.00 | 1.00 | 0.045 | 0.015 | 16.5-18.5 | 10.0-14.5 | 2.00-2.50 | N 0.11 |
| | Grade X2CrNiMo18-14-3 | --- | 1.4435 | 0.030 | 2.00 | 1.00 | 0.045 | 0.015 | 17.0-19.0 | 12.5-15.0 | 2.50-3.00 | N 0.11 |
| GB/T 12770-2002 | Grade 00Cr17Ni14Mo2 | --- | --- | 0.030 | 2.00 | 1.00 | 0.035 | 0.03 | 16.00-18.00 | 12.00-15.00 | 2.00-3.00 | --- |
| GB/T 14975-2002 | Grade 00Cr17Ni14Mo2 | --- | --- | 0.030 | 2.00 | 1.00 | 0.035 | 0.03 | 16.00-18.00 | 12.00-15.00 | 2.00-3.00 | --- |
| EN 10296-2:2005 C2:2007 | Grade X3CrNiMo17-13-3 | --- | 1.4436 | 0.05 | 2.00 | 1.00 | 0.045 | 0.015 | 16.5-18.5 | 10.5-13.0 | 2.50-3.00 | N 0.11 |
| | Grade X5CrNiMo17-12-2 | --- | 1.4401 | 0.07 | 2.00 | 1.00 | 0.045 | 0.015 | 16.5-18.5 | 10.0-13.0 | 2.00-2.50 | N 0.11 |
| EN 10297-2:2005 C1:2007 | Grade X3CrNiMo17-13-3 | --- | 1.4436 | 0.05 | 2.00 | 1.00 | 0.045 | 0.015 | 16.5-18.5 | 10.5-14.0 | 2.50-3.00 | N 0.11 |
| | Grade X5CrNiMo17-12-2 | --- | 1.4401 | 0.07 | 2.00 | 1.00 | 0.045 | 0.015 | 16.5-18.5 | 10.0-13.0 | 2.00-2.50 | N 0.11 |
| GB/T 12770-2002 | Grade 0Cr17Ni12Mo2 | --- | --- | 0.08 | 2.00 | 1.00 | 0.035 | 0.03 | 16.00-18.00 | 10.00-14.00 | 2.00-3.00 | --- |
| GB/T 14975-2002 | Grade 0Cr17Ni12Mo2 | --- | --- | 0.08 | 2.00 | 1.00 | 0.035 | 0.03 | 16.00-18.50 | 10.00-14.00 | 2.00-3.00 | --- |
| ASTM A269/A269M-14e1 | Grade TP 304LN | S30453 | --- | 0.035 | 2.00 | 1.00 | 0.045 | 0.030 | 18.0-20.0 | 8.0-11.0 | --- | N 0.10-0.16 |
| EN 10296-2:2005 C2:2007 | Grade X2CrNiN18-10 | --- | 1.4311 | 0.030 | 2.00 | 1.00 | 0.045 | 0.015 | 17.0-19.5 | 8.5-11.5 | --- | N 0.12-0.22 |
| EN 10297-2:2005 C1:2007 | Grade X2CrNiN18-10 | --- | 1.4311 | 0.030 | 2.00 | 1.00 | 0.045 | 0.015 | 17.0-19.5 | 8.5-11.5 | --- | N 0.12-0.22 |
| GB/T 14975-2002 | Grade 00Cr18Ni10N | --- | --- | 0.030 | 2.00 | 1.00 | 0.035 | 0.03 | 17.00-19.00 | 8.50-11.50 | --- | N 0.12-0.22 |
| ASTM A269/A269M-14e1 | Grade TP316LN | S31653 | --- | 0.035 | 2.00 | 1.00 | 0.045 | 0.030 | 16.0-18.0 | 10.0-13.0 | 2.00-3.00 | N 0.10-0.16 |
| EN 10296-2:2005 C2:2007 | Grade X2CrNiMoN17-13-3 | --- | 1.4429 | 0.030 | 2.00 | 1.00 | 0.045 | 0.015 | 16.5-18.5 | 11.0-14.0 | 2.50-3.00 | N 0.12-0.22 |
| EN 10297-2:2005 C1:2007 | Grade X2CrNiMoN17-13-3 | --- | 1.4429 | 0.030 | 2.00 | 1.00 | 0.045 | 0.015 | 16.5-18.5 | 11.0-15.0 | 2.50-3.00 | N 0.12-0.22 |
| GB/T 14975-2002 | Grade 00Cr17Ni13Mo2N | --- | --- | 0.030 | 2.00 | 1.00 | 0.035 | 0.03 | 16.00-18.50 | 10.50-14.50 | 2.0-3.0 | N 0.12-0.22 |
| EN 10296-2:2005 C2:2007 | Grade X5CrNi18-10 | --- | 1.4301 | 0.07 | 2.00 | 1.00 | 0.045 | 0.015 | 17.0-19.5 | 8.0-10.5 | --- | N 0.11 |
| EN 10297-2:2005 C1:2007 | Grade X5CrNi18-10 | --- | 1.4301 | 0.07 | 2.00 | 1.00 | 0.045 | 0.015 | 17.0-19.5 | 8.0-10.5 | --- | N 0.11 |
| GB/T 12770-2002 | Grade 0Cr18Ni9 | --- | --- | 0.07 | 2.00 | 1.00 | 0.035 | 0.03 | 17.00-19.00 | 8.00-11.00 | --- | --- |
| GB/T 14975-2002 | Grade 0Cr18Ni9 | --- | --- | 0.07 | 2.00 | 1.00 | 0.035 | 0.03 | 17.00-19.00 | 8.00-11.00 | --- | --- |
| ASTM A511/A511M-15a | Grade MT 302 | S30200 | --- | 0.08-0.20 | 2.00 | 1.00 | 0.040 | 0.030 | 17.0-19.0 | 8.0-10.0 | --- | --- |
| ASTM A554-15 | Grade MT-302 | S30200 | --- | 0.15 | 2.00 | 1.00 | 0.045 | 0.030 | 17.0-19.0 | 8.0-10.0 | --- | --- |
| GB/T 12770-2002 | Grade 1Cr18Ni9 | --- | --- | 0.15 | 2.00 | 1.00 | 0.035 | 0.03 | 17.00-19.00 | 8.00-10.00 | --- | --- |
| GB/T 14975-2002 | Grade 1Cr18Ni9 | --- | --- | 0.15 | 2.00 | 1.00 | 0.035 | 0.03 | 17.00-19.00 | 8.00-10.00 | --- | --- |
| ASTM A511/A511M-15a | Grade MT 317 | S31700 | --- | 0.08 | 2.00 | 1.00 | 0.040 | 0.030 | 18.0-20.0 | 11.0-14.0 | 3.0-4.0 | --- |
| ASTM A554-15 | Grade MT-317 | S31700 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 18.0-20.0 | 11.0-14.0 | 3.0-4.0 | --- |
| ASTM A632-04 (2014) | Grade TP 317 | S31700 | --- | 0.08 | 2.00 | 0.75 | 0.045 | 0.030 | 18.0-20.0 | 11.0-14.0 | 3.00-4.00 | --- |
| GB/T 14975-2002 | Grade 0Cr19Ni13Mo3 | --- | --- | 0.08 | 2.00 | 1.00 | 0.035 | 0.03 | 18.00-20.00 | 11.00-15.00 | 3.00-4.00 | --- |
| ASME SA-213/SA-213M | Grade TP321 | S32100 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 17.0-19.0 | 9.0-12.0 | --- | Ti 5x(C+N) to 0.70 |
| ASME SA-249/SA-249M | Grade TP321 | S32100 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 17.0-19.0 | 9.0-12.0 | --- | N 0.10; Ti 5x(C+N) to 0.70 |

Note: This section continued on next page.

**5.3 Stainless Steel Tubes for General and Structural Applications**

**5.3.2A Chemical Composition of Austenitic Stainless Steel Tubes for General and Structural Applications (Continued)**

| Specification | Designation | UNS No. | Steel No. | Weight, % max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASTM A249/A249M-14a | Grade TP321 | S32100 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 17.0-19.0 | 9.0-12.0 | --- | N 0.10; Ti 5x(C+N) to 0.70 |
| ASTM A269/A269M-14e1 | Grade TP321 | S32100 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 17.0-19.0 | 9.0-12.0 | --- | Ti 5x(C+N) to 0.70 |
| ASTM A511/A511M-15a | Grade MT 321 | S32100 | --- | 0.08 | 2.00 | 1.00 | 0.040 | 0.030 | 17.0-20.0 | 9.0-13.0 | --- | Ti 5xC to 0.60 |
| ASTM A554-15 | Grade MT-321 | S32100 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 17.0-20.0 | 9.0-13.0 | --- | Ti 5xC to 0.60 |
| ASTM A632-04 (2014) | Grade TP 321 | S32100 | --- | 0.08 | 2.00 | 0.75 | 0.045 | 0.030 | 17.0-20.0 | 9.0-13.0 | --- | Ti 5xC to 0.60 |
| ASTM A778-01 (2009)e1 | Grade TP 321 | S32100 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 17.0-19.0 | 9.0-12.0 | --- | Ti 5xC to 0.70 |
| EN 10296-2:2005 C2:2007 | Grade X6CrNiTi18-10 | --- | 1.4541 | 0.08 | 2.00 | 1.00 | 0.045 | 0.015 | 17.0-19.0 | 9.0-12.0 | --- | Ti 5xC to 0.70 |
| EN 10297-2:2005 C1:2007 | Grade X6CrNiTi18-10 | --- | 1.4541 | 0.08 | 2.00 | 1.00 | 0.045 | 0.015 | 17.0-19.0 | 9.0-12.0 | --- | Ti 5xC to 0.70 |
| GB/T 12770-2002 | Grade 0Cr18Ni10Ti | --- | --- | 0.08 | 2.00 | 1.00 | 0.035 | 0.03 | 17.00-19.00 | 9.00-12.00 | --- | Ti 5xC min. |
| GB/T 14975-2002 | Grade 0Cr18Ni10Ti | --- | --- | 0.08 | 2.00 | 1.00 | 0.035 | 0.03 | 17.00-19.00 | 9.00-12.00 | --- | Ti 5xC min. |
| JIS G 3446:2012 | Symbol SUS321TKA | --- | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 17.00-19.00 | 9.00-13.00 | --- | Ti 5xC min |
| EN 10296-2:2005 C2:2007 | Grade X6CrNiMoTi17-12-2 | --- | 1.4571 | 0.08 | 2.00 | 1.00 | 0.045 | 0.015 | 16.5-18.5 | 10.5-13.5 | 2.00-2.50 | Ti 5xC to 0.70 |
| EN 10297-2:2005 C1:2007 | Grade X6CrNiMoTi17-12-2 | --- | 1.4571 | 0.08 | 2.00 | 1.00 | 0.045 | 0.015 | 16.5-18.5 | 10.5-14.0 | 2.00-2.50 | Ti 5xC to 0.70 |
| GB/T 14975-2002 | Grade 0Cr18Ni12Mo2Ti | --- | --- | 0.08 | 2.00 | 1.00 | 0.035 | 0.03 | 16.00-19.00 | 11.00-14.00 | 1.80-2.50 | Ti 5xC to 0.70 |
| ASTM A269/A269M-14e1 | Grade TP347 | S34700 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 17.0-19.0 | 9.0-12.0 | --- | Cb 10xC to 1.10 |
| ASTM A511/A511M-15a | Grade MT 347 | S34700 | --- | 0.08 | 2.00 | 1.00 | 0.040 | 0.030 | 17.0-20.0 | 9.0-13.0 | --- | Cb 10xC to 1.00 |
| ASTM A554-15 | Grade MT-347 | S34700 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 17.0-20.0 | 9.0-13.0 | --- | Cb 10xC to 1.00 |
| ASTM A632-04 (2014) | Grade TP 347 | S34700 | --- | 0.08 | 2.00 | 0.75 | 0.045 | 0.030 | 17.0-20.0 | 9.0-13.0 | --- | (Cb+Ta) 10xC to 1.0 |
| ASTM A778-01 (2009)e1 | Grade TP 347 | S34700 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 17.0-19.0 | 9.0-12.0 | --- | (Cb+Ta) 10xC to 1.10 |
| EN 10296-2:2005 C2:2007 | Grade X6CrNiNb18-10 | --- | 1.4550 | 0.08 | 2.00 | 1.00 | 0.045 | 0.015 | 17.0-19.0 | 9.0-12.0 | --- | Nb 10xC to 1.00 |
| EN 10297-2:2005 C1:2007 | Grade X6CrNiNb18-10 | --- | 1.4550 | 0.08 | 2.00 | 1.00 | 0.045 | 0.015 | 17.0-19.0 | 9.0-12.0 | --- | Nb 10xC to 1.00 |
| GB/T 12770-2002 | Grade 0Cr18Ni11Nb | --- | --- | 0.08 | 2.00 | 1.00 | 0.035 | 0.03 | 17.00-19.00 | 9.00-13.00 | --- | Nb 10xC min. |
| GB/T 14975-2002 | Grade 0Cr18Ni11Nb | --- | --- | 0.08 | 2.00 | 1.00 | 0.035 | 0.03 | 17.00-19.00 | 9.00-13.00 | --- | Nb 10xC min. |
| JIS G 3446:2012 | Symbol SUS347TKA | --- | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 17.00-19.00 | 9.00-13.00 | --- | Nb 10xC min |
| ASME SA-249/SA-249M | --- | S30415 | --- | 0.04-0.06 | 0.80 | 1.00-2.00 | 0.045 | 0.030 | 18.0-19.0 | 9.0-10.0 | --- | N 0.12-0.18; Ce 0.03-0.08 |
| ASME SA-312/SA-312M | --- | S30415 | --- | 0.04-0.06 | 0.80 | 1.00-2.00 | 0.045 | 0.030 | 18.0-19.0 | 9.0-10.0 | --- | N 0.12-0.18; Ce 0.03-0.08 |
| ASME SA-358/SA-358M* | --- | S30415 | --- | 0.04-0.06 | 0.80 | 1.00-2.00 | 0.045 | 0.030 | 18.0-19.0 | 9.0-10.0 | --- | N 0.12-0.18; Ce 0.03-0.08 |
| ASTM A249/A249M-14a | --- | S30415 | --- | 0.04-0.06 | 0.80 | 1.00-2.00 | 0.045 | 0.030 | 18.0-19.0 | 9.0-10.0 | --- | N 0.12-0.18; Ce 0.03-0.08 |
| ASTM A312/A312M-15 | --- | S30415 | --- | 0.04-0.06 | 0.80 | 1.00-2.00 | 0.045 | 0.030 | 18.0-19.0 | 9.0-10.0 | --- | N 0.12-0.18; Ce 0.03-0.08 |
| ASTM A358/A358M-14a* | --- | S30415 | --- | 0.04-0.06 | 0.80 | 1.00-2.00 | 0.045 | 0.030 | 18.0-19.0 | 9.0-10.0 | --- | N 0.12-0.18; Ce 0.03-0.08 |
| EN 10296-2:2005 C2:2007 | Grade X6CrNiSiNCe19-10 | --- | 1.4818 | 0.04-0.08 | 1.00 | 1.00-2.00 | 0.045 | 0.015 | 18.0-20.0 | 9.0-11.0 | --- | N 0.12-0.20; Ce 0.03-0.08 |
| GB/T 14975-2002 | Grade 0Cr19Ni9N | --- | --- | 0.08 | 2.00 | 1.00 | 0.035 | 0.03 | 18.00-20.00 | 7.00-10.50 | --- | N 0.10-0.25 |
| ASME SA-213/SA-213M | Grade TP317LM | S31725 | --- | 0.03 | 2.00 | 1.00 | 0.045 | 0.030 | 18.0-20.0 | 13.5-17.5 | 4.0-5.0 | N 0.20 max; Cu 0.75 max |
| ASTM A213/A213M-15a | Grade TP317LM | S31725 | --- | 0.03 | 2.00 | 1.00 | 0.045 | 0.030 | 18.0-20.0 | 13.5-17.5 | 4.0-5.0 | N 0.20 max; Cu 0.75 max |
| ASTM A269/A269M-14e1 | --- | S31725 | --- | 0.035 | 2.00 | 1.00 | 0.045 | 0.030 | 18.0-20.0 | 13.5-17.5 | 4.0-5.0 | N 0.20 max |
| EN 10296-2:2005 C2:2007 | Grade X2CrNiMoN17-13-5 | --- | 1.4439 | 0.030 | 2.00 | 1.00 | 0.045 | 0.015 | 16.5-18.5 | 12.5-14.5 | 4.0-5.0 | N 0.12-0.22 |
| EN 10297-2:2005 C1:2007 | Grade X2CrNiMoN17-13-5 | --- | 1.4439 | 0.030 | 2.00 | 1.00 | 0.045 | 0.015 | 16.5-18.5 | 12.5-14.5 | 4.0-5.0 | N 0.12-0.22 |

*: See "List of Standards" at the beginning of the chapter.

**5.3 Stainless Steel Tubes for General and Structural Applications**

**5.3.2B Mechanical Properties of Austenitic Stainless Steel Tubes for General and Structural Applications**

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter | | Yield Strength | | Tensile Strength | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | %, min. | | |
| AFNOR NF A 49-647:1979 | TS Z 6 CN 18-09 | --- | --- | --- | --- | 400 | --- | 600 | --- | 35 | AM | --- |
| ASME SA-249/SA-249M | Grade TP304 | S30400 | --- | 0.4 ≤ t < 8.1 | 0.015 ≤ t < 0.320 | 205 | 30 | 515 | 75 | 35 | ST+Q or RC | 90 max HRB |
| ASME SA-409/SA-409M | Grade TP304 | S30400 | --- | t ≥ 0.46 | t ≥ 0.018 | 205 | 30 | 515 T | 75 T | --- | HT+Q or RC | --- |
| ASME SA-688/SA-688M | Grade TP 304 | S30400 | --- | 15.9 ≤ O.D. ≤ 25.4 | 0.625 ≤ O.D. ≤ 1 | 205 | 30 | 515 | 75 | 35 | SA | 90 max HRB |
| ASTM A269/A269M-14e1 | Grade TP304 | S30400 | --- | 0.51 ≤ t < 1.65 | 0.020 ≤ t < 0.065 | --- | --- | --- | --- | --- | HT | 200 max HV<br>88 max HR15_T<br>74 max HR30_T |
| | | | | t ≥ 1.65 | t ≥ 0.065 | --- | --- | --- | --- | --- | HT | 192 max HBW/<br>200 max HV or<br>90 max HRB |
| ASTM A511/A511M-15a* | Grade MT 304 | S30400 | --- | O.D. ≤ 325 | O.D. ≤ 12.75 | 210 | 30 | 515 | 75 | 35 | A | 192 max HBW;<br>90 max HRB |
| ASTM A554-15* | Grade MT-304 | S30400 | --- | t ≥ 0.51 | t ≥ 0.020 | 207 | 30 | 517 | 75 | 35 | A | 192 max HB;<br>90 max HRB |
| ASTM A632-04 (2014) | Grade TP 304 | S30400 | --- | 0.13 ≤ t ≤ 0.38 | 0.005 ≤ t ≤ 0.015 | --- | --- | 515 | 75 | 25 | HT | --- |
| | | | | 0.38 < t ≤ 1.65 | 0.015 < t ≤ 0.065 | 205 | 30 | 515 | 75 | 35 | HT | --- |
| ASTM A908-03 (2013) | Type 304 | S30400 | --- | 0.05 ≤ t ≤ 0.4 | 0.002 ≤ t ≤ 0.015 | --- | --- | 1030-1370 | 150-200 | --- | --- | --- |
| JIS G 3446:2012 | Symbol SUS304TKA | --- | --- | 1 < t ≤ 2 | --- | 205 | --- | 520 | --- | 26 | ST | --- |
| | | | | 2 < t ≤ 3 | --- | 205 | --- | 520 | --- | 28 | ST | --- |
| | | | | 3 < t ≤ 4 | --- | 205 | --- | 520 | --- | 29 | ST | --- |
| | | | | 4 < t ≤ 5 | --- | 205 | --- | 520 | --- | 30 | ST | --- |
| | | | | 5 < t ≤ 6 | --- | 205 | --- | 520 | --- | 32 | ST | --- |
| | | | | 6 < t ≤ 7 | --- | 205 | --- | 520 | --- | 34 | ST | --- |
| | | | | 7 < t < 8 | --- | 205 | --- | 520 | --- | 35 | ST | --- |
| | | | | t ≥ 8 | --- | 205 | --- | 520 | --- | 35 | ST | --- |
| | Symbol SUS304TKC | --- | --- | 1 < t ≤ 2 | --- | 205 | --- | 520 | --- | 26 | AM | --- |
| | | | | 2 < t ≤ 3 | --- | 205 | --- | 520 | --- | 28 | AM | --- |
| | | | | 3 < t ≤ 4 | --- | 205 | --- | 520 | --- | 29 | AM | --- |
| | | | | 4 < t ≤ 5 | --- | 205 | --- | 520 | --- | 30 | AM | --- |
| | | | | 5 < t ≤ 6 | --- | 205 | --- | 520 | --- | 32 | AM | --- |
| | | | | 6 < t ≤ 7 | --- | 205 | --- | 520 | --- | 34 | AM | --- |
| | | | | 7 < t < 8 | --- | 205 | --- | 520 | --- | 35 | AM | --- |
| | | | | t ≥ 8 | --- | 205 | --- | 520 | --- | 35 | AM | --- |

*: See "List of Standards" at the beginning of the chapter.

**5.3 Stainless Steel Tubes for General and Structural Applications**

**5.3.2B Mechanical Properties of Austenitic Stainless Steel Tubes for General and Structural Applications (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter | | Yield Strength | | Tensile Strength | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | %, min. | | |
| AFNOR NF A 49-647:1979 | TS Z 2 CN 18-10 | --- | --- | --- | --- | 400 | --- | 600 | --- | 35 | AM | --- |
| ASTM A269/A269M-14e1 | Grade TP304L | S30403 | --- | 0.51 ≤ t < 1.65 | 0.020 ≤ t < 0.065 | --- | --- | --- | --- | --- | HT | 200 max HV<br>88 max HR15_T<br>74 max HR30_T |
| | | | | t ≥ 1.65 | t ≥ 0.065 | --- | --- | --- | --- | --- | HT | 192 max HBW/<br>200 max HV or<br>90 max HRB |
| ASTM A511/A511M-15a* | Grade MT 304L | S30403 | --- | O.D. ≤ 325 | O.D. ≤ 12.75 | 210 | 30 | 515 | 75 | 35 | A | 192 max HBW;<br>90 max HRB |
| ASTM A554-15* | Grade MT-304L | S30403 | --- | t ≥ 0.51 | t ≥ 0.020 | 172 | 25 | 483 | 70 | 35 | A | 192 max HB;<br>90 max HRB |
| ASTM A632-04 (2014) | Grade TP 304L | S30403 | --- | 0.13 ≤ t ≤ 0.38 | 0.005 ≤ t ≤ 0.015 | --- | --- | 485 | 70 | 25 | HT | --- |
| | | | | 0.38 < t ≤ 1.65 | 0.015 < t ≤ 0.065 | 170 | 25 | 485 | 70 | 35 | HT | --- |
| ASTM A778-01 (2009)e1 | Grade TP 304L | S30403 | --- | 1.5 ≤ t ≤ 12.5 | 0.062 ≤ t ≤ 0.500 | --- | --- | 485 T | 70 T | --- | AM | --- |
| EN 10296-2:2005 C2:2007 | Grade X2CrNi19-11 | --- | 1.4306 | t ≤ 30 | --- | 180 | --- | 460 | --- | 40 L, 35 T | AW or SA | --- |
| EN 10297-2:2005 C1:2007 | Grade X2CrNi19-11 | --- | 1.4306 | --- | --- | 180 | --- | 460 | --- | 40 L, 35 T | SA | --- |
| GB/T 12770-2002 | Grade 00Cr19Ni10 | --- | --- | --- | --- | --- | --- | 480 | --- | 35 | ST | --- |
| | | | | --- | --- | --- | --- | 480 | --- | 25 | W | --- |
| GB/T 14975-2002 | Grade 00Cr19Ni10 | --- | --- | --- | --- | 175 | --- | 480 T | --- | 35 T | BA | --- |

*: See "List of Standards" at the beginning of the chapter.

**5.3 Stainless Steel Tubes for General and Structural Applications**

**5.3.2B Mechanical Properties of Austenitic Stainless Steel Tubes for General and Structural Applications (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter | | Yield Strength | | Tensile Strength | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | %, min. | | |
| AFNOR NF A 49-647:1979 | TS Z 6 CND 17-11 | --- | --- | --- | --- | 400 | --- | 600 | --- | 35 | AM | --- |
| ASTM A269/A269M-14e1 | Grade TP316 | S31600 | --- | 0.51 ≤ t < 1.65 | 0.020 ≤ t < 0.065 | --- | --- | --- | --- | --- | HT | 200 max HV<br>88 max HR15_T<br>74 max HR30_T |
| | | | | t ≥ 1.65 | t ≥ 0.065 | --- | --- | --- | --- | --- | HT | 192 max HBW/<br>200 max HV or<br>90 max HRB |
| ASTM A511/A511M-15a* | Grade MT 316 | S31600 | --- | O.D. ≤ 325 | O.D. ≤ 12.75 | 210 | 30 | 515 | 75 | 35 | A | 192 max HBW;<br>90 max HRB |
| ASTM A554-15* | Grade MT-316 | --- | --- | t ≥ 0.51 | t ≥ 0.020 | 207 | 30 | 517 | 75 | 35 | A | 192 max HB;<br>90 max HRB |
| ASTM A632-04 (2014) | Grade TP 316 | S31600 | --- | 0.13 ≤ t ≤ 0.38 | 0.005 ≤ t ≤ 0.015 | --- | --- | 515 | 75 | 25 | HT | --- |
| | | | | 0.38 < t ≤ 1.65 | 0.015 < t ≤ 0.065 | 205 | 30 | 515 | 75 | 35 | HT | --- |
| JIS G 3446:2012 | Symbol SUS316TKA | --- | --- | 1 < t ≤ 2 | --- | 205 | --- | 520 | --- | 26 | ST | --- |
| | | | | 2 < t ≤ 3 | --- | 205 | --- | 520 | --- | 28 | ST | --- |
| | | | | 3 < t ≤ 4 | --- | 205 | --- | 520 | --- | 29 | ST | --- |
| | | | | 4 < t ≤ 5 | --- | 205 | --- | 520 | --- | 30 | ST | --- |
| | | | | 5 < t ≤ 6 | --- | 205 | --- | 520 | --- | 32 | ST | --- |
| | | | | 6 < t ≤ 7 | --- | 205 | --- | 520 | --- | 34 | ST | --- |
| | | | | 7 < t < 8 | --- | 205 | --- | 520 | --- | 35 | ST | --- |
| | | | | t ≥ 8 | --- | 205 | --- | 520 | --- | 35 | ST | --- |
| | Symbol SUS316TKC | --- | --- | 1 < t ≤ 2 | --- | 205 | --- | 520 | --- | 26 | AM | --- |
| | | | | 2 < t ≤ 3 | --- | 205 | --- | 520 | --- | 28 | AM | --- |
| | | | | 3 < t ≤ 4 | --- | 205 | --- | 520 | --- | 29 | AM | --- |
| | | | | 4 < t ≤ 5 | --- | 205 | --- | 520 | --- | 30 | AM | --- |
| | | | | 5 < t ≤ 6 | --- | 205 | --- | 520 | --- | 32 | AM | --- |
| | | | | 6 < t ≤ 7 | --- | 205 | --- | 520 | --- | 34 | AM | --- |
| | | | | 7 < t < 8 | --- | 205 | --- | 520 | --- | 35 | AM | --- |
| | | | | t ≥ 8 | --- | 205 | --- | 520 | --- | 35 | AM | --- |

*: See "List of Standards" at the beginning of the chapter.

**5.3 Stainless Steel Tubes for General and Structural Applications**

**5.3.2B Mechanical Properties of Austenitic Stainless Steel Tubes for General and Structural Applications (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter | | Yield Strength | | Tensile Strength | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | %, min. | | |
| ASTM A269/A269M-14e1 | Grade TP316L | S31603 | --- | 0.51 ≤ t < 1.65 | 0.020 ≤ t < 0.065 | --- | --- | --- | --- | --- | HT | 200 max HV<br>88 max HR15_T<br>74 max HR30_T |
| | | | | t ≥ 1.65 | t ≥ 0.065 | --- | --- | --- | --- | --- | HT | 192 max HBW/<br>200 max HV or<br>90 max HRB |
| ASTM A511/A511M-15a* | Grade MT 316L | --- | --- | O.D. ≤ 325 | O.D. ≤ 12.75 | 210 | 30 | 515 | 75 | 35 | A | 192 max HBW;<br>90 max HRB |
| ASTM A554-15* | Grade MT-316L | S31603 | --- | t ≥ 0.51 | t ≥ 0.020 | 172 | 25 | 483 | 70 | 35 | A | 192 max HB;<br>90 max HRB |
| ASTM A632-04 (2014) | Grade TP 316L | S31603 | --- | 0.13 ≤ t ≤ 0.38 | 0.005 ≤ t ≤ 0.015 | --- | --- | 485 | 70 | 25 | HT | --- |
| | | | | 0.38 < t ≤ 1.65 | 0.015 < t ≤ 0.065 | 170 | 25 | 485 | 70 | 35 | HT | --- |
| ASTM A778-01 (2009)e1 | Grade TP 316L | S31603 | --- | 1.5 ≤ t ≤ 12.5 | 0.062 ≤ t ≤ 0.500 | --- | --- | 485 T | 70 T | --- | AM | --- |
| EN 10296-2:2005 C2:2007 | Grade X2CrNiMo17-12-2 | --- | 1.4404 | t ≤ 30 | --- | 190 | --- | 490 | --- | 40 L, 30 T | AW or SA | --- |
| | Grade X2CrNiMo17-12-3 | --- | 1.4432 | t ≤ 30 | --- | 190 | --- | 490 | --- | 40 L, 30 T | AW or SA | --- |
| | Grade X2CrNiMo18-14-3 | --- | 1.4435 | t ≤ 30 | --- | 190 | --- | 490 | --- | 40 L, 35 T | AW or SA | --- |
| EN 10297-2:2005 C1:2007 | Grade X2CrNiMo17-12-2 | --- | 1.4404 | --- | --- | 190 | --- | 490 | --- | 40 L, 30 T | SA | --- |
| | Grade X2CrNiMo18-14-3 | --- | 1.4435 | --- | --- | 190 | --- | 490 | --- | 40 L, 35 T | SA | --- |
| GB/T 12770-2002 | Grade 00Cr17Ni14Mo2 | --- | --- | --- | --- | --- | --- | 480 | --- | 35 | ST | --- |
| | | | | --- | --- | --- | --- | 480 | --- | 25 | W | --- |
| GB/T 14975-2002 | Grade 00Cr17Ni14Mo2 | --- | --- | --- | --- | 175 | --- | 480 T | --- | 35 T | BA | --- |
| EN 10296-2:2005 C2:2007 | Grade X3CrNiMo17-13-3 | --- | 1.4436 | t ≤ 30 | --- | 205 | --- | 510 | --- | 40 L, 30 T | AW or SA | --- |
| | Grade X5CrNiMo17-12-2 | --- | 1.4401 | t ≤ 30 | --- | 205 | --- | 510 | --- | 40 L, 30 T | AW or SA | --- |
| EN 10297-2:2005 C1:2007 | Grade X3CrNiMo17-13-3 | --- | 1.4436 | --- | --- | 205 | --- | 510 | --- | 40 L, 30 T | SA | --- |
| | Grade X5CrNiMo17-12-2 | --- | 1.4401 | --- | --- | 205 | --- | 510 | --- | 40 L, 30 T | SA | --- |
| GB/T 12770-2002 | Grade 0Cr17Ni12Mo2 | --- | --- | --- | --- | --- | --- | 520 | --- | 35 | ST | --- |
| | | | | --- | --- | --- | --- | 520 | --- | 25 | W | --- |
| GB/T 14975-2002 | Grade 0Cr17Ni12Mo2 | --- | --- | --- | --- | 205 | --- | 520 T | --- | 35 T | BA | --- |
| ASTM A269/A269M-14e1 | Grade TP 304LN | S30453 | --- | 0.51 ≤ t < 1.65 | 0.020 ≤ t < 0.065 | --- | --- | --- | --- | --- | HT | 200 max HV<br>88 max HR15_T<br>74 max HR30_T |
| | | | | t ≥ 1.65 | t ≥ 0.065 | --- | --- | --- | --- | --- | HT | 192 max HBW/<br>200 max HV or<br>90 max HRB |
| EN 10296-2:2005 C2:2007 | Grade X2CrNiN18-10 | --- | 1.4311 | t ≤ 30 | --- | 270 | --- | 550 | --- | 35 L, 30 T | AW or SA | --- |
| EN 10297-2:2005 C1:2007 | Grade X2CrNiN18-10 | --- | 1.4311 | --- | --- | 270 | --- | 550 | --- | 35 L, 30 T | SA | --- |
| GB/T 14975-2002 | Grade 00Cr18Ni10N | --- | --- | --- | --- | 245 | --- | 550 T | --- | 40 T | BA | --- |

*: See "List of Standards" at the beginning of the chapter.

**5.3 Stainless Steel Tubes for General and Structural Applications**

**5.3.2B Mechanical Properties of Austenitic Stainless Steel Tubes for General and Structural Applications (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter | | Yield Strength | | Tensile Strength | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | %, min. | | |
| ASTM A269/A269M-14e1 | Grade TP316LN | S31653 | --- | 0.51 ≤ t < 1.65 | 0.020 ≤ t < 0.065 | --- | --- | --- | --- | --- | HT | 200 max HV<br>88 max HR15_T<br>74 max HR30_T |
| | | | | t ≥ 1.65 | t ≥ 0.065 | --- | --- | --- | --- | --- | HT | 192 max HBW/<br>200 max HV or<br>90 max HRB |
| EN 10296-2:2005 C2:2007 | Grade X2CrNiMoN17-13-3 | --- | 1.4429 | t ≤ 30 | --- | 295 | --- | 580 | --- | 35 L, 30 T | AW or SA | --- |
| EN 10297-2:2005 C1:2007 | Grade X2CrNiMoN17-13-3 | --- | 1.4429 | --- | --- | 295 | --- | 580 | --- | 35 L, 30 T | SA | --- |
| GB/T 14975-2002 | Grade 00Cr17Ni13Mo2N | --- | --- | --- | --- | 245 | --- | 550 T | --- | 40 T | BA | --- |
| EN 10296-2:2005 C2:2007 | Grade X5CrNi18-10 | --- | 1.4301 | t ≤ 30 | --- | 195 | --- | 500 | --- | 40 L, 35 T | AW or SA | --- |
| EN 10297-2:2005 C1:2007 | Grade X5CrNi18-10 | --- | 1.4301 | --- | --- | 195 | --- | 500 | --- | 40 L, 35 T | SA | --- |
| GB/T 12770-2002 | Grade 0Cr18Ni9 | --- | --- | --- | --- | --- | --- | 520 | --- | 35 | ST | --- |
| | | | | --- | --- | --- | --- | 520 | --- | 25 | W | --- |
| GB/T 14975-2002 | Grade 0Cr18Ni9 | --- | --- | --- | --- | 205 | --- | 520 T | --- | 35 T | BA | --- |
| ASTM A511/A511M-15a* | Grade MT 302 | S30200 | --- | O.D. ≤ 325 | O.D. ≤ 12.75 | 210 | 30 | 515 | 75 | 35 | A | 192 max HBW;<br>90 max HRB |
| ASTM A554-15* | Grade MT-302 | S30200 | --- | t ≥ 0.51 | t ≥ 0.020 | 207 | 30 | 517 | 75 | 35 | A | 192 max HB;<br>90 max HRB |
| GB/T 12770-2002 | Grade 1Cr18Ni9 | --- | --- | --- | --- | --- | --- | 520 | --- | 35 | ST | --- |
| | | | | --- | --- | --- | --- | 520 | --- | 25 | W | --- |
| GB/T 14975-2002 | Grade 1Cr18Ni9 | --- | --- | --- | --- | 205 | --- | 520 T | --- | 35 T | BA | --- |
| ASTM A511/A511M-15a* | Grade MT 317 | S31700 | --- | O.D. ≤ 325 | O.D. ≤ 12.75 | 210 | 30 | 515 | 75 | 35 | A+Q or RC | 192 max HBW;<br>90 max HRB |
| ASTM A554-15* | Grade MT-317 | S31700 | --- | t ≥ 0.51 | t ≥ 0.020 | 207 | 30 | 517 | 75 | 35 | A | 192 max HB;<br>90 max HRB |
| ASTM A632-04 (2014) | Grade TP 317 | S31700 | --- | 0.13 ≤ t ≤ 0.38 | 0.005 ≤ t ≤ 0.015 | --- | --- | 515 | 75 | 25 | HT+Q or RC | --- |
| | | | | 0.38 < t ≤ 1.65 | 0.015 < t ≤ 0.065 | 205 | 30 | 515 | 75 | 35 | HT+Q or RC | --- |
| GB/T 14975-2002 | Grade 0Cr19Ni13Mo3 | --- | --- | --- | --- | 205 | --- | 520 T | --- | 35 T | BA | --- |

*: See "List of Standards" at the beginning of the chapter.

**5.3 Stainless Steel Tubes for General and Structural Applications**

**5.3.2B Mechanical Properties of Austenitic Stainless Steel Tubes for General and Structural Applications (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter | | Yield Strength | | Tensile Strength | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | %, min. | | |
| ASME SA-213/SA-213M | Grade TP321 | S32100 | --- | t ≥ 0.4 | t ≥ 0.015 | 205 | 30 | 515 | 75 | 35 | ST+Q or RC | 192 max HBW/ 200 max HV; 90 max HRB |
| ASME SA-249/SA-249M | Grade TP321 | S32100 | --- | 0.4 ≤ t < 8.1 | 0.015 ≤ t < 0.320 | 205 | 30 | 515 | 75 | 35 | ST+Q or RC | 90 max HRB |
| ASTM A249/A249M-14a | Grade TP321 | S32100 | --- | 0.4 ≤ t < 8.1 | 0.015 ≤ t < 0.320 | 205 | 30 | 515 | 75 | 35 | ST+Q or RC | 90 max HRB |
| ASTM A269/A269M-14e1 | Grade TP321 | S32100 | --- | 0.51 ≤ t < 1.65 | 0.020 ≤ t < 0.065 | --- | --- | --- | --- | --- | HT | 200 max HV 88 max HR15_T 74 max HR30_T |
| | | | | t ≥ 1.65 | t ≥ 0.065 | --- | --- | --- | --- | --- | HT | 192 max HBW/ 200 max HV or 90 max HRB |
| ASTM A511/A511M-15a* | Grade MT 321 | S32100 | --- | O.D. ≤ 325 | O.D. ≤ 12.75 | 210 | 30 | 515 | 75 | 35 | A | 192 max HBW; 90 max HRB |
| ASTM A554-15* | Grade MT-321 | S32100 | --- | t ≥ 0.51 | t ≥ 0.020 | 207 | 30 | 517 | 75 | 35 | A | 192 max HB; 90 max HRB |
| ASTM A632-04 (2014) | Grade TP 321 | S32100 | --- | 0.13 ≤ t ≤ 0.38 | 0.005 ≤ t ≤ 0.015 | --- | --- | 515 | 75 | 25 | HT | --- |
| | | | | 0.38 < t ≤ 1.65 | 0.015 < t ≤ 0.065 | 205 | 30 | 515 | 75 | 35 | HT | --- |
| ASTM A778-01 (2009)e1 | Grade TP 321 | S32100 | --- | 1.5 ≤ t ≤ 12.5 | 0.062 ≤ t ≤ 0.500 | --- | --- | 515 T | 75 T | --- | AM | --- |
| EN 10296-2:2005 C2:2007 | Grade X6CrNiTi18-10 | --- | 1.4541 | t ≤ 30 | --- | 200 | --- | 500 | --- | 35 L, 30 T | AW or SA | --- |
| EN 10297-2:2005 C1:2007 | Grade X6CrNiTi18-10 | --- | 1.4541 | --- | --- | 200 | --- | 500 | --- | 35 L, 30 T | SA, CF | --- |
| | | | | --- | --- | 180 | --- | 460 | --- | 35 L, 30 T | SA, HF | --- |
| GB/T 12770-2002 | Grade 0Cr18Ni10Ti | --- | --- | --- | --- | --- | --- | 520 | --- | 35 | ST | --- |
| | | | | --- | --- | --- | --- | 520 | --- | 25 | W | --- |
| GB/T 14975-2002 | Grade 0Cr18Ni10Ti | --- | --- | --- | --- | 205 | --- | 520 T | --- | 35 T | BA | --- |
| JIS G 3446:2012 | Symbol SUS321TKA | --- | --- | 1 < t ≤ 2 | --- | 205 | --- | 520 | --- | 26 | ST | --- |
| | | | | 2 < t ≤ 3 | --- | 205 | --- | 520 | --- | 28 | ST | --- |
| | | | | 3 < t ≤ 4 | --- | 205 | --- | 520 | --- | 29 | ST | --- |
| | | | | 4 < t ≤ 5 | --- | 205 | --- | 520 | --- | 30 | ST | --- |
| | | | | 5 < t ≤ 6 | --- | 205 | --- | 520 | --- | 32 | ST | --- |
| | | | | 6 < t ≤ 7 | --- | 205 | --- | 520 | --- | 34 | ST | --- |
| | | | | 7 < t < 8 | --- | 205 | --- | 520 | --- | 35 | ST | --- |
| | | | | t ≥ 8 | --- | 205 | --- | 520 | --- | 35 | ST | --- |
| EN 10296-2:2005 C2:2007 | Grade X6CrNiMoTi17-12-2 | --- | 1.4571 | t ≤ 30 | --- | 210 | --- | 510 | --- | 35 L, 30 T | AW or SA | --- |
| EN 10297-2:2005 C1:2007 | Grade X6CrNiMoTi17-12-2 | --- | 1.4571 | --- | --- | 210 | --- | 500 | --- | 35 L, 30 T | SA, CF | --- |
| | | | | --- | --- | 190 | --- | 490 | --- | 35 L, 30 T | SA, HF | --- |
| GB/T 14975-2002 | Grade 0Cr18Ni12Mo2Ti | --- | --- | --- | --- | 205 | --- | 530 T | --- | 35 T | BA | --- |

*: See "List of Standards" at the beginning of the chapter.

**5.3 Stainless Steel Tubes for General and Structural Applications**

**5.3.2B Mechanical Properties of Austenitic Stainless Steel Tubes for General and Structural Applications (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter | | Yield Strength | | Tensile Strength | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | %, min. | | |
| ASTM A269/A269M-14e1 | Grade TP347 | S34700 | --- | 0.51 ≤ t < 1.65 | 0.020 ≤ t < 0.065 | --- | --- | --- | --- | --- | HT | 200 max HV<br>88 max HR15_T<br>74 max HR30_T |
| | | | | t ≥ 1.65 | t ≥ 0.065 | --- | --- | --- | --- | --- | HT | 192 max HBW/<br>200 max HV or<br>90 max HRB |
| ASTM A511/A511M-15a* | Grade MT 347 | S34700 | --- | O.D. ≤ 325 | O.D. ≤ 12.75 | 210 | 30 | 515 | 75 | 35 | A | 192 max HBW;<br>90 max HRB |
| ASTM A554-15* | Grade MT-347 | S34700 | --- | t ≥ 0.51 | t ≥ 0.020 | 207 | 30 | 517 | 75 | 35 | A | 192 max HB;<br>90 max HRB |
| ASTM A632-04 (2014) | Grade TP 347 | S34700 | --- | 0.13 ≤ t ≤ 0.38 | 0.005 ≤ t ≤ 0.015 | --- | --- | 515 | 75 | 25 | HT | --- |
| | | | | 0.38 < t ≤ 1.65 | 0.015 < t ≤ 0.065 | 205 | 30 | 515 | 75 | 35 | HT | --- |
| ASTM A778-01 (2009)e1 | Grade TP 347 | S34700 | --- | 1.5 ≤ t ≤ 12.5 | 0.062 ≤ t ≤ 0.500 | --- | --- | 515 T | 75 T | --- | AM | --- |
| EN 10296-2:2005 C2:2007 | Grade X6CrNiNb18-10 | --- | 1.4550 | t ≤ 30 | --- | 205 | --- | 510 | --- | 35 L, 30 T | AW or SA | --- |
| EN 10297-2:2005 C1:2007 | Grade X6CrNiNb18-10 | --- | 1.4550 | --- | --- | 205 | --- | 510 | --- | 35 L, 30 T | SA | --- |
| GB/T 12770-2002 | Grade 0Cr18Ni11Nb | --- | --- | --- | --- | --- | --- | 520 | --- | 35 | ST | --- |
| | | | | --- | --- | --- | --- | 520 | --- | 25 | W | --- |
| GB/T 14975-2002 | Grade 0Cr18Ni11Nb | --- | --- | --- | --- | 205 | --- | 520 T | --- | 35 T | BA | --- |
| JIS G 3446:2012 | Symbol SUS347TKA | --- | --- | 1 < t ≤ 2 | --- | 205 | --- | 520 | --- | 26 | ST | --- |
| | | | | 2 < t ≤ 3 | --- | 205 | --- | 520 | --- | 28 | ST | --- |
| | | | | 3 < t ≤ 4 | --- | 205 | --- | 520 | --- | 29 | ST | --- |
| | | | | 4 < t ≤ 5 | --- | 205 | --- | 520 | --- | 30 | ST | --- |
| | | | | 5 < t ≤ 6 | --- | 205 | --- | 520 | --- | 32 | ST | --- |
| | | | | 6 < t ≤ 7 | --- | 205 | --- | 520 | --- | 34 | ST | --- |
| | | | | 7 < t < 8 | --- | 205 | --- | 520 | --- | 35 | ST | --- |
| | | | | t ≥ 8 | --- | 205 | --- | 520 | --- | 35 | ST | --- |
| ASME SA-249/SA-249M | --- | S30415 | --- | 0.4 ≤ t < 8.1 | 0.015 ≤ t < 0.320 | 290 | 42 | 600 | 87 | 35 | ST+Q or RC | 96 max HRB |
| ASME SA-312/SA-312M | --- | S30415 | --- | --- | --- | 290 | 42 | 600 | 87 | 35 L, 25 T | A+Q or RC | --- |
| ASME SA-358/SA-358M* | --- | S30415 | --- | --- | --- | 290 | 42 | 600 | 87 | 40 | A+Q or ST | 217 max HBW or<br>95 max HRBW |
| ASTM A249/A249M-14a | --- | S30415 | --- | 0.4 ≤ t < 8.1 | 0.015 ≤ t < 0.320 | 290 | 42 | 600 | 87 | 35 | ST+Q or RC | 96 max HRB |
| ASTM A312/A312M-15 | --- | S30415 | --- | --- | --- | 290 | 42 | 600 | 87 | 35 L, 25 T | A+Q or RC | --- |
| ASTM A358/A358M-14a* | --- | S30415 | --- | --- | --- | 290 | 42 | 600 | 87 | 40 | A+Q or ST | 217 max HBW or<br>95 max HRBW |
| EN 10296-2:2005 C2:2007 | Grade X6CrNiSiNCe19-10 | --- | 1.4818 | --- | --- | 290 | --- | 600 | --- | 40 L, 40 T | SA | --- |
| GB/T 14975-2002 | Grade 0Cr19Ni9N | --- | --- | --- | --- | 275 | --- | 550 T | --- | 35 T | BA | --- |

*: See "List of Standards" at the beginning of the chapter.

**5.3 Stainless Steel Tubes for General and Structural Applications**

**5.3.2B Mechanical Properties of Austenitic Stainless Steel Tubes for General and Structural Applications (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter | | Yield Strength | | Tensile Strength | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | %, min. | | |
| ASME SA-213/SA-213M | Grade TP317LM | S31725 | --- | t ≥ 0.4 | t ≥ 0.015 | 205 | 30 | 515 | 75 | 35 | ST+Q or RC | 192 max HBW/ 200 max HV; 90 max HRB |
| ASTM A213/A213M-15a | Grade TP317LM | S31725 | --- | t ≥ 0.4 | t ≥ 0.015 | 205 | 30 | 515 | 75 | 35 | ST+Q or RC | 192 max HBW/ 200 max HV; 90 max HRB |
| ASTM A269/A269M-14e1 | --- | S31725 | --- | 0.51 ≤ t < 1.65 | 0.020 ≤ t < 0.065 | --- | --- | --- | --- | --- | HT | 200 max HV 88 max HR15_T 74 max HR30_T |
| | | | | t ≥ 1.65 | t ≥ 0.065 | --- | --- | --- | --- | --- | HT | 192 max HBW/ 200 max HV or 90 max HRB |
| EN 10296-2:2005 C2:2007 | Grade X2CrNiMoN17-13-5 | --- | 1.4439 | t ≤ 30 | --- | 285 | --- | 580 | --- | 35 L, 30 T | AW or SA | --- |
| EN 10297-2:2005 C1:2007 | Grade X2CrNiMoN17-13-5 | --- | 1.4439 | --- | --- | 285 | --- | 580 | --- | 35 L, 30 T | SA | --- |

**5.3 Stainless Steel Tubes for General and Structural Applications**

**5.3.3A Chemical Composition of Duplex Stainless Steel Tubes and Pipes for General and Structural Applications**

| Specification | Designation | UNS No. | Steel No. | Weight, % max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASME SA-789/SA-789M | --- | S31500 | --- | 0.030 | 1.20-2.00 | 1.40-2.00 | 0.030 | 0.030 | 18.0-19.0 | 4.3-5.2 | 2.50-3.00 | N 0.05-0.1 |
| ASTM A789/A789M-14 | --- | S31500 | --- | 0.030 | 1.20-2.00 | 1.40-2.00 | 0.030 | 0.030 | 18.0-19.0 | 4.3-5.2 | 2.50-3.00 | N 0.05-0.1 |
| EN 10297-2:2005 C1:2007 | Grade X2CrNiMoSi18-5-3 | --- | 1.4424 | 0.030 | 1.20-2.00 | 1.40-2.00 | 0.035 | 0.015 | 18.0-19.0 | 4.5-5.2 | 2.50-3.00 | N 0.05-0.10 |
| GB/T 14975-2002 | Grade 00Cr18Ni5Mo3Si2 | --- | --- | 0.030 | 1.00-2.00 | 1.30-2.00 | 0.035 | 0.03 | 18.00-19.00 | 4.50-5.50 | 2.50-3.00 | --- |
| ASME SA-789/SA-789M | --- | S31803 | --- | 0.030 | 2.00 | 1.00 | 0.030 | 0.020 | 21.0-23.0 | 4.5-6.5 | 2.5-3.5 | N 0.08-0.20 |
| | | S32205 | --- | 0.030 | 2.00 | 1.00 | 0.030 | 0.020 | 22.0-23.0 | 4.5-6.5 | 3.0-3.5 | N 0.14-0.20 |
| ASTM A270/A270M-15 | --- | S31803 | --- | 0.030 | 2.00 | 1.00 | 0.030 | 0.020 | 21.0-23.0 | 4.5-6.5 | 2.5-3.5 | N 0.08-0.20 |
| | Grade 2205 | S32205 | --- | 0.030 | 2.00 | 1.00 | 0.030 | 0.020 | 22.0-23.0 | 4.5-6.5 | 3.0-3.5 | N 0.14-0.20 |
| ASTM A789/A789M-14 | --- | S31803 | --- | 0.030 | 2.00 | 1.00 | 0.030 | 0.020 | 21.0-23.0 | 4.5-6.5 | 2.5-3.5 | N 0.08-0.20 |
| | | S32205 | --- | 0.030 | 2.00 | 1.00 | 0.030 | 0.020 | 22.0-23.0 | 4.5-6.5 | 3.0-3.5 | N 0.14-0.20 |
| EN 10296-2:2005 C2:2007 | Grade X2CrNiMoN22-5-3 | --- | 1.4462 | 0.030 | 2.00 | 1.00 | 0.035 | 0.015 | 21.0-23.0 | 4.5-6.5 | 2.50-3.5 | N 0.10-0.22 |
| EN 10297-2:2005 C1:2007 | Grade X2CrNiMoN22-5-3 | --- | 1.4462 | 0.030 | 2.00 | 1.00 | 0.035 | 0.015 | 21.0-23.0 | 4.5-6.5 | 2.5-3.5 | N 0.10-0.22 |
| ASME SA-789/SA-789M | --- | S32304 | --- | 0.030 | 2.50 | 1.00 | 0.040 | 0.040 | 21.5-24.5 | 3.0-5.5 | 0.05-0.60 | Cu 0.05-0.60; N 0.05-0.20 |
| ASTM A789/A789M-14 | --- | S32304 | --- | 0.030 | 2.50 | 1.00 | 0.040 | 0.040 | 21.5-24.5 | 3.0-5.5 | 0.05-0.60 | Cu 0.05-0.60; N 0.05-0.20 |
| EN 10296-2:2005 C2:2007 | Grade X2CrNiN23-4 | --- | 1.4362 | 0.030 | 2.00 | 1.00 | 0.035 | 0.015 | 22.0-24.0 | 3.5-5.5 | 0.10-0.60 | Cu 0.10-0.60; N 0.05-0.20 |
| EN 10297-2:2005 C1:2007 | Grade X2CrNiN23-4 | --- | 1.4362 | 0.030 | 2.00 | 1.00 | 0.035 | 0.015 | 22.0-24.0 | 3.5-5.5 | 0.10-0.60 | Cu 0.10-0.60; N 0.05-0.20 |
| ASME SA-789/SA-789M | --- | S32760 | --- | 0.05 | 1.00 | 1.00 | 0.030 | 0.010 | 24.0-26.0 | 6.0-8.0 | 3.0-4.0 | Cu 0.50-1.00; W 0.50-1.00; N 0.20-0.30; [Cr+(3.3xMo)+(16xN)] 40 min. |
| ASTM A789/A789M-14 | --- | S32760 | --- | 0.030 | 1.00 | 1.00 | 0.030 | 0.010 | 24.0-26.0 | 6.0-8.0 | 3.0-4.0 | Cu 0.50-1.00; W 0.50-1.00; N 0.20-0.30; [Cr+(3.3xMo)+(16xN)] 40 min. |
| EN 10297-2:2005 C1:2007 | Grade X2CrNiMoCuWN25-7-4 | --- | 1.4501 | 0.030 | 1.00 | 1.00 | 0.035 | 0.015 | 24.0-26.0 | 6.0-8.0 | 3.0-4.0 | Cu 0.50-1.00; W 0.50-1.00; N 0.20-0.30 |
| ASME SA-789/SA-789M | --- | S32750 | --- | 0.030 | 1.20 | 0.80 | 0.035 | 0.020 | 24.0-26.0 | 6.0-8.0 | 3.0-5.0 | Cu 0.50; N 0.24-0.32 |
| ASTM A270/A270M-15 | Grade 2507 | S32750 | --- | 0.030 | 1.20 | 0.80 | 0.035 | 0.020 | 24.0-26.0 | 6.0-8.0 | 3.0-5.0 | Cu 0.50; N 0.24-0.32 |
| ASTM A789/A789M-14 | --- | S32750 | --- | 0.030 | 1.20 | 0.80 | 0.035 | 0.020 | 24.0-26.0 | 6.0-8.0 | 3.0-5.0 | Cu 0.50; N 0.24-0.32; [Cr+(3.3xMo)+(16xN)] 41 min. |
| EN 10296-2:2005 C2:2007 | Grade X2CrNiMoN25-7-4 | --- | 1.4410 | 0.030 | 2.00 | 1.00 | 0.035 | 0.015 | 24.0-26.0 | 6.0-8.0 | 3.0-4.5 | N 0.24-0.35 |
| EN 10297-2:2005 C1:2007 | Grade X2CrNiMoN25-7-4 | --- | 1.4410 | 0.030 | 2.00 | 1.00 | 0.035 | 0.015 | 24.0-26.0 | 6.0-8.0 | 3.0-4.5 | N 0.24-0.35 |
| ASME SA-789/SA-789M | --- | S32906 | --- | 0.030 | 0.80-1.50 | 0.80 | 0.030 | 0.030 | 28.0-30.0 | 5.8-7.5 | 1.50-2.60 | Cu 0.80; N 0.30-0.40 |
| ASTM A789/A789M-14 | --- | S32906 | --- | 0.030 | 0.80-1.50 | 0.80 | 0.030 | 0.030 | 28.0-30.0 | 5.8-7.5 | 1.50-2.60 | Cu 0.80; N 0.30-0.40 |
| EN 10297-2:2005 C1:2007 | Grade X2CrNiMoN29-7-2 | --- | 1.4477 | 0.030 | 0.80-1.50 | 0.50 | 0.030 | 0.015 | 28.0-30.0 | 5.8-7.5 | 1.50-2.60 | N 0.30-0.40 |

**5.3 Stainless Steel Tubes for General and Structural Applications**

**5.3.3B Mechanical Properties of Duplex Stainless Steel Tubes and Pipes for General and Structural Applications**

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter | | Yield Strength | | Tensile Strength | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | %, min. | | |
| ASME SA-789/SA-789M | --- | S31500 | --- | --- | --- | 440 | 64 | 630 | 92 | 30 | ST+Q | 290 max HBW; 30 max HRC |
| ASTM A789/A789M-14 | --- | S31500 | --- | --- | --- | 440 | 64 | 630 | 92 | 30 | ST+Q | 290 max HBW; 30 max HRC |
| EN 10297-2:2005 C1:2007 | Grade X2CrNiMoSi18-5-3 | --- | 1.4424 | --- | --- | 480 | --- | 700 | --- | 30 L, 30 T | SA | --- |
| GB/T 14975-2002 | Grade 00Cr18Ni5Mo3Si2 | --- | --- | --- | --- | 390 | --- | 590 T | --- | 20 T | BA | --- |
| ASME SA-789/SA-789M | --- | S31803 | --- | --- | --- | 450 | 65 | 620 | 90 | 25 | ST+Q | 290 max HBW; 30 max HRC |
| | | S32205 | --- | --- | --- | 485 | 70 | 655 | 95 | 25 | ST+Q | 290 max HBW; 30 max HRC |
| ASTM A270/A270M-15* | --- | S31803 | --- | O.D. ≤ 300 | O.D. ≤ 12 | 450 | 65 | 620 | 90 | 25 | HT+Q or RC | 30.5 max HRC |
| | Grade 2205 | S32205 | --- | O.D. ≤ 300 | O.D. ≤ 12 | 485 | 70 | 655 | 95 | 25 | HT+Q or RC | 30.5 max HRC |
| ASTM A789/A789M-14 | --- | S31803 | --- | --- | --- | 450 | 65 | 620 | 90 | 25 | ST+Q | 290 max HBW; 30 max HRC |
| | | S32205 | --- | --- | --- | 485 | 70 | 655 | 95 | 25 | ST+Q | 290 max HBW; 30 max HRC |
| EN 10296-2:2005 C2:2007 | Grade X2CrNiMoN22-5-3 | --- | 1.4462 | t ≤ 30 | --- | 450 | --- | 700 | --- | 22 L | AW or SA | --- |
| EN 10297-2:2005 C1:2007 | Grade X2CrNiMoN22-5-3 | --- | 1.4462 | --- | --- | 450 | --- | 640 | --- | 22 L | SA | --- |
| ASME SA-789/SA-789M | --- | S32304 | --- | O.D. ≤ 25 | O.D. ≤ 1 | 450 | 65 | 690 | 100 | 25 | ST+Q | --- |
| | | | | O.D. > 25 | O.D. > 1 | 400 | 58 | 600 | 87 | 25 | ST+Q | 290 max HBW; 30 max HRC |
| ASTM A789/A789M-14 | --- | S32304 | --- | O.D. ≤ 25 | O.D. ≤ 1 | 450 | 65 | 690 | 100 | 25 | ST+Q | --- |
| | | | | O.D. > 25 | O.D. > 1 | 400 | 58 | 600 | 87 | 25 | ST+Q | 290 max HBW; 30 max HRC |
| EN 10296-2:2005 C2:2007 | Grade X2CrNiN23-4 | --- | 1.4362 | t ≤ 30 | --- | 400 | --- | 600 | --- | 20 L | AW or SA | --- |
| EN 10297-2:2005 C1:2007 | Grade X2CrNiN23-4 | --- | 1.4362 | --- | --- | 400 | --- | 600 | --- | 25 L, 25 T | SA | --- |
| ASME SA-789/SA-789M | --- | S32760 | --- | --- | --- | 550 | 80 | 750 | 109 | 25 | ST+Q | 300 max HBW |
| ASTM A789/A789M-14 | --- | S32760 | --- | --- | --- | 550 | 80 | 750 | 109 | 25 | ST+Q | 300 max HBW |
| EN 10297-2:2005 C1:2007 | Grade X2CrNiMoCuWN25-7-4 | --- | 1.4501 | --- | --- | 550 | --- | 800 | --- | 20 L, 20 T | SA | --- |

*: See "List of Standards" at the beginning of the chapter.

**5.3 Stainless Steel Tubes for General and Structural Applications**

**5.3.3B Mechanical Properties of Duplex Stainless Steel Tubes and Pipes for General and Structural Applications (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter | | Yield Strength | | Tensile Strength | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | %, min. | | |
| ASME SA-789/SA-789M | --- | S32750 | --- | --- | --- | 550 | 80 | 800 | 116 | 15 | ST+Q | 300 max HBW; 32 max HRC |
| ASTM A270/A270M-15* | Grade 2507 | S32750 | --- | O.D. ≤ 300 | O.D. ≤ 12 | 550 | 80 | 800 | 116 | 15 | HT+Q or RC | 32 max HRC |
| ASTM A789/A789M-14 | --- | S32750 | --- | --- | --- | 550 | 80 | 800 | 116 | 15 | ST+Q | 300 max HBW; 32 max HRC |
| EN 10296-2:2005 C2:2007 | Grade X2CrNiMoN25-7-4 | --- | 1.4410 | t ≤ 30 | --- | 550 | --- | 800 | --- | 15 L | AW or SA | --- |
| EN 10297-2:2005 C1:2007 | Grade X2CrNiMoN25-7-4 | --- | 1.4410 | --- | --- | 550 | --- | 800 | --- | 20 L, 20 T | SA | --- |
| ASME SA-789/SA-789M | --- | S32906 | --- | t < 10 | t < 0.40 | 650 | 94 | 800 | 116 | 25 | ST+Q | 300 max HBW; 32 max HRC |
| | | | | t ≥ 10 | t ≥ 0.40 | 550 | 80 | 750 | 109 | 25 | ST+Q | 300 max HBW; 32 max HRC |
| ASTM A789/A789M-14 | --- | S32906 | --- | t < 10 | t < 0.40 | 650 | 94 | 800 | 116 | 25 | ST+Q | 300 max HBW; 32 max HRC |
| | | | | t ≥ 10 | t ≥ 0.40 | 550 | 80 | 750 | 109 | 25 | ST+Q | 300 max HBW; 32 max HRC |
| EN 10297-2:2005 C1:2007 | Grade X2CrNiMoN29-7-2 | --- | 1.4477 | --- | --- | 550 | --- | 750 | --- | 25 L, 25 T | SA | --- |

*: See "List of Standards" at the beginning of the chapter.

### 5.4 Carbon Steel Tubes and Pipes for Low-Temperature Service

#### 5.4A Mechanical Properties of Carbon Steel Tubes and Pipes – With Impact Testing Below –20°C

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter | | Yield Strength | | Tensile Strength | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | %, min. | | |
| EN 10216-4:2013 | P215NL | --- | 1.0451 | t ≤ 10 | --- | 215 | --- | 360-480 | --- | 25 L; 23 T | N | see standard for impact data |
| EN 10217-4:2002 A1:2005 | P215NL | --- | 1.0451 | t ≤ 10 | --- | 215 | --- | 360-480 | --- | 25 L; 23 T | see standard | see standard for impact data |
| EN 10217-6:2002 A1:2005 | P215NL | --- | 1.0451 | t ≤ 10 | --- | 215 | --- | 360-480 | --- | 25 L; 23 T | see standard | see standard for impact data |
| ISO 9329-3:1997 | PL 21 | --- | --- | t ≤ 13 | --- | 215 | --- | 360-480 | --- | 24 | N | t ≤ 10 mm L: 40 J at -40°C |
| | | | | 13 < t ≤ 25 | --- | 215 | --- | 360-480 | --- | 24 | N | t ≤ 10 mm L: 40 J at -40°C |
| ISO 9330-3:1997 | PL 21 | --- | --- | --- | --- | 215 | --- | 360-480 | --- | 24 | N | L: 40 J at -40°C |
| ISO 9330-5:2000 | PL 21 | --- | --- | t ≤ 13 | --- | 215 | --- | 360-480 | --- | 24 | N | ≤ 10 mm L: 40 J at -40°C |
| | | | | 13 < t ≤ 25 | --- | 215 | --- | 360-480 | --- | 24 | N | ≤ 10 mm L: 40 J at -40°C |
| EN 10216-4:2013 | P255QL | --- | 1.0452 | t ≤ 40 | --- | 255 | --- | 360-490 | --- | 23 L; 21 T | QT | see standard for impact data |
| ISO 9329-3:1997 | PL 25 | --- | --- | t ≤ 13 | --- | 255 | --- | 360-490 | --- | 21 | QT | L: 40 J at -50°C |
| | | | | 13 < t ≤ 25 | --- | 255 | --- | 360-490 | --- | 21 | QT | L: 40 J at -50°C |
| | | | | 25 < t ≤ 40 | --- | 235 | --- | 360-490 | --- | 21 | QT | L: 40 J at -40°C |
| ISO 9330-3:1997 | PL 25 | --- | --- | --- | --- | 255 | --- | 360-490 | --- | 21 | QT | L: 40 J at -50°C |
| ISO 9330-5:2000 | PL 25 | --- | --- | t ≤ 13 | --- | 255 | --- | 360-490 | --- | 21 | N | L: 40 J at -50°C |
| | | | | 13 < t ≤ 25 | --- | 255 | --- | 360-490 | --- | 21 | N | L: 40 J at -50°C |
| | | | | 25 < t ≤ 40 | --- | 235 | --- | 360-490 | --- | 21 | N | L: 40 J at -40°C |
| ASME SA-333/SA-333M | Grade 1 | K03008 | --- | --- | --- | 205 | 30 | 380 | 55 | 35 L, 25 T | N or N+T | see standard |
| ASME SA-334/SA-334M | Grade 1 | K03008 | --- | t ≥ 0.4 | t ≥ 0.015 | 205 | 30 | 380 | 55 | 35 | N or N+T | 163 max HB; 85 max HRB; see standard |
| ASTM A333/A333M-13 | Grade 1 | K03008 | --- | --- | --- | 205 | 30 | 380 | 55 | t ≥ 8mm (5/16 in.) 35 L; 25 T | N, NT | 18 J at -45°C |
| ASTM A334/A334M-04a (2010) | Grade 1 | K03008 | --- | t ≥ 0.4 | t ≥ 0.015 | 205 | 30 | 380 | 55 | t ≥ 5/16 in. (8 mm): 35 | N, NT | 85 max HRB; 163 max HB; 18 J at -45°C |
| JIS G 3460:2013 | Symbol STPL380 | --- | --- | --- | --- | 205 | --- | 380 | --- | 35 | N, NT or QT | 21 J at -45°C |

Note: This section continued on next page.

**5.4 Carbon Steel Tubes and Pipes for Low-Temperature Service**

**5.4A Mechanical Properties of Carbon Steel Tubes and Pipes – With Impact Testing Below –20°C (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter | | Yield Strength | | Tensile Strength | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | %, min. | | |
| JIS G 3464:2013 | Symbol STBL380 | --- | --- | O.D. < 10 | --- | 205 | --- | 380 | --- | 27 L | N, NT or QT | 21 J at -45°C |
| | | | | 10 ≤ O.D. < 20 | --- | 205 | --- | 380 | --- | 30 L | N, NT or QT | 21 J at -45°C |
| | | | | O.D. ≥ 20 | --- | 205 | --- | 380 | --- | 35 L | N, NT or QT | 21 J at -45°C |
| GB/T 18984-2003 | Grade 09DG | --- | --- | --- | --- | 210 | --- | 385 L | --- | 35 L | N | see standard |
| EN 10216-3:2013 | P275NL2 | --- | 1.1104 | t ≤ 12 | --- | 275 | --- | 390-530 | --- | 24 L; 22 T | N | see standard for impact data |
| | | | | 12 < t ≤ 20 | --- | 275 | --- | 390-530 | --- | 24 L; 22 T | N | see standard for impact data |
| | | | | 20 < t ≤ 40 | --- | 275 | --- | 390-510 | --- | 24 L; 22 T | N | see standard for impact data |
| | | | | 40 < t ≤ 50 | --- | 265 | --- | 390-510 | --- | 24 L; 22 T | N | see standard for impact data |
| | | | | 50 < t ≤ 65 | --- | 255 | --- | 390-510 | --- | 24 L; 22 T | N | see standard for impact data |
| | | | | 65 < t ≤ 80 | --- | 245 | --- | 360-480 | --- | 24 L; 22 T | N | see standard for impact data |
| | | | | 80 < t ≤ 100 | --- | 235 | --- | 360-480 | --- | 24 L; 22 T | N | see standard for impact data |

**5.4 Carbon Steel Tubes and Pipes for Low-Temperature Service**

**5.4A Mechanical Properties of Carbon Steel Tubes and Pipes – With Impact Testing Below –20°C (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter mm | Section Thickness/Diameter in. | Yield Strength MPa | Yield Strength ksi | Tensile Strength MPa | Tensile Strength ksi | Elongation %, min. | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GB/T 18984-2003 | Grade 10MnDG | --- | --- | --- | --- | 240 | --- | 400 L | --- | 35 L | N | see standard |
| | Grade 16MnDG | --- | --- | t ≤ 16 | --- | 325 | --- | 490-665 L | --- | 30 L | N | see standard |
| | | | | t > 16 | --- | 315 | --- | 490-665 L | --- | 30 L | N | see standard |
| ISO 9330-3:1997 | PL 23 | --- | --- | --- | --- | 235 | --- | 410-530 | --- | 22 | N | L: 27 J at -50°C |
| ISO 9330-5:2000 | PL 23 | --- | --- | t ≤ 13 | --- | 235 | --- | 410-530 | --- | 22 | N | L: 27 J at -50°C |
| | | | | 13 < t ≤ 25 | --- | 235 | --- | 410-530 | --- | 22 | N | L: 27 J at -50°C |
| ISO 9329-3:1997 | PL 23 | --- | --- | t ≤ 13 | --- | 235 | --- | 410-530 | --- | 22 | N | L: 27 J at -50°C |
| | | | | 13 < t ≤ 25 | --- | 235 | --- | 410-530 | --- | 22 | N | L: 27 J at -50°C |
| EN 10216-4:2013 | P265NL | --- | 1.0453 | t ≤ 25 | --- | 265 | --- | 410-570 | --- | 24 L; 22 T | N | see standard for impact data |
| EN 10217-4:2002 A1:2005 | P265NL | --- | 1.0453 | t ≤ 16 | --- | 265 | --- | 410-570 | --- | 24 L; 22 T | see standard | see standard for impact data |
| EN 10217-6:2002 A1:2005 | P265NL | --- | 1.0453 | t ≤ 25 | --- | 265 | --- | 410-570 | --- | 24 L; 22 T | see standard | see standard for impact data |
| ASME SA-334/SA-334M | Grade 6 | K03006 | --- | t ≥ 0.4 | t ≥ 0.015 | 240 | 35 | 415 | 60 | 30 | N or N+T | 190 max HB; 90 max HRB; see standard |
| ASTM A333/A333M-13 | Grade 6 | K03006 | --- | --- | --- | 240 | 35 | 415 | 60 | t ≥ 8mm (5/16 in.) 30 L; 16.5 T | N, NT | 18 J at -45°C |
| ASTM A334/A334M-04a (2010) | Grade 6 | K03006 | --- | t ≥ 0.4 | t ≥ 0.015 | 240 | 35 | 415 | 60 | t ≥ 5/16 in. (8 mm): 30 | N, NT | 90 max HRB 190 max HB 18 J at -45°C |
| ASME SA-333/SA-333M | Grade 6 | K03006 | --- | --- | --- | 240 | 35 | 415 | 60 | 30 L, 16.5 T | N or N+T | see standard |
| | Grade 3 | K31918 | --- | --- | --- | 240 | 35 | 450 | 65 | 30 L, 20 T | N or N+T | see standard |
| ASTM A333/A333M-13 | Grade 3 | K31918 | --- | --- | --- | 240 | 35 | 450 | 65 | t ≥ 8mm (5/16 in.) 30 L; 20 T | N, NT | 18 J at -100°C |
| JIS G 3460:2013 | Symbol STPL450 | --- | --- | --- | --- | 245 | --- | 450 | --- | 30 | N, NT or QT | 21 J at -100°C |
| ASME SA-333/SA-333M | Grade 8 | K81340 | --- | --- | --- | 515 | 75 | 690 | 100 | 22 L | Q+T or NN+T | --- |
| ASTM A333/A333M-13 | Grade 8 | K81340 | --- | --- | --- | 515 | 75 | 690 | 100 | t ≥ 8mm (5/16 in.) 22 L | QT or NNT | --- |
| JIS G 3460:2013 | Symbol STPL690 | --- | --- | --- | --- | 520 | --- | 690 | --- | 21 | NNT or QT | 21 J at -196°C |

**5.4 Carbon Steel Tubes and Pipes for Low-Temperature Service**

**5.4B Chemical Composition of Carbon Steel Tubes and Pipes – With Impact Testing Below -20°C**

| Specification | Designation | UNS No. | Steel No. | Weight, % max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| EN 10216-4:2013 | P215NL | --- | 1.0451 | 0.15 | 0.40-1.20 | 0.35 | 0.025 | 0.010 | 0.30 | 0.30 | 0.08 | Al 0.020 min; Cu 0.30; Nb 0.010; Ti 0.040; V 0.02 |
| EN 10217-4:2002 A1:2005 | P215NL | --- | 1.0451 | 0.15 | 0.40-1.20 | 0.35 | 0.025 | 0.020 | 0.30 | 0.30 | 0.08 | Al 0.020 min; Cu 0.30; Nb 0.010; Ti 0.03; V 0.02 |
| EN 10217-6:2002 A1:2005 | P215NL | --- | 1.0451 | 0.15 | 0.40-1.20 | 0.35 | 0.025 | 0.020 | 0.30 | 0.30 | 0.08 | Al 0.020 min; Cu 0.30; Nb 0.010; Ti 0.03; V 0.02 |
| ISO 9329-3:1997 | PL 21 | --- | --- | 0.17 | 0.40-1.00 | 0.35 | 0.030 | 0.025 | --- | --- | --- | Al 0.015 min |
| ISO 9330-3:1997 | PL 21 | --- | --- | 0.17 | 0.40-1.00 | 0.35 | 0.030 | 0.025 | --- | --- | --- | Al 0.015 min |
| ISO 9330-5:2000 | PL 21 | --- | --- | 0.17 | 0.40-1.00 | 0.35 | 0.030 | 0.025 | --- | --- | --- | Al 0.015 min |
| EN 10216-4:2013 | P255QL | --- | 1.0452 | 0.17 | 0.40-1.20 | 0.35 | 0.025 | 0.010 | 0.30 | 0.30 | 0.08 | Al 0.020 min; Cu 0.30; Nb 0.010; Ti 0.040; V 0.02 |
| ISO 9329-3:1997 | PL 25 | --- | --- | 0.17 | 0.40-1.00 | 0.35 | 0.030 | 0.025 | --- | --- | --- | Al 0.015 min |
| ISO 9330-3:1997 | PL 25 | --- | --- | 0.17 | 0.60-1.20 | 0.35 | 0.030 | 0.025 | --- | --- | --- | Al 0.015 min |
| ISO 9330-5:2000 | PL 25 | --- | --- | 0.17 | 0.40-1.00 | 0.35 | 0.030 | 0.025 | --- | --- | --- | Al 0.015 min |
| ASME SA-333/SA-333M | Grade 1 | K03008 | --- | 0.30 | 0.40-1.06 | --- | 0.025 | 0.025 | --- | --- | --- | --- |
| ASME SA-334/SA-334M | Grade 1 | K03008 | --- | 0.30 | 0.40-1.06 | --- | 0.025 | 0.025 | --- | --- | --- | --- |
| ASTM A333/A333M-13 | Grade 1 | K03008 | --- | 0.30 | 0.40-1.06 | --- | 0.025 | 0.025 | --- | --- | --- | --- |
| ASTM A334/A334M-04a (2010) | Grade 1 | K03008 | --- | 0.30 | 0.40-1.06 | --- | 0.025 | 0.025 | --- | --- | --- | --- |
| JIS G 3460:2013 | Symbol STPL380 | --- | --- | 0.25 | 1.35 | 0.35 | 0.035 | 0.035 | --- | --- | --- | --- |
| JIS G 3464:2013 | Symbol STBL380 | --- | --- | 0.25 | 1.35 | 0.35 | 0.035 | 0.035 | --- | --- | --- | --- |
| GB/T 18984-2003 | Grade 09DG | --- | --- | 0.12 | 0.95 | 0.17-0.37 | 0.025 | 0.025 | --- | --- | --- | V 0.07 |
| EN 10216-3:2013 | P275NL2 | --- | 1.1104 | 0.16 | 0.50-1.50 | 0.40 | 0.025 | 0.005 | 0.30 | 0.50 | 0.08 | Al 0.020 min; Cu 0.30; N 0.020; Nb 0.05; Ti 0.040; V 0.05; (Nb+Ti+V) 0.05; (Cr+Cu+Mo) 0.45 |

**5.4 Carbon Steel Tubes and Pipes for Low-Temperature Service**

**5.4B Chemical Composition of Carbon Steel Tubes and Pipes – With Impact Testing Below -20°C (Continued)**

| Specification | Designation | UNS No. | Steel No. | Weight, % max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| GB/T 18984-2003 | Grade 10MnDG | --- | --- | 0.13 | 1.35 | 0.17-0.37 | 0.025 | 0.025 | --- | --- | --- | V 0.07 |
| | Grade 16MnDG | --- | --- | 0.12-0.20 | 1.20-1.60 | 0.20-0.55 | 0.025 | 0.025 | --- | --- | --- | --- |
| ISO 9329-3:1997 | PL 23 | --- | --- | 0.19 | 0.60-1.20 | 0.35 | 0.030 | 0.025 | --- | --- | --- | Al 0.015 min |
| ISO 9330-3:1997 | PL 23 | --- | --- | 0.19 | 0.60-1.20 | 0.35 | 0.030 | 0.025 | --- | --- | --- | Al 0.015 min |
| ISO 9330-5:2000 | PL 23 | --- | --- | 0.19 | 0.60-1.20 | 0.35 | 0.030 | 0.025 | --- | --- | --- | Al 0.015 min |
| EN 10216-4:2013 | P265NL | --- | 1.0453 | 0.20 | 0.60-1.40 | 0.40 | 0.025 | 0.010 | 0.30 | 0.30 | 0.08 | Al 0.020 min; Cu 0.30; Nb 0.010; Ti 0.040; V 0.02 |
| EN 10217-4:2002 A1:2005 | P265NL | --- | 1.0453 | 0.20 | 0.60-1.40 | 0.40 | 0.025 | 0.020 | 0.30 | 0.30 | 0.08 | Al 0.020 min; Cu 0.30; Nb 0.010; Ti 0.03; V 0.02 |
| EN 10217-6:2002 A1:2005 | P265NL | --- | 1.0453 | 0.20 | 0.60-1.40 | 0.40 | 0.025 | 0.020 | 0.30 | 0.30 | 0.08 | Al 0.020 min; Cu 0.30; Nb 0.010; Ti 0.03; V 0.02 |
| ASME SA-334/SA-334M | Grade 6 | K03006 | --- | 0.30 | 0.29-1.06 | 0.10 min. | 0.025 | 0.025 | --- | --- | --- | --- |
| ASTM A333/A333M-13 | Grade 6 | K03006 | --- | 0.30 | 0.29-1.06 | 0.10 min | 0.025 | 0.025 | 0.30 | 0.40 | 0.12 | Cu 0.40; V 0.08; Cb 0.02 |
| ASTM A334/A334M-04a (2010) | Grade 6 | K03006 | --- | 0.30 | 0.29-1.06 | 0.10 min | 0.025 | 0.025 | --- | --- | --- | --- |
| ASME SA-333/SA-333M | Grade 6 | K03006 | --- | 0.30 | 0.29-1.06 | 0.10 min. | 0.025 | 0.025 | --- | --- | --- | --- |
| | Grade 3 | K31918 | --- | 0.19 | 0.31-0.64 | 0.18-0.37 | 0.025 | 0.025 | --- | 3.18-3.82 | --- | --- |
| ASTM A333/A333M-13 | Grade 3 | K31918 | --- | 0.19 | 0.31-0.64 | 0.18-0.37 | 0.025 | 0.025 | --- | 3.18-3.82 | --- | --- |
| JIS G 3460:2013 | Symbol STPL450 | --- | --- | 0.18 | 0.30-0.60 | 0.10-0.35 | 0.030 | 0.030 | --- | 3.20-3.80 | --- | --- |
| ASME SA-333/SA-333M | Grade 8 | K81340 | --- | 0.13 | 0.90 | 0.13-0.32 | 0.025 | 0.025 | --- | 8.40-9.60 | --- | --- |
| ASTM A333/A333M-13 | Grade 8 | K81340 | --- | 0.13 | 0.90 | 0.13-0.32 | 0.025 | 0.025 | --- | 8.40-9.60 | --- | --- |
| JIS G 3460:2013 | Symbol STPL690 | --- | --- | 0.13 | 0.90 | 0.10-0.35 | 0.030 | 0.030 | --- | 8.50-9.50 | --- | --- |

## 5.5 Alloy Steel Tubes and Pipes for Low-Temperature Service

### 5.5A Chemical Composition of Alloy Steel Tubes and Pipes for Low-Temperature Service

| Specification | Designation | UNS No. | Steel No. | Weight, % max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| EN 10216-4:2013 | 11MnNi5-3 | --- | 1.6212 | 0.14 | 0.70-1.50 | 0.50 | 0.025 | 0.010 | --- | 0.30-0.80 | --- | Al 0.020 min; Cu 0.30; Nb 0.05; V 0.05 |
| ISO 9329-3:1997 | 11 MnNi 5-3 | --- | --- | 0.14 | 0.70-1.50 | 0.50 | 0.030 | 0.025 | --- | 0.30-0.80 | --- | Al 0.020 min; V 0.05; Nb 0.05 |
| ISO 9330-3:1997 | 11 MnNi 5-3 | --- | --- | 0.14 | 0.70-1.50 | 0.50 | 0.030 | 0.025 | --- | 0.30-0.80 | --- | Al 0.020 min; V 0.05; Nb 0.05 |
| ISO 9330-5:2000 | 11 MnNi 5-3 | --- | --- | 0.14 | 0.70-1.50 | 0.50 | 0.030 | 0.025 | --- | 0.30-0.80 | --- | Al 0.020 min; V 0.05; Nb 0.05 |
| EN 10216-4:2013 | 13MnNi6-3 | --- | 1.6217 | 0.16 | 0.85-1.70 | 0.50 | 0.025 | 0.010 | --- | 0.30-0.85 | --- | Al 0.020 min; Cu 0.30; Nb 0.05; V 0.05 |
| ISO 9329-3:1997 | 13 MnNi 6-3 | --- | --- | 0.18 | 0.85-1.65 | 0.50 | 0.030 | 0.025 | --- | 0.30-0.85 | --- | Al 0.020 min; V 0.05; Nb 0.05 |
| ISO 9330-3:1997 | 13 MnNi 6-3 | --- | --- | 0.18 | 0.85-1.65 | 0.50 | 0.030 | 0.025 | --- | 0.30-0.80 | --- | Al 0.020 min; V 0.05; Nb 0.05 |
| ISO 9330-5:2000 | 13 MnNi 6-3 | --- | --- | 0.18 | 0.85-1.65 | 0.50 | 0.030 | 0.025 | --- | 0.30-0.85 | --- | Al 0.020 min; V 0.05; Nb 0.05 |
| ASME SA-334/SA-334M | Grade 3 | K31918 | --- | 0.19 | 0.31-0.64 | 0.18-0.37 | 0.025 | 0.025 | --- | 3.18-3.82 | --- | --- |
| ASTM A333/A333M-13 | Grade 3 | K31918 | --- | 0.19 | 0.31-0.64 | 0.18-0.37 | 0.025 | 0.025 | --- | 3.18-3.82 | --- | --- |
| ASTM A334/A334M-04a (2010) | Grade 3 | K31918 | --- | 0.19 | 0.31-0.64 | 0.18-0.37 | 0.025 | 0.025 | --- | 3.18-3.82 | --- | --- |
| EN 10216-4:2013 | 12Ni14 | --- | 1.5637 | 0.15 | 0.30-0.80 | 0.15-0.35 | 0.025 | 0.005 | --- | 3.25-3.75 | --- | Cu 0.30; V 0.05 |
| GB/T 18984-2003 | Grade 06Ni3MoDG | --- | --- | 0.08 | 0.85 | 0.17-0.37 | 0.025 | 0.025 | --- | 2.5-3.7 | 0.15-0.30 | V 0.05 |
| ISO 9329-3:1997 | 12 Ni 14 | --- | --- | 0.15 | 0.30-0.85 | 0.15-0.35 | 0.025 | 0.020 | --- | 3.25-3.75 | --- | V 0.05 |
| ISO 9330-3:1997 | 12 Ni 14 | --- | --- | 0.15 | 0.30-0.85 | 0.15-0.35 | 0.025 | 0.020 | --- | 3.25-3.75 | --- | V 0.05 |
| ISO 9330-5:2000 | 12 Ni 14 | --- | --- | 0.15 | 0.3-0.8 | 0.35 | 0.025 | 0.020 | --- | 3.25-3.75 | --- | V 0.05 |
| JIS G 3460:2013 | Symbol STPL450 | --- | --- | 0.18 | 0.30-0.60 | 0.10-0.35 | 0.030 | 0.030 | --- | 3.20-3.80 | --- | --- |
| JIS G 3464:2013 | Symbol STBL450 | --- | --- | 0.18 | 0.30-0.60 | 0.10-0.35 | 0.030 | 0.030 | --- | 3.20-3.80 | --- | --- |
| EN 10216-4:2013 | X12Ni5 | --- | 1.5680 | 0.15 | 0.30-0.80 | 0.35 | 0.020 | 0.005 | --- | 4.5-5.3 | --- | Cu 0.30; V 0.05 |
| ISO 9329-3:1997 | X 12 Ni 5 | --- | --- | 0.15 | 0.30-0.80 | 0.35 | 0.025 | 0.020 | --- | 4.50-5.30 | --- | V 0.05 |
| ISO 9330-3:1997 | X 12 Ni 5 | --- | --- | 0.15 | 0.30-0.80 | 0.35 | 0.025 | 0.020 | --- | 4.50-5.30 | --- | V 0.05 |
| ISO 9330-5:2000 | X 12 Ni 5 | --- | --- | 0.15 | 0.3-0.8 | 0.35 | 0.025 | 0.020 | --- | 4.50-5.30 | --- | V 0.05 |
| ASME SA-334/SA-334M | Grade 8 | K81340 | --- | 0.13 | 0.90 | 0.13-0.32 | 0.025 | 0.025 | --- | 8.40-9.60 | --- | --- |
| ASTM A333/A333M-13 | Grade 8 | K81340 | --- | 0.13 | 0.90 | 0.13-0.32 | 0.025 | 0.025 | --- | 8.40-9.60 | --- | --- |
| ASTM A334/A334M-04a (2010) | Grade 8 | K81340 | --- | 0.13 | 0.90 | 0.13-0.32 | 0.025 | 0.025 | --- | 8.40-9.60 | --- | --- |
| EN 10216-4:2013 | X10Ni9 | --- | 1.5682 | 0.13 | 0.30-0.80 | 0.15-0.35 | 0.020 | 0.005 | --- | 8.5-9.5 | 0.10 | Cu 0.30; V 0.05 |
| ISO 9329-3:1997 | X 10 Ni 9 | --- | --- | 0.13 | 0.30-0.80 | 0.15-0.35 | 0.025 | 0.020 | --- | 8.50-9.50 | 0.10 | V 0.05 |
| ISO 9330-5:2000 | X 10 Ni 9 | --- | --- | 0.13 | 0.3-0.8 | 0.35 | 0.025 | 0.020 | --- | 8.50-9.50 | 0.10 | V 0.05 |
| JIS G 3460:2013 | Symbol STPL690 | --- | --- | 0.13 | 0.90 | 0.10-0.35 | 0.030 | 0.030 | --- | 8.50-9.50 | --- | --- |
| JIS G 3464:2013 | Symbol STBL690 | --- | --- | 0.13 | 0.90 | 0.10-0.35 | 0.030 | 0.030 | --- | 8.50-9.50 | --- | --- |
| EN 10216-4:2013 | 26CrMo4-2 | --- | 1.7219 | 0.22-0.29 | 0.50-0.80 | 0.35 | 0.025 | 0.010 | 0.90-1.20 | --- | 0.15-0.30 | Cu 0.30 |
| ISO 9329-3:1997 | 26 CrMo 4 | --- | --- | 0.22-0.29 | 0.50-0.80 | 0.35 | 0.030 | 0.025 | 0.90-1.20 | --- | 0.15-0.30 | --- |

**5.5 Alloy Steel Tubes and Pipes for Low-Temperature Service**

**5.5B Mechanical Properties of Alloy Steel Tubes and Pipes for Low-Temperature Service**

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter | | Yield Strength | | Tensile Strength | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | %, min. | | |
| EN 10216-4:2013 | 11MnNi5-3 | --- | 1.6212 | t ≤ 40 | --- | 285 | --- | 410-530 | --- | 24 L; 22 T | N | see standard for impact data |
| ISO 9329-3:1997 | 11 MnNi 5-3 | --- | --- | t ≤ 13 | --- | 285 | --- | 410-530 | --- | 22 | N | L: 40 J at -60°C |
| | | | | 13 < t ≤ 25 | --- | 275 | --- | 410-530 | --- | 22 | N | L: 40 J at -60°C |
| | | | | 25 < t ≤ 40 | --- | 265 | --- | 410-530 | --- | 22 | N | L: 40 J at -60°C |
| ISO 9330-3:1997 | 11 MnNi 5-3 | --- | --- | t ≤ 13 | --- | 285 | --- | 410-530 | --- | 22 | N | L: 40 J at -60°C |
| ISO 9330-5:2000 | 11 MnNi 5-3 | --- | --- | t ≤ 13 | --- | 285 | --- | 410-530 | --- | 22 | N | L: 40 J at -60°C |
| | | | | 13 < t ≤ 25 | --- | 275 | --- | 410-530 | --- | 22 | N | L: 40 J at -60°C |
| | | | | 25 < t ≤ 40 | --- | 265 | --- | 410-530 | --- | 22 | N | L: 40 J at -60°C |
| EN 10216-4:2013 | 13MnNi6-3 | --- | 1.6217 | t ≤ 40 | --- | 355 | --- | 490-610 | --- | 22 L; 20 T | N | see standard for impact data |
| ISO 9329-3:1997 | 13 MnNi 6-3 | --- | --- | t ≤ 13 | --- | 355 | --- | 490-610 | --- | 20 | N | L: 40 J at -60°C |
| | | | | 13 < t ≤ 25 | --- | 345 | --- | 490-610 | --- | 20 | N | L: 40 J at -60°C |
| | | | | 25 < t ≤ 40 | --- | 335 | --- | 490-610 | --- | 20 | N | L: 40 J at -60°C |
| ISO 9330-3:1997 | 13 MnNi 6-3 | --- | --- | t ≤ 13 | --- | 355 | --- | 490-610 | --- | 20 | N | L: 40 J at -60°C |
| ISO 9330-5:2000 | 13 MnNi 6-3 | --- | --- | t ≤ 13 | --- | 355 | --- | 490-610 | --- | 20 | N | L: 40 J at -60°C |
| | | | | 13 < t ≤ 25 | --- | 345 | --- | 490-610 | --- | 20 | N | L: 40 J at -60°C |
| | | | | 25 < t ≤ 40 | --- | 335 | --- | 490-610 | --- | 20 | N | L: 40 J at -60°C |

**5.5 Alloy Steel Tubes and Pipes for Low-Temperature Service**

**5.5B Mechanical Properties of Alloy Steel Tubes and Pipes for Low-Temperature Service (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter mm | Section Thickness/Diameter in. | Yield Strength MPa | Yield Strength ksi | Tensile Strength MPa | Tensile Strength ksi | Elongation %, min. | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ASME SA-334/SA-334M | Grade 3 | K31918 | --- | t ≥ 0.4 | t ≥ 0.015 | 240 | 35 | 450 | 65 | 30 | N or N+T | 190 max.HB; 90 max.HRB; see standard |
| ASTM A333/A333M-13 | Grade 3 | K31918 | --- | --- | --- | 240 | 35 | 450 | 65 | 30 L; 20 T | N, NT | 18 J at –100°C |
| ASTM A334/A334M-04a (2010) | Grade 3 | K31918 | --- | t ≥ 0.4 | t ≥ 0.015 | 240 | 35 | 450 | 65 | t ≥ 5/16 in. (8 mm): 30 | N, NT | 90 max HRB 190 max HB 18 J at –100°C |
| EN 10216-4:2013 | 12Ni14 | --- | 1.5637 | t ≤ 40 | --- | 345 | --- | 440-620 | --- | 22 L; 20 T | NT, QT | see standard for impact data |
| GB/T 18984-2003 | Grade 06Ni3MoDG | --- | --- | --- | --- | 250 | --- | 455 L | --- | 30 L | N | see standard |
| ISO 9329-3:1997 | 12 Ni 14 | --- | --- | t ≤ 13 | --- | 245 | --- | 440-590 | --- | 16 | QT | L: 40 J at –100°C |
| | | | | 13 < t ≤ 25 | --- | 245 | --- | 440-590 | --- | 16 | QT | L: 40 J at –100°C |
| | | | | 25 < t ≤ 40 | --- | 245 | --- | 440-590 | --- | 16 | QT | L: 40 J at –90°C |
| ISO 9330-3:1997 | 12 Ni 14 | --- | --- | t ≤ 13 | --- | 245 | --- | 440-590 | --- | 16 | QT | L: 40 J at –100°C |
| ISO 9330-5:2000 | 12 Ni 14 | --- | --- | t ≤ 13 | --- | 245 | --- | 440-590 | --- | 16 | QT | L: 40 J at –100°C |
| | | | | 13 < t ≤ 25 | --- | 245 | --- | 440-590 | --- | 16 | QT | L: 40 J at –100°C |
| | | | | 25 < t ≤ 40 | --- | 245 | --- | 440-590 | --- | 16 | QT | L: 40 J at –90°C |
| JIS G 3460:2013 | Symbol STPL450 | --- | --- | --- | --- | 245 | --- | 450 | --- | see standard | N, NT or QT | 21 J at –100°C |
| JIS G 3464:2013 | Symbol STBL450 | --- | --- | O.D. < 10 | --- | 245 | --- | 450 | --- | 22 | N, NT or QT | 21 J at –100°C |
| | | | | 10 ≤ O.D. < 20 | --- | 245 | --- | 450 | --- | 25 | N, NT or QT | 21 J at –100°C |
| | | | | O.D. ≥ 20 | --- | 245 | --- | 450 | --- | 30 | N, NT or QT | 21 J at –100°C |
| EN 10216-4:2013 | X12Ni5 | --- | 1.5680 | t ≤ 40 | --- | 390 | --- | 510-710 | --- | 21 L; 19 T | NT, QT | see standard for impact data |
| ISO 9329-3:1997 | X 12 Ni 5 | --- | --- | t ≤ 13 | --- | 390 | --- | 510-710 | --- | 17 | QT | L: 40 J at –120°C |
| | | | | 13 < t ≤ 25 | --- | 390 | --- | 510-710 | --- | 17 | QT | L: 40 J at –120°C |
| | | | | 25 < t ≤ 40 | --- | 380 | --- | 510-710 | --- | 17 | QT | L: 40 J at –110°C |
| ISO 9330-3:1997 | X 12 Ni 5 | --- | --- | t ≤ 13 | --- | 390 | --- | 510-710 | --- | 17 | QT | L: 40 J at –120°C |
| ISO 9330-5:2000 | X 12 Ni 5 | --- | --- | t ≤ 13 | --- | 390 | --- | 510-710 | --- | 17 | QT | L: 40 J at –120°C |
| | | | | 13 < t ≤ 25 | --- | 390 | --- | 510-710 | --- | 17 | QT | L: 40 J at –120°C |
| | | | | 25 < t ≤ 40 | --- | 380 | --- | 510-710 | --- | 17 | QT | L: 40 J at –110°C |

**5.5 Alloy Steel Tubes and Pipes for Low-Temperature Service**

**5.5B Mechanical Properties of Alloy Steel Tubes and Pipes for Low-Temperature Service (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter mm | Section Thickness/Diameter in. | Yield Strength MPa | Yield Strength ksi | Tensile Strength MPa | Tensile Strength ksi | Elongation %, min. | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ASME SA-334/SA-334M | Grade 8 | K81340 | --- | t ≥ 0.4 | t ≥ 0.015 | 520 | 75 | 690 | 100 | 22 | Q+T or NN+T | --- |
| ASTM A333/A333M-13 | Grade 8 | K81340 | --- | --- | ---- | 515 | 75 | 690 | 100 | 22 L | QT or NNT | --- |
| ASTM A334/A334M-04a (2010) | Grade 8 | K81340 | --- | t ≥ 0.4 | t ≥ 0.015 | 520 | 75 | 690 | 100 | t ≥ 5/16 in. (8 mm): 22 | QT or NNT | --- |
| EN 10216-4:2013 | X10Ni9 | --- | 1.5682 | t ≤ 40 | --- | 510 | --- | 690-840 | --- | 20 L; 18 T | QT, N, NT | see standard for impact data |
| ISO 9329-3:1997 | X 10 Ni 9 | --- | --- | t ≤ 13 | --- | 510 | --- | 690-840 | --- | 15 | QT | L: 40 J at -196°C |
| | | | | 13 < t ≤ 25 | --- | 510 | --- | 690-840 | --- | 15 | QT | L: 40 J at -196°C |
| | | | | 25 < t ≤ 40 | --- | 510 | --- | 690-840 | --- | 15 | QT | L: 40 J at -196°C |
| ISO 9330-5:2000 | X 10 Ni 9 | --- | --- | t ≤ 13 | --- | 510 | --- | 690-840 | --- | 15 | QT | L: 40 J at -196°C |
| | | | | 13 < t ≤ 25 | --- | 510 | --- | 690-840 | --- | 15 | QT | L: 40 J at -196°C |
| | | | | 25 < t ≤ 40 | --- | 510 | --- | 690-840 | --- | 15 | QT | L: 40 J at -196°C |
| JIS G 3460:2013 | Symbol STPL690 | --- | --- | --- | --- | 520 | --- | 690 | --- | see standard | NNT or QT | 21 J at -196°C |
| JIS G 3464:2013 | Symbol STBL 690 | --- | --- | O.D. < 10 | --- | 520 | --- | 690 | --- | 13 | NNT or QT | 21 J at -196°C |
| | | | | 10 ≤ O.D. < 20 | --- | 520 | --- | 690 | --- | 16 | NNT or QT | 21 J at -196°C |
| | | | | O.D. ≥ 20 | --- | 520 | --- | 690 | --- | 21 | NNT or QT | 21 J at -196°C |
| EN 10216-4:2013 | 26CrMo4-2 | --- | 1.7219 | t ≤ 40 | --- | 440 | --- | 560-740 | --- | 18 L; 16 T | QT | see standard for impact data |
| ISO 9329-3:1997 | 26 CrMo 4 | --- | --- | t ≤ 13 | --- | 440 | --- | 560-740 | --- | 16 | QT | L: 40 J at -60°C |
| | | | | 13 < t ≤ 25 | --- | 440 | --- | 560-740 | --- | 16 | QT | L: 40 J at -60°C |
| | | | | 25 < t ≤ 40 | --- | 420 | --- | 560-740 | --- | 16 | QT | L: 40 J at -60°C |

## 5.6 Carbon Steel Tubes and Pipes for Pressure Purposes

### 5.6A Mechanical Properties of Carbon Steel Tubes and Pipes for Pressure Purposes

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter | | Yield Strength | | Tensile Strength | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | %, min. | | |
| EN 10216-1:2013 | P195TR1 | --- | 1.0107 | t ≤ 16 | --- | 195 | --- | 320-440 | --- | 27 L; 25 T | HF: AF, N or NF; HFCF: N | --- |
| | | | | 16 < t ≤ 40 | --- | 185 | --- | 320-440 | --- | 27 L; 25 T | HF: AF, N or NF; HFCF: N | --- |
| | | | | 40 < t ≤ 60 | --- | 175 | --- | 320-440 | --- | 27 L; 25 T | HF: AF, N or NF; HFCF: N | --- |
| | P195TR2 | --- | 1.0108 | t ≤ 16 | --- | 195 | --- | 320-440 | --- | 27 L; 25 T | HF: N or NF; HFCF: N | see standard for impact data |
| | | | | 16 < t ≤ 40 | --- | 185 | --- | 320-440 | --- | 27 L; 25 T | HF: N or NF; HFCF: N | |
| | | | | 40 < t ≤ 60 | --- | 175 | --- | 320-440 | --- | 27 L; 25 T | HF: N or NF; HFCF: N | |
| EN 10217-1:2002 A1:2005 | P195TR1 | --- | 1.0107 | t ≤ 16 | --- | 195 | --- | 320-440 | --- | 27 L; 25 T | see standard | --- |
| | | | | 16 < t ≤ 40 | --- | 185 | --- | 320-440 | --- | 27 L; 25 T | see standard | --- |
| | P195TR2 | --- | 1.0108 | t ≤ 16 | --- | 195 | --- | 320-440 | --- | 27 L; 25 T | see standard | see standard for impact data |
| | | | | 16 < t ≤ 40 | --- | 185 | --- | 320-440 | --- | 27 L; 25 T | see standard | |
| ASME SA-53/SA-53M | Grade A Type E | --- | --- | --- | --- | 205 | 30 | 330 L | 48 L | see standard | --- | --- |
| | Grade A Type F | --- | --- | --- | --- | 205 | 30 | 330 L | 48 L | see standard | --- | --- |
| | Grade A Type S | --- | --- | --- | --- | 205 | 30 | 330 L | 48 L | see standard | --- | --- |
| ASME SA-135 | Grade A | K02509 | --- | 2.11 ≤ t ≤ 12.70 | 0.083 ≤ t ≤ 0.500 | 207 | 30 | 331 L | 48 L | 35 L | --- | --- |
| ASTM A53/A53M-12 | Type E Grade A | K02504 | --- | --- | --- | 205 | 30 | 330 | 48 | see standard | AM | --- |
| | Type F Grade A | --- | --- | --- | --- | 205 | 30 | 330 | 48 | see standard | AM | --- |
| | Type S Grade A | K02504 | --- | --- | --- | 205 | 30 | 330 | 48 | see standard | AM | --- |
| ASTM A139/A139M-04 (2010) | Grade A | --- | --- | t ≤ 25.4 | t ≤ 1.0 | 205 | 30 | 330 | 48 | t ≥ 7.9 mm (5/16 in.) 35 L | see standard | --- |
| ASTM A135/A135M-09 (2014) | Grade A | K02509 | --- | --- | --- | 205 | 30 | 330 | 48 | t ≥ 7.9 mm (5/16 in.) 35 L | AM | --- |
| GB 6479-2000 | Grade 10 | --- | --- | --- | --- | 205 | --- | 335-490 L | --- | 24 L | N | see standard |

**5.6 Carbon Steel Tubes and Pipes for Pressure Purposes**

**5.6A Mechanical Properties of Carbon Steel Tubes and Pipes for Pressure Purposes (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter mm | Section Thickness/Diameter in. | Yield Strength MPa | Yield Strength ksi | Tensile Strength MPa | Tensile Strength ksi | Elongation %, min. | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| EN 10216-1:2013 | P235TR1 | --- | 1.0254 | t ≤ 16 | --- | 235 | --- | 360-500 | --- | 25L; 23 T | HF: AF, N or NF; HFCF: N | --- |
| | | | | 16 < t ≤ 40 | --- | 225 | --- | 360-500 | --- | 25L; 23 T | HF: AF, N or NF; HFCF: N | --- |
| | | | | 40 < t ≤ 60 | --- | 215 | --- | 360-500 | --- | 25L; 23 T | HF: AF, N or NF; HFCF: N | --- |
| | P235TR2 | --- | 1.0255 | t ≤ 16 | --- | 235 | --- | 360-500 | --- | 25 L; 23 T | HF: N or NF; HFCF: N | see standard for impact data |
| | | | | 16 < t ≤ 40 | --- | 225 | --- | 360-500 | --- | 25 L; 23 T | HF: N or NF; HFCF: N | |
| | | | | 40 < t ≤ 60 | --- | 215 | --- | 360-500 | --- | 25 L; 23 T | HF: N or NF; HFCF: N | |
| EN 10217-1:2002 A1:2005 | P235TR1 | --- | 1.0254 | t ≤ 16 | --- | 235 | --- | 360-500 | --- | 25 L; 23 T | see standard | --- |
| | | | | 16 < t ≤ 40 | --- | 225 | --- | 360-500 | --- | 25 L; 23 T | see standard | --- |
| | P235TR2 | --- | 1.0255 | t ≤ 16 | --- | 235 | --- | 360-500 | --- | 25 L; 23 T | see standard | see standard for impact data |
| | | | | 16 < t ≤ 40 | --- | 225 | --- | 360-500 | --- | 25 L; 23 T | see standard | |
| JIS G 3454:2012 | Symbol STPG370 | --- | --- | --- | --- | 215 | --- | 370 | --- | 28 L; 23 T | AM or CF+A | --- |
| JIS G 3457:2012 | Symbol STPY400 | --- | --- | --- | --- | 225 | --- | 400 | --- | 18 T | AW or ACE | --- |
| GB 6479-2000 | Grade 20 | --- | --- | --- | --- | 245 | --- | 410-550 L | --- | 24 L | N | see standard |
| EN 10216-1:2013 | P265TR1 | --- | 1.0258 | t ≤ 16 | --- | 265 | --- | 410-570 | --- | 21 L; 19 T | HF: AF, N or NF; HFCF: N | --- |
| | | | | 16 < t ≤ 40 | --- | 255 | --- | 410-570 | --- | 21 L; 19 T | HF: AF, N or NF; HFCF: N | --- |
| | | | | 40 < t ≤ 60 | --- | 245 | --- | 410-570 | --- | 21 L; 19 T | HF: AF, N or NF; HFCF: N | --- |
| | P265TR2 | --- | 1.0259 | t ≤ 16 | --- | 265 | --- | 410-570 | --- | 21 L; 19 T | HF: N or NF; HFCF: N | see standard for impact data |
| | | | | 16 < t ≤ 40 | --- | 255 | --- | 410-570 | --- | 21 L; 19 T | HF: N or NF; HFCF: N | |
| | | | | 40 < t ≤ 60 | --- | 245 | --- | 410-570 | --- | 21 L; 19 T | HF: N or NF; HFCF: N | |
| EN 10217-1:2002 A1:2005 | P265TR1 | --- | 1.0258 | t ≤ 16 | --- | 265 | --- | 410-570 | --- | 21 L; 19 T | see standard | --- |
| | | | | 16 < t ≤ 40 | --- | 255 | --- | 410-570 | --- | 21 L; 19 T | see standard | --- |
| | P265TR2 | --- | 1.0259 | t ≤ 16 | --- | 265 | --- | 410-570 | --- | 21 L; 19 T | see standard | see standard for impact data |
| | | | | 16 < t ≤ 40 | --- | 255 | --- | 410-570 | --- | 21 L; 19 T | see standard | |

Note: This section continued on next page.

**5.6 Carbon Steel Tubes and Pipes for Pressure Purposes**

**5.6A Mechanical Properties of Carbon Steel Tubes and Pipes for Pressure Purposes (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter | | Yield Strength | | Tensile Strength | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | %, min. | | |
| JIS G 3454:2012 | Symbol STPG410 | --- | --- | --- | --- | 245 | --- | 410 | --- | 24 L; 19 T | AM or CF+A | --- |
| ASME SA-135 | Grade B | K03018 | --- | 2.11 ≤ t ≤ 12.70 | 0.083 ≤ t ≤ 0.500 | 241 | 35 | 414 L | 60 L | 30 L | --- | --- |
| ASME SA-53/SA-53M | Grade B Type E | --- | --- | --- | --- | 240 | 35 | 415 L | 60 L | see standard | --- | --- |
| | Grade B Type S | --- | --- | --- | --- | 240 | 35 | 415 L | 60 L | see standard | --- | --- |
| ASTM A135/A135M-09 (2014) | Grade B | --- | --- | --- | --- | 240 | 35 | 415 | 60 | t ≥ 7 9mm (5/16 in.) 30 L | T | --- |
| ASTM A53/A53M-12 | Type E Grade B | K03005 | --- | --- | --- | 240 | 35 | 415 | 60 | see standard | T | --- |
| | Type S Grade B | K03005 | --- | --- | --- | 240 | 35 | 415 | 60 | see standard | AM | --- |
| ASTM A139/A139M-04 (2010) | Grade B | K03003 | --- | t ≤ 25.4 | t ≤ 1.0 | 240 | 35 | 415 | 60 | t ≥ 7 9mm (5/16 in.) 30 L | see standard | --- |
| | Grade C | K03004 | --- | t ≤ 25.4 | t ≤ 1.0 | 290 | 42 | 415 | 60 | t ≥ 7 9mm (5/16 in.) 25 L | see standard | --- |
| | Grade D | K03010 | --- | t ≤ 25.4 | t ≤ 1.0 | 315 | 46 | 415 | 60 | t ≥ 7 9mm (5/16 in.) 23 L | see standard | --- |
| | Grade E | K03012 | --- | t ≤ 25.4 | t ≤ 1.0 | 360 | 52 | 455 | 66 | t ≥ 7 9mm (5/16 in.) 22 L | see standard | --- |

**5.6 Carbon Steel Tubes and Pipes for Pressure Purposes**

**5.6B Chemical Composition of Carbon Steel Tubes and Pipes for Pressure Purposes**

| Specification | Designation | UNS No. | Steel No. | Weight, % max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| EN 10216-1:2013 | P195TR1 | --- | 1.0107 | 0.13 | 0.70 | 0.35 | 0.025 | 0.020 | 0.30 | 0.30 | 0.08 | Cu 0.30; Nb 0.010; Ti 0.04; V 0.02; (Cr+Cu+Mo+Ni) 0.70 |
| | P195TR2 | --- | 1.0108 | 0.13 | 0.70 | 0.35 | 0.025 | 0.015 | 0.30 | 0.30 | 0.08 | Al 0.02 min; Cu 0.30; Nb 0.010; Ti 0.04; V 0.02; (Cr+Cu+Mo+Ni) 0.70 |
| EN 10217-1:2002 A1:2005 | P195TR1 | --- | 1.0107 | 0.13 | 0.70 | 0.35 | 0.025 | 0.020 | 0.30 | 0.30 | 0.08 | Cu 0.30; Nb 0.010; Ti 0.04; V 0.02; (Cr+Cu+Mo+Ni) 0.70 |
| | P195TR2 | --- | 1.0108 | 0.13 | 0.70 | 0.35 | 0.025 | 0.020 | 0.30 | 0.30 | 0.08 | Al 0.02 min; Cu 0.30; Nb 0.010; Ti 0.04; V 0.02; (Cr+Cu+Mo+Ni) 0.70 |
| ASME SA-53/SA-53M | Grade A Type E | K02504 | --- | 0.25 | 0.95 | --- | 0.05 | 0.045 | 0.40 | 0.40 | 0.15 | V 0.08; Cu 0.40; (Cu+Ni+Cr+Mo+V) 1.00 |
| | Grade A Type F | --- | --- | 0.30 | 1.20 | --- | 0.05 | 0.045 | 0.40 | 0.40 | 0.15 | V 0.08; Cu 0.40; (Cu+Ni+Cr+Mo+V) 1.00 |
| | Grade A Type S | K02504 | --- | 0.25 | 0.95 | --- | 0.05 | 0.045 | 0.40 | 0.40 | 0.15 | V 0.08; Cu 0.40; (Cu+Ni+Cr+Mo+V) 1.00 |
| ASME SA-135 | Grade A | K02509 | --- | 0.25 | 0.95 | --- | 0.035 | 0.035 | --- | --- | --- | --- |
| ASTM A53/A53M-12 | Type E Grade A | K02504 | --- | 0.25 | 0.95 | --- | 0.05 | 0.045 | 0.40 | 0.40 | 0.15 | Cu 0.40; V 0.08; (Cu+Ni+Cr+Mo+V) 1.00 |
| | Type F Grade A | --- | --- | 0.30 | 1.20 | --- | 0.05 | 0.045 | 0.40 | 0.40 | 0.15 | Cu 0.40; V 0.08; (Cu+Ni+Cr+Mo+V) 1.00 |
| | Type S Grade A | K02504 | --- | 0.25 | 0.95 | --- | 0.05 | 0.045 | 0.40 | 0.40 | 0.15 | Cu 0.40; V 0.08; (Cu+Ni+Cr+Mo+V) 1.00 |
| ASTM A139/A139M-04 (2010) | Grade A | --- | --- | 0.25 | 1.00 | --- | 0.035 | 0.035 | --- | --- | --- | --- |
| ASTM A135/A135M-09 (2014) | Grade A | K02509 | --- | 0.25 | 0.95 | --- | 0.035 | 0.035 | --- | --- | --- | --- |
| GB 6479-2000 | Grade 10 | --- | --- | 0.07-0.14 | 0.35-0.65 | 0.17-0.37 | 0.03 | 0.03 | 0.15 | 0.25 | --- | Cu 0.20 |
| EN 10216-1:2013 | P235TR1 | --- | 1.0254 | 0.16 | 1.20 | 0.35 | 0.025 | 0.020 | 0.30 | 0.30 | 0.08 | Cu 0.30; Nb 0.010; Ti 0.04; V 0.02; (Cr+Cu+Mo+Ni) 0.70 |
| | P235TR2 | --- | 1.0255 | 0.16 | 1.20 | 0.35 | 0.025 | 0.015 | 0.30 | 0.30 | 0.08 | Al 0.02 min; Cu 0.30; Nb 0.010; Ti 0.04; V 0.02; (Cr+Cu+Mo+Ni) 0.70 |
| EN 10217-1:2002 A1:2005 | P235TR1 | --- | 1.0254 | 0.16 | 1.20 | 0.35 | 0.025 | 0.020 | 0.30 | 0.30 | 0.08 | Cu 0.30; Nb 0.010; Ti 0.04; V 0.02; (Cr+Cu+Mo+Ni) 0.70 |
| | P235TR2 | --- | 1.0255 | 0.16 | 1.20 | 0.35 | 0.025 | 0.020 | 0.30 | 0.30 | 0.08 | Al 0.02 min; Cu 0.30; Nb 0.010; Ti 0.04; V 0.02; (Cr+Cu+Mo+Ni) 0.70 |
| JIS G 3454:2012 | Symbol STPG370 | --- | --- | 0.25 | 0.30-0.90 | 0.35 | 0.040 | 0.040 | --- | --- | --- | --- |

**5.6 Carbon Steel Tubes and Pipes for Pressure Purposes**

**5.6B Chemical Composition of Carbon Steel Tubes and Pipes for Pressure Purposes (Continued)**

| Specification | Designation | UNS No. | Steel No. | Weight, % max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| JIS G 3457:2012 | Symbol STPY400 | --- | --- | 0.25 | --- | --- | 0.040 | 0.040 | --- | --- | --- | --- |
| GB 6479-2000 | Grade 20 | --- | --- | 0.17-0.24 | 0.35-0.65 | 0.17-0.37 | 0.03 | 0.03 | 0.25 | 0.25 | 0.15 | V 0.08; Cu 0.20 |
| EN 10216-1:2013 | P265TR1 | --- | 1.0258 | 0.20 | 1.40 | 0.40 | 0.025 | 0.020 | 0.30 | 0.30 | 0.08 | Cu 0.30; Nb 0.010; Ti 0.04; V 0.02; (Cr+Cu+Mo+Ni) 0.70 |
| | P265TR2 | --- | 1.0259 | 0.20 | 1.40 | 0.40 | 0.025 | 0.015 | 0.30 | 0.30 | 0.08 | Al 0.02 min; Cu 0.30; Nb 0.010; Ti 0.04; V 0.02; (Cr+Cu+Mo+Ni) 0.70 |
| EN 10217-1:2002 A1:2005 | P265TR1 | --- | 1.0258 | 0.20 | 1.40 | 0.40 | 0.025 | 0.020 | 0.30 | 0.30 | 0.08 | Cu 0.30; Nb 0.010; Ti 0.04; V 0.02; (Cr+Cu+Mo+Ni) 0.70 |
| | P265TR2 | --- | 1.0259 | 0.20 | 1.40 | 0.40 | 0.025 | 0.020 | 0.30 | 0.30 | 0.08 | Al 0.02 min; Cu 0.30; Nb 0.010; Ti 0.04; V 0.02; (Cr+Cu+Mo+Ni) 0.70 |
| JIS G 3454:2012 | Symbol STPG410 | --- | --- | 0.30 | 0.30-1.00 | 0.35 | 0.040 | 0.040 | --- | --- | --- | --- |
| ASME SA-135 | Grade B | K03018 | --- | 0.30 | 1.20 | --- | 0.035 | 0.035 | --- | --- | --- | --- |
| ASME SA-53/SA-53M | Grade B Type E | --- | --- | 0.30 | 1.20 | --- | 0.05 | 0.045 | 0.40 | 0.40 | 0.15 | V 0.08; Cu 0.40; (Cu+Ni+Cr+Mo+V) 1.00 |
| | Grade B Type S | --- | --- | 0.30 | 1.20 | --- | 0.05 | 0.045 | 0.40 | 0.40 | 0.15 | V 0.08; Cu 0.40; (Cu+Ni+Cr+Mo+V) 1.00 |
| ASTM A135/A135M-09 (2014) | Grade B | --- | --- | 0.30 | 1.20 | --- | 0.035 | 0.035 | --- | --- | --- | --- |
| ASTM A53/A53M-12 | Type E Grade B | K03005 | --- | 0.30 | 1.20 | --- | 0.05 | 0.045 | 0.40 | 0.40 | 0.15 | Cu 0.40; V 0.08; (Cu+Ni+Cr+Mo+V) 1.00 |
| | Type S Grade B | K03005 | --- | 0.30 | 1.20 | --- | 0.05 | 0.045 | 0.40 | 0.40 | 0.15 | Cu 0.40; V 0.08; (Cu+Ni+Cr+Mo+V) 1.00 |
| ASTM A139/A139M-04 (2010) | Grade B | K03003 | --- | 0.26 | 1.00 | --- | 0.035 | 0.035 | --- | --- | --- | --- |
| | Grade C | K03004 | --- | 0.28 | 1.20 | --- | 0.035 | 0.035 | --- | --- | --- | --- |
| | Grade D | K03010 | --- | 0.30 | 1.30 | --- | 0.035 | 0.035 | --- | --- | --- | --- |
| | Grade E | K03012 | --- | 0.30 | 1.40 | --- | 0.035 | 0.035 | --- | --- | --- | --- |

### 5.7 Carbon Steel Tubes and Pipes for Pressure Purposes at High Temperatures

### 5.7A Mechanical Properties of Carbon Steel Tubes and Pipes for Pressure Purposes at High Temperatures

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter mm | Section Thickness/Diameter in. | Yield Strength MPa | Yield Strength ksi | Tensile Strength MPa | Tensile Strength ksi | Elongation %, min. | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ASME SA-214/SA-214M | --- | K01807 | --- | t ≥ 0.4 | t ≥ 0.015 | --- | --- | --- | --- | --- | see standard | 72 max HRB |
| ASME SA-556/SA-556M | Grade A2 | --- | --- | t ≥ 1.1 | t ≥ 0.045 | 180 | 26 | 320 | 47 | 35 | HT | 72 max HRB |
| ASTM A214/A214M-96 (2012) | --- | K01807 | --- | t ≥ 0.4 | t ≥ 0.015 | --- | --- | --- | --- | --- | see standard | 72 max HRB |
| ASTM A556/A556M-96 (2012) | Grade A2 | K01807 | --- | t ≥ 1.1 | t ≥ 0.045 | 180 | 26 | 320 | 47 | 35 | CD+1200°F min | 72 max HRB |
| EN 10216-2:2013 | P195GH | --- | 1.0348 | t ≤ 16 | --- | 195 | --- | 320-440 | --- | 27 L; 25 T | N, NF | L: 40 J at 0°C<br>L: 28 J at -10°C<br>T: 27 J at 0°C |
| | | | | 16 < t ≤ 100 | --- | --- | --- | 320-440 | --- | 27 L; 25 T | N, NF | L: 40 J at 0°C<br>L: 28 J at -10°C<br>T: 27 J at 0°C |
| EN 10217-2:2002 A1:2005 | P195GH | --- | 1.0348 | t ≤ 16 | --- | 195 | --- | 320-440 | --- | 27 L; 25 T | see standard | see standard for impact data |
| ASME SA-178/SA-178M* | Grade A | K01200 | --- | t ≥ 0.4 | t ≥ 0.015 | 180 | 26 | 325 | 47 | 35 | see standard | --- |
| ASME SA-179/SA-179M* | --- | --- | --- | t ≥ 0.4 | t ≥ 0.015 | 180 | 26 | 325 | 47 | 35 | HT | 72 max HRB |
| ASME SA-192/SA-192M* | --- | K01201 | --- | 0.4 ≤ t < 5.1 | 0.015 ≤ t < 0.200 | 180 | 26 | 325 | 47 | 35 | CF | 77 max HRB |
| | | | | t ≥ 5.1 | t ≥ 0.200 | 180 | 26 | 325 | 47 | 35 | CF | 137 max HB |
| ASTM A178/A178M-02 (2012)* | Grade A | K01200 | --- | t ≥ 0.4 | t ≥ 0.015 | 180 | 26 | 325 | 47 | 35 | see standard | --- |
| ASTM A179/A179M-90a (2012)* | --- | K01200 | --- | t ≥ 0.4 | t ≥ 0.015 | 180 | 26 | 325 | 47 | 35 | CD+1200°F min | 72 max HRB |
| ASTM A192/A192M-02 | --- | K01201 | --- | 0.4 ≤ t < 5.1 | 0.015 ≤ t < 0.200 | 180 | 26 | 325 | 47 | 35 | HF or CF + 1200°F min | 77 max HRB |
| (2012)* | | | | t ≥ 5.1 | t ≥ 0.200 | 180 | 26 | 325 | 47 | 35 | HF or CF + 1200°F min | 137 max HB |
| ASME SA-106 | Grade A | --- | --- | --- | --- | 205 | 30 | 330 L | 48 L | 28 L, 20 T | CF+HT or HF | --- |
| ASTM A106/A106M-14 | Grade A | K02501 | --- | --- | --- | 205 | 30 | 330 L | 48 L | 28 L; 20 T | HF or CD + 1200°F min | --- |
| GB 3087-1999 | Grade 10 | --- | --- | --- | --- | 195 | --- | 335-475 L | --- | 24 L | HF, CF or HT | --- |
| JIS G 3461:2012 | Symbol STB340 | --- | --- | d < 10 | --- | 175 | --- | 340 | --- | 27 | see standard | 77 max HRBW |
| | | | | 10 ≤ d < 20 | --- | 175 | --- | 340 | --- | 30 | see standard | 77 max HRBW |
| | | | | d ≥ 20 | --- | 175 | --- | 340 | --- | 35 | see standard | 77 max HRBW |

*: See "List of Standards" at the beginning of the chapter.

**5.7 Carbon Steel Tubes and Pipes for Pressure Purposes at High Temperatures**

**5.7A Mechanical Properties of Carbon Steel Tubes and Pipes for Pressure Purposes at High Temperatures (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter mm | Section Thickness/Diameter in. | Yield Strength MPa | Yield Strength ksi | Tensile Strength MPa | Tensile Strength ksi | Elongation %, min. | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AFNOR NF A 49-220:1990 | TU 37 C | --- | --- | --- | --- | 220 | --- | 360-460 | --- | --- | N | 32 J at 0°C |
| EN 10216-2:2013 | P235GH | --- | 1.0345 | t ≤ 16 | --- | 235 | --- | 360-500 | --- | 25 L; 23 T | N, NF | L: 40 J at 0°C<br>L: 28 J at –10°C<br>T: 27 J at 0°C |
| | | | | 16 < t ≤ 40 | --- | 225 | --- | 360-500 | --- | 25 L; 23 T | N, NF | L: 40 J at 0°C<br>L: 28 J at –10°C<br>T: 27 J at 0°C |
| | | | | 40 < t ≤ 60 | --- | 215 | --- | 360-500 | --- | 25 L; 23 T | N, NF | L: 40 J at 0°C<br>L: 28 J at –10°C<br>T: 27 J at 0°C |
| | | | | 60 < t ≤ 100 | --- | --- | --- | 360-500 | --- | 25 L; 23 T | N, NF | L: 40 J at 0°C<br>L: 28 J at –10°C<br>T: 27 J at 0°C |
| EN 10217-2:2002 A1:2005 | P235GH | --- | 1.0345 | t ≤ 16 | --- | 235 | --- | 360-500 | --- | 25 L; 23 T | see standard | see standard for impact data |
| EN 10217-5:2002 A1:2005 | P235GH | --- | 1.0345 | t ≤ 16 | --- | 235 | --- | 360-500 | --- | 25 L; 23 T | see standard | see standard for |
| | | | | 16 < t ≤ 40 | --- | 225 | --- | 360-500 | --- | 25 L; 23 T | see standard | impact data |
| JIS G 3455:2012 | Symbol STS370 | --- | --- | --- | --- | 215 | --- | 370 | --- | 28 L; 23 T | see standard | --- |
| JIS G 3456:2014 | Symbol STPT370 | --- | --- | --- | --- | 215 | --- | 370 | --- | 30 L; 25 T | see standard | --- |
| AFNOR NF A 49-220:1990 | TU 42 C | --- | --- | --- | --- | 235 | --- | 410-510 | --- | --- | N | 32 J at 0°C |
| JIS G 3455:2012 | Symbol STS410 | --- | --- | --- | --- | 245 | --- | 410 | --- | 24 L; 19 T | see standard | --- |
| JIS G 3456:2014 | Symbol STPT410 | --- | --- | --- | --- | 245 | --- | 410 | --- | 25 L; 20 T | see standard | --- |
| JIS G 3467:2013 | Symbol STF410 | --- | --- | --- | --- | 245 | --- | 410 | --- | 25 L; 20 T | HFS: AM<br>CFS: LTA, N | --- |
| GB 3087-1999 | Grade 20 | --- | --- | t < 15 | --- | 245 | --- | 410-550 L | --- | 20 L | HF, CF or HT | --- |
| | | | | t ≥ 15 | --- | 225 | --- | 410-550 L | --- | 20 L | HF, CF or HT | --- |
| GB 5310-1995 | Grade 20G | --- | --- | --- | --- | 245 | --- | 410-550 L, 400 T | --- | 24 L, 22 T | N | see standard |
| | Grade 20MnG | --- | --- | --- | --- | 240 | --- | 415 L | --- | 22 L | N | see standard |
| JIS G 3461:2012 | Symbol STB410 | --- | --- | d < 10 | --- | 255 | --- | 410 | --- | 17 | see standard | --- |
| | | | | 10 ≤ d < 20 | --- | 255 | --- | 410 | --- | 20 | see standard | --- |
| | | | | d ≥ 20 | --- | 255 | --- | 410 | --- | 25 | see standard | --- |
| ASME SA-556/SA-556M | Grade B2 | K02707 | --- | t ≥ 1.1 | t ≥ 0.045 | 260 | 37 | 410 | 60 | 30 | HT | 79 max HRB |
| ASTM A556/A556M-96 (2012) | Grade B2 | K02707 | --- | t ≥ 1.1 | t ≥ 0.045 | 260 | 37 | 410 | 60 | 30 | CD+1200°F min | 79 max HRB |

Note: This section continued on next page.

**5.7 Carbon Steel Tubes and Pipes for Pressure Purposes at High Temperatures**

**5.7A Mechanical Properties of Carbon Steel Tubes and Pipes for Pressure Purposes at High Temperatures (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter | | Yield Strength | | Tensile Strength | | Elongation %, min. | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | | | |
| EN 10216-2:2013 | P265GH | --- | 1.0425 | t ≤ 16 | --- | 265 | --- | 410-570 | --- | 23 L; 21 T | N, NF | L: 40 J at 0°C<br>L: 28 J at -10°C<br>T: 27 J at 0°C |
| | | | | 16 < t ≤ 40 | --- | 255 | --- | 410-570 | --- | 23 L; 21 T | N, NF | L: 40 J at 0°C<br>L: 28 J at -10°C<br>T: 27 J at 0°C |
| | | | | 40 < t ≤ 60 | --- | 245 | --- | 410-570 | --- | 23 L; 21 T | N, NF | L: 40 J at 0°C<br>L: 28 J at -10°C<br>T: 27 J at 0°C |
| | | | | 60 < t ≤ 100 | --- | --- | --- | 410-570 | --- | 23 L; 21 T | N, NF | L: 40 J at 0°C<br>L: 28 J at -10°C<br>T: 27 J at 0°C |
| EN 10217-2:2002 A1:2005 | P265GH | --- | 1.0425 | t ≤ 16 | --- | 265 | --- | 410-570 | --- | 23 L; 21 T | see standard | see standard for impact data |
| EN 10217-5:2002 A1:2005 | P265GH | --- | 1.0425 | t ≤ 16 | --- | 265 | --- | 410-570 | --- | 23 L; 21 T | see standard | see standard for |
| | | | | 16 < t ≤ 40 | --- | 255 | --- | 410-570 | --- | 23 L; 21 T | see standard | impact data |
| ASME SA-106 | Grade B | --- | --- | --- | --- | 240 | 35 | 415 L | 60 L | 22 L, 12 T | CF+HT or HF | --- |
| ASME SA-178/SA-178M* | Grade C | K03503 | --- | t ≥ 0.4 | t ≥ 0.015 | 255 | 37 | 415 | 60 | 30 | see standard | --- |
| ASME SA-210/SA-210M | Grade A-1 | K02707 | --- | t ≥ 0.4 | t ≥ 0.015 | 255 | 37 | 415 | 60 | 30 | HF or CF+A or CF+N | 143 max HB; 79 max HRB |
| ASTM A106/A106M-14 | Grade B | K03006 | --- | --- | --- | 240 | 35 | 415 | 60 | 22 L; 12 T | HF or CD + 1200°F min | --- |
| ASTM A178/A178M-02 2012)* | Grade C | K03503 | --- | t ≥ 0.4 | t ≥ 0.015 | 255 | 37 | 415 | 60 | 30 | see standard | --- |
| ASTM A210/A210M-02 (2012) | Grade A-1 | K02707 | --- | t ≥ 0.4 | t ≥ 0.015 | 255 | 37 | 415 | 60 | 30 | HF or CF + SA, A, N | 79 max HRB; 143 max HB |

*: See "List of Standards" at the beginning of the chapter.

**5.7 Carbon Steel Tubes and Pipes for Pressure Purposes at High Temperatures**

**5.7A Mechanical Properties of Carbon Steel Tubes and Pipes for Pressure Purposes at High Temperatures (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter | | Yield Strength | | Tensile Strength | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | %, min. | | |
| AFNOR NF A 49-220:1990 | TU 48 C | --- | --- | --- | --- | 275 | --- | 470-570 | --- | --- | N | 40 J at 0°C |
| JIS G 3455:2012 | Symbol STS480 | --- | --- | --- | --- | 275 | --- | 480 | --- | 22 L; 17 T | see standard | --- |
| JIS G 3456:2014 | Symbol STPT480 | --- | --- | --- | --- | 275 | --- | 480 | --- | 25 L; 20 T | see standard | --- |
| ASME SA-556/SA-556M | Grade C2 | K03006 | --- | t ≥ 1.1 | t ≥ 0.045 | 280 | 40 | 480 | 70 | 30 | HT | 89 max HRB |
| ASTM A556/A556M-96 (2012) | Grade C2 | K03006 | --- | t ≥ 1.1 | t ≥ 0.045 | 280 | 40 | 480 | 70 | 30 | CD+1200°F min | 89 max HRB |
| ASTM A178/A178M-02 (2012)* | Grade D | K02709 | --- | t ≥ 0.4 | t ≥ 0.015 | 275 | 40 | 485 | 70 | 30 | see standard | --- |
| ASTM A210/A210M-02 (2012) | Grade C | K03501 | --- | t ≥ 0.4 | t ≥ 0.015 | 275 | 40 | 485 | 70 | 30 | HF or CF + SA, A, N | 89 max HRB<br>179 max HB |
| ASME SA-106 | Grade C | K03501 | --- | --- | --- | 275 | 40 | 485 L | 70 L | 20 L, 12 T | CF+HT or HF | --- |
| ASTM A106/A106M-14 | Grade C | K03501 | --- | --- | --- | 275 | 40 | 485 | 70 | 20 L; 12 T | HF or CD + 1200°F min | --- |
| ASME SA-178/SA-178M* | Grade D | K02709 | --- | t ≥ 0.4 | t ≥ 0.015 | 275 | 40 | 485 | 70 | 30 | see standard | --- |
| ASME SA-210/SA-210M* | Grade C | K03501 | --- | t ≥ 0.4 | t ≥ 0.015 | 275 | 40 | 485 | 70 | 30 | HF or CF+A or CF+N | 179 max HB;<br>89 max HRB |
| GB 5310-1995 | Grade 25MnG | --- | --- | --- | --- | 275 | --- | 485 L | --- | 20 L | N | see standard |
| JIS G 3461:2012 | Symbol STB510 | --- | --- | d < 10 | --- | 295 | --- | 510 | --- | 17 | N | --- |
| | | | | 10 ≤ d < 20 | --- | 295 | --- | 510 | --- | 20 | N | --- |
| | | | | d ≥ 20 | --- | 295 | --- | 510 | --- | 25 | N | --- |
| AFNOR NF A 49-220:1990 | TU 52 C | --- | --- | --- | --- | 350 | --- | 510-630 | --- | --- | N | 40 J at 0°C |

* See "List of Standards" at the beginning of the chapter.

**5.7 Carbon Steel Tubes and Pipes for Pressure Purposes at High Temperatures**

**5.7B Chemical Composition of Carbon Steel Tubes and Pipes for Pressure Purposes at High Temperatures**

| Specification | Designation | UNS No. | Steel No. | Weight, % max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASME SA-214/SA-214M | --- | K01807 | --- | 0.18 | 0.27-0.63 | --- | 0.035 | 0.035 | --- | --- | --- | --- |
| ASME SA-556/SA-556M | Grade A2 | --- | --- | 0.18 | 0.27-0.63 | --- | 0.035 | 0.035 | --- | --- | --- | --- |
| ASTM A214/A214M-96 (2012) | --- | K01807 | --- | 0.18 | 0.27-0.63 | --- | 0.035 | 0.035 | --- | --- | --- | --- |
| ASTM A556/A556M-96 (2012) | Grade A2 | K01807 | --- | 0.18 | 0.27-0.63 | --- | 0.035 | 0.035 | --- | --- | --- | --- |
| EN 10216-2:2013 | P195GH | --- | 1.0348 | 0.13 | 0.70 | 0.35 | 0.025 | 0.010 | 0.30 | 0.30 | 0.08 | Al 0.020 min; Cu 0.30; Nb 0.010; Ti 0.040; V 0.02; (Cr+Cu+Mo+Ni) 0.70 |
| EN 10217-2:2002 A1:2005 | P195GH | --- | 1.0348 | 0.13 | 0.70 | 0.35 | 0.025 | 0.020 | 0.30 | 0.30 | 0.08 | Cu 0.30; Nb 0.010; Ti 0.03; V 0.02; Al 0.020 min; (Cr+Cu+Mo+Ni) 0.70 |
| ASME SA-178/SA-178M* | Grade A | K01200 | --- | 0.06-0.18 | 0.27-0.63 | --- | 0.035 | 0.035 | --- | --- | --- | --- |
| ASME SA-179/SA-179M* | --- | --- | --- | 0.06-0.18 | 0.27-0.63 | --- | 0.035 | 0.035 | --- | --- | --- | --- |
| ASME SA-192/SA-192M* | --- | K01201 | --- | 0.06-0.18 | 0.27-0.63 | 0.25 | 0.035 | 0.035 | --- | --- | --- | --- |
| ASTM A178/A178M-02 (2012)* | Grade A | K01200 | --- | 0.06-0.18 | 0.27-0.63 | --- | 0.035 | 0.035 | --- | --- | --- | --- |
| ASTM A179/A179M-90a (2012)* | --- | K01200 | --- | 0.06-0.18 | 0.27-0.63 | --- | 0.035 | 0.035 | --- | --- | --- | --- |
| ASTM A192/A192M-02 (2012)* | --- | K01201 | --- | 0.06-0.18 | 0.27-0.63 | 0.25 | 0.035 | 0.035 | --- | --- | --- | --- |
| ASME SA-106 | Grade A | --- | --- | 0.25 | 0.27-0.93 | 0.10 min. | 0.035 | 0.035 | 0.40 | 0.40 | 0.15 | V 0.08; Cu 0.40; (Cr+Cu+Mo+Ni+V) 1.00 |
| ASTM A106/A106M-14 | Grade A | K02501 | --- | 0.25 | 0.27-0.93 | 0.10 min. | 0.035 | 0.035 | 0.40 | 0.40 | 0.15 | Cu 0.40; V 0.08; (Cu+Ni+Cr+Mo+V) 1.0 |
| GB 3087-1999 | Grade 10 | --- | --- | 0.07-0.13 | 0.35-0.65 | 0.17-0.37 | 0.035 | 0.035 | 0.15 | 0.30 | --- | Cu 0.25 |
| JIS G 3461:2012 | Symbol STB340 | --- | --- | 0.18 | 0.30-0.60 | 0.35 | 0.035 | 0.035 | --- | --- | --- | --- |
| AFNOR NF A 49-220:1990 | TU 37 C | --- | --- | 0.16 | 0.35-0.75 | 0.06-0.30 | 0.025 | 0.025 | --- | --- | --- | --- |
| EN 10216-2:2013 | P235GH | --- | 1.0345 | 0.16 | 1.20 | 0.35 | 0.025 | 0.010 | 0.30 | 0.30 | 0.08 | Al 0.020 min; Cu 0.30; Nb 0.020; Ti 0.040; V 0.02; (Cr+Cu+Mo+Ni) 0.70 |
| EN 10217-2:2002 A1:2005 | P235GH | --- | 1.0345 | 0.16 | 1.20 | 0.35 | 0.025 | 0.020 | 0.30 | 0.30 | 0.08 | Cu 0.30; Nb 0.010; Ti 0.03; V 0.02; Al 0.020 min; (Cr+Cu+Mo+Ni) 0.70 |
| EN 10217-5:2002 A1:2005 | P235GH | --- | 1.0345 | 0.16 | 1.20 | 0.35 | 0.025 | 0.020 | 0.30 | 0.30 | 0.08 | Cu 0.30; Nb 0.010; Ti 0.03; V 0.02; Al 0.020 min; (Cr+Cu+Mo+Ni) 0.70 |
| JIS G 3455:2012 | Symbol STS370 | --- | --- | 0.25 | 0.30-1.10 | 0.10-0.35 | 0.035 | 0.035 | --- | --- | --- | --- |
| JIS G 3456:2014 | Symbol STPT370 | --- | --- | 0.25 | 0.30-0.90 | 0.10-0.35 | 0.035 | 0.035 | --- | --- | --- | --- |

*: See "List of Standards" at the beginning of the chapter.

**5.7 Carbon Steel Tubes and Pipes for Pressure Purposes at High Temperatures**

**5.7B Chemical Composition of Carbon Steel Tubes and Pipes for Pressure Purposes at High Temperatures (Continued)**

| Specification | Designation | UNS No. | Steel No. | Weight, % max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| AFNOR NF A 49-220:1990 | TU 42 C | --- | --- | 0.20 | 0.45-1.00 | 0.08-0.35 | 0.025 | 0.025 | --- | --- | --- | --- |
| JIS G 3455:2012 | Symbol STS410 | --- | --- | 0.30 | 0.30-1.40 | 0.10-0.35 | 0.035 | 0.035 | --- | --- | --- | --- |
| JIS G 3456:2014 | Symbol STPT410 | --- | --- | 0.30 | 0.30-1.00 | 0.10-0.35 | 0.035 | 0.035 | --- | --- | --- | --- |
| JIS G 3467:2013 | Symbol STF410 | --- | --- | 0.30 | 0.30-1.00 | 0.10-0.35 | 0.035 | 0.035 | --- | --- | --- | --- |
| GB 3087-1999 | Grade 20 | --- | --- | 0.17-0.23 | 0.35-0.65 | 0.17-0.37 | 0.035 | 0.035 | 0.25 | 0.30 | --- | Cu 0.25 |
| GB 5310-1995 | Grade 20G | --- | --- | 0.17-0.24 | 0.35-0.65 | 0.17-0.37 | 0.03 | 0.03 | 0.25 | 0.25 | 0.15 | V 0.08; Cu 0.20 |
| | Grade 20MnG | --- | --- | 0.17-0.24 | 0.70-1.00 | 0.17-0.37 | 0.03 | 0.03 | 0.25 | 0.25 | 0.15 | V 0.08; Cu 0.20 |
| JIS G 3461:2012 | Symbol STB410 | --- | --- | 0.32 | 0.30-0.80 | 0.35 | 0.035 | 0.035 | --- | --- | --- | --- |
| ASME SA-556/SA-556M | Grade B2 | K02707 | --- | 0.27 | 0.29-0.93 | 0.10 min. | 0.035 | 0.035 | --- | --- | --- | --- |
| ASTM A556/A556M-96 (2012) | Grade B2 | K02707 | --- | 0.27 | 0.29-0.93 | 0.10 min. | 0.035 | 0.035 | --- | --- | --- | --- |
| EN 10216-2:2013 | P265GH | --- | 1.0425 | 0.20 | 1.40 | 0.40 | 0.025 | 0.010 | 0.30 | 0.30 | 0.08 | Al 0.020 min; Cu 0.30; Nb 0.020; Ti 0.040; V 0.02; (Cr+Cu+Mo+Ni) 0.70 |
| EN 10217-2:2002 A1:2005 | P265GH | --- | 1.0425 | 0.20 | 1.40 | 0.40 | 0.025 | 0.020 | 0.30 | 0.30 | 0.08 | Cu 0.30; Nb 0.010; Ti 0.03; V 0.02; Al 0.020 min; (Cr+Cu+Mo+Ni) 0.70 |
| EN 10217-5:2002 A1:2005 | P265GH | --- | 1.0425 | 0.20 | 1.40 | 0.40 | 0.025 | 0.020 | 0.30 | 0.30 | 0.08 | Cu 0.30; Nb 0.010; Ti 0.03; V 0.02; Al 0.020 min; (Cr+Cu+Mo+Ni) 0.70 |
| ASME SA-106 | Grade B | --- | --- | 0.30 | 0.29-1.06 | 0.10 min. | 0.035 | 0.035 | 0.40 | 0.40 | 0.15 | V 0.08; Cu 0.40; (Cr+Cu+Mo+Ni+V) 1.00 |
| ASME SA-178/SA-178M* | Grade C | K03503 | --- | 0.35 | 0.80 | --- | 0.035 | 0.035 | --- | --- | --- | --- |
| ASME SA-210/SA-210M | Grade A-1 | K02707 | --- | 0.27 | 0.93 | 0.10 min. | 0.035 | 0.035 | --- | --- | --- | --- |
| ASTM A106/A106M-14 | Grade B | K03006 | --- | 0.30 | 0.29-1.06 | 0.10 min. | 0.035 | 0.035 | 0.40 | 0.40 | 0.15 | Cu 0.40; V 0.08; (Cu+Ni+Cr+Mo+V) 1.0 |
| ASTM A178/A178M-02 (2012)* | Grade C | K03503 | --- | 0.35 | 0.80 | --- | 0.035 | 0.035 | --- | --- | --- | --- |
| ASTM A210/A210M-02 (2012) | Grade A-1 | K02707 | --- | 0.27 | 0.93 | 0.10 min. | 0.035 | 0.035 | --- | --- | --- | --- |

*: See "List of Standards" at the beginning of the chapter.

**5.7 Carbon Steel Tubes and Pipes for Pressure Purposes at High Temperatures**

**5.7B Chemical Composition of Carbon Steel Tubes and Pipes for Pressure Purposes at High Temperatures (Continued)**

| Specification | Designation | UNS No. | Steel No. | Weight, % max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| AFNOR NF A 49-220:1990 | TU 48 C | --- | --- | 0.22 | 0.65-1.25 | 0.10-0.35 | 0.025 | 0.025 | --- | --- | --- | --- |
| JIS G 3455:2012 | Symbol STS480 | --- | --- | 0.33 | 0.30-1.50 | 0.10-0.35 | 0.035 | 0.035 | --- | --- | --- | --- |
| JIS G 3456:2014 | Symbol STPT480 | --- | --- | 0.33 | 0.30-1.00 | 0.10-0.35 | 0.035 | 0.035 | --- | --- | --- | --- |
| ASME SA-556/SA-556M | Grade C2 | K03006 | --- | 0.30 | 0.29-1.06 | 0.10 min. | 0.035 | 0.035 | --- | --- | --- | --- |
| ASTM A556/A556M-96 (2012) | Grade C2 | K03006 | --- | 0.30 | 0.29-1.06 | 0.10 min. | 0.035 | 0.035 | --- | --- | --- | --- |
| ASTM A178/A178M-02 (2012)* | Grade D | K02709 | --- | 0.27 | 1.00-1.50 | 0.10 min | 0.030 | 0.015 | --- | --- | --- | --- |
| ASTM A210/A210M-02 (2012) | Grade C | K03501 | --- | 0.35 | 0.29-1.06 | 0.10 min. | 0.035 | 0.035 | --- | --- | --- | --- |
| ASME SA-106 | Grade C | K03501 | --- | 0.35 | 0.29-1.06 | 0.10 min. | 0.035 | 0.035 | 0.40 | 0.40 | 0.15 | V 0.08; Cu 0.40; (Cr+Cu+Mo+Ni+V) 1.00 |
| ASTM A106/A106M-14 | Grade C | K03501 | --- | 0.35 | 0.29-1.06 | 0.10 min. | 0.035 | 0.035 | 0.40 | 0.40 | 0.15 | Cu 0.40; V 0.08; (Cu+Ni+Cr+Mo+V) 1.0 |
| ASME SA-178/SA-178M* | Grade D | K02709 | --- | 0.27 | 1.00-1.50 | 0.10 min. | 0.030 | 0.015 | --- | --- | --- | --- |
| ASME SA-210/SA-210M | Grade C | K03501 | --- | 0.35 | 0.29-1.06 | 0.10 min. | 0.035 | 0.035 | --- | --- | --- | --- |
| GB 5310-1995 | Grade 25MnG | --- | --- | 0.22-0.30 | 0.70-1.00 | 0.17-0.37 | 0.03 | 0.03 | 0.25 | 0.25 | 0.15 | V 0.08; Cu 0.20 |
| AFNOR NF A 49-220:1990 | TU 52 C | --- | --- | 0.20 | 1.00-1.50 | 0.15-0.50 | 0.025 | 0.025 | --- | --- | --- | --- |
| JIS G 3461:2012 | Symbol STB510 | --- | --- | 0.25 | 1.00-1.50 | 0.35 | 0.035 | 0.035 | --- | --- | --- | --- |

*: See "List of Standards" at the beginning of the chapter.

## 5.8 Alloy Steel Tubes and Pipes for Pressure Purposes at High Temperatures

### 5.8.1A Chemical Composition of ¼ Mo Alloy Steel Tubes and Pipes for Pressure Purposes at High Temperatures

| Specification | Designation | UNS No. | Steel No. | Weight, % max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| AFNOR NF A 49-220:1990 | TU 15 D 3 | --- | --- | 0.12-0.20 | 0.50-0.80 | 0.15-0.35 | 0.025 | 0.025 | 0.30 | --- | 0.25-0.35 | --- |
| EN 10216-2:2013 | 16Mo3 | --- | 1.5415 | 0.12-0.20 | 0.40-0.90 | 0.35 | 0.025 | 0.010 | 0.30 | 0.30 | 0.25-0.35 | Al 0.040; Cu 0.30 |
| EN 10217-2:2002 A1:2005 | 16Mo3 | --- | 1.5415 | 0.12-0.20 | 0.40-0.90 | 0.35 | 0.025 | 0.020 | 0.30 | 0.30 | 0.25-0.35 | Cu 0.30; Al 0.040 |
| EN 10217-5:2002 A1:2005 | 16Mo3 | --- | 1.5415 | 0.12-0.20 | 0.40-0.90 | 0.35 | 0.025 | 0.020 | 0.30 | 0.30 | 0.25-0.35 | Cu 0.30; Al 0.040 |
| GB 5310-1995 | Grade 15MoG | --- | --- | 0.12-0.20 | 0.40-0.80 | 0.17-0.37 | 0.03 | 0.03 | 0.3 | 0.3 | 0.25-0.35 | Cu 0.20 |
| ISO 9329-2:1997 | Grade 16 Mo 3 | --- | --- | 0.12-0.20 | 0.40-0.80 | 0.15-0.35 | 0.035 | 0.035 | --- | --- | 0.25-0.35 | Al 0.020 |

### 5.8.1B Mechanical Properties of ¼Mo Alloy Steel Tubes and Pipes for Pressure Purposes at High Temperatures

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter | | Yield Strength | | Tensile Strength | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | %, min. | | |
| AFNOR NF A 49-220:1990 | TU 15 D 3 | --- | --- | --- | --- | 265 | --- | 430-550 | --- | 22 | heat + air cool | --- |
| EN 10216-2:2013 | 16Mo3 | --- | 1.5415 | t ≤ 16 | --- | 280 | --- | 450-600 | --- | 22 L; 20 T | N, NF | L: 40 J at 20°C<br>T: 27 J at 20°C |
| | | | | 16 < t ≤ 40 | --- | 270 | --- | 450-600 | --- | 22 L; 20 T | N, NF | L: 40 J at 20°C<br>T: 27 J at 20°C |
| | | | | 40 < t ≤ 60 | --- | 260 | --- | 450-600 | --- | 22 L; 20 T | N, NF | L: 40 J at 20°C<br>T: 27 J at 20°C |
| | | | | 60 < t ≤ 100 | --- | --- | --- | 450-600 | --- | 22 L; 20 T | N, NF | L: 40 J at 20°C<br>T: 27 J at 20°C |
| EN 10217-2:2002 A1:2005 | 16Mo3 | --- | 1.5415 | t ≤ 16 | --- | 280 | --- | 450-600 | --- | 22 L; 20 T | see standard | L: 40 J at 20°C<br>T: 27 J at 20°C |
| EN 10217-5:2002 A1:2005 | 16Mo3 | --- | 1.5415 | t ≤ 16 | --- | 280 | --- | 450-600 | --- | 22 L; 20 T | see standard | L: 40 J at 20°C<br>T: 27 J at 20°C |
| | | | | 16 < t ≤ 40 | --- | 270 | --- | 450-600 | --- | 22 L; 20 T | see standard | L: 40 J at 20°C<br>T: 27 J at 20°C |
| GB 5310-1995 | Grade 15MoG | --- | --- | --- | --- | 270 | --- | 450-600 L | --- | 22 L, 20 T | N | see standard |
| ISO 9329-2:1997 | Grade 16 Mo 3 | --- | --- | t ≤ 10 | --- | 280 | --- | 450-600 | --- | 22 L, 20 T | N | L: 35 J @ RT |
| | | | | 10 < t ≤ 40 | --- | 270 | --- | 450-600 | --- | 22 L, 20 T | N | see standard |
| | | | | 40 < t ≤ 60 | --- | 260 | --- | 450-600 | --- | 22 L, 20 T | N | see standard |

**5.8 Alloy Steel Tubes and Pipes for Pressure Purposes at High Temperatures**

**5.8.2A Chemical Composition of ½Mo Alloy Steel Tubes and Pipes for Pressure Purposes at High Temperatures**

| Specification | Designation | UNS No. | Steel No. | Weight, % max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASME SA-209/SA-209M | Grade T1 | K11522 | --- | 0.10-0.20 | 0.30-0.80 | 0.10-0.50 | 0.025 | 0.025 | --- | --- | 0.44-0.65 | --- |
| | Grade T1a | K12023 | --- | 0.15-0.25 | 0.30-0.80 | 0.10-0.50 | 0.025 | 0.025 | --- | --- | 0.44-0.65 | --- |
| | Grade T1b | K11422 | --- | 0.14 | 0.30-0.80 | 0.10-0.50 | 0.025 | 0.025 | --- | --- | 0.44-0.65 | --- |
| ASME SA-250/SA-250M | Grade T1 | K11522 | --- | 0.10-0.20 | 0.30-0.80 | 0.10-0.50 | 0.025 | 0.025 | --- | --- | 0.44-0.65 | --- |
| | Grade T1a | K12023 | --- | 0.15-0.25 | 0.30-0.80 | 0.10-0.50 | 0.025 | 0.025 | --- | --- | 0.44-0.65 | --- |
| | Grade T1b | K11422 | --- | 0.14 | 0.30-0.80 | 0.10-0.50 | 0.025 | 0.025 | --- | --- | 0.44-0.65 | --- |
| ASME SA-335/SA-335M | Grade P1 | K11522 | --- | 0.10-0.20 | 0.30-0.80 | 0.10-0.50 | 0.025 | 0.025 | --- | --- | 0.44-0.65 | --- |
| ASTM A209/A209M-03 (2012) | Grade T1 | K11522 | --- | 0.10-0.20 | 0.30-0.80 | 0.10-0.50 | 0.025 | 0.025 | --- | --- | 0.44-0.65 | --- |
| | Grade T1a | K12023 | --- | 0.15-0.25 | 0.30-0.80 | 0.10-0.50 | 0.025 | 0.025 | --- | --- | 0.44-0.65 | --- |
| | Grade T1b | K11422 | --- | 0.14 | 0.30-0.80 | 0.10-0.50 | 0.025 | 0.025 | --- | --- | 0.44-0.65 | --- |
| ASTM A250/A250M-05 (2014) | Grade T1 | K11522 | --- | 0.10-0.20 | 0.30-0.80 | 0.10-0.50 | 0.025 | 0.025 | --- | --- | 0.44-0.65 | --- |
| | Grade T1a | K12023 | --- | 0.15-0.25 | 0.30-0.80 | 0.10-0.50 | 0.025 | 0.025 | --- | --- | 0.44-0.65 | --- |
| | Grade T1b | K11422 | --- | 0.14 | 0.30-0.80 | 0.10-0.50 | 0.025 | 0.025 | --- | --- | 0.44-0.65 | --- |
| ASTM A335/A335M-15 | Grade P1 | K11522 | --- | 0.10-0.20 | 0.30-0.80 | 0.10-0.50 | 0.025 | 0.025 | --- | --- | 0.44-0.65 | --- |
| EN 10216-2:2013 | 8MoB5-4 | --- | 1.5450 | 0.06-0.10 | 0.60-0.80 | 0.10-0.35 | 0.025 | 0.010 | 0.30 | --- | 0.40-0.50 | Al 0.060; Cu 0.30; Ti 0.060; B 0.002-0.006 |
| GB 5310-1995 | Grade 20MoG | --- | --- | 0.15-0.25 | 0.40-0.80 | 0.17-0.37 | 0.03 | 0.03 | 0.3 | 0.3 | 0.44-0.65 | Cu 0.20 |
| JIS G 3458:2013 | Symbol STPA12 | --- | --- | 0.10-0.20 | 0.30-0.80 | 0.10-0.50 | 0.035 | 0.035 | --- | --- | 0.45-0.65 | --- |
| JIS G 3462:2014 | Symbol STBA12 | --- | --- | 0.10-0.20 | 0.30-0.80 | 0.10-0.50 | 0.035 | 0.035 | --- | --- | 0.45-0.65 | --- |
| JIS G 3467:2013 | Symbol STFA12 | --- | --- | 0.10-0.20 | 0.30-0.80 | 0.10-0.50 | 0.035 | 0.035 | --- | --- | 0.45-0.65 | --- |
| JIS G 3462:2014 | Symbol STBA13 | --- | --- | 0.15-0.25 | 0.30-0.80 | 0.10-0.50 | 0.035 | 0.035 | --- | --- | 0.45-0.65 | --- |

**5.8 Alloy Steel Tubes and Pipes for Pressure Purposes at High Temperatures**

**5.8.2B Mechanical Properties of ½Mo Alloy Steel Tubes and Pipes for Pressure Purposes at High Temperatures**

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter | | Yield Strength | | Tensile Strength | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | %, min. | | |
| ASME SA-209/SA-209M | Grade T1 | K11522 | --- | 0.9 ≤ t < 5.1 | 0.035 ≤ t < 0.200 | 205 | 30 | 380 | 55 | 30 | HF or CF+IA, FA or N+T | 80 max HRB |
| | | | | 5.1 < t ≤ 12.7 | 0.200 < t ≤ 0.500 | 205 | 30 | 380 | 55 | 30 | HF or CF+IA, FA or N+T | 146 max HBW |
| | Grade T1a | K12023 | --- | 0.9 ≤ t < 5.1 | 0.035 ≤ t < 0.200 | 220 | 32 | 415 | 60 | 30 | HF or CF+IA, FA or N+T | 81 max HRB |
| | | | | 5.1 < t ≤ 12.7 | 0.200 < t ≤ 0.500 | 220 | 32 | 415 | 60 | 30 | HF or CF+IA, FA or N+T | 153 max HBW |
| | Grade T1b | K11422 | --- | 0.9 ≤ t < 5.1 | 0.035 ≤ t < 0.200 | 195 | 28 | 365 | 53 | 30 | HF or CF+IA, FA or N+T | 77 max HRB |
| | | | | 5.1 < t ≤ 12.7 | 0.200 < t ≤ 0.500 | 195 | 28 | 365 | 53 | 30 | HF or CF+IA, FA or N+T | 137 max HBW |
| ASME SA-250/SA-250M | Grade T1 | K11522 | --- | 0.4 ≤ t < 5.1 | 0.015 ≤ t < 0.200 | 205 | 30 | 380 | 55 | 30 | FA, IA, N or N+T | 80 max HRB |
| | | | | t ≥ 5.1 | t ≥ 0.200 | 205 | 30 | 380 | 55 | 30 | FA, IA, N or N+T | 146 max HBW |
| | Grade T1a | K12023 | --- | 0.4 ≤ t < 5.1 | 0.015 ≤ t < 0.200 | 220 | 32 | 415 | 60 | 30 | FA, IA, N or N+T | 81 max HRB |
| | | | | t ≥ 5.1 | t ≥ 0.200 | 220 | 32 | 415 | 60 | 30 | FA, IA, N or N+T | 153 max HBW |
| | Grade T1b | K11422 | --- | 0.4 ≤ t < 5.1 | 0.015 ≤ t < 0.200 | 195 | 28 | 365 | 53 | 30 | FA, IA, N or N+T | 77 max HRB |
| | | | | t ≥ 5.1 | t ≥ 0.200 | 195 | 28 | 365 | 53 | 30 | FA, IA, N or N+T | 137 max HBW |
| ASME SA-335/SA-335M | Grade P1 | K11522 | --- | --- | --- | 205 | 30 | 380 | 55 | 30 L, 20 T | A, N+T or SA | --- |
| ASTM A209/A209M-03 (2012) | Grade T1 | K11522 | --- | 0.9 ≤ t < 5.1 | 0.035 ≤ t < 0.200 | 205 | 30 | 380 | 55 | 30 | see standard | 80 max HRB |
| | | | | 5.1 < t ≤ 12.7 | 0.200 < t ≤ 0.500 | 205 | 30 | 380 | 55 | 30 | see standard | 146 max HBW |
| | Grade T1a | K12023 | --- | 0.9 ≤ t < 5.1 | 0.035 ≤ t < 0.200 | 220 | 32 | 415 | 60 | 30 | see standard | 81 max HRB |
| | | | | 5.1 < t ≤ 12.7 | 0.200 < t ≤ 0.500 | 220 | 32 | 415 | 60 | 30 | see standard | 153 max HBW |
| | Grade T1b | K11422 | --- | 0.9 ≤ t < 5.1 | 0.035 ≤ t < 0.200 | 195 | 28 | 365 | 53 | 30 | see standard | 77 max HRB |
| | | | | 5.1 < t ≤ 12.7 | 0.200 < t ≤ 0.500 | 195 | 28 | 365 | 53 | 30 | see standard | 137 max HBW |
| ASTM A250/A250M-05 (2014) | Grade T1 | K11522 | --- | 0.4 ≤ t < 5.1 | 0.015 ≤ t < 0.200 | 205 | 30 | 380 | 55 | 30 | A, IA, N or NT | 80 max HRB |
| | | | | t ≥ 5.1 | t ≥ 0.200 | 205 | 30 | 380 | 55 | 30 | A, IA, N or NT | 146 max HBW |
| | Grade T1a | K12023 | --- | 0.4 ≤ t < 5.1 | 0.015 ≤ t < 0.200 | 220 | 32 | 415 | 60 | 30 | A, IA, N or NT | 81 max HRB |
| | | | | t ≥ 5.1 | t ≥ 0.200 | 220 | 32 | 415 | 60 | 30 | A, IA, N or NT | 153 max HBW |
| | Grade T1b | K11422 | --- | 0.4 ≤ t < 5.1 | 0.015 ≤ t < 0.200 | 195 | 28 | 365 | 53 | 30 | A, IA, N or NT | 77 max HRB |
| | | | | t ≥ 5.1 | t ≥ 0.200 | 195 | 28 | 365 | 53 | 30 | A, IA, N or NT | 137 max HBW |
| ASTM A335/A335M-15 | Grade P1 | K11522 | --- | --- | --- | 205 | 30 | 380 | 55 | t ≥ 8mm (5/16 in.) 30 L; 20 T | FA, IA, NT or SA | --- |

Note: This section continued on next page.

**5.8 Alloy Steel Tubes and Pipes for Pressure Purposes at High Temperatures**

**5.8.2B Mechanical Properties of ½Mo Alloy Steel Tubes and Pipes for Pressure Purposes at High Temperatures (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter | | Yield Strength | | Tensile Strength | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | %, min. | | |
| EN 10216-2:2013 | 8MoB5-4 | --- | 1.5450 | t ≤ 16 | --- | 400 | --- | 540-690 | --- | 19 L; 17 T | N, NF | L: 40 J at 20°C<br>T: 27 J at 20°C |
| | | | | 16 < t ≤ 100 | --- | --- | --- | 540-690 | --- | 19 L; 17 T | N, NF | L: 40 J at 20°C<br>T: 27 J at 20°C |
| GB 5310-1995 | Grade 20MoG | --- | --- | --- | --- | 220 | --- | 415 L | --- | 22 L | N | see standard |
| JIS G 3458:2013 | Symbol STPA12 | --- | --- | --- | --- | 205 | --- | 380 | --- | 24 L; 19 T | LTA, IA, FA,<br>N, or NT | --- |
| JIS G 3462:2014 | Symbol STBA12 | --- | --- | d < 10 | --- | 205 | --- | 380 | --- | 22 L | LTA, IA, A, N or NT | --- |
| | | | | 10 ≤ d < 20 | --- | 205 | --- | 380 | --- | 25 L | LTA, IA, A, N or NT | --- |
| | | | | d ≥ 20 | --- | 205 | --- | 380 | --- | 30 L | LTA, IA, A, N or NT | --- |
| JIS G 3467:2013 | Symbol STFA12 | --- | --- | --- | --- | 205 | --- | 380 | --- | 30 | LTA, IA, A, N or NT | --- |
| JIS G 3462:2014 | Symbol STBA13 | --- | --- | d < 10 | --- | 205 | --- | 410 | --- | 22 | LTA, IA, A, N or NT | --- |
| | | | | 10 ≤ d < 20 | --- | 205 | --- | 410 | --- | 25 | LTA, IA, A, N or NT | --- |
| | | | | d ≥ 20 | --- | 205 | --- | 410 | --- | 30 | LTA, IA, A, N or NT | --- |

## 5.8 Alloy Steel Tubes and Pipes for Pressure Purposes at High Temperatures

### 5.8.3A Chemical Composition of ½Cr-½Mo Alloy Steel Tubes and Pipes for Pressure Purposes at High Temperatures

| Specification | Designation | UNS No. | Steel No. | Weight, % max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| AFNOR NF A 49-220:1990 | TU 15 CD 2-05 | --- | --- | 0.10-0.18 | 0.50-0.90 | 0.10-0.35 | 0.025 | 0.025 | 0.40-0.65 | --- | 0.45-0.60 | --- |
| ASME SA-213/SA-213M | Grade T2 | K11547 | --- | 0.10-0.20 | 0.30-0.61 | 0.10-0.30 | 0.025 | 0.025 | 0.50-0.81 | --- | 0.44-0.65 | --- |
| ASME SA-250/SA-250M | Grade T2 | K11547 | --- | 0.10-0.20 | 0.30-0.61 | 0.10-0.30 | 0.025 | 0.020 | 0.50-0.81 | --- | 0.44-0.65 | --- |
| ASME SA-335/SA-335M | Grade P2 | K11547 | --- | 0.10-0.20 | 0.30-0.61 | 0.10-0.30 | 0.025 | 0.025 | 0.50-0.81 | --- | 0.44-0.65 | --- |
| ASTM A213/A213M-15a | Grade T2 | K11547 | --- | 0.10-0.20 | 0.30-0.61 | 0.10-0.30 | 0.025 | 0.025 | 0.50-0.81 | --- | 0.44-0.65 | --- |
| ASTM A250/A250M-05 (2014) | Grade T2 | K11547 | --- | 0.10-0.20 | 0.30-0.61 | 0.10-0.30 | 0.025 | 0.020 | 0.50-0.81 | --- | 0.44-0.65 | --- |
| ASTM A335/A335M-15 | Grade P2 | K11547 | --- | 0.10-0.20 | 0.30-0.61 | 0.10-0.30 | 0.025 | 0.025 | 0.50-0.81 | --- | 0.44-0.65 | --- |
| GB 5310-1995 | Grade 12CrMoG | --- | --- | 0.08-0.15 | 0.40-0.70 | 0.17-0.37 | 0.03 | 0.03 | 0.40-0.70 | 0.3 | 0.40-0.55 | Cu 0.20 |
| GB 6479-2000 | Grade 12CrMo | --- | --- | 0.08-0.15 | 0.40-0.70 | 0.17-0.37 | 0.03 | 0.03 | 0.40-0.70 | 0.3 | 0.40-0.55 | Cu 0.20 |
| JIS G 3458:2013 | Symbol STPA20 | --- | --- | 0.10-0.20 | 0.30-0.60 | 0.10-0.50 | 0.035 | 0.035 | 0.50-0.80 | --- | 0.40-0.65 | --- |
| JIS G 3462:2014 | Symbol STBA20 | --- | --- | 0.10-0.20 | 0.30-0.60 | 0.10-0.50 | 0.035 | 0.035 | 0.50-0.80 | --- | 0.40-0.65 | --- |
| EN 10216-2:2013 | 14MoV6-3 | --- | 1.7715 | 0.10-0.15 | 0.40-0.70 | 0.15-0.35 | 0.025 | 0.010 | 0.30-0.60 | 0.30 | 0.50-0.70 | Al 0.040; Cu 0.30; V 0.22-0.28 |
| ISO 9329-2:1997 | Grade 12 MoCrV 6-2 | --- | --- | 0.10-0.15 | 0.40-0.70 | 0.15-0.35 | 0.035 | 0.035 | 0.30-0.60 | --- | 0.50-0.70 | V 0.22-0.28; Al 0.020 |

**5.8 Alloy Steel Tubes and Pipes for Pressure Purposes at High Temperatures**

**5.8.3B Mechanical Properties of ½Cr–½Mo Alloy Steel Tubes and Pipes for Pressure Purposes at High Temperatures**

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter | | Yield Strength | | Tensile Strength | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | %, min. | | |
| AFNOR NF A 49-220:1990 | TU 15 CD 2-05 | --- | --- | --- | --- | 275 | --- | 440-570 | --- | 22 | heat + air cool + T | 32 J at 0°C |
| ASME SA-213/SA-213M | Grade T2 | K11547 | --- | 0.4 ≤ t ≤ 12.7 | 0.015 ≤ t ≤ 0.500 | 205 | 30 | 415 | 60 | 30 | A+N+T+SCA | 163 max HB/ 170 max HV; 85 max HRB |
| ASME SA-250/SA-250M | Grade T2 | K11547 | --- | 0.4 ≤ t < 5.1 | 0.015 ≤ t < 0.200 | 205 | 30 | 415 | 60 | 30 | FA, IA, N or N+T | 85 max HRB |
| | | | | t ≥ 5.1 | t ≥ 0.200 | 205 | 30 | 415 | 60 | 30 | FA, IA, N or N+T | 163 max HBW |
| ASME SA-335/SA-335M | Grade P2 | K11547 | --- | --- | --- | 205 | 30 | 380 | 55 | 30 L, 20 T | A, N+T or SA | --- |
| ASTM A213/A213M-15a | Grade T2 | K11547 | --- | 0.4 < t ≤ 12.7 | 0.015 ≤ t ≤ 0.500 | 205 | 30 | 415 | 60 | 30 | A, IA, NT, SA | 163 max HB/ 170 max HV; 85 max HRB |
| ASTM A250/A250M-05 (2014) | Grade T2 | K11547 | --- | 0.4 ≤ t < 5.1 | 0.015 ≤ t < 0.200 | 205 | 30 | 415 | 60 | 30 | A, IA, N or NT | 85 max HRB |
| | | | | t ≥ 5.1 | t ≥ 0.200 | 205 | 30 | 415 | 60 | 30 | A, IA, N or NT | 163 max HBW |
| ASTM A335/A335M-15 | Grade P2 | K11547 | --- | --- | --- | 205 | 30 | 380 | 55 | t ≥ 8mm (5/16 in.) 30 L; 20 T | FA, IA, NT or SA | --- |
| GB 5310-1995 | Grade 12CrMoG | --- | --- | --- | --- | 205 | --- | 410-560 L | --- | 21 L | N+T | see standard |
| GB 6479-2000 | Grade 12CrMo | --- | --- | --- | --- | 205 | --- | 410-560 L | --- | 21 L | N+T | L: 55 J @ RT |
| JIS G 3458:2013 | Symbol STPA20 | --- | | --- | --- | 205 | --- | 410 | --- | 24 L; 19 T | LTA, IA, FA, or NT | --- |
| JIS G 3462:2014 | Symbol STBA20 | --- | --- | d < 10 | --- | 205 | --- | 410 | --- | 22 L | LTA, IA, A, or NT | --- |
| | | | | 10 ≤ d < 20 | --- | 205 | --- | 410 | --- | 25 L | LTA, IA, A, or NT | --- |
| | | | | d ≥ 20 | --- | 205 | --- | 410 | --- | 30 L | LTA, IA, A, or NT | --- |
| EN 10216-2:2013 | 14MoV6-3 | --- | 1.7715 | t ≤ 16 | --- | 320 | --- | 460-610 | --- | 20 L; 18 T | NT, NF, QT | L: 40 J at 20°C T: 27 J at 20°C |
| | | | | 16 < t ≤ 40 | --- | 320 | --- | 460-610 | --- | 20 L; 18 T | NT, NF, QT | L: 40 J at 20°C T: 27 J at 20°C |
| | | | | 40 < t ≤ 60 | --- | 310 | --- | 460-610 | --- | 20 L; 18 T | NT, NF, QT | L: 40 J at 20°C T: 27 J at 20°C |
| | | | | 60 < t ≤ 100 | --- | --- | --- | 460-610 | --- | 20 L; 18 T | NT, NF, QT | L: 40 J at 20°C T: 27 J at 20°C |
| ISO 9329-2:1997 | Grade 12 MoCrV 6-2 | --- | --- | t ≤ 40 | --- | 320 | --- | 460-610 | --- | 20 L, 18 T | N+T | see standard |
| | | | | 40 < t ≤ 60 | --- | 310 | --- | 460-610 | --- | 20 L, 18 T | N+T | see standard |

### 5.8 Alloy Steel Tubes and Pipes for Pressure Purposes at High Temperatures

#### 5.8.4A Chemical Composition of 1/2 Cr – 1 Mo Alloy Steel Tubes and Pipes for Pressure Purposes at High Temperatures

| Specification | Designation | UNS No. | Steel No. | Weight, % max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASME SA-335/SA-335M | Grade P911 | K91061 | --- | 0.09-0.13 | 0.30-0.60 | 0.10-0.50 | 0.020 | 0.010 | 8.50-9.50 | 0.40 | 0.90-1.10 | V 0.18-0.25; Al 0.02; Ti 0.01; Cb 0.060-0.10; W 0.90-1.10; N 0.04-0.09; B 0.0003-0.006; Zr 0.01 |
| ASTM A213/A213M-15a | Grade T36 Class 1 | K21001 | --- | 0.10-0.17 | 0.80-1.20 | 0.25-0.50 | 0.030 | 0.025 | 0.30 | 1.00-1.30 | 0.25-0.50 | V 0.02; Al 0.050; Cu 0.50-0.80; Nb 0.015-0.045; N 0.02 |
| | Grade T36 Class 2 | K21001 | --- | 0.10-0.17 | 0.80-1.20 | 0.25-0.50 | 0.030 | 0.025 | 0.30 | 1.00-1.30 | 0.25-0.50 | V 0.02; Al 0.050; Cu 0.50-0.80; Nb 0.015-0.045; N 0.02 |
| ASTM A335/A335M-15 | Grade P911 | K91061 | --- | 0.09-0.13 | 0.30-0.60 | 0.10-0.50 | 0.020 | 0.010 | 8.5-9.5 | 0.40 | 0.90-1.10 | V 0.18-0.25; Al 0.02; Ti 0.01; W 0.90-1.10; Cb 0.060-0.10; N 0.04-0.09; B 0.0003-0.006; Zr 0.01 |
| EN 10216-2:2013 | 15NiCuMoNb5-6-4 | --- | 1.6368 | 0.17 | 0.80-1.20 | 0.25-0.50 | 0.025 | 0.010 | 0.30 | 1.00-1.30 | 0.25-0.50 | Al 0.050; Cu 0.50-0.80; Nb 0.015-0.045 |
| ISO 9329-2:1997 | Grade 9 NiMnMoNb 5-4-4 | --- | --- | 0.17 | 0.80-1.20 | 0.25-0.50 | 0.03 | 0.03 | 0.3 | 1.00-1.30 | 0.25-0.40 | Al 0.020; Cu 0.05-0.80; Nb 0.015-0.045 |

#### 5.8.4B Mechanical Properties of 1/2 Cr – 1 Mo Alloy Steel Tubes and Pipes for Pressure Purposes at High Temperatures

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter | | Yield Strength | | Tensile Strength | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | %, min. | | |
| ASME SA-335/SA-335M | Grade P911 | K91061 | --- | --- | --- | 440 | 64 | 620 | 90 | 20 L | N+T | --- |
| ASTM A213/A213M-15a | Grade T36 Class 1 | K21001 | --- | 0.4 ≤ t ≤ 12.7 | 0.015 ≤ t ≤ 0.500 | 440 | 64 | 620 | 90 | 15 | NT | 250 max HBW/ 265 max HV; 25 max HRC |
| | Grade T36 Class 2 | K21001 | --- | 0.4 ≤ t ≤ 12.7 | 0.015 ≤ t ≤ 0.500 | 460 | 66.5 | 660 | 95.5 | 15 | NT | 250 max HBW/ 265 max HV; 25 max HRC |
| ASTM A335/A335M-15 | Grade P911 | K91061 | --- | --- | --- | 440 | 64 | 620 | 90 | 20 L | NT | --- |
| EN 10216-2:2013 | 15NiCuMoNb5-6-4 | --- | 1.6368 | t ≤ 16 | --- | 440 | --- | 610-780 | --- | 19 L, 17 T | NT | L: 40 J at 20°C T: 27 J at 20°C |
| | | | | 16 < t ≤ 40 | --- | 440 | --- | 610-780 | --- | 19 L, 17 T | NT | L: 40 J at 20°C T: 27 J at 20°C |
| | | | | 40 < t ≤ 60 | --- | 440 | --- | 610-780 | --- | 19 L, 17 T | NT | L: 40 J at 20°C T: 27 J at 20°C |
| | | | | 60 < t ≤ 80 | --- | 440 | --- | 610-780 | --- | 19 L, 17 T | NT | L: 40 J at 20°C T: 27 J at 20°C |
| ISO 9329-2:1997 | Grade 9 NiMnMoNb 5-4-4 | --- | --- | t ≤ 60 | --- | 440 | --- | 610-780 | --- | 19 L, 17 T | N+T | see standard |

**5.8 Alloy Steel Tubes and Pipes for Pressure Purposes at High Temperatures**

**5.8.5A Chemical Composition of 1Cr-½Mo Alloy Steel Tubes and Pipes for Pressure Purposes at High Temperatures**

| Specification | Designation | UNS No. | Steel No. | Weight, % max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| AFNOR NF A 49-220:1990 | TU 13 CD 4-04 | --- | --- | 0.10-0.18 | 0.40-0.70 | 0.10-0.35 | 0.025 | 0.025 | 0.70-1.10 | --- | 0.45-0.65 | --- |
| ASME SA-213/SA-213M | Grade T12 | K11562 | --- | 0.05-0.15 | 0.30-0.61 | 0.50 | 0.025 | 0.025 | 0.80-1.25 | --- | 0.44-0.65 | --- |
| ASME SA-250/SA-250M | Grade T12 | K11562 | --- | 0.05-0.15 | 0.30-0.61 | 0.50 | 0.030 | 0.020 | 0.80-1.25 | --- | 0.44-0.65 | --- |
| ASME SA-335/SA-335M | Grade P12 | K11562 | --- | 0.05-0.15 | 0.30-0.61 | 0.50 | 0.025 | 0.025 | 0.80-1.25 | --- | 0.44-0.65 | --- |
| ASTM A213/A213M-15a | Grade T12 | K11562 | --- | 0.05-0.15 | 0.30-0.61 | 0.50 | 0.025 | 0.025 | 0.80-1.25 | --- | 0.44-0.65 | --- |
| ASTM A250/A250M-05 (2014) | Grade T12 | K11562 | --- | 0.05-0.15 | 0.30-0.61 | 0.50 | 0.030 | 0.020 | 0.80-1.25 | --- | 0.44-0.65 | --- |
| ASTM A335/A335M-15 | Grade P12 | K11562 | --- | 0.05-0.15 | 0.30-0.61 | 0.50 | 0.025 | 0.025 | 0.80-1.25 | --- | 0.44-0.65 | --- |
| BS 3604-2:1991 | 620 | --- | --- | 0.09-0.18 | 0.40-0.65 | 0.15-0.40 | 0.025 | 0.015 | 0.80-1.15 | 0.30 | 0.45-0.60 | Cu 0.30; Al 0.02 |
| EN 10216-2:2013 | 13CrMo4-5 | --- | 1.7335 | 0.10-0.17 | 0.40-0.70 | 0.35 | 0.025 | 0.010 | 0.70-1.15 | 0.30 | 0.40-0.60 | Al 0.040; Cu 0.30 |
| GB 5310-1995 | Grade 15CrMoG | --- | --- | 0.12-0.18 | 0.40-0.70 | 0.17-0.37 | 0.03 | 0.03 | 0.80-1.10 | 0.3 | 0.40-0.55 | Cu 0.20 |
| GB 6479-2000 | Grade 15CrMo | --- | --- | 0.12-0.18 | 0.40-0.70 | 0.17-0.37 | 0.03 | 0.03 | 0.80-1.10 | 0.3 | 0.40-0.55 | Cu 0.20 |
| ISO 9329-2:1997 | Grade 13 CrMo 4-5 | --- | --- | 0.10-0.17 | 0.40-0.70 | 0.15-0.35 | 0.035 | 0.035 | 0.70-1.10 | --- | 0.45-0.65 | Al 0.020 |
| | Grade 8 CrMo 4-5 | --- | --- | 0.15 | 0.30-0.60 | 0.50 | 0.035 | 0.035 | 0.80-1.25 | --- | 0.45-0.65 | Al 0.020 |
| JIS G 3458:2013 | Symbol STPA22 | --- | --- | 0.15 | 0.30-0.60 | 0.50 | 0.035 | 0.035 | 0.80-1.25 | --- | 0.45-0.65 | --- |
| JIS G 3462:2014 | Symbol STBA22 | --- | --- | 0.15 | 0.30-0.60 | 0.50 | 0.035 | 0.035 | 0.80-1.25 | --- | 0.45-0.65 | --- |
| JIS G 3467:2013 | Symbol STFA22 | --- | --- | 0.15 | 0.30-0.60 | 0.50 | 0.035 | 0.035 | 0.80-1.25 | --- | 0.45-0.65 | --- |

**5.8 Alloy Steel Tubes and Pipes for Pressure Purposes at High Temperatures**

**5.8.5B Mechanical Properties of 1Cr–½Mo Alloy Steel Tubes and Pipes for Pressure Purposes at High Temperatures**

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter | | Yield Strength | | Tensile Strength | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | %, min. | | |
| AFNOR NF A 49-220:1990 | TU 13 CD 4-04 | --- | --- | --- | --- | 290 | --- | 440-590 | --- | 22 | heat + air cool + T | 32 J at 0°C |
| ASME SA-213/SA-213M | Grade T12 | K11562 | --- | 0.4 ≤ t ≤ 12.7 | 0.015 ≤ t ≤ 0.500 | 220 | 32 | 415 | 60 | 30 | A+N+T+SCA | 163 max HBW/ 170 max HV; 85 max HRB |
| ASME SA-250/SA-250M | Grade T12 | K11562 | --- | 0.4 ≤ t < 5.1 | 0.015 ≤ t < 0.200 | 220 | 32 | 415 | 60 | 30 | FA, IA, N or N+T | 85 max HRB |
| | | | | t ≥ 5.1 | t ≥ 0.200 | 220 | 32 | 415 | 60 | 30 | FA, IA, N or N+T | 163 max HBW |
| ASME SA-335/SA-335M | Grade P12 | K11562 | --- | --- | --- | 220 | 32 | 415 | 60 | 30 L, 20 T | A, N+T or SA | --- |
| ASTM A213/A213M-15a | Grade T12 | K11562 | --- | 0.4 ≤ t ≤ 12.7 | 0.015 ≤ t ≤ 0.500 | 220 | 32 | 415 | 60 | 30 | A, IA, NT, SA | 163 max HBW/ 170 max HV; 85 max HRB |
| ASTM A250/A250M-05 (2014) | Grade T12 | K11562 | --- | 0.4 ≤ t < 5.1 | 0.015 ≤ t < 0.200 | 220 | 32 | 415 | 60 | 30 | A, IA, N or NT | 85 max HRB |
| | | | | t ≥ 5.1 | t ≥ 0.200 | 220 | 32 | 415 | 60 | 30 | A, IA, N or NT | 163 max HBW |
| ASTM A335/A335M-15 | Grade P12 | K11562 | --- | --- | --- | 220 | 32 | 415 | 60 | t ≥ 8mm (5/16 in.) 30 L; 20 T | FA, IA, NT or SA | --- |
| BS 3604-2:1991 | 620 | --- | --- | --- | --- | 340 | --- | 480-600 | --- | 18 | see standard | --- |
| EN 10216-2:2013 | 13CrMo4-5 | --- | 1.7335 | t ≤ 16 | --- | 290 | --- | 440-590 | --- | 22 L; 20 T | NT, NF, QT | L: 40 J at 20°C T: 27 J at 20°C |
| | | | | 16 < t ≤ 40 | --- | 290 | --- | 440-590 | --- | 22 L; 20 T | NT, NF, QT | L: 40 J at 20°C T: 27 J at 20°C |
| | | | | 40 < t ≤ 60 | --- | 280 | --- | 440-590 | --- | 22 L; 20 T | NT, NF, QT | L: 40 J at 20°C T: 27 J at 20°C |
| | | | | 60 < t ≤ 100 | --- | --- | --- | 440-590 | --- | 22 L; 20 T | NT, NF, QT | L: 40 J at 20°C T: 27 J at 20°C |
| GB 5310-1995 | Grade 15CrMoG | --- | --- | --- | --- | 235 | --- | 440-640 L, 440 T | --- | 21 L, 20 T | N+T | see standard |
| GB 6479-2000 | Grade 15CrMo | --- | --- | --- | --- | 235 | --- | 440-640 L | --- | 21 L | N+T | L: 47 J @ RT |
| ISO 9329-2:1997 | Grade 13 CrMo 4-5 | --- | --- | t ≤ 10 | --- | 300 | --- | 440-590 | --- | 22 L, 20 T | N+T | L: 35 J @ RT |
| | | | | 10 < t ≤ 40 | --- | 290 | --- | 440-590 | --- | 22 L, 20 T | N+T | see standard |
| | | | | 40 < t ≤ 60 | --- | 280 | --- | 440-590 | --- | 22 L, 20 T | N+T | see standard |
| | Grade 8 CrMo 4-5 | --- | --- | t ≤ 60 | --- | 205 | --- | 410-560 | --- | 22 L, 20 T | N+T | see standard |
| JIS G 3458:2013 | Symbol STPA22 | --- | --- | --- | --- | 205 | --- | 410 | --- | 24 L; 19 T | LTA, IA, FA, or NT | --- |
| JIS G 3462:2014 | Symbol STBA22 | --- | --- | d < 10 | --- | 205 | --- | 410 | --- | 22 L | LTA, IA, A, or NT | --- |
| | | | | 10 ≤ d < 20 | --- | 205 | --- | 410 | --- | 25 L | LTA, IA, A, or NT | --- |
| | | | | d ≥ 20 | --- | 205 | --- | 410 | --- | 30 L | LTA, IA, A, or NT | --- |
| JIS G 3467:2013 | Symbol STFA22 | --- | --- | --- | --- | 205 | --- | 410 | --- | 30 | LTA, IA, A or NT | --- |

**5.8 Alloy Steel Tubes and Pipes for Pressure Purposes at High Temperatures**

**5.8.6A Chemical Composition of 1¼ Cr–½Mo Alloy Steel Tubes and Pipes for Pressure Purposes at High Temperatures**

| Specification | Designation | UNS No. | Steel No. | Weight, % max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| AFNOR NF A 49-220:1990 | TU 10 CD 5-05 | --- | --- | 0.15 | 0.30-0.60 | 0.50-1.00 | 0.025 | 0.025 | 1.00-1.50 | --- | 0.45-0.65 | --- |
| ASME SA-213/SA-213M | Grade T11 | K11597 | --- | 0.05-0.15 | 0.30-0.60 | 0.50-1.00 | 0.025 | 0.025 | 1.00-1.50 | --- | 0.44-0.65 | --- |
| ASME SA-250/SA-250M | Grade T11 | K11597 | --- | 0.05-0.15 | 0.30-0.60 | 0.50-1.00 | 0.025 | 0.020 | 1.00-1.50 | --- | 0.44-0.65 | --- |
| ASME SA-335/SA-335M | Grade P11 | K11597 | --- | 0.05-0.15 | 0.30-0.60 | 0.50-1.00 | 0.025 | 0.025 | 1.00-1.50 | --- | 0.44-0.65 | --- |
| ASTM A213/A213M-15a | Grade T11 | K11597 | --- | 0.05-0.15 | 0.30-0.60 | 0.50-1.00 | 0.025 | 0.025 | 1.00-1.50 | --- | 0.44-0.65 | --- |
| ASTM A250/A250M-05 (2014) | Grade T11 | K11597 | --- | 0.05-0.15 | 0.30-0.60 | 0.50-1.00 | 0.025 | 0.020 | 1.00-1.50 | --- | 0.44-0.65 | --- |
| ASTM A335/A335M-15 | Grade P11 | K11597 | --- | 0.05-0.15 | 0.30-0.60 | 0.50-1.00 | 0.025 | 0.025 | 1.00-1.50 | --- | 0.45-0.65 | --- |
| BS 3604-2:1991 | 621 | --- | --- | 0.09-0.17 | 0.40-0.65 | 0.50-0.80 | 0.025 | 0.015 | 1.00-1.50 | 0.30 | 0.45-0.60 | Cu 0.30; Al 0.02 |
| EN 10216-2:2013 | 10CrMo5-5 | --- | 1.7338 | 0.15 | 0.30-0.60 | 0.50-1.00 | 0.025 | 0.010 | 1.00-1.50 | 0.30 | 0.45-0.65 | Al 0.040; Cu 0.30 |
| ISO 9329-2:1997 | Grade 8 CrMo 5-5 | --- | --- | 0.15 | 0.30-0.60 | 0.50-1.00 | 0.03 | 0.03 | 1.00-1.50 | --- | 0.45-0.65 | Al 0.020 |
| JIS G 3462:2014 | Symbol STBA23 | --- | --- | 0.15 | 0.30-0.60 | 0.50-1.00 | 0.030 | 0.030 | 1.00-1.50 | --- | 0.45-0.65 | --- |
| JIS G 3467:2013 | Symbol STFA23 | --- | --- | 0.15 | 0.30-0.60 | 0.50-1.00 | 0.030 | 0.030 | 1.00-1.50 | --- | 0.45-0.65 | --- |
| JIS G 3458:2013 | Symbol STPA23 | --- | --- | 0.15 | 0.30-0.60 | 0.50-1.00 | 0.030 | 0.030 | 1.00-1.50 | --- | 0.45-0.65 | --- |

**5.8 Alloy Steel Tubes and Pipes for Pressure Purposes at High Temperatures**

**5.8.6B Mechanical Properties of 1¼Cr–½Mo Alloy Steel Tubes and Pipes for Pressure Purposes at High Temperatures**

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter | | Yield Strength | | Tensile Strength | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | %, min. | | |
| AFNOR NF A 49-220:1990 | TU 10 CD 5-05 | --- | --- | --- | --- | 225 | --- | 440-590 | --- | 22 | see standard | --- |
| | | | | --- | --- | 325 | --- | 440-640 | --- | 20 | heat + air cool + T | 32 J at 0°C |
| ASME SA-213/SA-213M | Grade T11 | K11597 | --- | 0.4 ≤ t ≤ 12.7 | 0.015 ≤ t ≤ 0.500 | 205 | 30 | 415 | 60 | 30 | A+N+T | 163 max HB/ 170 max HV; 85 max HRB |
| ASME SA-250/SA-250M | Grade T11 | K11597 | --- | 0.4 ≤ t < 5.1 | 0.015 ≤ t < 0.200 | 205 | 30 | 415 | 60 | 30 | FA, IA, N or N+T | 85 max HRB |
| | | | | t ≥ 5.1 | t ≥ 0.200 | 205 | 30 | 415 | 60 | 30 | FA, IA, N or N+T | 163 max HBW |
| ASME SA-335/SA-335M | Grade P11 | K11597 | --- | --- | --- | 205 | 30 | 415 | 60 | 30 L, 20 T | A or N+T | --- |
| ASTM A213/A213M-15a | Grade T11 | K11597 | --- | 0.4 ≤ t ≤ 12.7 | 0.015 ≤ t ≤ 0.500 | 205 | 30 | 415 | 60 | 30 | A, IA, NT | 163 max HB/ 170 max HV; 85 max HRB |
| ASTM A250/A250M-05 (2014) | Grade T11 | K11597 | --- | 0.4 ≤ t < 5.1 | 0.015 ≤ t < 0.200 | 205 | 30 | 415 | 60 | 30 | A, IA, N or NT | 85 max HRB |
| | | | | t ≥ 5.1 | t ≥ 0.200 | 205 | 30 | 415 | 60 | 30 | A, IA, N or NT | 163 max HBW |
| ASTM A335/A335M-15 | Grade P11 | K11597 | --- | --- | --- | 205 | 30 | 415 | 60 | t ≥ 8mm (5/16 in.) 30 L; 20 T | FA, IA or NT | --- |
| BS 3604-2:1991 | 621 | --- | --- | --- | --- | 340 | --- | 515-690 | --- | 18 | see standard | --- |
| EN 10216-2:2013 | 10CrMo5-5 | --- | 1.7338 | t ≤ 16 | --- | 275 | --- | 410-560 | --- | 22 L; 20 T | NT, NF, QT | L: 40 J at 20°C T: 27 J at 20°C |
| | | | | 16 < t ≤ 40 | --- | 275 | --- | 410-560 | --- | 22 L; 20 T | NT, NF, QT | L: 40 J at 20°C T: 27 J at 20°C |
| | | | | 40 < t ≤ 60 | --- | 265 | --- | 410-560 | --- | 22 L; 20 T | NT, NF, QT | L: 40 J at 20°C T: 27 J at 20°C |
| | | | | 60 < t ≤ 100 | --- | --- | --- | 410-560 | --- | 22 L; 20 T | NT, NF, QT | L: 40 J at 20°C T: 27 J at 20°C |
| ISO 9329-2:1997 | Grade 8 CrMo 5-5 | --- | --- | t ≤ 60 | --- | 205 | --- | 410-560 | --- | 22 L, 20 T | N+T | see standard |
| JIS G 3462:2014 | Symbol STBA23 | --- | --- | d < 10 | --- | 205 | --- | 410 | --- | 22 L | IA, A or NT | --- |
| | | | | 10 ≤ d < 20 | --- | 205 | --- | 410 | --- | 25 L | IA, A or NT | --- |
| | | | | d ≥ 20 | --- | 205 | --- | 410 | --- | 30 L | IA, A or NT | --- |
| JIS G 3467:2013 | Symbol STFA23 | --- | --- | --- | --- | 205 | --- | 410 | --- | 30 | IA, A or NT | --- |
| JIS G 3458:2013 | Symbol STPA23 | --- | --- | --- | --- | 205 | --- | 410 | --- | 24 L; 19 T | IA, FA or NT | --- |

**5.8 Alloy Steel Tubes and Pipes for Pressure Purposes at High Temperatures**

**5.8.7A Chemical Composition of 2¼Cr-1Mo Alloy Steel Tubes and Pipes for Pressure Purposes at High Temperatures**

| Specification | Designation | UNS No. | Steel No. | Weight, % max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| AFNOR NF A 49-220:1990 | TU 10 CD 9-10 | --- | --- | 0.15 | 0.30-0.60 | 0.10-0.50 | 0.025 | 0.025 | 2.00-2.50 | --- | 0.90-1.10 | --- |
| ASME SA-213/SA-213M | Grade T22 | K21590 | --- | 0.05-0.15 | 0.30-0.60 | 0.50 | 0.025 | 0.025 | 1.90-2.60 | --- | 0.87-1.13 | --- |
| ASME SA-250/SA-250M | Grade T22 | K21590 | --- | 0.15 | 0.30-0.60 | 0.50 | 0.025 | 0.020 | 1.90-2.60 | --- | 0.87-1.13 | --- |
| ASME SA-335/SA-335M | Grade P22 | K21590 | --- | 0.05-0.15 | 0.30-0.60 | 0.50 | 0.025 | 0.025 | 1.90-2.60 | --- | 0.87-1.13 | --- |
| ASTM A213/A213M-15a | Grade T22 | K21590 | --- | 0.05-0.15 | 0.30-0.60 | 0.50 | 0.025 | 0.025 | 1.90-2.60 | --- | 0.87-1.13 | --- |
| ASTM A250/A250M-05 (2014) | Grade T22 | K21590 | --- | 0.15 | 0.30-0.60 | 0.50 | 0.025 | 0.020 | 1.90-2.60 | --- | 0.87-1.13 | --- |
| ASTM A335/A335M-15 | Grade P22 | K21590 | --- | 0.05-0.15 | 0.30-0.60 | 0.50 | 0.025 | 0.025 | 1.90-2.60 | --- | 0.87-1.13 | --- |
| BS 3604-2:1991 | 622 | --- | --- | 0.09-0.15 | 0.30-0.60 | 0.50 | 0.025 | 0.015 | 2.00-2.50 | 0.30 | 0.90-1.10 | Cu 0.30; Al 0.02 |
| EN 10216-2:2013 | 10CrMo9-10 | --- | 1.7380 | 0.08-0.14 | 0.30-0.70 | 0.50 | 0.020 | 0.010 | 2.00-2.50 | 0.30 | 0.90-1.10 | Al 0.040; Cu 0.30 |
| | 11CrMo9-10 | --- | 1.7383 | 0.08-0.15 | 0.40-0.80 | 0.50 | 0.025 | 0.010 | 2.00-2.50 | 0.30 | 0.90-1.10 | Al 0.040; Cu 0.30 |
| GB 5310-1995 | Grade 12Cr2MoG | --- | --- | 0.08-0.15 | 0.40-0.70 | 0.50 | 0.03 | 0.03 | 2.00-2.50 | 0.3 | 0.90-1.20 | Cu 0.20 |
| GB 6479-2000 | Grade 12Cr2Mo | --- | --- | 0.08-0.15 | 0.40-0.70 | 0.50 | 0.03 | 0.03 | 2.0-2.50 | 0.3 | 0.90-1.20 | Cu 0.20 |
| ISO 9329-2:1997 | Grade 11 CrMo 9-10 TA | --- | --- | 0.08-0.15 | 0.30-0.70 | 0.15-0.40 | 0.035 | 0.035 | 2.00-2.50 | --- | 0.90-1.20 | Al 0.020 |
| | Grade 11 CrMo 9-10 TN+TT | --- | --- | 0.08-0.15 | 0.30-0.70 | 0.15-0.40 | 0.035 | 0.035 | 2.00-2.50 | --- | 0.90-1.20 | Al 0.020 |
| JIS G 3458:2013 | Symbol STPA24 | --- | --- | 0.15 | 0.30-0.60 | 0.50 | 0.030 | 0.030 | 1.90-2.60 | --- | 0.87-1.13 | --- |
| JIS G 3462:2014 | Symbol STBA24 | --- | --- | 0.15 | 0.30-0.60 | 0.50 | 0.030 | 0.030 | 1.90-2.60 | --- | 0.87-1.13 | --- |
| JIS G 3467:2013 | Symbol STFA24 | --- | --- | 0.15 | 0.30-0.60 | 0.50 | 0.030 | 0.030 | 1.90-2.60 | --- | 0.87-1.13 | --- |

**5.8 Alloy Steel Tubes and Pipes for Pressure Purposes at High Temperatures**

**5.8.7B Mechanical Properties of 2¼Cr–1Mo Alloy Steel Tubes and Pipes for Pressure Purposes at High Temperatures**

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter | | Yield Strength | | Tensile Strength | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | %, min. | | |
| AFNOR NF A 49-220:1990 | TU 10 CD 9-10 | --- | --- | --- | --- | 225 | --- | 410-560 | --- | 22 | see standard | --- |
| | | | | --- | --- | 325 | --- | 490-640 | --- | 20 | heat + air cool + T | 32 J at 0°C |
| ASME SA-213/SA-213M | Grade T22 | K21590 | --- | 0.4 ≤ t ≤ 12.7 | 0.015 ≤ t ≤ 0.500 | 205 | 30 | 415 | 60 | 30 | A+N+T | 163 max HB/ 170 max HV; 85 max HRB |
| ASME SA-250/SA-250M | Grade T22 | K21590 | --- | 0.4 ≤ t < 5.1 | 0.015 ≤ t < 0.200 | 205 | 30 | 415 | 60 | 30 | FA, IA, N or N+T | 85 max HRB |
| | | | | t ≥ 5.1 | t ≥ 0.200 | 205 | 30 | 415 | 60 | 30 | FA, IA, N or N+T | 163 max HBW |
| ASME SA-335/SA-335M | Grade P22 | K21590 | --- | --- | --- | 205 | 30 | 415 | 60 | 30 L, 20 T | A or N+T | --- |
| ASTM A213/A213M-15a | Grade T22 | K21590 | --- | 0.4 ≤ t ≤ 12.7 | 0.015 ≤ t ≤ 0.500 | 205 | 30 | 415 | 60 | 30 | A, IA, NT | 163 max HB/ 170 max HV; 85 max HRB |
| ASTM A250/A250M-05 (2014) | Grade T22 | K21590 | --- | 0.4 ≤ t < 5.1 | 0.015 ≤ t < 0.200 | 205 | 30 | 415 | 60 | 30 | A, IA, N or NT | 85 max HRB |
| | | | | t ≥ 5.1 | t ≥ 0.200 | 205 | 30 | 415 | 60 | 30 | A, IA, N or NT | 163 max HBW |
| ASTM A335/A335M-15 | Grade P22 | K21590 | --- | --- | --- | 205 | 30 | 415 | 60 | t ≥ 8mm (5/16 in.) 30 L; 20 T | FA, IA or NT | --- |
| BS 3604-2:1991 | 622 | --- | --- | --- | --- | 310 | --- | 515-690 | --- | 16 | see standard | --- |
| EN 10216-2:2013 | 10CrMo9-10 | --- | 1.7380 | t ≤ 16 | --- | 280 | --- | 480-630 | --- | 22 L; 20 T | NT, NF, QT | L: 40 J at 20°C T: 27 J at 20°C |
| | | | | 16 < t ≤ 40 | --- | 280 | --- | 480-630 | --- | 22 L; 20 T | NT, NF, QT | L: 40 J at 20°C T: 27 J at 20°C |
| | | | | 40 < t ≤ 60 | --- | 270 | --- | 480-630 | --- | 22 L; 20 T | NT, NF, QT | L: 40 J at 20°C T: 27 J at 20°C |
| | 11CrMo9-10 | --- | 1.7383 | t ≤ 16 | --- | 355 | --- | 540-680 | --- | 20 L; 18 T | QT | L: 40 J at 20°C T: 27 J at 20°C |
| | | | | 16 < t ≤ 40 | --- | 355 | --- | 540-680 | --- | 20 L; 18 T | QT | L: 40 J at 20°C T: 27 J at 20°C |
| | | | | 40 < t ≤ 60 | --- | 355 | --- | 540-680 | --- | 20 L; 18 T | QT | L: 40 J at 20°C T: 27 J at 20°C |
| GB 5310-1995 | Grade 12Cr2MoG | --- | --- | --- | --- | 280 | --- | 450-600 L | --- | 20 L, 18 T | N+T | see standard |
| GB 6479-2000 | Grade 12Cr2Mo | --- | --- | --- | --- | 280 | --- | 450-600 L | --- | 20 L | N+T | L: 38 J @ RT |
| ISO 9329-2:1997 | Grade 11 CrMo 9-10 TA | --- | --- | t ≤ 60 | --- | 205 | --- | 410-560 | --- | 22 L, 20 T | A | see standard |
| | Grade 11 CrMo 9-10 TN+TT | --- | --- | t ≤ 60 | --- | 280 | --- | 480-630 | --- | 20 L, 18 T | N+T | see standard |
| JIS G 3458:2013 | Symbol STPA24 | --- | --- | --- | --- | 205 | --- | 410 | --- | 24 L; 19 T | IA, FA or NT | --- |
| JIS G 3462:2014 | Symbol STBA24 | --- | --- | d < 10 | --- | 205 | --- | 410 | --- | 22 L | IA, A or NT | --- |
| | | | | 10 ≤ d < 20 | --- | 205 | --- | 410 | --- | 25 L | IA, A or NT | --- |
| | | | | d ≥ 20 | --- | 205 | --- | 410 | --- | 30 L | IA, A or NT | --- |
| JIS G 3467:2013 | Symbol STFA24 | --- | --- | --- | --- | 205 | --- | 410 | --- | 30 | IA, A or NT | --- |

## 5.8 Alloy Steel Tubes and Pipes for Pressure Purposes at High Temperatures

### 5.8.8A Chemical Composition of 5Cr-½Mo Alloy Steel Tubes and Pipes for Pressure Purposes at High Temperatures

| Specification | Designation | UNS No. | Steel No. | Weight, % max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASME SA-213/SA-213M | Grade T5 | K41545 | --- | 0.15 | 0.30-0.60 | 0.50 | 0.025 | 0.025 | 4.00-6.00 | --- | 0.45-0.65 | --- |
| | Grade T5b | K51545 | --- | 0.15 | 0.30-0.60 | 1.00-2.00 | 0.025 | 0.025 | 4.00-6.00 | --- | 0.45-0.65 | --- |
| ASME SA-335/SA-335M | Grade P5 | K41545 | --- | 0.15 | 0.30-0.60 | 0.50 | 0.025 | 0.025 | 4.00-6.00 | --- | 0.45-0.65 | --- |
| ASTM A213/A213M-15a | Grade T5 | K41545 | --- | 0.15 | 0.30-0.60 | 0.50 | 0.025 | 0.025 | 4.00-6.00 | --- | 0.45-0.65 | --- |
| | Grade T5b | K51545 | --- | 0.15 | 0.30-0.60 | 1.00-2.00 | 0.025 | 0.025 | 4.00-6.00 | --- | 0.45-0.65 | --- |
| ASTM A335/A335M-15 | Grade P5 | K41545 | --- | 0.15 | 0.30-0.60 | 0.50 | 0.025 | 0.025 | 4.00-6.00 | --- | 0.45-0.65 | --- |
| EN 10216-2:2013 | X11CrMo5+I | --- | 1.7362+I | 0.08-0.15 | 0.30-0.60 | 0.15-0.50 | 0.025 | 0.010 | 4.0-6.0 | --- | 0.45-0.65 | Al 0.040; Cu 0.30 |
| | X11CrMo5+NT1 | --- | 1.7362+NT1 | 0.08-0.15 | 0.30-0.60 | 0.15-0.50 | 0.025 | 0.010 | 4.0-6.0 | --- | 0.45-0.65 | Al 0.040; Cu 0.30 |
| | X11CrMo5+NT2 | --- | 1.7362+NT2 | 0.08-0.15 | 0.30-0.60 | 0.15-0.50 | 0.025 | 0.010 | 4.0-6.0 | --- | 0.45-0.65 | Al 0.040; Cu 0.30 |
| GB 6479-2000 | Grade 1Cr5Mo | --- | --- | 0.15 | 0.60 | 0.50 | 0.03 | 0.03 | 4.00-6.00 | 0.6 | 0.45-0.60 | Cu 0.20 |
| ISO 9329-2:1997 | Grade X11 CrMo 5 TA | --- | --- | 0.08-0.15 | 0.30-0.60 | 0.15-0.50 | 0.03 | 0.03 | 4.00-6.00 | --- | 0.45-0.65 | Al 0.020 |
| | Grade X11 CrMo 5 TN+TT | --- | --- | 0.08-0.15 | 0.30-0.60 | 0.15-0.50 | 0.03 | 0.03 | 4.00-6.00 | --- | 0.45-0.65 | Al 0.020 |
| JIS G 3458:2013 | Symbol STPA25 | --- | --- | 0.15 | 0.30-0.60 | 0.50 | 0.030 | 0.030 | 4.00-6.00 | --- | 0.45-0.65 | --- |
| JIS G 3462:2014 | Symbol STBA25 | --- | --- | 0.15 | 0.30-0.60 | 0.50 | 0.030 | 0.030 | 4.00-6.00 | --- | 0.45-0.65 | --- |
| JIS G 3467:2013 | Symbol STFA25 | --- | --- | 0.15 | 0.30-0.60 | 0.50 | 0.030 | 0.030 | 4.00-6.00 | --- | 0.45-0.65 | --- |

**5.8 Alloy Steel Tubes and Pipes for Pressure Purposes at High Temperatures**

**5.8.8B Mechanical Properties of 5Cr–½Mo Alloy Steel Tubes and Pipes for Pressure Purposes at High Temperatures**

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter mm | Section Thickness/Diameter in. | Yield Strength MPa | Yield Strength ksi | Tensile Strength MPa | Tensile Strength ksi | Elongation %, min. | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ASME SA-213/SA-213M | Grade T5 | K41545 | --- | 0.4 ≤ t ≤ 12.7 | 0.015 ≤ t ≤ 0.500 | 205 | 30 | 415 | 60 | 30 | A+N+T | 163 max HB/ 170 max HV; 85 max HRB |
| | Grade T5b | K51545 | --- | 0.4 ≤ t ≤ 12.7 | 0.015 ≤ t ≤ 0.500 | 205 | 30 | 415 | 60 | 30 | A+N+T | 179 max HBW/ 190 max HV; 89 max HRB |
| ASME SA-335/SA-335M | Grade P5 | K41545 | --- | --- | --- | 205 | 30 | 415 | 60 | 30 L, 20 T | A or N+T | --- |
| ASTM A213/A213M-15a | Grade T5 | K41545 | --- | 0.4 ≤ t ≤ 12.7 | 0.015 ≤ t ≤ 0.500 | 205 | 30 | 415 | 60 | 30 | A, IA, NT | 163 max HB/ 170 max HV; 85 max HRB |
| | Grade T5b | K51545 | --- | 0.4 ≤ t ≤ 12.7 | 0.015 ≤ t ≤ 0.500 | 205 | 30 | 415 | 60 | 30 | A, IA, NT | 179 max HBW/ 190 max HV 89 max HRB |
| ASTM A335/A335M-15 | Grade P5 | K41545 | --- | --- | --- | 205 | 30 | 415 | 60 | t ≥ 8mm (5/16 in.) 30 L; 20 T | FA, IA or NT | --- |
| EN 10216-2:2013 | X11CrMo5+I | --- | 1.7362+ I | t ≤ 16 | --- | 175 | --- | 430-580 | --- | 22 L; 20 T | I | L: 40 J at 20°C T: 27 J at 20°C |
| | | | | 16 < t ≤ 40 | --- | 175 | --- | 430-580 | --- | 22 L; 20 T | I | L: 40 J at 20°C T: 27 J at 20°C |
| | | | | 40 < t ≤ 60 | --- | 175 | --- | 430-580 | --- | 22 L; 20 T | I | L: 40 J at 20°C T: 27 J at 20°C |
| | | | | 60 < t ≤ 100 | --- | 175 | --- | 430-580 | --- | 22 L; 20 T | I | L: 40 J at 20°C T: 27 J at 20°C |
| | X11CrMo5+NT1 | --- | 1.7362+ NT1 | t ≤ 16 | --- | 280 | --- | 480-640 | --- | 20 L; 18 T | NT | L: 40 J at 20°C T: 27 J at 20°C |
| | | | | 16 < t ≤ 40 | --- | 280 | --- | 480-640 | --- | 20 L; 18 T | NT | L: 40 J at 20°C T: 27 J at 20°C |
| | | | | 40 < t ≤ 60 | --- | 280 | --- | 480-640 | --- | 20 L; 18 T | NT | L: 40 J at 20°C T: 27 J at 20°C |
| | | | | 60 < t ≤ 100 | --- | 280 | --- | 480-640 | --- | 20 L; 18 T | NT | L: 40 J at 20°C T: 27 J at 20°C |
| | X11CrMo5+NT2 | --- | 1.7362+ NT2 | t ≤ 16 | --- | 390 | --- | 570-740 | --- | 18 L; 16 T | NT, QT | L: 40 J at 20°C T: 27 J at 20°C |
| | | | | 16 < t ≤ 40 | --- | 390 | --- | 570-740 | --- | 18 L; 16 T | NT, QT | L: 40 J at 20°C T: 27 J at 20°C |
| | | | | 40 < t ≤ 60 | --- | 390 | --- | 570-740 | --- | 18 L; 16 T | NT, QT | L: 40 J at 20°C T: 27 J at 20°C |
| | | | | 60 < t ≤ 100 | --- | 390 | --- | 570-740 | --- | 18 L; 16 T | NT, QT | L: 40 J at 20°C T: 27 J at 20°C |

Note: This section continued on next page.

**5.8 Alloy Steel Tubes and Pipes for Pressure Purposes at High Temperatures**

**5.8.8B Mechanical Properties of 5Cr–½Mo Alloy Steel Tubes and Pipes for Pressure Purposes at High Temperatures (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter | | Yield Strength | | Tensile Strength | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | %, min. | | |
| GB 6479-2000 | Grade 1Cr5Mo | --- | --- | --- | --- | 195 | --- | 390-590 L | --- | 22 L | A | L: 94 J @ RT |
| ISO 9329-2:1997 | Grade X11 CrMo 5 TA | --- | --- | t ≤ 60 | --- | 175 | --- | 430-580 | --- | 22 L, 18 T | A | see standard |
| | Grade X11 CrMo 5 TN+TT | --- | --- | t ≤ 60 | --- | 280 | --- | 480-640 | --- | 20 L, 18 T | N+T | see standard |
| JIS G 3458:2013 | Symbol STPA25 | --- | --- | --- | --- | 205 | --- | 410 | --- | 24 L; 19 T | IA, FA or NT | --- |
| JIS G 3462:2014 | Symbol STBA25 | --- | --- | d < 10 | --- | 205 | --- | 410 | --- | 22 L | IA, A or NT | --- |
| | | | | 10 ≤ d < 20 | --- | 205 | --- | 410 | --- | 25 L | IA, A or NT | --- |
| | | | | d ≥ 20 | --- | 205 | --- | 410 | --- | 30 L | IA, A or NT | --- |
| JIS G 3467:2013 | Symbol STFA25 | --- | --- | --- | --- | 205 | --- | 410 | --- | 30 | IA, A or NT | --- |

**5.8 Alloy Steel Tubes and Pipes for Pressure Purposes at High Temperatures**

**5.8.9A Chemical Composition of 9Cr-1Mo Alloy Steel Tubes and Pipes for Pressure Purposes at High Temperatures**

| Specification | Designation | UNS No. | Steel No. | Weight, % max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASME SA-213/SA-213M | Grade T9 | K90941 | --- | 0.15 | 0.30-0.60 | 0.25-1.00 | 0.025 | 0.025 | 8.00-10.00 | --- | 0.90-1.10 | --- |
| ASME SA-335/SA-335M | Grade P9 | S50400 | --- | 0.15 | 0.30-0.60 | 0.25-1.00 | 0.025 | 0.025 | 8.00-10.00 | --- | 0.90-1.10 | --- |
| ASTM A213/A213M-15a | Grade T9 | K90941 | --- | 0.15 | 0.30-0.60 | 0.25-1.00 | 0.025 | 0.025 | 8.00-10.00 | --- | 0.90-1.10 | --- |
| ASTM A335/A335M-15 | Grade P9 | S50400 | --- | 0.15 | 0.30-0.60 | 0.25-1.00 | 0.025 | 0.025 | 8.00-10.00 | --- | 0.90-1.10 | --- |
| EN 10216-2:2013 | X11CrMo9-1+I | --- | 1.7386+I | 0.08-0.15 | 0.30-0.60 | 0.25-1.00 | 0.025 | 0.010 | 8.0-10.0 | --- | 0.90-1.10 | Al 0.040; Cu 0.30 |
| | X11CrMo9-1+NT | --- | 1.7386+NT | 0.08-0.15 | 0.30-0.60 | 0.25-1.00 | 0.025 | 0.010 | 8.0-10.0 | --- | 0.90-1.10 | Al 0.040; Cu 0.30 |
| ISO 9329-2:1997 | Grade X11 CrMo 9-1 TA | --- | --- | 0.08-0.15 | 0.30-0.60 | 0.25-1.00 | 0.03 | 0.03 | 8.00-10.00 | --- | 0.90-1.10 | Al 0.020 |
| | Grade X11 CrMo 9-1 TN+TT | --- | --- | 0.08-0.15 | 0.30-0.60 | 0.25-1.00 | 0.03 | 0.03 | 8.00-10.00 | --- | 0.90-1.10 | Al 0.020 |
| JIS G 3458:2013 | Symbol STPA26 | --- | --- | 0.15 | 0.30-0.60 | 0.25-1.00 | 0.030 | 0.030 | 8.00-10.00 | --- | 0.90-1.10 | --- |
| JIS G 3462:2014 | Symbol STBA26 | --- | --- | 0.15 | 0.30-0.60 | 0.25-1.00 | 0.030 | 0.030 | 8.00-10.00 | --- | 0.90-1.10 | --- |
| JIS G 3467:2013 | Symbol STFA26 | --- | --- | 0.15 | 0.30-0.60 | 0.25-1.00 | 0.030 | 0.030 | 8.00-10.00 | --- | 0.90-1.10 | --- |
| ASME SA-213/SA-213M | Grade T91 | K90901 | --- | 0.07-0.14 | 0.30-0.60 | 0.20-0.50 | 0.020 | 0.010 | 8.0-9.5 | 0.40 | 0.85-1.05 | V 0.18-0.25; Al 0.02; Nb 0.06-0.10; N 0.030-0.070; Ti 0.01; Zr 0.01 |
| ASTM A213/A213M-15a | Grade T91 | K90901 | --- | 0.07-0.14 | 0.30-0.60 | 0.20-0.50 | 0.020 | 0.010 | 8.0-9.5 | 0.40 | 0.85-1.05 | V 0.18-0.25; Nb 0.06-0.10; Zr 0.01 N 0.030-0.070; Al 0.02; Ti 0.01 |
| EN 10216-2:2013 | X10CrMoVNb9-1 | --- | 1.4903 | 0.08-0.12 | 0.30-0.60 | 0.20-0.50 | 0.020 | 0.005 | 8.0-9.5 | 0.40 | 0.85-1.05 | V 0.18-0.25; Nb 0.06-0.10; Zr 0.01 N 0.030-0.070; Al 0.02; Cu 0.30 |
| ISO 9329-2:1997 | Grade X10 CrMoVNb 9-1 | --- | --- | 0.08-0.12 | 0.30-0.60 | 0.20-0.50 | 0.02 | 0.02 | 8.00-9.50 | 0.4 | 0.85-1.05 | V 0.18-0.25; Al 0.020; Nb 0.06-0.10; N 0.030-0.070 |
| ASME SA-335/SA-335M | Grade P91 | K91560 | --- | 0.08-0.12 | 0.30-0.60 | 0.20-0.50 | 0.020 | 0.010 | 8.00-9.50 | 0.40 | 0.85-1.05 | V 0.18-0.25; Cb 0.06-0.10; Al 0.02; N 0.030-0.070; Ti 0.01; Zr 0.01 |
| | Grade P92 | K92460 | --- | 0.07-0.13 | 0.30-0.60 | 0.50 | 0.020 | 0.010 | 8.50-9.50 | 0.40 | 0.30-0.60 | V 0.15-0.25; Cb 0.04-0.09; Al 0.02; N 0.03-0.07; B 0.001-0.006; W 1.5-2.00; Ti 0.01; Zr 0.01 |
| ASTM A335/A335M-15 | Grade P91 | K91560 | --- | 0.08-0.12 | 0.30-0.60 | 0.20-0.50 | 0.020 | 0.010 | 8.00-9.50 | 0.40 | 0.85-1.05 | V 0.18-0.25; Al 0.02; Cb 0.06-0.10; N 0.030-0.070; Zr 0.01; Ti 0.01 |
| | Grade P92 | K92460 | --- | 0.07-0.13 | 0.30-0.60 | 0.50 | 0.020 | 0.010 | 8.50-9.50 | 0.40 | 0.30-0.60 | V 0.15-0.25; Al 0.02; Ti 0.01; W 1.5-2.00; Cb 0.04-0.09; Zr 0.01 N 0.03-0.07; B 0.001-0.006 |
| GB 5310-1995 | Grade 10Cr9Mo1VNb | --- | --- | 0.08-0.12 | 0.30-0.60 | 0.20-0.50 | 0.02 | 0.01 | 8.00-9.50 | 0.4 | 0.85-1.05 | V 0.18-0.25; Al 0.040; Cu 0.20; Nb 0.06-0.10; N 0.030-0.070 |

**5.8 Alloy Steel Tubes and Pipes for Pressure Purposes at High Temperatures**

**5.8.9B Mechanical Properties of 9Cr-1Mo Alloy Steel Tubes and Pipes for Pressure Purposes at High Temperatures**

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter | | Yield Strength | | Tensile Strength | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | %, min. | | |
| ASME SA-213/SA-213M | Grade T9 | K90941 | --- | 0.4 ≤ t ≤ 12.7 | 0.015 ≤ t ≤ 0.500 | 205 | 30 | 415 | 60 | 30 | A+N+T | 179 max HBW/ 190 max HV; 89 max HRB |
| ASME SA-335/SA-335M | Grade P9 | K50400 | --- | --- | --- | 205 | 30 | 415 | 60 | 30 L, 20 T | A or N+T | --- |
| ASTM A213/A213M-15a | Grade T9 | K90941 | --- | 0.4 ≤ t ≤ 12.7 | 0.015 ≤ t ≤ 0.500 | 205 | 30 | 415 | 60 | 30 | A, IA, NT | 179 max HBW/ 190 max HV; 89 max HRB |
| ASTM A335/A335M-15 | Grade P9 | S50400 | --- | --- | --- | 205 | 30 | 415 | 60 | t ≥ 8mm (5/16 in.) 30 L; 20 T | FA, IA or NT | --- |
| EN 10216-2:2013 | X11CrMo9-1+I | --- | 1.7386+I | t ≤ 16 | --- | 210 | --- | 460-640 | --- | 20 L; 18 T | I | L: 40 J at 20°C T: 27 J at 20°C |
| | | | | 16 < t ≤ 40 | --- | 210 | --- | 460-640 | --- | 20 L; 18 T | I | L: 40 J at 20°C T: 27 J at 20°C |
| | | | | 40 < t ≤ 60 | --- | 210 | --- | 460-640 | --- | 20 L; 18 T | I | L: 40 J at 20°C T: 27 J at 20°C |
| | X11CrMo9-1+NT | --- | 1.7386+NT | t ≤ 16 | --- | 390 | --- | 590-740 | --- | 18 L; 16 T | NT, QT | L: 40 J at 20°C T: 27 J at 20°C |
| | | | | 16 < t ≤ 40 | --- | 390 | --- | 590-740 | --- | 18 L; 16 T | NT, QT | L: 40 J at 20°C T: 27 J at 20°C |
| | | | | 40 < t ≤ 60 | --- | 390 | --- | 590-740 | --- | 18 L; 16 T | NT, QT | L: 40 J at 20°C T: 27 J at 20°C |
| ISO 9329-2:1997 | Grade X11 CrMo 9-1 TA | --- | --- | t ≤ 60 | --- | 205 | --- | 440-620 | --- | 20 L, 18 T | A | see standard |
| | Grade X11 CrMo 9-1 TN+TT | --- | --- | t ≤ 60 | --- | 390 | --- | 590-740 | --- | 18 L, 16 T | N+T | see standard |
| JIS G 3458:2013 | Symbol STPA26 | --- | --- | --- | --- | 205 | --- | 410 | --- | 24 L; 19 T | IA, FA or NT | --- |
| JIS G 3462:2014 | Symbol STBA26 | --- | --- | d < 10 | --- | 205 | --- | 410 | --- | 22 L | IA, A or NT | --- |
| | | | | 10 ≤ d < 20 | --- | 205 | --- | 410 | --- | 25 L | IA, A or NT | --- |
| | | | | d ≥ 20 | --- | 205 | --- | 410 | --- | 30 L | IA, A or NT | --- |
| JIS G 3467:2013 | Symbol STFA26 | --- | --- | --- | --- | 205 | --- | 410 | --- | 30 | IA, A or NT | --- |

**5.8 Alloy Steel Tubes and Pipes for Pressure Purposes at High Temperatures**

**5.8.9B Mechanical Properties of 9Cr-1Mo Alloy Steel Tubes and Pipes for Pressure Purposes at High Temperatures (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter | | Yield Strength | | Tensile Strength | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | %, min. | | |
| ASME SA-213/SA-213M | Grade T91 | K90901 | --- | 0.4 ≤ t ≤ 12.7 | 0.015 ≤ t ≤ 0.500 | 415 | 60 | 585 | 85 | 20 | N+T | 250 max HBW/ 265 max HV; 25 max HRC |
| ASTM A213/A213M-15a | Grade T91 | K90901 | --- | 0.4 ≤ t ≤ 12.7 | 0.015 ≤ t ≤ 0.500 | 415 | 60 | 585 | 85 | 20 | NT | 190-250 HBW/ 196-265 HV; 90 HRB to 25 HRC |
| EN 10216-2:2013 | X10CrMoVNb9-1 | --- | 1.4903 | t ≤ 16 | --- | 450 | --- | 630-830 | --- | 19 L; 17 T | NT, QT | L: 40 J at 20°C T: 27 J at 20°C |
| | | | | 16 < t ≤ 40 | --- | 450 | --- | 630-830 | --- | 19 L; 17 T | NT, QT | L: 40 J at 20°C T: 27 J at 20°C |
| | | | | 40 < t ≤ 60 | --- | 450 | --- | 630-830 | --- | 19 L; 17 T | NT, QT | L: 40 J at 20°C T: 27 J at 20°C |
| | | | | 60 < t ≤ 100 | --- | 450 | --- | 630-830 | --- | 19 L; 17 T | NT, QT | L: 40 J at 20°C T: 27 J at 20°C |
| ISO 9329-2:1997 | Grade X10 CrMoVNb 9-1 | --- | --- | t ≤ 60 | --- | 415 | --- | 590-770 | --- | 20 L, 16 T | N+T | see standard |
| ASME SA-335/SA-335M | Grade P91 | K91560 | --- | --- | --- | 415 | 60 | 585 | 85 | 20 L | N+T or Q+T | 250 max HB/ 265 max HV; 25 max HRC |
| | Grade P92 | K92460 | --- | --- | --- | 440 | 64 | 620 | 90 | 20 L | N+T | 250 max HB/ 265 max HV; 25 max HRC |
| ASTM A335/A335M-15 | Grade P91 | K91560 | --- | --- | --- | 415 | 60 | 585 | 85 | 20 L | NT or QT | 190-250 HBW/ 196-265 HV; 91 HRB to 25 HRC |
| | Grade P92 | K92460 | --- | --- | --- | 440 | 64 | 620 | 90 | 20 L | NT | 250 max HBW/ 265 max HV; 25 max HRC |
| GB 5310-1995 | Grade 10Cr9Mo1VNb | --- | --- | --- | --- | 415 | --- | 585 L | --- | 20 L | N+T | see standard |

## 5.9 Stainless Steel Tubes and Pipes for Pressure Purposes and High Temperatures

### 5.9.1A Chemical Composition of Ferritic and Martensitic Stainless Steel Tubes and Pipes for Pressure Purposes and High Temperatures

| Specification | Designation | UNS No. | Steel No. | Weight, % max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASME SA-268/SA-268M | Grade TP409 | S40900 | --- | 0.08 | 1.00 | 1.00 | 0.045 | 0.030 | 10.5-11.7 | 0.50 | --- | Ti 6xC to 0.75 |
| ASME SA-803/SA-803M | Grade TP409 | S40900 | --- | 0.08 | 1.00 | 1.00 | 0.045 | 0.030 | 10.5-11.7 | 0.50 | --- | Ti 6xC to 0.75 |
| ASTM A268/A268M-10 | Grade TP409 | S40900 | --- | 0.08 | 1.00 | 1.00 | 0.045 | 0.030 | 10.5-11.7 | 0.50 | --- | Ti 6xC to 0.75 |
| ASTM A803/A803M-12 | Grade TP409 | S40900 | --- | 0.08 | 1.00 | 1.00 | 0.045 | 0.030 | 10.5-11.7 | 0.50 | --- | Ti 6xC to 0.75 |
| JIS G 3463:2012 | Symbol SUS409TB | --- | --- | 0.08 | 1.00 | 1.00 | 0.040 | 0.030 | 10.50-11.75 | 0.60 | --- | Ti 6xC to 0.75 |
| ASME SA-268/SA-268M | Grade TP410 | S41000 | --- | 0.15 | 1.00 | 1.00 | 0.040 | 0.030 | 11.5-13.5 | --- | --- | --- |
| ASTM A268/A268M-10 | Grade TP410 | S41000 | --- | 0.15 | 1.00 | 1.00 | 0.040 | 0.030 | 11.5-13.5 | --- | --- | --- |
| JIS G 3463:2012 | Symbol SUS410TB | --- | --- | 0.15 | 1.00 | 1.00 | 0.040 | 0.030 | 11.50-13.50 | 0.60 | --- | --- |
| ASME SA-268/SA-268M | Grade TP430 | S43000 | --- | 0.12 | 1.00 | 1.00 | 0.040 | 0.030 | 16.0-18.0 | --- | --- | --- |
| ASTM A268/A268M-10 | Grade TP430 | S43000 | --- | 0.12 | 1.00 | 1.00 | 0.040 | 0.030 | 16.0-18.0 | --- | --- | --- |
| JIS G 3463:2012 | Symbol SUS430TB | --- | --- | 0.12 | 1.00 | 0.75 | 0.040 | 0.030 | 16.00-18.00 | 0.60 | --- | --- |
| | Symbol SUS430LXTB | --- | --- | 0.030 | 1.00 | 0.75 | 0.040 | 0.030 | 16.00-19.00 | 0.60 | --- | Ti or Nb 0.10-1.00 |
| ASME SA-803/SA-803M | Grade TP XM-27 | S44627 | --- | 0.01 | 0.40 | 0.40 | 0.02 | 0.02 | 25.0-27.5 | --- | 0.75-1.50 | Cu 0.20; Cb 0.05-0.20; N 0.015; (Ni+Cu) 0.5 |
| ASTM A803/A803M-12 | Grade TP XM-27 | S44627 | --- | 0.01 | 0.40 | 0.40 | 0.02 | 0.02 | 25.0-27.5 | --- | 0.75-1.50 | Cu 0.20; N 0.015; Cb 0.05-0.20; (Ni+Cu) 0.5 |
| JIS G 3463:2012 | Symbol SUSXM27TB | --- | --- | 0.010 | 0.40 | 0.40 | 0.030 | 0.020 | 25.00-27.50 | 0.50 | 0.75-1.50 | Cu 0.20; N 0.015; (Ni+Cu) 0.50 |

**5.9 Stainless Steel Tubes and Pipes for Pressure Purposes and High Temperatures**

**5.9.1B Mechanical Properties of Ferritic and Martensitic Stainless Steel Tubes and Pipes for Pressure Purposes and High Temperatures**

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter | | Yield Strength | | Tensile Strength | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | %, min. | | |
| ASME SA-268/SA-268M | Grade TP409 | S40900 | --- | t ≥ 0.4 | t ≥ 0.015 | 170 | 25 | 380 | 55 | 20 | HT | 207 max HB; 95 max HRB |
| ASME SA-803/SA-803M | Grade TP409 | S40900 | --- | t ≥ 0.7 | t ≥ 0.028 | 205 | 30 | 380 | 55 | 20 L | SA | 207 max HB; 95 max HRB |
| ASTM A268/A268M-10 | Grade TP409 | S40900 | --- | t ≥ 0.4 | t ≥ 0.015 | 170 | 25 | 380 | 55 | 20 | HT | 207 max HB; 95 max HRB |
| ASTM A803/A803M-12 | Grade TP409 | S40900 | --- | t ≥ 0.7 | t ≥ 0.028 | 205 | 30 | 380 | 55 | 20 L | SA | 207 max HB; 95 max HRB |
| JIS G 3463:2012 | Symbol SUS409TB | --- | --- | d < 10 | --- | 205 | --- | 410 | --- | 12 L | A | --- |
| | | | | 10 ≤ d < 20 | --- | 205 | --- | 410 | --- | 15 L | A | --- |
| | | | | d ≥ 20 | --- | 205 | --- | 410 | --- | 20 L | A | --- |
| ASME SA-268/SA-268M | Grade TP410 | S41000 | --- | t ≥ 0.4 | t ≥ 0.015 | 205 | 30 | 415 | 60 | 20 | HT | 207 max HB; 95 max HRB |
| ASTM A268/A268M-10 | Grade TP410 | S41000 | --- | t ≥ 0.4 | t ≥ 0.015 | 205 | 30 | 415 | 60 | 20 | HT | 207 max HB; 95 max HRB |
| JIS G 3463:2012 | Symbol SUS410TB | --- | --- | d < 10 | --- | 205 | --- | 410 | --- | 12 L | A | --- |
| | | | | 10 ≤ d < 20 | --- | 205 | --- | 410 | --- | 15 L | A | --- |
| | | | | d ≥ 20 | --- | 205 | --- | 410 | --- | 20 L | A | --- |
| ASME SA-268/SA-268M | Grade TP430 | S43000 | --- | t ≥ 0.4 | t ≥ 0.015 | 240 | 35 | 415 | 60 | 20 | HT | 190 max HB; 90 max HRB |
| ASTM A268/A268M-10 | Grade TP430 | S43000 | --- | t ≥ 0.4 | t ≥ 0.015 | 240 | 35 | 415 | 60 | 20 | HT | 190 max HB; 90 max HRB |
| JIS G 3463:2012 | Symbol SUS430TB | --- | --- | d < 10 | --- | 245 | --- | 410 | --- | 12 L | A | --- |
| | | | | 10 ≤ d < 20 | --- | 245 | --- | 410 | --- | 15 L | A | --- |
| | | | | d ≥ 20 | --- | 245 | --- | 410 | --- | 20 L | A | --- |
| | Symbol SUS430LXTB | --- | --- | d < 10 | --- | 175 | --- | 360 | --- | 12 L | A | --- |
| | | | | 10 ≤ d < 20 | --- | 175 | --- | 360 | --- | 15 L | A | --- |
| | | | | d ≥ 20 | --- | 175 | --- | 360 | --- | 20 L | A | --- |
| ASME SA-803/SA-803M | Grade TP XM-27 | S44627 | --- | t ≥ 0.7 | t ≥ 0.028 | 275 | 40 | 450 | 65 | 20 L | SA | 241 max HB; 100 max HRB |
| ASTM A803/A803M-12 | Grade TP XM-27 | S44627 | --- | t ≥ 0.7 | t ≥ 0.028 | 275 | 40 | 450 | 65 | 20 | SA | 241 max HB; 100 max HRB |
| JIS G 3463:2012 | Symbol SUSXM27TB | | --- | d < 10 | --- | 245 | --- | 410 | --- | 12 L | A | --- |
| | | | | 10 ≤ d < 20 | --- | 245 | --- | 410 | --- | 15 L | A | --- |
| | | | | d ≥ 20 | --- | 245 | --- | 410 | --- | 20 L | A | --- |

## 5.9 Stainless Steel Tubes and Pipes for Pressure Purposes and High Temperatures

### 5.9.2A Chemical Composition of Austenitic Stainless Steel Tubes and Pipes for Pressure Purposes and High Temperatures

| Specification | Designation | UNS No. | Steel No. | Weight, % max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASME SA-213/SA-213M | Grade TP304 | S30400 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 18.0-20.0 | 8.0-11.0 | --- | --- |
| ASME SA-249/SA-249M | Grade TP304 | S30400 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 18.0-20.0 | 8.0-11.0 | --- | --- |
| ASME SA-312/SA-312M | Grade TP304 | S30400 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 18.0-20.0 | 8.0-11.0 | --- | --- |
| ASME SA-358/SA-358M* | Grade 304 | S30400 | --- | 0.07 | 2.00 | 0.75 | 0.045 | 0.030 | 17.5-19.5 | 8.0-10.5 | --- | N 0.10 |
| ASME SA-376/SA-376M | Grade TP304 | S30400 | --- | 0.08 | 2.00 | 0.75 | 0.045 | 0.030 | 18.0-20.0 | 8.0-11.0 | --- | --- |
| ASME SA-409/SA-409M | Grade TP304 | S30400 | --- | 0.08 | 2.00 | 0.75 | 0.045 | 0.030 | 18.0-20.0 | 8.0-11.0 | --- | --- |
| ASME SA-688/SA-688M | Grade TP 304 | S30400 | --- | 0.08 | 2.00 | 0.75 | 0.040 | 0.030 | 18.00-20.00 | 8.00-11.00 | --- | --- |
| ASTM A213/A213M-15a | Grade TP304 | S30400 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 18.0-20.0 | 8.00-11.0 | --- | --- |
| ASTM A249/A249M-14a | Grade TP304 | S30400 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 18.0-20.0 | 8.0-11.0 | --- | --- |
| ASTM A270/A270M-15 | Grade TP 304 | S30400 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 18.0-20.0 | 8.0-11.0 | --- | --- |
| ASTM A312/A312M-15 | Grade TP304 | S30400 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 18.0-20.0 | 8.0-11.0 | --- | --- |
| ASTM A358/A358M-14a* | Grade 304 | S30400 | --- | 0.07 | 2.00 | 0.75 | 0.045 | 0.030 | 17.5-19.5 | 8.0-10.5 | --- | N 0.10 |
| ASTM A376/A376M-14 | Grade TP304 | S30400 | --- | 0.08 | 2.00 | 0.75 | 0.045 | 0.030 | 18.0-20.0 | 8.0-11.0 | --- | --- |
| ASTM A409/A409M-15 | Grade TP304 | S30400 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 18.0-20.0 | 8.0-11.0 | --- | --- |
| ASTM A688/A688M-15 | Grade TP304 | S30400 | --- | 0.08 | 2.00 | 0.75 | 0.040 | 0.030 | 18.00-20.00 | 8.00-11.00 | --- | --- |
| ASTM A908-03 (2013) | Type 304 | S30400 | --- | 0.08 | 2.00 | 0.75 | 0.040 | 0.030 | 18.0-20.0 | 8.0-11.0 | --- | --- |
| EN 10216-5:2013 | X5CrNi18-10 | --- | 1.4301 | 0.07 | 2.00 | 1.00 | 0.040 | 0.015 | 17.0-19.5 | 8.0-10.5 | --- | N 0.10 |
| EN 10217-7:2014 | X5CrNi18-10 | --- | 1.4301 | 0.07 | 2.00 | 1.00 | 0.045 | 0.015 | 17.5-19.5 | 8.0-10.5 | --- | N 0.10 |
| JIS G 3459:2012 | Symbol SUS304TP | --- | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 18.00-20.00 | 8.00-11.00 | --- | --- |
| JIS G 3463:2012 | Symbol SUS304TB | --- | --- | 0.08 | 2.00 | 1.00 | 0.040 | 0.030 | 18.00-20.00 | 8.00-11.00 | --- | --- |
| JIS G 3467:2013 | Symbol SUS304TF | --- | --- | 0.08 | 2.00 | 1.00 | 0.040 | 0.030 | 18.00-20.00 | 8.00-11.00 | --- | --- |
| JIS G 3468:2011 | Symbol SUS304TPY | --- | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 18.00-20.00 | 8.00-10.50 | --- | --- |
| ASME SA-213/SA-213M | Grade TP304L | S30403 | --- | 0.035 | 2.00 | 1.00 | 0.045 | 0.030 | 18.0-20.0 | 8.0-12.0 | --- | --- |
| ASME SA-249/SA-249M | Grade TP304L | S30403 | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 18.0-20.0 | 8.0-12.0 | --- | --- |
| | Grade TP304N | S30451 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 18.0-20.0 | 8.0-11.0 | --- | N 0.10-0.16 |
| ASME SA-312/SA-312M | Grade TP304L | S30403 | --- | 0.035 | 2.00 | 1.00 | 0.045 | 0.030 | 18.0-20.0 | 8.0-13.0 | --- | --- |
| ASME SA-358/SA-358M* | Grade 304L | S30403 | --- | 0.030 | 2.00 | 0.75 | 0.045 | 0.030 | 17.5-19.5 | 8.0-12.0 | --- | N 0.10 |
| ASME SA-409/SA-409M | Grade TP304L | S30403 | --- | 0.035 | 2.00 | 0.75 | 0.045 | 0.030 | 18.0-20.0 | 8.00-13.0 | --- | --- |
| ASME SA-688/SA-688M | Grade TP 304L | S30403 | --- | 0.035 | 2.00 | 0.75 | 0.040 | 0.030 | 18.00-20.00 | 8.00-13.00 | --- | --- |
| ASTM A213/A213M-15a | Grade TP304L | S30403 | --- | 0.035 | 2.00 | 1.00 | 0.045 | 0.030 | 18.0-20.0 | 8.0-12.0 | --- | --- |
| ASTM A249/A249M-14 | Grade TP304L | S30403 | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 18.0-20.0 | 8.0-12.0 | --- | --- |
| | Grade TP304N | S30451 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 18.0-20.0 | 8.0-11.0 | --- | N 0.10-0.16 |
| ASTM A312/A312M-15 | Grade TP304L | S30403 | --- | 0.035 | 2.00 | 1.00 | 0.045 | 0.030 | 18.0-20.0 | 8.0-13.0 | --- | --- |

*: See "List of Standards" at the beginning of the chapter.

Note: This section continued on next page.

**5.9 Stainless Steel Tubes and Pipes for Pressure Purposes and High Temperatures**

**5.9.2A Chemical Composition of Austenitic Stainless Steel Tubes and Pipes for Pressure Purposes and High Temperatures (Continued)**

| Specification | Designation | UNS No. | Steel No. | Weight, % max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASTM A358/A358M-14a* | Grade 304L | S30403 | --- | 0.030 | 2.00 | 0.75 | 0.045 | 0.030 | 17.5-19.5 | 8.0-12.0 | --- | N 0.10 |
| ASTM A409/A409M-15 | Grade TP304L | S30403 | --- | 0.035 | 2.00 | 1.00 | 0.045 | 0.030 | 18.0-20.0 | 8.0-12.0 | --- | --- |
| ASTM A688/A688M-15 | Grade TP304L | S30403 | --- | 0.035 | 2.00 | 0.75 | 0.040 | 0.030 | 18.00-20.00 | 8.00-13.00 | --- | --- |
| EN 10216-5:2013 | X2CrNi18-9 | --- | 1.4307 | 0.030 | 2.00 | 1.00 | 0.040 | 0.015 | 17.5-19.5 | 8.0-10.0 | --- | N 0.10 |
| | X2CrNi19-11 | --- | 1.4306 | 0.030 | 2.00 | 1.00 | 0.040 | 0.015 | 18.0-20.0 | 10.0-12.0 | --- | N 0.10 |
| EN 10217-7:2014 | X2CrNi18-9 | --- | 1.4307 | 0.030 | 2.00 | 1.00 | 0.045 | 0.015 | 17.5-19.5 | 8.0-10.5 | --- | N 0.10 |
| | X2CrNi19-11 | --- | 1.4306 | 0.030 | 2.00 | 1.00 | 0.045 | 0.015 | 18.0-20.0 | 10.0-12.0 | --- | N 0.10 |
| JIS G 3459:2012 | Symbol SUS304LTP | --- | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 18.00-20.00 | 9.00-13.00 | --- | --- |
| JIS G 3463:2012 | Symbol SUS304LTB | --- | --- | 0.030 | 2.00 | 1.00 | 0.040 | 0.030 | 18.00-20.00 | 9.00-13.00 | --- | --- |
| JIS G 3468:2011 | Symbol SUS304LTPY | --- | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 18.00-20.00 | 9.00-13.00 | --- | --- |
| ASME SA-213/SA-213M | Grade TP304LN | S30453 | --- | 0.035 | 2.00 | 1.00 | 0.045 | 0.030 | 18.0-20.0 | 8.0-11.0 | --- | N 0.10-0.16 |
| ASME SA-249/SA-249M | Grade TP304LN | S30453 | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 18.0-20.0 | 8.0-11.0 | --- | N 0.10-0.16 |
| ASME SA-376/SA-376M | Grade TP304LN | S30453 | --- | 0.035 | 2.00 | 0.75 | 0.045 | 0.030 | 18.0-20.0 | 8.0-11.0 | --- | N 0.10-0.16 |
| ASME SA-688/SA-688M | Grade TP 304LN | S30453 | --- | 0.035 | 2.00 | 0.75 | 0.040 | 0.030 | 18.00-20.00 | 8.00-13.00 | --- | N 0.10-0.16 |
| ASTM A213/A213M-15a | Grade TP304LN | S30453 | --- | 0.035 | 2.00 | 1.00 | 0.045 | 0.030 | 18.0-20.0 | 8.0-11.0 | --- | N 0.10-0.16 |
| ASTM A249/A249M-14a | Grade TP304LN | S30453 | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 18.0-20.0 | 8.0-11.0 | --- | N 0.10-0.16 |
| ASTM A376/A376M-14 | Grade TP304LN | S30453 | --- | 0.035 | 2.00 | 0.75 | 0.045 | 0.030 | 18.0-20.0 | 8.0-11.0 | --- | N 0.10-0.16 |
| ASTM A688/A688M-15 | Grade TP304LN | S30453 | --- | 0.035 | 2.00 | 0.75 | 0.040 | 0.030 | 18.00-20.00 | 8.00-13.00 | --- | N 0.10-0.16 |
| EN 10216-5:2013 | X2CrNiN18-10 | --- | 1.4311 | 0.030 | 2.00 | 1.00 | 0.040 | 0.015 | 17.0-19.5 | 8.5-11.5 | --- | N 0.12-0.22 |
| EN 10217-7:2014 | X2CrNiN18-10 | --- | 1.4311 | 0.030 | 2.00 | 1.00 | 0.045 | 0.015 | 17.5-19.5 | 8.5-11.5 | --- | N 0.12-0.22 |
| ASME SA-213/SA-213M | Grade TP304H | S30409 | --- | 0.04-0.10 | 2.00 | 1.00 | 0.045 | 0.030 | 18.0-20.0 | 8.0-11.0 | --- | --- |
| ASME SA-249/SA-249M | Grade TP304H | S30409 | --- | 0.04-0.10 | 2.00 | 1.00 | 0.045 | 0.030 | 18.0-20.0 | 8.0-11.0 | --- | --- |
| ASME SA-312/SA-312M | Grade TP304H | S30409 | --- | 0.04-0.10 | 2.00 | 1.00 | 0.045 | 0.030 | 18.0-20.0 | 8.0-11.0 | --- | --- |
| ASME SA-358/SA-358M* | Grade 304H | S30409 | --- | 0.04-0.10 | 2.00 | 0.75 | 0.045 | 0.030 | 18.0-20.0 | 8.0-10.5 | --- | --- |
| ASME SA-376/SA-376M | Grade TP304H | S30409 | --- | 0.04-0.10 | 2.00 | 0.75 | 0.045 | 0.030 | 18.0-20.0 | 8.0-11.0 | --- | --- |
| ASTM A213/A213M-15a | Grade TP304H | S30409 | --- | 0.04-0.10 | 2.00 | 1.00 | 0.045 | 0.030 | 18.0-20.0 | 8.0-11.0 | --- | --- |
| ASTM A249/A249M-14a | Grade TP304H | S30409 | --- | 0.04-0.10 | 2.00 | 1.00 | 0.045 | 0.030 | 18.0-20.0 | 8.0-11.0 | --- | --- |
| ASTM A312/A312M-15 | Grade TP304H | S30409 | --- | 0.04-0.10 | 2.00 | 1.00 | 0.045 | 0.030 | 18.0-20.0 | 8.0-11.0 | --- | --- |
| ASTM A358/A358M-14a* | Grade 304H | S30409 | --- | 0.04-0.10 | 2.00 | 0.75 | 0.045 | 0.030 | 18.0-20.0 | 8.0-10.5 | --- | --- |
| ASTM A376/A376M-14 | Grade TP304H | S30409 | --- | 0.04-0.10 | 2.00 | 0.75 | 0.045 | 0.030 | 18.0-20.0 | 8.0-11.0 | --- | --- |
| EN 10216-5:2013 | X6CrNi18-10 | --- | 1.4948 | 0.04-0.08 | 2.00 | 1.00 | 0.035 | 0.015 | 17.0-19.0 | 8.0-11.0 | --- | N 0.10 |
| GB 5310-1995 | Grade 1Cr18Ni9 | --- | --- | 0.15 | 2.00 | 1.00 | 0.035 | 0.03 | 17.00-19.00 | 8.00-10.00 | --- | Cu 0.20 |
| JIS G 3459:2012 | Symbol SUS304HTP | --- | --- | 0.04-0.10 | 2.00 | 0.75 | 0.040 | 0.030 | 18.00-20.00 | 8.00-11.00 | --- | --- |
| JIS G 3463:2012 | Symbol SUS304HTB | --- | --- | 0.04-0.10 | 2.00 | 0.75 | 0.040 | 0.030 | 18.00-20.00 | 8.00-11.00 | --- | --- |
| JIS G 3467:2013 | Symbol SUS304HTF | --- | --- | 0.04-0.10 | 2.00 | 0.75 | 0.040 | 0.030 | 18.00-20.00 | 8.00-11.00 | --- | --- |

*: See "List of Standards" at the beginning of the chapter.

**5.9 Stainless Steel Tubes and Pipes for Pressure Purposes and High Temperatures**

**5.9.2A Chemical Composition of Austenitic Stainless Steel Tubes and Pipes for Pressure Purposes and High Temperatures (Continued)**

| Specification | Designation | UNS No. | Steel No. | Weight, % max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASME SA-213/SA-213M | Grade TP309S | S30908 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 22.0-24.0 | 12.0-15.0 | --- | --- |
| ASME SA-249/SA-249M | Grade TP309S | S30908 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 22.0-24.0 | 12.0-15.0 | --- | --- |
| ASME SA-312/SA-312M | Grade TP309S | S30908 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 22.0-24.0 | 12.0-15.0 | 0.75 | --- |
| ASME SA-358/SA-358M* | Grade 309S | S30908 | --- | 0.08 | 2.00 | 0.75 | 0.045 | 0.030 | 22.0-24.0 | 12.0-15.0 | --- | --- |
| ASTM A213/A213M-15a | Grade TP309S | S30908 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 22.0-24.0 | 12.0-15.0 | --- | --- |
| ASTM A249/A249M-14a | Grade TP309S | S30908 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 22.0-24.0 | 12.0-15.0 | --- | --- |
| ASTM A312/A312M-15 | Grade TP309S | S30908 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 22.0-24.0 | 12.0-15.0 | 0.75 | --- |
| ASTM A358/A358M-14a* | Grade 309S | S30908 | --- | 0.08 | 2.00 | 0.75 | 0.045 | 0.030 | 22.0-24.0 | 12.0-15.0 | --- | --- |
| JIS G 3459:2012 | Symbol SUS309STP | --- | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 22.00-24.00 | 12.00-15.00 | --- | --- |
| JIS G 3463:2012 | Symbol SUS309STB | --- | --- | 0.08 | 2.00 | 1.00 | 0.040 | 0.030 | 22.00-24.00 | 12.00-15.00 | --- | --- |
| JIS G 3468:2011 | Symbol SUS309STPY | --- | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 22.00-24.00 | 12.00-15.00 | --- | --- |
| ASME SA-213/SA-213M | Grade TP309H | S30909 | --- | 0.04-0.10 | 2.00 | 1.00 | 0.045 | 0.030 | 22.0-24.0 | 12.0-15.0 | --- | --- |
| ASME SA-249/SA-249M | Grade TP309H | S30909 | --- | 0.04-0.10 | 2.00 | 1.00 | 0.045 | 0.030 | 22.0-24.0 | 12.0-15.0 | --- | --- |
| ASTM A213/A213M-15a | Grade TP309H | S30909 | --- | 0.04-0.10 | 2.00 | 1.00 | 0.045 | 0.030 | 22.0-24.0 | 12.0-15.0 | --- | --- |
| ASTM A249/A249M-14a | Grade TP309H | S30909 | --- | 0.04-0.10 | 2.00 | 1.00 | 0.045 | 0.030 | 22.0-24.0 | 12.0-15.0 | --- | --- |
| JIS G 3459:2012 | Symbol SUS309TP | --- | --- | 0.15 | 2.00 | 1.00 | 0.040 | 0.030 | 22.00-24.00 | 12.00-15.00 | --- | --- |
| JIS G 3463:2012 | Symbol SUS309TB | --- | --- | 0.15 | 2.00 | 1.00 | 0.040 | 0.030 | 22.00-24.00 | 12.00-15.00 | --- | --- |
| ASME SA-213/SA-213M | Grade TP310S | S31008 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 24.0-26.0 | 19.0-22.0 | --- | --- |
| ASME SA-249/SA-249M | Grade TP310S | S31008 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 24.0-26.0 | 19.0-22.0 | --- | --- |
| ASME SA-312/SA-312M | Grade TP310S | S31008 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 24.0-26.0 | 19.0-22.0 | 0.75 | --- |
| ASME SA-358/SA-358M* | Grade 310S | S31008 | --- | 0.08 | 2.00 | 1.50 | 0.045 | 0.030 | 24.0-26.0 | 19.0-22.0 | --- | --- |
| ASTM A213/A213M-15a | Grade TP310S | S31008 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 24.0-26.0 | 19.0-22.0 | --- | --- |
| ASTM A249/A249M-14a | Grade TP310S | S31008 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 24.0-26.0 | 19.0-22.0 | --- | --- |
| ASTM A312/A312M-15 | Grade TP310S | S31008 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 24.0-26.0 | 19.0-22.0 | 0.75 | --- |
| ASTM A358/A358M-14a* | Grade 310S | S31008 | --- | 0.08 | 2.00 | 1.50 | 0.045 | 0.030 | 24.0-26.0 | 19.0-22.0 | --- | --- |
| JIS G 3459:2012 | Symbol SUS310STP | --- | --- | 0.08 | 2.00 | 1.50 | 0.045 | 0.030 | 24.00-26.00 | 19.00-22.00 | --- | --- |
| JIS G 3463:2012 | Symbol SUS310STB | --- | --- | 0.08 | 2.00 | 1.50 | 0.040 | 0.030 | 24.00-26.00 | 19.00-22.00 | --- | --- |
| JIS G 3468:2011 | Symbol SUS310STPY | --- | --- | 0.08 | 2.00 | 1.50 | 0.045 | 0.030 | 24.00-26.00 | 19.00-22.00 | --- | --- |
| ASME SA-213/SA-213M | Grade TP310H | S31009 | --- | 0.04-0.10 | 2.00 | 1.00 | 0.045 | 0.030 | 24.0-26.0 | 19.0-22.0 | --- | --- |
| ASTM A213/A213M-15a | Grade TP310H | S31009 | --- | 0.04-0.10 | 2.00 | 1.00 | 0.045 | 0.030 | 24.0-26.0 | 19.0-22.0 | --- | --- |
| JIS G 3463:2012 | Symbol SUS310TB | --- | --- | 0.15 | 2.00 | 1.50 | 0.040 | 0.030 | 24.00-26.00 | 19.00-22.00 | --- | --- |
| JIS G 3467:2013 | Symbol SUS310TF | --- | --- | 0.15 | 2.00 | 1.50 | 0.040 | 0.030 | 24.00-26.00 | 19.00-22.00 | --- | --- |

*: See "List of Standards" at the beginning of the chapter.

**5.9 Stainless Steel Tubes and Pipes for Pressure Purposes and High Temperatures**

**5.9.2A Chemical Composition of Austenitic Stainless Steel Tubes and Pipes for Pressure Purposes and High Temperatures (Continued)**

| Specification | Designation | UNS No. | Steel No. | Weight, % max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASME SA-213/SA-213M | Grade TP316 | S31600 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 16.0-18.0 | 10.0-14.0 | 2.00-3.00 | --- |
| ASME SA-249/SA-249M | Grade TP316 | S31600 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 16.0-18.0 | 10.0-14.0 | 2.00-3.00 | --- |
| ASME SA-312/SA-312M | Grade TP316 | S31600 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 16.0-18.0 | 11.0-14.0 | 2.00-3.00 | --- |
| ASME SA-358/SA-358M* | Grade 316 | S31600 | --- | 0.08 | 2.00 | 0.75 | 0.045 | 0.030 | 16.0-18.0 | 10.0-14.0 | 2.00-3.00 | N 0.10 |
| ASME SA-376/SA-376M | Grade TP316 | S31600 | --- | 0.08 | 2.00 | 0.75 | 0.045 | 0.030 | 16.0-18.0 | 11.0-14.0 | 2.00-3.00 | --- |
| ASME SA-409/SA-409M | Grade TP316 | S31600 | --- | 0.08 | 2.00 | 0.75 | 0.045 | 0.030 | 16.0-18.0 | 10.0-14.0 | 2.0-3.0 | --- |
| ASME SA-688/SA-688M | Grade TP 316 | S31600 | --- | 0.08 | 2.00 | 0.75 | 0.040 | 0.030 | 16.00-18.00 | 10.00-14.00 | 2.00-3.00 | --- |
| ASTM A213/A213M-15a | Grade TP316 | S31600 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 16.0-18.0 | 10.0-14.0 | 2.00-3.00 | --- |
| ASTM A249/A249M-14a | Grade TP316 | S31600 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 16.0-18.0 | 10.0-14.0 | 2.00-3.00 | --- |
| ASTM A312/A312M-15 | Grade TP316 | S31600 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 16.0-18.0 | 11.0-14.0 | 2.00-3.00 | --- |
| ASTM A358/A358M-14a* | Grade 316 | S31600 | --- | 0.08 | 2.00 | 0.75 | 0.045 | 0.030 | 16.0-18.0 | 10.0-14.0 | 2.00-3.00 | N 0.10 |
| ASTM A376/A376M-14 | Grade TP316 | S31600 | --- | 0.08 | 2.00 | 0.75 | 0.045 | 0.030 | 16.0-18.0 | 11.0-14.0 | 2.00-3.00 | --- |
| ASTM A409/A409M-15 | Grade TP316 | S31600 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 16.0-18.0 | 10.0-14.0 | 2.00-3.00 | --- |
| ASTM A688/A688M-15 | Grade TP316 | S31600 | --- | 0.08 | 2.00 | 0.75 | 0.040 | 0.030 | 16.00-18.00 | 10.00-14.00 | 2.00-3.00 | --- |
| EN 10216-5:2013 | X5CrNiMo17-12-2 | --- | 1.4401 | 0.07 | 2.00 | 1.00 | 0.040 | 0.015 | 16.5-18.5 | 10.0-13.0 | 2.0-2.5 | N 0.10 |
| | X3CrNiMo17-13-3 | --- | 1.4436 | 0.05 | 2.00 | 1.00 | 0.040 | 0.015 | 16.5-18.5 | 10.5-13.0 | 2.50-3.0 | N 0.10 |
| EN 10217-7:2014 | X5CrNiMo17-12-2 | --- | 1.4401 | 0.07 | 2.00 | 1.00 | 0.045 | 0.015 | 16.5-18.5 | 10.0-13.0 | 2.00-2.50 | N 0.10 |
| | X3CrNiMo17-13-3 | --- | 1.4436 | 0.05 | 2.00 | 1.00 | 0.045 | 0.015 | 16.5-18.5 | 10.5-13.0 | 2.50-3.0 | N 0.10 |
| JIS G 3459:2012 | Symbol SUS316TP | --- | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 16.00-18.00 | 10.00-14.00 | 2.00-3.00 | --- |
| JIS G 3463:2012 | Symbol SUS316TB | --- | --- | 0.08 | 2.00 | 1.00 | 0.040 | 0.030 | 16.00-18.00 | 10.00-14.00 | 2.00-3.00 | --- |
| JIS G 3467:2013 | Symbol SUS316TF | --- | --- | 0.08 | 2.00 | 1.00 | 0.040 | 0.030 | 16.00-18.00 | 10.00-14.00 | 2.00-3.00 | --- |
| JIS G 3468:2011 | Symbol SUS316TPY | --- | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 16.00-18.00 | 10.00-14.00 | 2.00-3.00 | --- |

*: See "List of Standards" at the beginning of the chapter.

**5.9 Stainless Steel Tubes and Pipes for Pressure Purposes and High Temperatures**

**5.9.2A Chemical Composition of Austenitic Stainless Steel Tubes and Pipes for Pressure Purposes and High Temperatures (Continued)**

| Specification | Designation | UNS No. | Steel No. | Weight, % max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASME SA-213/SA-213M | Grade TP316L | S31603 | --- | 0.035 | 2.00 | 1.00 | 0.045 | 0.030 | 16.0-18.0 | 10.0-14.0 | 2.00-3.00 | --- |
| ASME SA-249/SA-249M | Grade TP316L | S31603 | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 16.0-18.0 | 10.0-14.0 | 2.00-3.00 | --- |
| ASME SA-312/SA-312M | Grade TP316L | S31603 | --- | 0.035 | 2.00 | 1.00 | 0.045 | 0.030 | 16.0-18.0 | 10.0-14.0 | 2.00-3.00 | --- |
| ASME SA-358/SA-358M* | Grade 316L | S31603 | --- | 0.030 | 2.00 | 0.75 | 0.045 | 0.030 | 16.0-18.0 | 10.0-14.0 | 2.00-3.00 | N 0.10 |
| ASME SA-409/SA-409M | Grade TP316L | S31603 | --- | 0.035 | 2.00 | 0.75 | 0.045 | 0.030 | 16.0-18.0 | 10.0-15.0 | 2.0-3.0 | --- |
| ASME SA-688/SA-688M | Grade TP 316L | S31603 | --- | 0.035 | 2.00 | 0.75 | 0.040 | 0.030 | 16.00-18.00 | 10.00-15.00 | 2.00-3.00 | --- |
| ASTM A213/A213M-15a | Grade TP316L | S31603 | --- | 0.035 | 2.00 | 1.00 | 0.045 | 0.030 | 16.0-18.0 | 10.0-14.0 | 2.00-3.00 | --- |
| ASTM A249/A249M-14a | Grade TP316L | S31603 | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 16.0-18.0 | 10.0-14.0 | 2.00-3.00 | --- |
| ASTM A312/A312M-15 | Grade TP316L | S31603 | --- | 0.035 | 2.00 | 1.00 | 0.045 | 0.030 | 16.0-18.0 | 10.0-14.0 | 2.00-3.00 | --- |
| ASTM A358/A358M-14a* | Grade 316L | S31603 | --- | 0.030 | 2.00 | 0.75 | 0.045 | 0.030 | 16.0-18.0 | 10.0-14.0 | 2.00-3.00 | N 0.10 |
| ASTM A409/A409M-15 | Grade TP316L | S31603 | --- | 0.035 | 2.00 | 1.00 | 0.045 | 0.030 | 16.0-18.0 | 10.0-14.0 | 2.00-3.00 | --- |
| ASTM A688/A688M-15 | Grade TP316L | S31603 | --- | 0.035 | 2.00 | 0.75 | 0.040 | 0.030 | 16.00-18.00 | 10.00-15.00 | 2.00-3.00 | --- |
| EN 10216-5:2013 | X2CrNiMo17-12-2 | --- | 1.4404 | 0.030 | 2.00 | 1.00 | 0.040 | 0.015 | 16.5-18.5 | 10.0-13.0 | 2.0-2.5 | N 0.10 |
| | X2CrNiMo18-14-3 | --- | 1.4435 | 0.030 | 2.00 | 1.00 | 0.040 | 0.015 | 17.0-19.0 | 12.5-15.0 | 2.50-3.0 | N 0.10 |
| EN 10217-7:2014 | X2CrNiMo17-12-2 | --- | 1.4404 | 0.030 | 2.00 | 1.00 | 0.045 | 0.015 | 16.5-18.5 | 10.0-13.0 | 2.00-2.50 | N 0.10 |
| | X2CrNiMo17-12-3 | --- | 1.4432 | 0.030 | 2.00 | 1.00 | 0.045 | 0.015 | 16.5-18.5 | 10.5-13.0 | 2.50-3.0 | N 0.10 |
| | X2CrNiMo18-14-3 | --- | 1.4435 | 0.030 | 2.00 | 1.00 | 0.045 | 0.015 | 17.0-19.0 | 12.5-15.0 | 2.50-3.0 | N 0.10 |
| JIS G 3459:2012 | Symbol SUS316LTP | --- | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 16.00-18.00 | 12.00-16.00 | 2.00-3.00 | --- |
| JIS G 3463:2012 | Symbol SUS316LTB | --- | --- | 0.030 | 2.00 | 1.00 | 0.040 | 0.030 | 16.00-18.00 | 12.00-16.00 | 2.00-3.00 | --- |
| JIS G 3468:2011 | Symbol SUS316LTPY | --- | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 16.00-18.00 | 12.00-15.00 | 2.00-3.00 | --- |
| ASME SA-213/SA-213M | Grade TP316LN | S31653 | --- | 0.035 | 2.00 | 1.00 | 0.045 | 0.030 | 16.0-18.0 | 10.0-13.0 | 2.00-3.00 | N 0.10-0.16 |
| ASME SA-249/SA-249M | Grade TP316LN | S31653 | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 16.0-18.0 | 10.0-13.0 | 2.00-3.00 | N 0.10-0.16 |
| ASME SA-376/SA-376M | Grade TP316LN | S31653 | --- | 0.035 | 2.00 | 0.75 | 0.045 | 0.030 | 16.0-18.0 | 11.0-14.0 | 2.00-3.00 | N 0.10-0.16 |
| ASME SA-688/SA-688M | Grade TP 316LN | S31653 | --- | 0.035 | 2.00 | 0.75 | 0.040 | 0.030 | 16.00-18.00 | 10.00-15.00 | 2.00-3.00 | N 0.10-0.16 |
| ASTM A213/A213M-15a | Grade TP316LN | S31653 | --- | 0.035 | 2.00 | 1.00 | 0.045 | 0.030 | 16.0-18.0 | 10.0-13.0 | 2.00-3.00 | N 0.10-0.16 |
| ASTM A249/A249M-14a | Grade TP316LN | S31653 | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 16.0-18.0 | 10.0-13.0 | 2.00-3.00 | N 0.10-0.16 |
| ASTM A376/A376M-14 | Grade TP316LN | S31653 | --- | 0.035 | 2.00 | 0.75 | 0.045 | 0.030 | 16.0-18.0 | 11.0-14.0 | 2.00-3.00 | N 0.10-0.16 |
| ASTM A688/A688M-15 | Grade TP316LN | S31653 | --- | 0.035 | 2.00 | 0.75 | 0.040 | 0.030 | 16.00-18.00 | 10.00-15.00 | 2.00-3.00 | N 0.10-0.16 |
| EN 10216-5:2013 | X2CrNiMoN17-13-3 | --- | 1.4429 | 0.030 | 2.00 | 1.00 | 0.040 | 0.015 | 16.5-18.5 | 11.0-14.0 | 2.50-3.0 | N 0.12-0.22 |
| EN 10217-7:2014 | X2CrNiMoN17-13-3 | --- | 1.4429 | 0.030 | 2.00 | 1.00 | 0.045 | 0.015 | 16.5-18.5 | 11.0-14.0 | 2.50-3.0 | N 0.12-0.22 |

*: See "List of Standards" at the beginning of the chapter.

**5.9 Stainless Steel Tubes and Pipes for Pressure Purposes and High Temperatures**

**5.9.2A Chemical Composition of Austenitic Stainless Steel Tubes and Pipes for Pressure Purposes and High Temperatures (Continued)**

| Specification | Designation | UNS No. | Steel No. | Weight, % max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASME SA-213/SA-213M | Grade TP316H | S31609 | --- | 0.04-0.10 | 2.00 | 1.00 | 0.045 | 0.030 | 16.0-18.0 | 11.0-14.0 | 2.00-3.00 | --- |
| ASME SA-249/SA-249M | Grade TP316H | S31609 | --- | 0.04-0.10 | 2.00 | 1.00 | 0.045 | 0.030 | 16.0-18.0 | 10.0-14.0 | 2.00-3.00 | --- |
| ASME SA-312/SA-312M | Grade TP316H | S31609 | --- | 0.04-0.10 | 2.00 | 1.00 | 0.045 | 0.030 | 16.0-18.0 | 11.0-14.0 | 2.00-3.00 | --- |
| ASME SA-358/SA-358M* | Grade 316H | S31609 | --- | 0.04-0.10 | 2.00 | 0.75 | 0.045 | 0.030 | 16.0-18.0 | 10.0-14.0 | 2.00-3.00 | --- |
| ASME SA-376/SA-376M | Grade TP316H | S31609 | --- | 0.04-0.10 | 2.00 | 0.75 | 0.045 | 0.030 | 16.0-18.0 | 11.0-14.0 | 2.00-3.00 | --- |
| ASTM A213/A213M-15a | Grade TP316H | S31609 | --- | 0.04-0.10 | 2.00 | 1.00 | 0.045 | 0.030 | 16.0-18.0 | 11.0-14.0 | 2.00-3.00 | --- |
| ASTM A249/A249M-14a | Grade TP316H | S31609 | --- | 0.04-0.10 | 2.00 | 1.00 | 0.045 | 0.030 | 16.0-18.0 | 10.0-14.0 | 2.00-3.00 | --- |
| ASTM A312/A312M-15 | Grade TP316H | S31609 | --- | 0.04-0.10 | 2.00 | 1.00 | 0.045 | 0.030 | 16.0-18.0 | 11.0-14.0 | 2.00-3.00 | --- |
| ASTM A358/A358M-14a* | Grade 316H | S31609 | --- | 0.04-0.10 | 2.00 | 0.75 | 0.045 | 0.030 | 16.0-18.0 | 10.0-14.0 | 2.00-3.00 | --- |
| ASTM A376/A376M-14 | Grade TP316H | S31609 | --- | 0.04-0.10 | 2.00 | 0.75 | 0.045 | 0.030 | 16.0-18.0 | 11.0-14.0 | 2.00-3.00 | --- |
| EN 10216-5:2013 | X6CrNiMo17-13-2 | --- | 1.4918 | 0.04-0.08 | 2.00 | 0.75 | 0.035 | 0.015 | 16.0-18.0 | 12.0-14.0 | 2.00-2.50 | --- |
| JIS G 3459:2012 | Symbol SUS316HTP | --- | --- | 0.04-0.10 | 2.00 | 0.75 | 0.030 | 0.030 | 16.00-18.00 | 11.00-14.00 | 2.00-3.00 | --- |
| JIS G 3463:2012 | Symbol SUS316HTB | --- | --- | 0.04-0.10 | 2.00 | 0.75 | 0.030 | 0.030 | 16.00-18.00 | 11.00-14.00 | 2.00-3.00 | --- |
| JIS G 3467:2013 | Symbol SUS316HTF | --- | --- | 0.04-0.10 | 2.00 | 0.75 | 0.030 | 0.030 | 16.00-18.00 | 11.00-14.00 | 2.00-3.00 | --- |
| EN 10216-5:2013 | X6CrNiMoTi17-12-2 | --- | 1.4571 | 0.08 | 2.00 | 1.00 | 0.040 | 0.015 | 16.5-18.5 | 10.5-13.5 | 2.00-2.50 | Ti 5xC to 0.70 |
| EN 10217-7:2014 | X6CrNiMoTi17-12-2 | --- | 1.4571 | 0.08 | 2.00 | 1.00 | 0.045 | 0.015 | 16.5-18.5 | 10.5-13.5 | 2.00-2.50 | Ti 5xC to 0.70 |
| JIS G 3459:2012 | Symbol SUS316TiTP | --- | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 16.00-18.00 | 10.00-14.00 | 2.00-3.00 | Ti 5xC min |
| JIS G 3463:2012 | Symbol SUS316TiTB | --- | --- | 0.08 | 2.00 | 1.00 | 0.040 | 0.030 | 16.00-18.00 | 10.00-1400 | 2.00-3.00 | Ti 5xC min |
| ASME SA-213/SA-213M | Grade TP317 | S31700 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 18.0-20.0 | 11.0-15.0 | 3.0-4.0 | --- |
| ASME SA-249/SA-249M | Grade TP317 | S31700 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 18.0-20.0 | 11.0-15.0 | 3.0-4.0 | --- |
| ASME SA-312/SA-312M | Grade TP317 | S31700 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 18.0-20.0 | 11.0-14.0 | 3.0-4.0 | --- |
| ASME SA-409/SA-409M | Grade TP317 | S31700 | --- | 0.08 | 2.00 | 0.75 | 0.045 | 0.030 | 18.0-20.0 | 11.0-14.0 | 3.0-4.0 | --- |
| ASTM A213/A213M-15a | Grade TP317 | S31700 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 18.0-20.0 | 11.0-15.0 | 3.0-4.0 | --- |
| ASTM A249/A249M-14a | Grade TP317 | S31700 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 18.0-20.0 | 11.0-15.0 | 3.0-4.0 | --- |
| ASTM A312/A312M-15 | Grade TP317 | S31700 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 18.0-20.0 | 11.0-15.0 | 3.0-4.0 | --- |
| ASTM A409/A409M-15 | Grade TP317 | S31700 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 18.0-20.0 | 11.0-15.0 | 3.0-4.0 | --- |
| JIS G 3459:2012 | Symbol SUS317TP | --- | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 18.00-20.00 | 11.00-15.00 | 3.00-4.00 | --- |
| JIS G 3463:2012 | Symbol SUS317TB | --- | --- | 0.08 | 2.00 | 1.00 | 0.040 | 0.030 | 18.00-20.00 | 11.00-15.00 | 3.00-4.00 | --- |
| JIS G 3468:2011 | Symbol SUS317TPY | --- | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 18.00-20.00 | 11.00-15.00 | 3.00-4.00 | --- |

*: See "List of Standards" at the beginning of the chapter.

**5.9 Stainless Steel Tubes and Pipes for Pressure Purposes and High Temperatures**

**5.9.2A Chemical Composition of Austenitic Stainless Steel Tubes and Pipes for Pressure Purposes and High Temperatures (Continued)**

| Specification | Designation | UNS No. | Steel No. | Weight, % max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASME SA-213/SA-213M | Grade TP317L | S31703 | --- | 0.035 | 2.00 | 1.00 | 0.045 | 0.030 | 18.0-20.0 | 11.0-15.0 | 3.0-4.0 | --- |
| ASME SA-249/SA-249M | Grade TP317L | S31703 | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 18.0-20.0 | 11.0-15.0 | 3.0-4.0 | --- |
| ASME SA-312/SA-312M | Grade TP317L | S31703 | --- | 0.035 | 2.00 | 1.00 | 0.045 | 0.030 | 18.0-20.0 | 11.0-15.0 | 3.0-4.0 | --- |
| ASTM A213/A213M-15a | Grade TP317L | S31703 | --- | 0.035 | 2.00 | 1.00 | 0.045 | 0.030 | 18.0-20.0 | 11.0-15.0 | 3.0-4.0 | --- |
| ASTM A249/A249M-14a | Grade TP317L | S31703 | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 18.0-20.0 | 11.0-15.0 | 3.0-4.0 | --- |
| ASTM A312/A312M-15 | Grade TP317L | S31703 | --- | 0.035 | 2.00 | 1.00 | 0.045 | 0.030 | 18.0-20.0 | 11.0-15.0 | 3.0-4.0 | --- |
| EN 10217-7:2014 | X2CrNiMo18-15-4 | --- | 1.4438 | 0.030 | 2.00 | 1.00 | 0.045 | 0.015 | 17.5-19.5 | 13.0-16.0 | 3.0-4.0 | N 0.10 |
| JIS G 3459:2012 | Symbol SUS317LTP | --- | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 18.00-20.00 | 11.00-15.00 | 3.00-4.00 | --- |
| JIS G 3463:2012 | Symbol SUS317LTB | --- | --- | 0.030 | 2.00 | 1.00 | 0.040 | 0.030 | 18.00-20.00 | 11.00-15.00 | 3.00-4.00 | --- |
| JIS G 3468:2011 | Symbol SUS317LTPY | --- | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 18.00-20.00 | 11.00-15.00 | 3.00-4.00 | --- |
| ASME SA-213/SA-213M | Grade TP317LM | S31725 | --- | 0.03 | 2.00 | 1.00 | 0.045 | 0.030 | 18.0-20.0 | 13.5-17.5 | 4.0-5.0 | Cu 0.75; N 0.20 |
| ASME SA-249/SA-249M | --- | S31725 | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 18.0-20.0 | 13.5-17.5 | 4.0-5.0 | N 0.20 |
| ASME SA-312/SA-312M | --- | S31725 | --- | 0.03 | 2.00 | 1.00 | 0.040 | 0.030 | 18.0-20.0 | 13.5-17.5 | 4.0-5.0 | Cu 0.75; N 0.10 |
| ASME SA-358/SA-358M* | --- | S31725 | --- | 0.030 | 2.00 | 0.75 | 0.045 | 0.030 | 18.0-20.0 | 13.5-17.5 | 4.0-5.0 | N 0.20 |
| ASME SA-376/SA-376M | --- | S31725 | --- | 0.030 | 2.00 | 0.75 | 0.045 | 0.030 | 18.0-20.0 | 13.5-17.5 | 4.0-5.0 | Cu 0.75; N 0.20 |
| ASME SA-409/SA-409M | --- | S31725 | --- | 0.03 | 2.00 | 0.75 | 0.045 | 0.030 | 18.0-20.0 | 13.5-17.5 | 4.0-5.0 | Cu 0.75; N 0.10 |
| ASTM A213/A213M-15a | Grade TP317LM | S31725 | --- | 0.03 | 2.00 | 1.00 | 0.045 | 0.030 | 18.0-20.0 | 13.5-17.5 | 4.0-5.0 | Cu 0.75; N 0.20 |
| ASTM A249/A249M-14a | --- | S31725 | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 18.0-20.0 | 13.5-17.5 | 4.0-5.0 | N 0.20 |
| ASTM A312/A312M-15 | --- | S31725 | --- | 0.03 | 2.00 | 1.00 | 0.040 | 0.030 | 18.0-20.0 | 13.5-17.5 | 4.0-5.0 | Cu 0.75; N 0.10 |
| ASTM A358/A358M-14a* | --- | S31725 | --- | 0.030 | 2.00 | 0.75 | 0.045 | 0.030 | 18.0-20.0 | 13.5-17.5 | 4.0-5.0 | N 0.20 |
| ASTM A376/A376M-14 | --- | S31725 | --- | 0.030 | 2.00 | 0.75 | 0.045 | 0.030 | 18.0-20.0 | 13.5-17.5 | 4.0-5.0 | Cu 0.75; N 0.20 |
| ASTM A409/A409M-15 | --- | S31725 | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 18.0-20.0 | 13.5-17.5 | 4.0-5.0 | N 0.020 |
| EN 10216-5:2013 | X2CrNiMoN17-13-5 | --- | 1.4439 | 0.030 | 2.00 | 1.00 | 0.040 | 0.015 | 16.5-18.5 | 12.5-14.5 | 4.0-5.0 | N 0.12-0.22 |
| EN 10217-7:2014 | X2CrNiMoN17-13-5 | --- | 1.4439 | 0.030 | 2.00 | 1.00 | 0.045 | 0.015 | 16.5-18.5 | 12.5-14.5 | 4.0-5.0 | N 0.12-0.22 |

*: See "List of Standards" at the beginning of the chapter.

**5.9 Stainless Steel Tubes and Pipes for Pressure Purposes and High Temperatures**

**5.9.2A Chemical Composition of Austenitic Stainless Steel Tubes and Pipes for Pressure Purposes and High Temperatures (Continued)**

| Specification | Designation | UNS No. | Steel No. | Weight, % max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASME SA-213/SA-213M | Grade TP321 | S32100 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 17.0-19.0 | 9.0-12.0 | --- | Ti 5x(C+N) to 0.70 |
| ASME SA-249/SA-249M | Grade TP321 | S32100 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 17.0-19.0 | 9.0-12.0 | --- | N 0.10; Ti 5x(C+N) to 0.70 |
| ASME SA-312/SA-312M | Grade TP321 | S32100 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 17.0-19.0 | 9.0-12.0 | --- | N 0.10; Ti 5xC to 0.70 |
| ASME SA-358/SA-358M* | Grade 321 | S32100 | --- | 0.08 | 2.00 | 0.75 | 0.045 | 0.030 | 17.0-19.0 | 9.0-12.0 | --- | N 0.10; Ti 5x(C+N) to 0.70 |
| ASME SA-376/SA-376M | Grade TP321 | S32100 | --- | 0.08 | 2.00 | 0.75 | 0.045 | 0.030 | 17.0-19.0 | 9.0-13.0 | --- | Ti 5xC to 0.70 |
| ASME SA-409/SA-409M | Grade TP321 | S32100 | --- | 0.08 | 2.00 | 0.75 | 0.045 | 0.030 | 17.0-20.0 | 9.00-12.0 | --- | Ti 5xC to 0.70 |
| ASTM A213/A213M-15a | Grade TP321 | S32100 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 17.0-19.0 | 9.0-12.0 | --- | Ti 5x(C+N) to 0.70 |
| ASTM A249/A249M-14a | Grade TP321 | S32100 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 17.0-19.0 | 9.0-12.0 | --- | N 0.10; Ti 5x(C+N) to 0.70 |
| ASTM A312/A312M-15 | Grade TP321 | S32100 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 17.0-19.0 | 9.0-12.0 | --- | N 0.10; Ti 5x(C+N) to 0.70 |
| ASTM A358/A358M-14a* | Grade 321 | S32100 | --- | 0.08 | 2.00 | 0.75 | 0.045 | 0.030 | 17.0-19.0 | 9.0-12.0 | --- | N 0.10; Ti 5x(C+N) to 0.70 |
| ASTM A376/A376M-14 | Grade TP321 | S32100 | --- | 0.08 | 2.00 | 0.75 | 0.045 | 0.030 | 17.0-19.0 | 9.0-13.0 | --- | Ti 5xC to 0.70 |
| ASTM A409/A409M-15 | Grade TP321 | S32100 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 17.0-20.0 | 9.00-12.0 | --- | Ti 5xC to 0.70 |
| EN 10216-5:2013 | X6CrNiTi18-10 | --- | 1.4541 | 0.08 | 2.00 | 1.00 | 0.040 | 0.015 | 17.0-19.0 | 9.0-12.0 | --- | Ti 5xC to 0.70 |
| EN 10217-7:2014 | X6CrNiTi18-10 | --- | 1.4541 | 0.08 | 2.00 | 1.00 | 0.045 | 0.015 | 17.0-19.0 | 9.0-12.0 | --- | Ti 5xC to 0.70 |
| JIS G 3459:2012 | Symbol SUS321TP | --- | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 17.00-19.00 | 9.00-13.00 | --- | Ti 5xC min |
| JIS G 3463:2012 | Symbol SUS321TB | --- | --- | 0.08 | 2.00 | 1.00 | 0.040 | 0.030 | 17.00-19.00 | 9.00-13.00 | --- | Ti 5xC min |
| JIS G 3467:2013 | Symbol SUS321TF | --- | --- | 0.08 | 2.00 | 1.00 | 0.040 | 0.030 | 17.00-19.00 | 9.00-13.00 | --- | Ti 5xC min |
| JIS G 3468:2011 | Symbol SUS321TPY | --- | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 17.00-19.00 | 9.00-13.00 | --- | Ti 5xC min |
| ASME SA-213/SA-213M | Grade TP321H | S32109 | --- | 0.04-0.10 | 2.00 | 1.00 | 0.045 | 0.030 | 17.0-19.0 | 9.0-12.0 | --- | Ti 4x(C+N) to 0.70 |
| ASME SA-249/SA-249M | Grade TP321H | S32109 | --- | 0.04-0.10 | 2.00 | 1.00 | 0.045 | 0.030 | 17.0-19.0 | 9.0-12.0 | --- | N 0.10; Ti 5x(C+N) to 0.70 |
| ASME SA-312/SA-312M | Grade TP321H | S32109 | --- | 0.04-0.10 | 2.00 | 1.00 | 0.045 | 0.030 | 17.0-19.0 | 9.0-12.0 | --- | Ti 4xC to 0.60 |
| ASME SA-376/SA-376M | Grade TP321H | S32109 | --- | 0.04-0.10 | 2.00 | 0.75 | 0.045 | 0.030 | 17.0-19.0 | 9.0-13.0 | --- | Ti 4xC to 0.70 |
| ASTM A213/A213M-15a | Grade TP321H | S32109 | --- | 0.04-0.10 | 2.00 | 1.00 | 0.045 | 0.030 | 17.0-19.0 | 9.00-12.0 | --- | Ti 4x(C+N) to 0.70 |
| ASTM A249/A249M-14a | Grade TP321H | S32109 | --- | 0.04-0.10 | 2.00 | 1.00 | 0.045 | 0.030 | 17.0-19.0 | 9.00-12.0 | --- | N 0.10; Ti 5x(C+N) to 0.70 |
| ASTM A312/A312M-15 | Grade TP321H | S32109 | --- | 0.04-0.10 | 2.00 | 1.00 | 0.045 | 0.030 | 17.0-19.0 | 9.0-12.0 | --- | N 0.10; Ti 4xC to 0.70 |
| ASTM A376/A376M-14 | Grade TP321H | S32109 | --- | 0.04-0.10 | 2.00 | 0.75 | 0.045 | 0.030 | 17.0-19.0 | 9.0-13.0 | --- | Ti 4xC to 0.70 |
| EN 10216-5:2013 | X7CrNiTi18-10 | --- | 1.4940 | 0.04-0.08 | 2.00 | 1.00 | 0.040 | 0.015 | 17.0-19.0 | 9.0-13.0 | --- | N 0.10; Ti 5x(C+N) to 0.80 |
| JIS G 3459:2012 | Symbol SUS321HTP | --- | --- | 0.04-0.10 | 2.00 | 0.75 | 0.030 | 0.030 | 17.00-20.00 | 9.00-13.00 | --- | Ti 4xC to 0.60 |
| JIS G 3463:2012 | Symbol SUS321HTB | --- | --- | 0.04-0.10 | 2.00 | 0.75 | 0.030 | 0.030 | 17.00-20.00 | 9.00-13.00 | --- | Ti 4xC to 0.60 |
| JIS G 3467:2013 | Symbol SUS321HTF | --- | --- | 0.04-0.10 | 2.00 | 0.75 | 0.030 | 0.030 | 17.00-20.00 | 9.00-13.00 | --- | Ti 4xC to 0.60 |

*: See "List of Standards" at the beginning of the chapter.

**5.9 Stainless Steel Tubes and Pipes for Pressure Purposes and High Temperatures**

**5.9.2A Chemical Composition of Austenitic Stainless Steel Tubes and Pipes for Pressure Purposes and High Temperatures (Continued)**

| Specification | Designation | UNS No. | Steel No. | Weight, % max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASME SA-213/SA-213M | Grade TP347 | S34700 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 17.0-20.0 | 9.0-13.0 | --- | Nb 10xC to 1.10 |
| ASME SA-249/SA-249M | Grade TP347 | S34700 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 17.0-19.0 | 9.0-12.0 | --- | Cb 10xC to 1.10 |
| ASME SA-312/SA-312M | Grade TP347 | S34700 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 17.0-19.0 | 9.0-13.0 | --- | Cb 10xC to 1.00 |
| ASME SA-358/SA-358M* | Grade 347 | S34700 | --- | 0.08 | 2.00 | 0.75 | 0.045 | 0.030 | 17.0-19.0 | 9.0-13.0 | --- | Cb 10xC to 1.00 |
| ASME SA-376/SA-376M | Grade TP347 | S34700 | --- | 0.08 | 2.00 | 0.75 | 0.045 | 0.030 | 17.0-19.0 | 9.0-13.0 | --- | Cb 10xC to 1.10 |
| ASME SA-409/SA-409M | Grade TP347 | S34700 | --- | 0.08 | 2.00 | 0.75 | 0.045 | 0.030 | 17.0-20.0 | 9.00-13.0 | --- | (Cb+Ta) 10xC to 1.0 |
| ASTM A213/A213M-15a | Grade TP347 | S34700 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 17.0-20.0 | 9.0-13.0 | --- | Nb 10xC to 1.10 |
| ASTM A249/A249M-14a | Grade TP347 | S34700 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 17.0-19.0 | 9.0-12.0 | --- | Cb 10xC to 1.10 |
| ASTM A312/A312M-15 | Grade TP347 | S34700 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 17.0-19.0 | 9.0-13.0 | --- | Cb 10xC to 1.00 |
| ASTM A358/A358M-14a* | Grade 347 | S34700 | --- | 0.08 | 2.00 | 0.75 | 0.045 | 0.030 | 17.0-19.0 | 9.0-13.0 | --- | Cb 10xC to 1.00 |
| ASTM A376/A376M-14 | Grade TP347 | S34700 | --- | 0.08 | 2.00 | 0.75 | 0.045 | 0.030 | 17.0-19.0 | 9.0-13.0 | --- | Cb 10xC to 1.10 |
| ASTM A409/A409M-15 | Grade TP347 | S34700 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 17.0-19.0 | 9.00-12.0 | --- | (Cb+Ta) 10xC to 1.10 |
| EN 10216-5:2013 | X6CrNiNb18-10 | --- | 1.4550 | 0.08 | 2.00 | 1.00 | 0.040 | 0.015 | 17.0-19.0 | 9.0-12.0 | --- | Nb 10xC to 1.00 |
| EN 10217-7:2014 | X6CrNiNb18-10 | --- | 1.4550 | 0.08 | 2.00 | 1.00 | 0.045 | 0.015 | 17.0-19.0 | 9.0-12.0 | --- | Nb 10xC to 1.00 |
| JIS G 3459:2012 | Symbol SUS347TP | --- | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 17.00-19.00 | 9.00-13.00 | --- | Nb 10xC min |
| JIS G 3463:2012 | Symbol SUS347TB | --- | --- | 0.08 | 2.00 | 1.00 | 0.040 | 0.030 | 17.00-19.00 | 9.00-13.00 | --- | Nb 10xC min |
| JIS G 3467:2013 | Symbol SUS347TF | --- | --- | 0.08 | 2.00 | 1.00 | 0.040 | 0.030 | 17.00-19.00 | 9.00-13.00 | --- | Nb 10xC min |
| JIS G 3468:2011 | Symbol SUS347TPY | --- | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 17.00-19.00 | 9.00-13.00 | --- | Nb 10xC min |
| ASME SA-213/SA-213M | Grade TP347H | S34709 | --- | 0.04-0.10 | 2.00 | 1.00 | 0.045 | 0.030 | 17.0-19.0 | 9.0-13.0 | --- | Nb 8xC to 1.10 |
| | Grade TP347HFG | S34710 | --- | 0.06-0.10 | 2.00 | 1.00 | 0.045 | 0.030 | 17.0-19.0 | 9.0-13.0 | --- | Nb 8xC to 1.10 |
| ASME SA-249/SA-249M | Grade TP347H | S34709 | --- | 0.04-0.10 | 2.00 | 1.00 | 0.045 | 0.030 | 17.0-19.0 | 9.0-12.0 | --- | Cb 8xC to 1.10 |
| ASME SA-312/SA-312M | Grade TP347H | S34709 | --- | 0.04-0.10 | 2.00 | 1.00 | 0.045 | 0.030 | 17.0-19.0 | 9.0-13.0 | --- | Cb 8xC to 1.0 |
| ASME SA-376/SA-376M | Grade TP347H | S34709 | --- | 0.04-0.10 | 2.00 | 0.75 | 0.045 | 0.030 | 17.0-19.0 | 9.0-13.0 | --- | Cb 8xC to 1.10 |
| ASTM A213/A213M-15a | Grade TP347H | S34709 | --- | 0.04-0.10 | 2.00 | 1.00 | 0.045 | 0.030 | 17.0-19.0 | 9.0-13.0 | --- | Nb 8xC to 1.10 |
| | Grade TP347HFG | S34710 | --- | 0.06-0.10 | 2.00 | 1.00 | 0.045 | 0.030 | 17.0-19.0 | 9.0-13.0 | --- | Nb 8xC to 1.10 |
| ASTM A249/A249M-14a | Grade TP347H | S34709 | --- | 0.04-0.10 | 2.00 | 1.00 | 0.045 | 0.030 | 17.0-19.0 | 9.0-12.0 | --- | Cb 8xC to 1.10 |
| ASTM A312/A312M-15 | Grade TP347H | S34709 | --- | 0.04-0.10 | 2.00 | 1.00 | 0.045 | 0.030 | 17.0-19.0 | 9.0-13.0 | --- | Cb 8xC to 1.0 |
| ASTM A376/A376M-14 | Grade TP347H | S34709 | --- | 0.04-0.10 | 2.00 | 0.75 | 0.045 | 0.030 | 17.0-19.0 | 9.0-13.0 | --- | Cb 8xC to 1.10 |
| EN 10216-5:2013 | X7CrNiNb18-10 | --- | 1.4912 | 0.04-0.10 | 2.00 | 1.00 | 0.040 | 0.015 | 17.0-19.0 | 9.0-12.0 | --- | Nb 10xC to 1.20 |
| GB 5310-1995 | Grade 1Cr19Ni11Nb | --- | --- | 0.04-0.10 | 2.00 | 1.00 | 0.03 | 0.03 | 17.00-20.00 | 9.00-13.00 | --- | (Nb+Ta) 0.80-1.00; Cu 0.20 |
| JIS G 3459:2012 | Symbol SUS347HTP | --- | --- | 0.04-0.10 | 2.00 | 1.00 | 0.030 | 0.030 | 17.00-20.00 | 9.00-13.00 | --- | Nb 8xC to 1.00 |
| JIS G 3463:2012 | Symbol SUS347HTB | --- | --- | 0.04-0.10 | 2.00 | 1.00 | 0.030 | 0.030 | 17.00-20.00 | 9.00-13.00 | --- | Nb 8xC to 1.00 |
| JIS G 3467:2013 | Symbol SUS347HTF | --- | --- | 0.04-0.10 | 2.00 | 0.75 | 0.030 | 0.030 | 17.00-20.00 | 9.00-13.00 | --- | Nb 8xC to 1.00 |

*: See "List of Standards" at the beginning of the chapter.

**5.9 Stainless Steel Tubes and Pipes for Pressure Purposes and High Temperatures**

**5.9.2A Chemical Composition of Austenitic Stainless Steel Tubes and Pipes for Pressure Purposes and High Temperatures (Continued)**

| Specification | Designation | UNS No. | Steel No. | Weight, % max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASTM A240/A240M-15a | Type 800 | N08800 | --- | 0.10 | 1.50 | 1.00 | 0.045 | 0.015 | 19.0-23.0 | 30.0-35.0 | --- | Cu 0.75; Ti 0.15-0.60 Al 0.15-0.60; Fe 39.5 min; |
| JIS G 3467:2013 | Symbol NCF800TF | --- | --- | 0.10 | 1.50 | 1.00 | 0.030 | 0.015 | 19.00-23.00 | 30.00-35.00 | --- | Cu 0.75; Al 0.15-0.60; Ti 0.15-0.60 |
| ASTM A240/A240M-15a | Type 800H | N08810 | --- | 0.05-0.10 | 1.50 | 1.00 | 0.045 | 0.015 | 19.0-23.0 | 30.0-35.0 | --- | Cu 0.75; Ti 0.15-0.60; Al 0.15-0.60; Fe 39.5 min |
| JIS G 3467:2013 | Symbol NCF800HTF | --- | --- | 0.05-0.10 | 1.50 | 1.00 | 0.030 | 0.015 | 19.00-23.00 | 30.00-35.00 | --- | Cu 0.75; Al 0.15-0.60; Ti 0.15-0.60 |
| ASME SA-249/SA-249M | --- | N08367 | --- | 0.030 | 2.00 | 1.00 | 0.040 | 0.030 | 20.0-22.0 | 23.5-25.5 | 6.0-7.0 | Cu 0.75; N 0.18-0.25 |
| | --- | N08926 | --- | 0.020 | 2.00 | 0.50 | 0.030 | 0.010 | 19.0-21.0 | 24.0-26.0 | 6.0-7.0 | Cu 0.50-1.50; N 0.15-0.25 |
| ASME SA-312/SA-312M | --- | N08926 | --- | 0.020 | 2.00 | 0.50 | 0.030 | 0.010 | 19.0-21.0 | 24.0-26.0 | 6.0-7.0 | Cu 0.50-1.50; N 0.15-0.25 |
| ASME SA-688/SA-688M | --- | N08367 | --- | 0.030 | 2.00 | 1.00 | 0.040 | 0.030 | 20.00-22.00 | 23.50-25.50 | 6.00-7.00 | Cu 0.75; N 0.18-0.25 |
| | --- | N08926 | --- | 0.020 | 2.00 | 0.5 | 0.03 | 0.01 | 19.00-21.00 | 24.00-26.00 | 6.0-7.0 | Cu 0.5-1.5; N 0.15-0.25 |
| ASTM A249/A249M-14a | --- | N08367 | --- | 0.030 | 2.00 | 1.00 | 0.040 | 0.030 | 20.0-22.0 | 23.5-25.5 | 6.0-7.0 | N 0.18-0.25; Cu 0.75 |
| | --- | N08926 | --- | 0.020 | 2.00 | 0.50 | 0.030 | 0.010 | 19.0-21.0 | 24.0-26.0 | 6.0-7.0 | N 0.15-0.25; Cu 0.50-1.50 |
| ASTM A312/A312M-15 | --- | N08926 | --- | 0.020 | 2.00 | 0.50 | 0.030 | 0.010 | 19.0-21.0 | 24.0-26.0 | 6.0-7.0 | N 0.15-0.25; Cu 0.50-1.50 |
| ASTM A688/A688M-15 | --- | N08367 | --- | 0.030 | 2.00 | 1.00 | 0.040 | 0.030 | 20.00-22.00 | 23.50-25.50 | 6.00-7.00 | N 0.18-0.25; Cu 0.75 |
| | --- | N08926 | --- | 0.020 | 2.00 | 0.5 | 0.03 | 0.01 | 19.00-21.00 | 24.00-26.00 | 6.0-7.0 | N 0.15-0.25; Cu 0.5-1.5 |
| JIS G 3463:2012 | Symbol SUS836LTB | --- | --- | 0.030 | 2.00 | 1.00 | 0.040 | 0.030 | 19.00-24.00 | 24.00-26.00 | 5.00-7.00 | N 0.25 |
| ASME SA-249/SA-249M | --- | N08904 | --- | 0.020 | 2.00 | 1.00 | 0.040 | 0.030 | 19.0-23.0 | 23.0-28.0 | 4.0-5.0 | N 0.10; Cu 1.00-2.00 |
| ASME SA-358/SA-358M* | --- | N08904 | --- | 0.020 | 2.00 | 1.00 | 0.045 | 0.035 | 19.0-23.0 | 23.0-28.0 | 4.00-5.00 | N 0.10; Cu 1.00-2.00 |
| | | N08926 | --- | 0.020 | 2.00 | 0.50 | 0.030 | 0.010 | 19.0-21.0 | 24.0-26.0 | 6.00-7.00 | N 0.15-0.25; Cu 0.50-1.50 |
| ASTM A249/A249M-14a | --- | N08904 | --- | 0.020 | 2.00 | 1.00 | 0.040 | 0.030 | 19.0-23.0 | 23.0-28.0 | 4.0-5.0 | N 0.10; Cu 1.00-2.00 |
| ASTM A269/A269M-14e1 | --- | N08904 | --- | 0.020 | 2.00 | 1.00 | 0.040 | 0.030 | 19.0-23.0 | 23.0-28.0 | 4.0-5.0 | N 0.10; Cu 1.00-2.00 |
| | --- | N08925 | --- | 0.020 | 1.00 | 0.50 | 0.045 | 0.030 | 19.0-21.0 | 24.0-26.0 | 6.0-7.0 | N 0.10-0.20; Cu 0.80-1.50 |
| ASTM A358/A358M-14a* | --- | N08904 | --- | 0.020 | 2.00 | 1.00 | 0.045 | 0.035 | 19.0-23.0 | 23.0-28.0 | 4.00-5.00 | N 0.10; Cu 1.00-2.00 |
| | | N08926 | --- | 0.020 | 2.00 | 0.50 | 0.030 | 0.010 | 19.0-21.0 | 24.0-26.0 | 6.00-7.00 | N 0.15-0.25; Cu 0.50-1.50 |
| EN 10216-5:2013 | X1NiCrMoCu25-20-5 | --- | 1.4539 | 0.020 | 2.00 | 0.70 | 0.030 | 0.010 | 19.0-21.0 | 24.0-26.0 | 4.0-5.0 | N 0.15; Cu 1.20-2.00 |
| | X1NiCrMoCuN25-20-7 | --- | 1.4529 | 0.020 | 1.00 | 0.50 | 0.030 | 0.010 | 19.0-21.0 | 24.0-26.0 | 6.0-7.0 | Cu 0.50-1.50; N 0.15-0.25 |
| EN 10217-7:2014 | X1NiCrMoCu25-20-5 | --- | 1.4539 | 0.020 | 2.00 | 0.70 | 0.030 | 0.010 | 19.0-21.0 | 24.0-26.0 | 4.0-5.0 | N 0.15; Cu 1.20-2.00 |
| | X1NiCrMoCuN25-20-7 | --- | 1.4529 | 0.020 | 1.00 | 0.50 | 0.030 | 0.010 | 19.0-21.0 | 24.0-26.0 | 6.0-7.0 | Cu 0.50-1.50; N 0.15-0.25 |
| JIS G 3459:2012 | Symbol SUS890LTP | --- | --- | 0.020 | 2.00 | 1.00 | 0.045 | 0.030 | 19.00-23.00 | 23.00-28.00 | 4.00-5.00 | Cu 1.00-2.00 |
| JIS G 3463:2012 | Symbol SUS890LTB | --- | --- | 0.020 | 2.00 | 1.00 | 0.040 | 0.030 | 19.00-23.00 | 23.00-28.00 | 4.00-5.00 | Cu 1.00-2.00 |

*: See "List of Standards" at the beginning of the chapter.

**5.9 Stainless Steel Tubes and Pipes for Pressure Purposes and High Temperatures**

**5.9.2B Mechanical Properties of Austenitic Stainless Steel Tubes and Pipes for Pressure Purposes and High Temperatures**

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter | | Yield Strength | | Tensile Strength | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | %, min. | | |
| ASME SA-213/SA-213M | Grade TP304 | S30400 | --- | 0.4 ≤ t ≤ 12.7 | 0.015 ≤ t ≤ 0.500 | 205 | 30 | 515 | 75 | 35 | ST+Q or RC | 192 max HBW/ 200 max HV; 90 max HRB |
| ASME SA-249/SA-249M | Grade TP304 | S30400 | --- | t ≥ 0.4 | t ≥ 0.015 | 205 | 30 | 515 | 75 | 35 | ST+Q or RC | 90 max HRB |
| ASME SA-312/SA-312M | Grade TP304 | S30400 | --- | --- | --- | 205 | 30 | 515 | 75 | 35 L, 25 T | A+Q or RC | --- |
| ASME SA-358/SA-358M* | Grade 304 | S30400 | --- | --- | --- | 205 | 30 | 515 | 75 | 40 | H or HT | 201 max HBW; 92 max HRBW |
| ASME SA-376/SA-376M | Grade TP304 | S30400 | --- | --- | --- | 205 | 30 | 515 L | 75 L | 35 L, 25 T | HT+Q or RC | --- |
| ASME SA-409/SA-409M | Grade TP304 | S30400 | --- | --- | --- | 205 | 30 | 515 T | 75 T | --- | HT+Q or RC | --- |
| ASME SA-688/SA-688M | Grade TP 304 | S30400 | --- | t ≥ 0.7 | t ≥ 0.028 | 205 | 30 | 515 | 75 | 35 | SA+RC | 90 max HRB |
| ASTM A213/A213M-15a | Grade TP304 | S30400 | --- | 0.4 ≤ t ≤ 12.7 | 0.015 ≤ t ≤ 0.500 | 205 | 30 | 515 | 75 | 35 | ST+Q or RC | 192 max HBW/ 200 max HV; 90 max HRB |
| ASTM A249/A249M-14a | Grade TP304 | S30400 | --- | t ≥ 0.4 | t ≥ 0.015 | 205 | 30 | 515 | 75 | 35 | ST+Q or RC | 90 max HRB |
| ASTM A270/A270M-15* | Grade TP 304 | S30400 | --- | O.D. ≤ 300 | O.D. ≤ 12 | 205 | 30 | 515 | 75 | 35 | HT+Q or RC | 90 max HRB |
| ASTM A312/A312M-15 | Grade TP304 | S30400 | --- | --- | --- | 205 | 30 | 515 | 75 | 35 L; 25 T | A+Q or RC | --- |
| ASTM A358/A358M-14a* | Grade 304 | S30400 | --- | --- | --- | 205 | 30 | 515 | 75 | 40 | H, HT, HT-O or HT-SO | 201 max HBW; 92 max HRBW |
| ASTM A376/A376M-14 | Grade TP304 | S30400 | --- | --- | --- | 205 | 30 | 515 | 75 | 35 L; 25 T | see standard | --- |
| ASTM A409/A409M-15 | Grade TP304 | S30400 | --- | --- | --- | 205 | 30 | 515 T | 75 T | --- | H, HT, HT-O or HT-SO | --- |
| ASTM A688/A688M-15 | Grade TP304 | S30400 | --- | t ≥ 0.7 | t ≥ 0.028 | 205 | 30 | 515 | 75 | 35 | SA+RC | 90 max HRB |
| ASTM A908-03 (2013) | Type 304 | S30400 | --- | 0.05 ≤ t ≤ 0.4 | 0.002 ≤ t ≤ 0.015 | --- | --- | 1030-1370 | 150-200 | --- | --- | --- |
| EN 10216-5:2013 | X5CrNi18-10 | --- | 1.4301 | t ≤ 60 | --- | 195 | --- | 500-700 | --- | 40 L, 35 T | SA | see standard for impact data |
| EN 10217-7:2014 | X5CrNi18-10 | --- | 1.4301 | t ≤ 60 | --- | 195 | --- | 500-700 | --- | 40 L, 35 T | SA | see standard for impact data |
| JIS G 3459:2012 | Symbol SUS304TP | --- | --- | d ≥ 40 | --- | 205 | --- | 520 | --- | 35 L; 25 T | ST | --- |
| JIS G 3463:2012 | Symbol SUS304TB | --- | --- | d < 10 | --- | 205 | --- | 520 | --- | 27 L | ST | --- |
| | | | | 10 ≤ d < 20 | --- | 205 | --- | 520 | --- | 30 L | ST | --- |
| | | | | d ≥ 20 | --- | 205 | --- | 520 | --- | 35 L | ST | --- |
| JIS G 3467:2013 | Symbol SUS304TF | --- | --- | --- | --- | 205 | --- | 520 | --- | 35 | ST | --- |
| JIS G 3468:2011 | Symbol SUS304TPY | --- | --- | --- | --- | 205 | --- | 520 | --- | 35 L; 25 T | ST | --- |

*: See "List of Standards" at the beginning of the chapter.

**5.9 Stainless Steel Tubes and Pipes for Pressure Purposes and High Temperatures**

**5.9.2B Mechanical Properties of Austenitic Stainless Steel Tubes and Pipes for Pressure Purposes and High Temperatures (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter | | Yield Strength | | Tensile Strength | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | %, min. | | |
| ASME SA-213/SA-213M | Grade TP304L | S30403 | --- | 0.4 ≤ t ≤ 12.7 | 0.015 ≤ t ≤ 0.500 | 170 | 25 | 485 | 70 | 35 | ST+Q or RC | 192 max HBW/ 200 max HV; 90 max HRB |
| ASME SA-249/SA-249M | Grade TP304L | S30403 | --- | t ≥ 0.4 | t ≥ 0.015 | 170 | 25 | 485 | 70 | 35 | ST+Q or RC | 90 max HRB |
| | Grade TP304N | S30451 | --- | t ≥ 0.4 | t ≥ 0.015 | 240 | 35 | 550 | 80 | 35 | ST+Q or RC | 90 max HRB |
| ASME SA-312/SA-312M | Grade TP304L | S30403 | --- | --- | --- | 170 | 25 | 485 | 70 | 35 L, 25 T | A+Q or RC | --- |
| ASME SA-358/SA-358M* | Grade 304L | S30403 | --- | --- | --- | 170 | 25 | 485 | 70 | 40 | H or HT | 201 max HBW; 92 max HRBW |
| ASME SA-409/SA-409M | Grade TP304L | S30403 | --- | --- | --- | 170 | 25 | 485 T | 70 T | --- | HT+Q or RC | --- |
| ASME SA-688/SA-688M | Grade TP 304L | S30403 | --- | t ≥ 0.7 | t ≥ 0.028 | 175 | 25 | 485 | 70 | 35 | SA+RC | 90 max HRB |
| ASTM A213/A213M-15a | Grade TP304L | S30403 | --- | 0.4 ≤ t ≤ 12.7 | 0.015 ≤ t ≤ 0.500 | 170 | 25 | 485 | 70 | 35 | ST+Q or RC | 192 max HBW/ 200 max HV; 90 max HRB |
| ASTM A249/A249M-14a | Grade TP304L | S30403 | --- | t ≥ 0.4 | t ≥ 0.015 | 170 | 25 | 485 | 70 | 35 | ST+Q or RC | 90 max HRB |
| | Grade TP304N | S30451 | --- | t ≥ 0.4 | t ≥ 0.015 | 240 | 35 | 550 | 80 | 35 | ST+Q or RC | 90 max HRB |
| ASTM A312/A312M-15 | Grade TP304L | S30403 | --- | --- | --- | 170 | 25 | 485 | 70 | 35 L; 25 T | A+Q or RC | --- |
| ASTM A358/A358M-14a* | Grade 304L | S30403 | --- | --- | --- | 170 | 25 | 485 | 70 | 40 | H, HT, HT-O or HT-SO | 201 max HBW; 92 max HRBW |
| ASTM A409/A409M-15 | Grade TP304L | S30403 | --- | --- | --- | 170 | 25 | 485 T | 70 T | --- | H, HT, HT-O or HT-SO | --- |
| ASTM A688/A688M-15 | Grade TP 304L | S30403 | --- | t ≥ 0.7 | t ≥ 0.028 | 175 | 25 | 485 | 70 | 35 | SA+RC | 90 max HRB |
| EN 10216-5:2013 | X2CrNi18-9 | --- | 1.4307 | t ≤ 60 | --- | 180 | --- | 460-680 | --- | 40 L, 35 T | SA | see standard for impact data |
| | X2CrNi19-11 | --- | 1.4306 | t ≤ 60 | --- | 180 | --- | 460-680 | --- | 40 L, 35 T | SA | see standard for impact data |
| EN 10217-7:2014 | X2CrNi18-9 | --- | 1.4307 | t ≤ 60 | --- | 180 | --- | 470-670 | --- | 40 L, 35 T | SA | see standard for impact data |
| | X2CrNi19-11 | --- | 1.4306 | t ≤ 60 | --- | 180 | --- | 460-680 | --- | 40 L, 35 T | SA | see standard for impact data |
| JIS G 3459:2012 | Symbol SUS304LTP | --- | --- | d ≥ 40 | --- | 175 | --- | 480 | --- | 35 L; 25 T | ST | --- |
| JIS G 3463:2012 | Symbol SUS304LTB | --- | --- | d < 10 | --- | 175 | --- | 480 | --- | 27 L | ST | --- |
| | | | | 10 ≤ d < 20 | --- | 175 | --- | 480 | --- | 30 L | ST | --- |
| | | | | d ≥ 20 | --- | 175 | --- | 480 | --- | 35 L | ST | --- |
| JIS G 3468:2011 | Symbol SUS304LTPY | --- | --- | --- | --- | 175 | --- | 480 | --- | 35 L; 25 T | ST | --- |

*: See "List of Standards" at the beginning of the chapter.

**5.9 Stainless Steel Tubes and Pipes for Pressure Purposes and High Temperatures**

**5.9.2B Mechanical Properties of Austenitic Stainless Steel Tubes and Pipes for Pressure Purposes and High Temperatures (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter | | Yield Strength | | Tensile Strength | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | %, min. | | |
| ASME SA-213/SA-213M | Grade TP304LN | S30453 | --- | 0.4 ≤ t ≤ 12.7 | 0.015 ≤ t ≤ 0.500 | 205 | 30 | 515 | 75 | 35 | ST+Q or RC | 192 max HBW/ 200 max HV; 90 max HRB |
| ASME SA-249/SA-249M | Grade TP304LN | S30453 | --- | t ≥ 0.4 | t ≥ 0.015 | 205 | 30 | 515 | 75 | 35 | ST+Q or RC | 90 max HRB |
| ASME SA-376/SA-376M | Grade TP304LN | S30453 | --- | --- | --- | 205 | 30 | 515 L | 75 L | 35 L, 25 T | HT+Q or RC | --- |
| ASME SA-688/SA-688M | Grade TP 304LN | S30453 | --- | t ≥ 0.7 | t ≥ 0.028 | 205 | 30 | 515 | 75 | 35 | SA+RC | 90 max HRB |
| ASTM A213/A213M-15a | Grade TP304LN | S30453 | --- | 0.4 ≤ t ≤ 12.7 | 0.015 ≤ t ≤ 0.500 | 205 | 30 | 515 | 75 | 35 | ST+Q or RC | 192 mac HBW/ 200 max HV; 90 max HRB |
| ASTM A249/A249M-14a | Grade TP304LN | S30453 | --- | t ≥ 0.4 | t ≥ 0.015 | 205 | 30 | 515 | 75 | 35 | ST+Q or RC | 90 max HRB |
| ASTM A376/A376M-14 | Grade TP304LN | S30453 | --- | --- | --- | 205 | 30 | 515 | 75 | 35 L; 25 T | see standard | --- |
| ASTM A688/A688M-15 | Grade TP304LN | S30453 | --- | t ≥ 0.7 | t ≥ 0.028 | 205 | 30 | 515 | 75 | 35 | SA+RC | 90 max HRB |
| EN 10216-5:2013 | X2CrNiN18-10 | --- | 1.4311 | t ≤ 60 | --- | 270 | --- | 550-760 | --- | 35 L, 30 T | SA | see standard for impact data |
| EN 10217-7:2014 | X2CrNiN18-10 | --- | 1.4311 | t ≤ 60 | --- | 270 | --- | 550-760 | --- | 35 L, 30 T | SA | see standard for impact data |

**5.9 Stainless Steel Tubes and Pipes for Pressure Purposes and High Temperatures**

**5.9.2B Mechanical Properties of Austenitic Stainless Steel Tubes and Pipes for Pressure Purposes and High Temperatures (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter | | Yield Strength | | Tensile Strength | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | %, min. | | |
| ASME SA-213/SA-213M | Grade TP304H | S30409 | --- | 0.4 ≤ t ≤ 12.7 | 0.015 ≤ t ≤ 0.500 | 205 | 30 | 515 | 75 | 35 | ST+Q or RC | 192 max HBW/ 200 max HV; 90 max HRB |
| ASME SA-249/SA-249M | Grade TP304H | S30409 | --- | t ≥ 0.4 | t ≥ 0.015 | 205 | 30 | 515 | 75 | 35 | ST+Q or RC | 90 max HRB |
| ASME SA-312/SA-312M | Grade TP304H | S30409 | --- | --- | --- | 205 | 30 | 515 | 75 | 35 L, 25 T | A+Q or RC | --- |
| ASME SA-358/SA-358M* | Grade 304H | S30409 | --- | --- | --- | 205 | 30 | 515 | 75 | 40 | A+Q or ST | 201 max HBW; 92 max HRBW |
| ASME SA-376/SA-376M | Grade TP304H | S30409 | --- | --- | --- | 205 | 30 | 515 | 75 | 35 L, 25 T | SA+Q or SA+RC | --- |
| ASTM A213/A213M-15a | Grade TP304H | S30409 | --- | 0.4 ≤ t ≤ 12.7 | 0.015 ≤ t ≤ 0.500 | 205 | 30 | 515 | 75 | 35 | ST+Q or RC | 192 max HBW/ 200 max HV; 90 max HRB |
| ASTM A249/A249M-14a | Grade TP304H | S30409 | --- | t ≥ 0.4 | t ≥ 0.015 | 205 | 30 | 515 | 75 | 35 | ST+Q or RC | 90 max HRB |
| ASTM A312/A312M-15 | Grade TP304H | S30409 | --- | --- | --- | 205 | 30 | 515 | 75 | 35 L; 25 T | A+Q or RC | --- |
| ASTM A358/A358M-14a* | Grade 304H | S30409 | --- | --- | --- | 205 | 30 | 515 | 75 | 40 | H, HT, HT-O or HT-SO | 201 max HBW; 92 max HRBW |
| ASTM A376/A376M-14 | Grade TP304H | S30409 | --- | --- | --- | 205 | 30 | 515 | 75 | 35 L; 25 T | see standard | --- |
| EN 10216-5:2013 | X6CrNi18-10 | --- | 1.4948 | t ≤ 50 | --- | 185 | --- | 500-700 | --- | 40 L, 35 T | SA | see standard for impact data |
| GB 5310-1995 | Grade 1Cr18Ni9 | --- | --- | --- | --- | 205 | --- | 520 L | --- | 35 L | ST | --- |
| JIS G 3459:2012 | Symbol SUS304HTP | --- | --- | d ≥ 40 | --- | 205 | --- | 520 | --- | 35 L; 25 T | ST | --- |
| JIS G 3463:2012 | Symbol SUS304HTB | --- | --- | d < 10 | --- | 205 | --- | 520 | --- | 27 L | ST | --- |
| | | | | 10 ≤ d < 20 | --- | 205 | --- | 520 | --- | 30 L | ST | --- |
| | | | | d ≥ 20 | --- | 205 | --- | 520 | --- | 35 L | ST | --- |
| JIS G 3467:2013 | Symbol SUS304HTF | --- | --- | --- | --- | 205 | --- | 520 | --- | 35 | ST | --- |

*: See "List of Standards" at the beginning of the chapter.

**5.9 Stainless Steel Tubes and Pipes for Pressure Purposes and High Temperatures**

**5.9.2B Mechanical Properties of Austenitic Stainless Steel Tubes and Pipes for Pressure Purposes and High Temperatures (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter | | Yield Strength | | Tensile Strength | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | %, min. | | |
| ASME SA-213/SA-213M | Grade TP309S | S30908 | --- | 0.4 ≤ t ≤ 12.7 | 0.015 ≤ t ≤ 0.500 | 205 | 30 | 515 | 75 | 35 | ST+Q or RC | 192 max HBW/ 200 max HV; 90 max HRB |
| ASME SA-249/SA-249M | Grade TP309S | S30908 | --- | t ≥ 0.4 | t ≥ 0.015 | 205 | 30 | 515 | 75 | 35 | ST+Q or RC | 90 max HRB |
| ASME SA-312/SA-312M | Grade TP309S | S30908 | --- | --- | --- | 205 | 30 | 515 | 75 | 35 L, 25 T | A+Q or RC | --- |
| ASME SA-358/SA-358M* | Grade 309S | S30908 | --- | --- | --- | 205 | 30 | 515 | 75 | 40 | H or HT | 217 max HBW; 95 max HRBW |
| ASTM A213/A213M-15a | Grade TP309S | S30908 | --- | 0.4 ≤ t ≤ 12.7 | 0.015 ≤ t ≤ 0.500 | 205 | 30 | 515 | 75 | 35 | ST+Q or RC | 192 max HBW/ 200 max HV; 90 max HRB |
| ASTM A249/A249M-14a | Grade TP309S | S30908 | --- | t ≥ 0.4 | t ≥ 0.015 | 205 | 30 | 515 | 75 | 35 | ST+Q or RC | 90 max HRB |
| ASTM A312/A312M-15 | Grade TP309S | S30908 | --- | --- | --- | 205 | 30 | 515 | 75 | 35 L; 25 T | A+Q, RC | --- |
| ASTM A358/A358M-14a* | Grade 309S | S30908 | --- | --- | --- | 205 | 30 | 515 | 75 | 40 | H, HT, HT-O or HT-SO | 217 max HBW; 95 max HRBW |
| JIS G 3459:2012 | Symbol SUS309STP | --- | --- | d ≥ 40 | --- | 205 | --- | 520 | --- | 35 L; 25 T | ST | --- |
| JIS G 3463:2012 | Symbol SUS309STB | --- | --- | d < 10 | --- | 205 | --- | 520 | --- | 27 L | ST | --- |
| | | | | 10 ≤ d < 20 | --- | 205 | --- | 520 | --- | 30 L | ST | --- |
| | | | | d ≥ 20 | --- | 205 | --- | 520 | --- | 35 L | ST | --- |
| JIS G 3468:2011 | Symbol SUS309STPY | --- | --- | --- | --- | 205 | --- | 520 | --- | 35 L; 25 T | ST | --- |

*: See "List of Standards" at the beginning of the chapter.

**5.9 Stainless Steel Tubes and Pipes for Pressure Purposes and High Temperatures**

**5.9.2B Mechanical Properties of Austenitic Stainless Steel Tubes and Pipes for Pressure Purposes and High Temperatures (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter | | Yield Strength | | Tensile Strength | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | %, min. | | |
| ASME SA-213/SA-213M | Grade TP309H | S30909 | --- | 0.4 ≤ t ≤ 12.7 | 0.015 ≤ t ≤ 0.500 | 205 | 30 | 515 | 75 | 35 | ST+Q or RC | 192 max HBW/ 200 max HV; 90 max HRB |
| ASME SA-249/SA-249M | Grade TP309H | S30909 | --- | t ≥ 0.4 | t ≥ 0.015 | 205 | 30 | 515 | 75 | 35 | ST+Q or RC | 90 max HRB |
| ASTM A213/A213M-15a | Grade TP309H | S30909 | --- | 0.4 ≤ t ≤ 12.7 | 0.015 ≤ t ≤ 0.500 | 205 | 30 | 515 | 75 | 35 | ST+Q or RC | 192 max HBW/ 200 max HV; 90 max HRB |
| ASTM A249/A249M-14a | Grade TP309H | S30909 | --- | t ≥ 0.4 | t ≥ 0.015 | 205 | 30 | 515 | 75 | 35 | ST+Q or RC | 90 max HRB |
| JIS G 3459:2012 | Symbol SUS309TP | --- | --- | d ≥ 40 | --- | 205 | --- | 520 | --- | 35 L; 25 T | ST | --- |
| JIS G 3463:2012 | Symbol SUS309TB | --- | --- | d < 10 | --- | 205 | --- | 520 | --- | 27 L | ST | --- |
| | | | | 10 ≤ d < 20 | --- | 205 | --- | 520 | --- | 30 L | ST | --- |
| | | | | d ≥ 20 | --- | 205 | --- | 520 | --- | 35 L | ST | --- |
| ASME SA-213/SA-213M | Grade TP310S | S31008 | --- | 0.4 ≤ t ≤ 12.7 | 0.015 ≤ t ≤ 0.500 | 205 | 30 | 515 | 75 | 35 | ST+Q or RC | 192 max HBW/ 200 max HV; 90 max HRB |
| ASME SA-249/SA-249M | Grade TP310S | S31008 | --- | t ≥ 0.4 | t ≥ 0.015 | 205 | 30 | 515 | 75 | 35 | ST+Q or RC | 90 max HRB |
| ASME SA-312/SA-312M | Grade TP310S | S31008 | --- | --- | --- | 205 | 30 | 515 | 75 | 35 L, 25 T | A+Q or RC | --- |
| ASME SA-358/SA-358M* | Grade 310S | S31008 | --- | --- | --- | 205 | 30 | 515 | 75 | 40 | H or HT | 217 max HBW; 95 max HRBW |
| ASTM A213/A213M-15a | Grade TP310S | S31008 | --- | 0.4 ≤ t ≤ 12.7 | 0.015 ≤ t ≤ 0.500 | 205 | 30 | 515 | 75 | 35 | ST+Q or RC | 192 max HBW/ 200 max HV; 90 max HRB |
| ASTM A249/A249M-14a | Grade TP310S | S31008 | --- | t ≥ 0.4 | t ≥ 0.015 | 205 | 30 | 515 | 75 | 35 | ST+Q or RC | 90 max HRB |
| ASTM A312/A312M-15 | Grade TP310S | S31008 | --- | --- | --- | 205 | 30 | 515 | 75 | 35 L; 25 T | A+Q, RC | --- |
| ASTM A358/A358M-14a* | Grade 310S | S31008 | --- | --- | --- | 205 | 30 | 515 | 75 | 40 | H, HT, HT-O or HT-SO | 217 max HBW; 95 max HRBW |
| JIS G 3459:2012 | Symbol SUS310STP | --- | --- | d ≥ 40 | --- | 205 | --- | 520 | --- | 35 L; 25 T | ST | --- |
| JIS G 3463:2012 | Symbol SUS310STB | --- | --- | d < 10 | --- | 205 | --- | 520 | --- | 27 L | ST | --- |
| | | | | 10 ≤ d < 20 | --- | 205 | --- | 520 | --- | 30 L | ST | --- |
| | | | | d ≥ 20 | --- | 205 | --- | 520 | --- | 35 L | ST | --- |
| JIS G 3468:2011 | Symbol SUS310STPY | --- | --- | --- | --- | 205 | --- | 520 | --- | 35 L; 25 T | ST | --- |

*: See "List of Standards" at the beginning of the chapter.

**5.9 Stainless Steel Tubes and Pipes for Pressure Purposes and High Temperatures**

**5.9.2B Mechanical Properties of Austenitic Stainless Steel Tubes and Pipes for Pressure Purposes and High Temperatures (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter | | Yield Strength | | Tensile Strength | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | %, min. | | |
| ASME SA-213/SA-213M | Grade TP310H | S31009 | --- | 0.4 ≤ t ≤ 12.7 | 0.015 ≤ t ≤ 0.500 | 205 | 30 | 515 | 75 | 35 | ST+Q or RC | 192 max HBW/ 200 max HV; 90 max HRB |
| ASTM A213/A213M-15a | Grade TP310H | S31009 | --- | 0.4 ≤ t ≤ 12.7 | 0.015 ≤ t ≤ 0.500 | 205 | 30 | 515 | 75 | 35 | ST+Q or RC | 192 max HBW/ 200 max HV; 90 max HRB |
| JIS G 3463:2012 | Symbol SUS310TB | --- | --- | d < 10 | --- | 205 | --- | 520 | --- | 27 L | ST | --- |
| | | | | 10 ≤ d < 20 | --- | 205 | --- | 520 | --- | 30 L | ST | --- |
| | | | | d ≥ 20 | --- | 205 | --- | 520 | --- | 35 L | ST | --- |
| JIS G 3467:2013 | Symbol SUS310TF | --- | --- | --- | --- | 205 | --- | 520 | --- | 35 | ST | --- |

**5.9 Stainless Steel Tubes and Pipes for Pressure Purposes and High Temperatures**

**5.9.2B Mechanical Properties of Austenitic Stainless Steel Tubes and Pipes for Pressure Purposes and High Temperatures (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter | | Yield Strength | | Tensile Strength | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | %, min. | | |
| ASME SA-213/SA-213M | Grade TP316 | S31600 | --- | 0.4 ≤ t ≤ 12.7 | 0.015 ≤ t ≤ 0.500 | 205 | 30 | 515 | 75 | 35 | ST+Q or RC | 192 max HBW/ 200 max HV; 90 max HRB |
| ASME SA-249/SA-249M | Grade TP316 | S31600 | --- | t ≥ 0.4 | t ≥ 0.015 | 205 | 30 | 515 | 75 | 35 | ST+Q or RC | 90 max HRB |
| ASME SA-312/SA-312M | Grade TP316 | S31600 | --- | --- | --- | 205 | 30 | 515 | 75 | 35 L, 25 T | A+Q or RC | --- |
| ASME SA-358/SA-358M* | Grade 316 | S31600 | --- | --- | --- | 205 | 30 | 515 | 75 | 40 | H or HT | 217 max HBW; 95 max HRBW |
| ASME SA-376/SA-376M | Grade TP316 | S31600 | --- | --- | --- | 205 | 30 | 515 | 75 | 35 L, 25 T | HT+Q or RC | --- |
| ASME SA-409/SA-409M | Grade TP316 | S31600 | --- | --- | --- | 205 | 30 | 515 T | 75 T | --- | HT+Q or RC | --- |
| ASME SA-688/SA-688M | Grade TP 316 | S31600 | --- | t ≥ 0.7 | t ≥ 0.028 | 205 | 30 | 515 | 75 | 35 | SA+RC | 90 max HRB |
| ASTM A213/A213M-15a | Grade TP316 | S31600 | --- | 0.4 ≤ t ≤ 12.7 | 0.015 ≤ t ≤ 0.500 | 205 | 30 | 515 | 75 | 35 | ST+Q or RC | 192 max HBW/ 200 max HV; 90 max HRB |
| ASTM A249/A249M-14a | Grade TP316 | S31600 | --- | t ≥ 0.4 | t ≥ 0.015 | 205 | 30 | 515 | 75 | 35 | ST+Q or RC | 90 max HRB |
| ASTM A312/A312M-15 | Grade TP316 | S31600 | --- | --- | --- | 205 | 30 | 515 | 75 | 35 L; 25 L | A+Q or RC | --- |
| ASTM A358/A358M-14a* | Grade 316 | S31600 | --- | --- | --- | 205 | 30 | 515 | 75 | 40 | H, HT, HT-O or HT-SO | 217 max HBW; 95 max HRBW |
| ASTM A376/A376M-14 | Grade TP316 | S31600 | --- | --- | --- | 205 | 30 | 515 | 75 | 35 L; 25 L | see standard | --- |
| ASTM A409/A409M-15 | Grade TP316 | S31600 | --- | --- | --- | 205 | 30 | 515 T | 75 T | --- | H, HT, HT-O or HT-SO | --- |
| ASTM A688/A688M-15 | Grade TP316 | S31600 | --- | t ≥ 0.7 | t ≥ 0.028 | 205 | 30 | 515 | 75 | 35 | SA+RC | 90 max HRB |
| EN 10216-5:2013 | X5CrNiMo17-12-2 | --- | 1.4401 | t ≤ 60 | --- | 205 | --- | 510-710 | --- | 40 L, 30 T | SA | see standard for |
| | X3CrNiMo17-13-3 | --- | 1.4436 | t ≤ 60 | --- | 205 | --- | 510-710 | --- | 40 L, 30 T | SA | impact data |
| EN 10217-7:2014 | X5CrNiMo17-12-2 | --- | 1.4401 | t ≤ 60 | --- | 205 | --- | 510-710 | --- | 40 L, 30 T | SA | see standard for |
| | X3CrNiMo17-13-3 | --- | 1.4436 | t ≤ 60 | --- | 205 | --- | 510-710 | --- | 40 L, 30 T | SA | impact data |
| JIS G 3459:2012 | Symbol SUS316TP | --- | --- | d ≥ 40 | --- | 205 | --- | 520 | --- | 35 L; 25 T | ST | --- |
| JIS G 3463:2012 | Symbol SUS316TB | --- | --- | d < 10 | --- | 205 | --- | 520 | --- | 27 L | ST | --- |
| | | | | 10 ≤ d < 20 | --- | 205 | --- | 520 | --- | 30 L | ST | --- |
| | | | | d ≥ 20 | --- | 205 | --- | 520 | --- | 35 L | ST | --- |
| JIS G 3467:2013 | Symbol SUS316TF | --- | --- | --- | --- | 205 | --- | 520 | --- | 35 | ST | --- |
| JIS G 3468:2011 | Symbol SUS316TPY | --- | --- | --- | --- | 205 | --- | 520 | --- | 35 L; 25 T | ST | --- |

*: See "List of Standards" at the beginning of the chapter.

**5.9 Stainless Steel Tubes and Pipes for Pressure Purposes and High Temperatures**

**5.9.2B Mechanical Properties of Austenitic Stainless Steel Tubes and Pipes for Pressure Purposes and High Temperatures (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter | | Yield Strength | | Tensile Strength | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | %, min. | | |
| ASME SA-213/SA-213M | Grade TP316L | S31603 | --- | 0.4 ≤ t ≤ 12.7 | 0.015 ≤ t ≤ 0.500 | 170 | 25 | 485 | 70 | 35 | ST+Q or RC | 192 max HBW/ 200 max HV; 90 max HRB |
| ASME SA-249/SA-249M | Grade TP316L | S31603 | --- | t ≥ 0.4 | t ≥ 0.015 | 170 | 25 | 485 | 70 | 35 | ST+Q or RC | 90 max HRB |
| ASME SA-312/SA-312M | Grade TP316L | S31603 | --- | --- | --- | 170 | 25 | 485 | 70 | 35 L, 25 T | A+Q or RC | --- |
| ASME SA-358/SA-358M* | Grade 316L | S31603 | --- | --- | --- | 170 | 25 | 485 | 70 | 40 | H or HT | 217 max HBW; 95 max HRBW |
| ASME SA-409/SA-409M | Grade TP316L | S31603 | --- | --- | --- | 170 | 25 | 485 T | 70 T | --- | HT+Q or RC | --- |
| ASME SA-688/SA-688M | Grade TP 316L | S31603 | --- | t ≥ 0.7 | t ≥ 0.028 | 175 | 25 | 485 | 70 | 35 | SA+RC | 90 max HRB |
| ASTM A213/A213M-15a | Grade TP316L | S31603 | --- | 0.4 ≤ t ≤ 12.7 | 0.015 ≤ t ≤ 0.500 | 170 | 25 | 485 | 70 | 35 | ST+Q or RC | 192 max HBW/ 200 max HV; 90 max HRB |
| ASTM A249/A249M-14a | Grade TP316L | S31603 | --- | t ≥ 0.4 | t ≥ 0.015 | 170 | 25 | 485 | 70 | 35 | ST+Q or RC | 90 max HRB |
| ASTM A312/A312M-15 | Grade TP316L | S31603 | --- | --- | --- | 170 | 25 | 485 | 70 | 35 L; 25 T | A+Q or RC | --- |
| ASTM A358/A358M-14a* | Grade 316L | S31603 | --- | --- | --- | 170 | 25 | 485 | 70 | 40 | H, HT, HT-O or HT-SO | 217 max HBW; 95 max HRBW |
| ASTM A409/A409M-15 | Grade TP316L | S31603 | --- | --- | --- | 170 | 25 | 485 | 70 | --- | H, HT, HT-O or HT-SO | --- |
| ASTM A688/A688M-15 | Grade TP316L | S31603 | --- | t ≥ 0.7 | t ≥ 0.028 | 175 | 25 | 485 | 70 | 35 | SA+RC | 90 max HRB |

Note: This section continued on next page.
*: See "List of Standards" at the beginning of the chapter.

**5.9 Stainless Steel Tubes and Pipes for Pressure Purposes and High Temperatures**

**5.9.2B Mechanical Properties of Austenitic Stainless Steel Tubes and Pipes for Pressure Purposes and High Temperatures (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter mm | Section Thickness/Diameter in. | Yield Strength MPa | Yield Strength ksi | Tensile Strength MPa | Tensile Strength ksi | Elongation %, min. | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| EN 10216-5:2013 | X2CrNiMo17-12-2 | --- | 1.4404 | t ≤ 60 | --- | 190 | --- | 490-690 | --- | 40 L, 30 T | SA | see standard for impact data |
| | X2CrNiMo18-14-3 | --- | 1.4435 | t ≤ 60 | --- | 190 | --- | 490-690 | --- | 40 L, 30 T | SA | see standard for impact data |
| EN 10217-7:2014 | X2CrNiMo17-12-2 | --- | 1.4404 | t ≤ 60 | --- | 190 | --- | 490-690 | --- | 40 L, 30 T | SA | see standard for impact data |
| | X2CrNiMo17-12-3 | --- | 1.4432 | t ≤ 60 | --- | 190 | --- | 490-690 | --- | 40 L, 30 T | SA | see standard for impact data |
| | X2CrNiMo18-14-3 | --- | 1.4435 | t ≤ 60 | --- | 190 | --- | 490-690 | --- | 40 L, 30 T | SA | see standard for impact data |
| JIS G 3459:2012 | Symbol SUS316LTP | --- | --- | d ≥ 40 | --- | 175 | --- | 480 | --- | 35 L; 25 T | ST | --- |
| JIS G 3463:2012 | Symbol SUS316LTB | --- | --- | d < 10 | --- | 175 | --- | 480 | --- | 27 L | ST | --- |
| | | | | 10 ≤ d < 20 | --- | 175 | --- | 480 | --- | 30 L | ST | --- |
| | | | | d ≥ 20 | --- | 175 | --- | 480 | --- | 35 L | ST | --- |
| JIS G 3468:2011 | Symbol SUS316LTPY | --- | --- | --- | --- | 175 | --- | 480 | --- | 35 L; 25 T | ST | --- |
| ASME SA-213/SA-213M | Grade TP316LN | S31653 | --- | --- | --- | --- | --- | --- | --- | --- | ST+Q or RC | --- |
| ASME SA-249/SA-249M | Grade TP316LN | S31653 | --- | t ≥ 0.4 | t ≥ 0.015 | 205 | 30 | 515 | 75 | 35 | ST+Q or RC | 90 max HRB |
| ASME SA-376/SA-376M | Grade TP316LN | S31653 | --- | --- | --- | 205 | 30 | 515 | 75 | 35 L, 25 T | HT+Q or RC | --- |
| ASME SA-688/SA-688M | Grade TP 316LN | S31653 | --- | t ≥ 0.7 | t ≥ 0.028 | 205 | 30 | 515 | 75 | 35 | SA+RC | 90 max HRB |
| ASTM A213/A213M-15a | Grade TP316LN | S31653 | --- | --- | --- | --- | --- | --- | --- | --- | ST+Q or RC | --- |
| ASTM A249/A249M-14a | Grade TP316LN | S31653 | --- | t ≥ 0.4 | t ≥ 0.015 | 205 | 30 | 515 | 75 | 35 | ST+Q or RC | 90 max HRB |
| ASTM A376/A376M-14 | Grade TP316LN | S31653 | --- | --- | --- | 205 | 30 | 515 | 75 | 35 L; 25 T | see standard | --- |
| ASTM A688/A688M-15 | Grade TP316LN | S31653 | --- | t ≥ 0.7 | t ≥ 0.028 | 205 | 30 | 515 | 75 | 35 | SA+RC | 90 max HRB |
| EN 10216-5:2013 | X2CrNiMoN17-13-3 | --- | 1.4429 | t ≤ 60 | --- | 295 | --- | 580-800 | --- | 35 L, 30 T | SA | see standard for impact data |
| EN 10217-7:2014 | X2CrNiMoN17-13-3 | --- | 1.4429 | t ≤ 60 | --- | 295 | --- | 580-800 | --- | 35 L, 30 T | SA | see standard for impact data |

**5.9 Stainless Steel Tubes and Pipes for Pressure Purposes and High Temperatures**

**5.9.2B Mechanical Properties of Austenitic Stainless Steel Tubes and Pipes for Pressure Purposes and High Temperatures (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter | | Yield Strength | | Tensile Strength | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | %, min. | | |
| ASME SA-213/SA-213M | Grade TP316H | S31609 | --- | 0.4 ≤ t ≤ 12.7 | 0.015 ≤ t ≤ 0.500 | 205 | 30 | 515 | 75 | 35 | ST+Q or RC | 192 max HBW/ 200 max HV; 90 max HRB |
| ASME SA-249/SA-249M | Grade TP316H | S31609 | --- | t ≥ 0.4 | t ≥ 0.015 | 205 | 30 | 515 | 75 | 35 | ST+Q or RC | 90 max HRB |
| ASME SA-312/SA-312M | Grade TP316H | S31609 | --- | --- | --- | 205 | 30 | 515 | 75 | 35 L, 25 T | A+Q or RC | --- |
| ASME SA-358/SA-358M* | Grade 316H | S31609 | --- | --- | --- | 205 | 30 | 515 | 75 | 40 | H or HT | 217 max HBW; 95 max HRBW |
| ASME SA-376/SA-376M | Grade TP316H | S31609 | --- | --- | --- | 205 | 30 | 515 | 75 | 35 L, 25 T | SA+Q or SA+RC | --- |
| ASTM A213/A213M-15a | Grade TP316H | S31609 | --- | 0.4 ≤ t ≤ 12.7 | 0.015 ≤ t ≤ 0.500 | 205 | 30 | 515 | 75 | 35 | ST+Q or RC | 192 max HBW/ 200 max HV; 90 max HRB |
| ASTM A249/A249M-14a | Grade TP316H | S31609 | --- | t ≥ 0.4 | t ≥ 0.015 | 205 | 30 | 515 | 75 | 35 | ST+Q or RC | 90 max HRB |
| ASTM A312/A312M-15 | Grade TP316H | S31609 | --- | --- | --- | 205 | 30 | 515 | 75 | 35 L; 25 T | A+Q or RC | --- |
| ASTM A358/A358M-14a* | Grade 316H | S31609 | --- | --- | --- | 205 | 30 | 515 | 75 | 40 | H, HT, HT-O or HT-SO | 217 max HBW; 95 max HRBW |
| ASTM A376/A376M-14 | Grade TP316H | S31609 | --- | --- | --- | 205 | 30 | 515 | 75 | 35 L; 25 T | see standard | --- |
| EN 10216-5:2013 | X6CrNiMo17-13-2 | --- | 1.4918 | t ≤ 50 | --- | 205 | --- | 490-690 | --- | 35 L, 30 T | SA | see standard for impact data |
| JIS G 3459:2012 | Symbol SUS316HTP | --- | --- | d ≥ 40 | --- | 205 | --- | 520 | --- | 35 L; 25 T | ST | --- |
| JIS G 3463:2012 | Symbol SUS316HTB | --- | --- | d < 10 | --- | 205 | --- | 520 | --- | 27 L | ST | --- |
| | | | | 10 ≤ d < 20 | --- | 205 | --- | 520 | --- | 30 L | ST | --- |
| | | | | d ≥ 20 | --- | 205 | --- | 520 | --- | 35 L | ST | --- |
| JIS G 3467:2013 | Symbol SUS316HTF | --- | --- | --- | --- | 205 | --- | 520 | --- | 35 | ST | --- |
| EN 10216-5:2013 | X6CrNiMoTi17-12-2 | --- | 1.4571 | t ≤ 60 | --- | 210 | --- | 500-730 | --- | 35 L, 30 T | SA+CF | see standard for impact data |
| | | | | t ≤ 60 | --- | 190 | --- | 490-690 | --- | 35 L, 30 T | SA+HF | see standard for impact data |
| EN 10217-7:2014 | X6CrNiMoTi17-12-2 | --- | 1.4571 | t ≤ 60 | --- | 210 | --- | 500-730 | --- | 35 L, 30 T | SA | see standard for impact data |
| JIS G 3459:2012 | Symbol SUS316TiTP | --- | --- | d ≥ 40 | --- | 205 | --- | 520 | --- | 35 L; 25 T | ST | --- |
| JIS G 3463:2012 | Symbol SUS316TiTB | --- | --- | d < 10 | --- | 205 | --- | 520 | --- | 27 L | ST | --- |
| | | | | 10 ≤ d < 20 | --- | 205 | --- | 520 | --- | 30 L | ST | --- |
| | | | | d ≥ 20 | --- | 205 | --- | 520 | --- | 35 L | ST | --- |

*: See "List of Standards" at the beginning of the chapter.

**5.9 Stainless Steel Tubes and Pipes for Pressure Purposes and High Temperatures**

**5.9.2B Mechanical Properties of Austenitic Stainless Steel Tubes and Pipes for Pressure Purposes and High Temperatures (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter | | Yield Strength | | Tensile Strength | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | %, min. | | |
| ASME SA-213/SA-213M | Grade TP317 | S31700 | --- | 0.4 ≤ t < 12.7 | 0.015 ≤ t ≤ 0.500 | 205 | 30 | 515 | 75 | 34 | ST+Q or RC | 192 max HBW/ 200 max HV; 90 max HRB |
| ASME SA-249/SA-249M | Grade TP317 | S31700 | --- | t ≥ 0.4 | t ≥ 0.015 | 205 | 30 | 515 | 75 | 35 | ST+Q or RC | 90 max HRB |
| ASME SA-312/SA-312M | Grade TP317 | S31700 | --- | --- | --- | 205 | 30 | 515 | 75 | 35 L, 25 T | A+Q or RC | --- |
| ASME SA-409/SA-409M | Grade TP317 | S31700 | --- | --- | --- | 205 | 30 | 515 T | 75 T | --- | HT+Q or RC | --- |
| ASTM A213/A213M-15a | Grade TP317 | S31700 | --- | 0.4 ≤ t ≤ 12.7 | 0.015 ≤ t ≤ 0.500 | 205 | 30 | 515 | 75 | 34 | ST+Q or RC | 192 max HBW/ 200 max HV; 90 max HRB |
| ASTM A249/A249M-14a | Grade TP317 | S31700 | --- | t ≥ 0.4 | t ≥ 0.015 | 205 | 30 | 515 | 75 | 35 | ST+Q or RC | 90 max HRB |
| ASTM A312/A312M-15 | Grade TP317 | S31700 | --- | --- | --- | 205 | 30 | 515 | 75 | 35 L; 25 T | A+Q or RC | --- |
| ASTM A409/A409M-15 | Grade TP317 | S31700 | --- | --- | --- | 205 | 30 | 515 | 75 | --- | H, HT, HT-O or HT-SO | --- |
| JIS G 3459:2012 | Symbol SUS317TP | --- | --- | d ≥ 40 | --- | 205 | --- | 520 | --- | 35 L; 25 T | ST | --- |
| JIS G 3463:2012 | Symbol SUS317TB | --- | --- | d < 10 | --- | 205 | --- | 520 | --- | 27 L | ST | --- |
| | | | | 10 ≤ d < 20 | --- | 205 | --- | 520 | --- | 30 L | ST | --- |
| | | | | d ≥ 20 | --- | 205 | --- | 520 | --- | 35 L | ST | --- |
| JIS G 3468:2011 | Symbol SUS317TPY | --- | --- | --- | --- | 205 | --- | 520 | --- | 35 L; 25 T | ST | --- |
| ASME SA-213/SA-213M | Grade TP317L | S31703 | --- | 0.4 ≤ t < 12.7 | 0.015 ≤ t ≤ 0.500 | 205 | 30 | 515 | 75 | 35 | ST+Q or RC | 192 max HBW/ 200 max HV; 90 max HRB |
| ASME SA-249/SA-249M | Grade TP317L | S31703 | --- | t ≥ 0.4 | t ≥ 0.015 | 205 | 30 | 515 | 75 | 35 | ST+Q or RC | 90 max HRB |
| ASME SA-312/SA-312M | Grade TP317L | S31703 | --- | --- | --- | 205 | 30 | 515 | 75 | 35 L, 25 T | A+Q or RC | --- |
| ASTM A213/A213M-15a | Grade TP317L | S31703 | --- | 0.4 ≤ t ≤ 12.7 | 0.015 ≤ t ≤ 0.500 | 205 | 30 | 515 | 75 | 35 | ST+Q or RC | 192 max HBW/ 200 max HV; 90 max HRB |
| ASTM A249/A249M-14a | Grade TP317L | S31703 | --- | t ≥ 0.4 | t ≥ 0.015 | 205 | 30 | 515 | 75 | 35 | ST+Q or RC | 90 max HRB |
| ASTM A312/A312M-15 | Grade TP317L | S31703 | --- | --- | --- | 205 | 30 | 515 | 75 | 35 L; 25 T | A+Q or RC | --- |
| EN 10217-7:2014 | X2CrNiMo18-15-4 | --- | 1.4438 | t ≤ 60 | --- | 220 | --- | 490-690 | --- | 35 L, 30 T | SA | see standard for impact data |
| JIS G 3459:2012 | Symbol SUS317LTP | --- | --- | d ≥ 40 | --- | 175 | --- | 480 | --- | 35 L; 25 T | ST | --- |
| JIS G 3463:2012 | Symbol SUS317LTB | --- | --- | d < 10 | --- | 175 | --- | 480 | --- | 27 L | ST | --- |
| | | | | 10 ≤ d < 20 | --- | 175 | --- | 480 | --- | 30 L | ST | --- |
| | | | | d ≥ 20 | --- | 175 | --- | 480 | --- | 35 L | ST | --- |
| JIS G 3468:2011 | Symbol SUS317LTPY | --- | --- | --- | --- | 175 | --- | 480 | --- | 35 L; 25 T | ST | --- |

**5.9 Stainless Steel Tubes and Pipes for Pressure Purposes and High Temperatures**

**5.9.2B Mechanical Properties of Austenitic Stainless Steel Tubes and Pipes for Pressure Purposes and High Temperatures (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter | | Yield Strength | | Tensile Strength | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | %, min. | | |
| ASME SA-213/SA-213M | Grade TP317LM | S31725 | --- | 0.4 ≤ t < 12.7 | 0.015 ≤ t ≤ 0.500 | 205 | 30 | 515 | 75 | 35 | ST+Q or RC | 192 max HBW/ 200 max HV; 90 max HRB |
| ASME SA-249/SA-249M | --- | S31725 | --- | t ≥ 0.4 | t ≥ 0.015 | 205 | 30 | 515 | 75 | 35 | ST+Q or RC | 90 max HRB |
| ASME SA-312/SA-312M | --- | S31725 | --- | --- | --- | 205 | 30 | 515 | 75 | 35 L, 25 T | A+Q or RC | --- |
| ASME SA-358/SA-358M* | --- | S31725 | --- | --- | --- | 205 | 30 | 515 | 75 | 40 | H or HT | 217 max HBW; 95 max HRBW |
| ASME SA-376/SA-376M | --- | S31725 | --- | --- | --- | 205 | 30 | 515 | 75 | 35 L, 25 T | HT+Q or RC | --- |
| ASME SA-409/SA-409M | --- | S31725 | --- | --- | --- | 205 | 30 | 515 T | 75 T | --- | HT+Q or RC | --- |
| ASTM A213/A213M-15a | Grade TP317LM | S31725 | --- | 0.4 ≤ t ≤ 12.7 | 0.015 ≤ t ≤ 0.500 | 205 | 30 | 515 | 75 | 35 | ST+Q or RC | 192 max HBW/ 200 max HV; 90 max HRB |
| ASTM A249/A249M-14a | --- | S31725 | --- | t ≥ 0.4 | t ≥ 0.015 | 205 | 30 | 515 | 75 | 35 | ST+Q or RC | 90 max HRB |
| ASTM A312/A312M-14 | --- | S31725 | --- | --- | --- | 205 | 30 | 515 | 75 | 35 L; 25 T | A+Q or RC | --- |
| ASTM A358/A358M-14a* | --- | S31725 | --- | --- | --- | 205 | 30 | 515 | 75 | 40 | H, HT, HT-O or HT-SO | 217 max HBW; 95 max HRBW |
| ASTM A376/A376M-14 | --- | S31725 | --- | --- | --- | 205 | 30 | 515 | 75 | 35 L; 25 T | HT | --- |
| ASTM A409/A409M-15 | --- | S31725 | --- | --- | --- | 205 | 30 | 515 | 75 | --- | H, HT, HT-O or HT-SO | --- |
| EN 10216-5:2013 | X2CrNiMoN17-13-5 | --- | 1.4439 | t ≤ 60 | -- | 285 | --- | 580-800 | --- | 35 L, 30 T | SA | see standard for impact data |
| EN 10217-7:2014 | X2CrNiMoN17-13-5 | --- | 1.4439 | t ≤ 60 | -- | 285 | --- | 580-800 | --- | 35 L, 30 T | SA | see standard for impact data |

*: See "List of Standards" at the beginning of the chapter.

**5.9 Stainless Steel Tubes and Pipes for Pressure Purposes and High Temperatures**

**5.9.2B Mechanical Properties of Austenitic Stainless Steel Tubes and Pipes for Pressure Purposes and High Temperatures (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter | | Yield Strength | | Tensile Strength | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | %, min. | | |
| ASME SA-213/SA-213M | Grade TP321 | S32100 | --- | 0.4 ≤ t < 12.7 | 0.015 ≤ t ≤ 0.500 | 205 | 30 | 515 | 75 | 35 | ST+Q or RC | 192 max HBW/ 200 max HV; 90 max HRB |
| ASME SA-249/SA-249M | Grade TP321 | S32100 | --- | t ≥ 0.4 | t ≥ 0.015 | 205 | 30 | 515 | 75 | 35 | ST+Q or RC | 90 max HRB |
| ASME SA-312/SA-312M | Grade TP321 | S32100 | --- | --- | --- | 205 | 30 | 515 | 75 | 35 L, 25 T | A+Q or RC | --- |
| | | | | --- | t ≤ 0.375 | 205 | 30 | 515 | 75 | 35 L, 25 T | A+Q or RC | --- |
| | | | | --- | t > 0.375 | 170 | 25 | 485 | 70 | 35 L, 25 T | A+Q or RC | --- |
| ASME SA-358/SA-358M* | Grade 321 | S32100 | --- | --- | --- | 205 | 30 | 515 | 75 | 40 | H or HT | 217 max HBW; 95 max HRBW |
| ASME SA-376/SA-376M | Grade TP321 | S32100 | --- | --- | t ≤ 0.375 | 205 | 30 | 515 | 75 | 35 L, 25 T | HT+Q or RC | --- |
| | | | | --- | t > 0.375 | 170 | 25 | 480 | 70 | 35 L, 25 T | HT+Q or RC | --- |
| ASME SA-409/SA-409M | Grade TP321 | S32100 | --- | --- | --- | 205 | 30 | 515 T | 75 T | --- | HT+Q or RC | --- |
| ASTM A213/A213M-15a | Grade TP321 | S32100 | --- | 0.4 ≤ t ≤ 12.7 | 0.015 ≤ t ≤ 0.500 | 205 | 30 | 515 | 75 | 35 | ST+Q or RC | 192 max HBW/ 200 max HV; 90 max HRB |
| ASTM A249/A249M-14a | Grade TP321 | S32100 | --- | t ≥ 0.4 | t ≥ 0.015 | 205 | 30 | 515 | 75 | 35 | ST+Q or RC | 90 max HRB |
| ASTM A312/A312M-15 | Grade TP321 | S32100 | --- | --- | t ≤ 0.375 | 205 | 30 | 515 | 75 | 35 L; 25 T | A+Q or RC | --- |
| | | | | --- | t > 0.375 | 170 | 25 | 485 | 70 | 35 L; 25 T | A+Q or RC | --- |
| ASTM A358/A358M-14a* | Grade 321 | S32100 | --- | --- | --- | 205 | 30 | 515 | 75 | 40 | H, HT, HT-O or HT-SO | 217 max HBW; 95 max HRBW |
| ASTM A376/A376M-14 | Grade TP321 | S32100 | --- | --- | t ≤ 0.375 | 205 | 30 | 515 | 75 | 35 L; 25 T | see standard | --- |
| | | | | --- | t > 0.375 | 170 | 25 | 480 | 70 | 35 L; 25 T | see standard | --- |
| ASTM A409/A409M-15 | Grade TP321 | S32100 | --- | --- | --- | 205 | 30 | 515 | 75 | --- | H, HT, HT-O or HT-SO | --- |
| EN 10216-5:2013 | X6CrNiTi18-10 | --- | 1.4541 | t ≤ 60 | --- | 200 | --- | 500-730 | --- | 35 L, 30 T | SA+CF | see standard for impact data |
| | | | | t ≤ 60 | --- | 180 | --- | 460-680 | --- | 35 L, 30 T | SA+HF | see standard for impact data |
| EN 10217-7:2014 | X6CrNiTi18-10 | --- | 1.4541 | t ≤ 60 | --- | 200 | --- | 500-730 | --- | 35 L, 30 T | SA | see standard for impact data |
| JIS G 3459:2012 | Symbol SUS321TP | --- | --- | d ≥ 40 | --- | 205 | --- | 520 | --- | 35 L; 25 T | ST | --- |
| JIS G 3463:2012 | Symbol SUS321TB | --- | --- | d < 10 | --- | 205 | --- | 520 | --- | 27 L | ST | --- |
| | | | | 10 ≤ d < 20 | --- | 205 | --- | 520 | --- | 30 L | ST | --- |
| | | | | d ≥ 20 | --- | 205 | --- | 520 | --- | 35 L | ST | --- |
| JIS G 3467:2013 | Symbol SUS321TF | --- | --- | --- | --- | 205 | --- | 520 | --- | 35 | ST | --- |
| | | | | --- | --- | 180 | --- | 460 | --- | 35 | ST | --- |
| JIS G 3468:2011 | Symbol SUS321TPY | --- | --- | --- | --- | 205 | --- | 520 | --- | 35 L; 25 T | ST | --- |

*: See "List of Standards" at the beginning of the chapter.

**5.9 Stainless Steel Tubes and Pipes for Pressure Purposes and High Temperatures**

**5.9.2B Mechanical Properties of Austenitic Stainless Steel Tubes and Pipes for Pressure Purposes and High Temperatures (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter | | Yield Strength | | Tensile Strength | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | %, min. | | |
| ASME SA-213/SA-213M | Grade TP321H | S32109 | --- | 0.4 ≤ t < 12.7 | 0.015 ≤ t ≤ 0.500 | 205 | 30 | 515 | 75 | 35 | ST+Q or RC | 192 max HBW/ 200 max HV; 90 max HRB |
| ASME SA-249/SA-249M | Grade TP321H | S32109 | --- | t ≥ 0.4 | t ≥ 0.015 | 205 | 30 | 515 | 75 | 35 | ST+Q or RC | 90 max HRB |
| ASME SA-312/SA-312M | Grade TP321H | S32109 | --- | --- | --- | 205 | 30 | 515 | 75 | 35 L, 25 T | A+Q or RC | --- |
| | | | | --- | t ≤ 0.1875 | 205 | 30 | 515 | 75 | 35 L, 25 T | A+Q or RC | --- |
| | | | | --- | t > 0.1875 | 170 | 25 | 480 | 70 | 35 L, 25 T | A+Q or RC | --- |
| ASME SA-376/SA-376M | Grade TP321H | S32109 | --- | t ≤ 9.5 | t ≤ 0.375 | 205 | 30 | 515 | 75 | 35 L, 25 T | SA+Q or SA+RC | --- |
| | | | | t > 9.5 | t > 0.375 | 170 | 25 | 480 | 70 | 35 L, 25 T | SA+Q or SA+RC | --- |
| ASTM A213/A213M-15a | Grade TP321H | S32109 | --- | 0.4 ≤ t ≤ 12.7 | 0.015 ≤ t ≤ 0.500 | 205 | 30 | 515 | 75 | 35 | ST+Q or RC | 192 max HBW/ 200 max HV; 90 max HRB |
| ASTM A249/A249M-14a | Grade TP321H | S32109 | --- | t ≥ 0.4 | t ≥ 0.015 | 205 | 30 | 515 | 75 | 35 | ST+Q or RC | 90 max HRB |
| ASTM A312/A312M-15 | Grade TP321H | S32109 | --- | --- | --- | 205 | 30 | 515 | 75 | 35 L; 25 T | A+Q or RC | --- |
| | | | | --- | t ≤ 0.375 | 205 | 30 | 515 | 75 | 35 L; 25 T | A+Q or RC | --- |
| | | | | --- | t > 0.375 | 170 | 25 | 480 | 70 | 35 L; 25 T | A+Q or RC | --- |
| ASTM A376/A376M-14 | Grade TP321H | S32109 | --- | t ≤ 9.5 | t ≤ 0.375 | 205 | 30 | 515 | 75 | 35 L; 25 T | see standard | --- |
| | | | | t > 9.5 | t > 0.375 | 170 | 25 | 480 | 70 | 35 L; 25 T | see standard | --- |
| EN 10216-5:2013 | X7CrNiTi18-10 | --- | 1.4940 | t ≤ 50 | --- | 190 | --- | 510-710 | --- | 35 L, 30 T | SA | see standard for impact data |
| JIS G 3459:2012 | Symbol SUS321HTP | --- | --- | d ≥ 40 | --- | 205 | --- | 520 | ---- | 35 L; 25 T | ST | --- |
| JIS G 3463:2012 | Symbol SUS321HTB | --- | --- | d < 10 | --- | 205 | --- | 520 | --- | 27 L | ST | --- |
| | | | | 10 ≤ d < 20 | --- | 205 | --- | 520 | --- | 30 L | ST | --- |
| | | | | d ≥ 20 | --- | 205 | --- | 520 | --- | 35 L | ST | --- |
| JIS G 3467:2013 | Symbol SUS321HTF | --- | --- | --- | --- | 205 | --- | 520 | --- | 35 | ST | --- |
| | | | | --- | --- | 180 | --- | 460 | --- | 35 | ST | --- |

**5.9 Stainless Steel Tubes and Pipes for Pressure Purposes and High Temperatures**

**5.9.2B Mechanical Properties of Austenitic Stainless Steel Tubes and Pipes for Pressure Purposes and High Temperatures (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter | | Yield Strength | | Tensile Strength | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | %, min. | | |
| ASME SA-213/SA-213M | Grade TP347 | S34700 | --- | 0.4 ≤ t < 12.7 | 0.015 ≤ t ≤ 0.500 | 205 | 30 | 515 | 75 | 35 | ST+Q or RC | 192 max HBW/ 200 max HV; 90 max HRB |
| ASME SA-249/SA-249M | Grade TP347 | S34700 | --- | t ≥ 0.4 | t ≥ 0.015 | 205 | 30 | 515 | 75 | 35 | ST+Q or RC | 90 max HRB |
| ASME SA-312/SA-312M | Grade TP347 | S34700 | --- | --- | --- | 205 | 30 | 515 | 75 | 35 L, 25 T | A+Q or RC | --- |
| ASME SA-358/SA-358M* | Grade 347 | S34700 | --- | --- | --- | 205 | 30 | 515 | 75 | 40 | H or HT | 201 max HBW; 92 max HRBW |
| ASME SA-376/SA-376M | Grade TP347 | S34700 | --- | --- | --- | 205 | 30 | 515 | 75 | 35 L, 25 T | HT+Q or RC | --- |
| ASME SA-409/SA-409M | Grade TP347 | S34700 | --- | --- | --- | 205 | 30 | 515 T | 75 T | --- | HT+Q or RC | --- |
| ASTM A213/A213M-15a | Grade TP347 | S34700 | --- | 0.4 ≤ t ≤ 12.7 | 0.015 ≤ t ≤ 0.500 | 205 | 30 | 515 | 75 | 35 | ST+Q or RC | 192 max HBW/ 200 max HV; 90 max HRB |
| ASTM A249/A249M-14a | Grade TP347 | S34700 | --- | t ≥ 0.4 | t ≥ 0.015 | 205 | 30 | 515 | 75 | 35 | ST+Q or RC | 90 max HRB |
| ASTM A312/A312M-15 | Grade TP347 | S34700 | --- | --- | --- | 205 | 30 | 515 | 75 | 35 L; 25 T | A+Q or RC | --- |
| ASTM A358/A358M-14a* | Grade 347 | S34700 | --- | --- | --- | 205 | 30 | 515 | 75 | 40 | H, HT, HT-O or HT-SO | 201 max HBW; 92 max HRBW |
| ASTM A376/A376M-14 | Grade TP347 | S34700 | --- | --- | --- | 205 | 30 | 515 | 75 | 35 L; 25 T | see standard | --- |
| ASTM A409/A409M-15 | Grade TP347 | S34700 | --- | --- | --- | 205 | 30 | 515 | 75 | --- | H, HT, HT-O or HT-SO | --- |
| EN 10216-5:2013 | X6CrNiNb18-10 | --- | 1.4550 | t ≤ 60 | --- | 205 | --- | 510-740 | --- | 35 L, 30 T | SA | see standard for impact data |
| EN 10217-7:2014 | X6CrNiNb18-10 | --- | 1.4550 | t ≤ 60 | --- | 205 | --- | 510-740 | --- | 35 L, 30 T | SA | see standard for impact data |
| JIS G 3459:2012 | Symbol SUS347TP | --- | --- | d ≥ 40 | --- | 205 | --- | 520 | --- | 35 L; 25 T | ST | --- |
| JIS G 3463:2012 | Symbol SUS347TB | --- | --- | d < 10 | --- | 205 | --- | 520 | --- | 27 L | ST | --- |
| | | | | 10 ≤ d < 20 | --- | 205 | --- | 520 | --- | 30 L | ST | --- |
| | | | | d ≥ 20 | --- | 205 | --- | 520 | --- | 35 L | ST | --- |
| JIS G 3467:2013 | Symbol SUS347TF | --- | --- | --- | --- | 205 | --- | 520 | --- | 35 | ST | --- |
| JIS G 3468:2011 | Symbol SUS347TPY | --- | --- | --- | --- | 205 | --- | 520 | --- | 35 L; 25 T | ST | --- |

*: See "List of Standards" at the beginning of the chapter.

**5.9 Stainless Steel Tubes and Pipes for Pressure Purposes and High Temperatures**

**5.9.2B Mechanical Properties of Austenitic Stainless Steel Tubes and Pipes for Pressure Purposes and High Temperatures (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter | | Yield Strength | | Tensile Strength | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | %, min. | | |
| ASME SA-213/SA-213M | Grade TP347H | S34709 | --- | 0.4 ≤ t < 12.7 | 0.015 ≤ t ≤ 0.500 | 205 | 30 | 515 | 75 | 35 | ST+Q or RC | 192 max HBW/ 200 max HV; 90 max HRB |
| | Grade TP347HFG | S34710 | --- | 0.4 ≤ t < 12.7 | 0.015 ≤ t ≤ 0.500 | 205 | 30 | 550 | 80 | 35 | ST+Q or RC | 192 max HBW/ 200 max HV; 90 max HRB |
| ASME SA-249/SA-249M | Grade TP347H | S34709 | --- | t ≥ 0.4 | t ≥ 0.015 | 205 | 30 | 515 | 75 | 35 | ST+Q or RC | 90 max HRB |
| ASME SA-312/SA-312M | Grade TP347H | S34709 | --- | --- | --- | 205 | 30 | 515 | 75 | 35 L, 25 T | A+Q or RC | --- |
| ASME SA-376/SA-376M | Grade TP347H | S34709 | --- | --- | --- | 205 | 30 | 515 | 75 | 35 L, 25 T | SA+Q or SA+RC | --- |
| ASTM A213/A213M-15a | Grade TP347H | S34709 | --- | 0.4 ≤ t ≤ 12.7 | 0.015 ≤ t ≤ 0.500 | 205 | 30 | 515 | 75 | 35 | ST+Q or RC | 192 max HBW/ 200 max HV; 90 max HRB |
| | Grade TP347HFG | S34710 | --- | 0.4 ≤ t ≤ 12.7 | 0.015 ≤ t ≤ 0.500 | 205 | 30 | 550 | 80 | 35 | ST+Q or RC | 192 max HBW/ 200 max HV; 90 max HRB |
| ASTM A249/A249M-14a | Grade TP347H | S34709 | --- | t ≥ 0.4 | t ≥ 0.015 | 205 | 30 | 515 | 75 | 35 | ST+Q or RC | 90 max HRB |
| ASTM A312/A312M-15 | Grade TP347H | S34709 | --- | --- | --- | 205 | 30 | 515 | 75 | 35 L; 25 T | A+Q or RC | --- |
| ASTM A376/A376M-14 | Grade TP347H | S34709 | --- | --- | --- | 205 | 30 | 515 | 75 | 35 L; 25 T | see standard | --- |
| EN 10216-5:2013 | X7CrNiNb18-10 | --- | 1.4912 | t ≤ 50 | --- | 205 | --- | 510-710 | --- | 40 L, 30 T | SA | see standard for impact data |
| GB 5310-1995 | Grade 1Cr19Ni11Nb | --- | --- | --- | --- | 205 | --- | 520 L | --- | 35 L | ST | --- |
| JIS G 3459:2012 | Symbol SUS347HTP | --- | --- | d ≥ 40 | --- | 205 | --- | 520 | --- | 35 L; 25 T | ST | --- |
| JIS G 3463:2012 | Symbol SUS347HTB | --- | --- | d < 10 | --- | 205 | --- | 520 | --- | 27 L | ST | --- |
| | | | | 10 ≤ d < 20 | --- | 205 | --- | 520 | --- | 30 L | ST | --- |
| | | | | d ≥ 20 | --- | 205 | --- | 520 | --- | 35 L | ST | --- |
| JIS G 3467:2013 | Symbol SUS347HTF | --- | --- | --- | --- | 205 | --- | 520 | --- | 35 | ST | --- |
| ASTM A240/A240M-15a | Type 800 | N08800 | --- | t ≥ 0.50 | t ≥ 0.020 | 205 | 30 | 520 | 75 | 30 | --- | --- |
| JIS G 3467:2013 | Symbol NCF800TF | --- | --- | --- | --- | 205 | --- | 520 | --- | 30 | ST | --- |
| | | | | --- | --- | 175 | --- | 450 | --- | 30 | ST | --- |
| ASTM A240/A240M-15a | Type 800H | N08810 | --- | t ≥ 0.50 | t ≥ 0.020 | 170 | 25 | 450 | 65 | 30 | --- | --- |
| JIS G 3467:2013 | Symbol NCF800HTF | --- | --- | --- | --- | 175 | --- | 450 | --- | 30 | ST | --- |

**5.9 Stainless Steel Tubes and Pipes for Pressure Purposes and High Temperatures**

**5.9.2B Mechanical Properties of Austenitic Stainless Steel Tubes and Pipes for Pressure Purposes and High Temperatures (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter | | Yield Strength | | Tensile Strength | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | %, min. | | |
| ASME SA-249/SA-249M | --- | N08367 | --- | --- | 0.015 < t ≤ 0.187 | 310 | 45 | 690 | 100 | 30 | ST+Q or RC | 100 max HRB |
| | | | | --- | t > 0.187 | 310 | 45 | 655 | 95 | 30 | ST+Q or RC | 100 max HRB |
| | | N08926 | --- | t ≥ 0.4 | t ≥ 0.015 | 295 | 43 | 650 | 94 | 35 | ST+Q or RC | 100 max HRB |
| ASME SA-312/SA-312M | --- | N08926 | --- | --- | --- | 295 | 43 | 650 | 94 | 35 L, 25 T | A+Q or RC | --- |
| ASME SA-688/SA-688M | --- | N08367 | --- | --- | 0.028 ≤ t ≤ 0.187 | 310 | 45 | 690 | 100 | 30 | SA+Q | 90 max HRB |
| | | | | --- | t > 0.187 | 310 | 45 | 655 | 95 | 30 | SA+Q | 90 max HRB |
| | | N08926 | --- | t ≥ 0.7 | t ≥ 0.028 | 295 | 43 | 650 | 94 | 35 | SA+Q or SA+RC | 90 max HRB |
| ASTM A249/A249M-14a | --- | N08367 | --- | --- | 0.015 < t ≤ 0.187 | 310 | 45 | 690 | 100 | 30 | ST+Q or RC | 100 max HRB |
| | | | | --- | t > 0.187 | 310 | 45 | 655 | 95 | 30 | ST+Q or RC | 100 max HRB |
| | --- | N08926 | --- | t ≥ 0.4 | t ≥ 0.015 | 295 | 43 | 650 | 94 | 35 | ST+Q or RC | 100 max HRB |
| ASTM A312/A312M-15 | --- | N08926 | --- | --- | --- | 295 | 43 | 650 | 94 | 35 L; 25 T | A+Q or RC | --- |
| ASTM A688/A688M-15 | --- | N08367 | --- | --- | 0.028 ≤ t ≤ 0.187 | 310 | 45 | 655 | 95 | 30 | SA+Q | 100 max HRB |
| | | | | --- | t > 0.187 | 310 | 45 | 655 | 95 | 30 | SA+Q | 100 max HRB |
| | --- | N08926 | --- | t ≥ 0.7 | t ≥ 0.028 | 295 | 43 | 650 | 94 | 35 | SA+Q or SA+RC | 90 max HRB |
| JIS G 3463:2012 | Symbol SUS836LTB | --- | --- | d < 10 | --- | 205 | --- | 520 | --- | 27 L | ST | --- |
| | | | | 10 ≤ d < 20 | --- | 205 | --- | 520 | --- | 30 L | ST | --- |
| | | | | d ≥ 20 | --- | 205 | --- | 520 | --- | 35 L | ST | --- |
| ASME SA-249/SA-249M | --- | N08904 | --- | t ≥ 0.4 | t ≥ 0.015 | 215 | 31 | 490 | 71 | 35 | ST+Q or RC | 90 max HRB |
| ASME SA-358/SA-358M* | --- | N08904 | --- | --- | --- | 220 | 31 | 490 | 71 | 35 | H or HT | 90 max HRBW |
| | | N08926 | --- | --- | --- | 295 | 43 | 650 | 94 | 35 | H or HT | --- |
| ASTM A249/A249M-14a | --- | N08904 | --- | t ≥ 0.4 | t ≥ 0.015 | 215 | 31 | 490 | 71 | 35 | ST+Q or RC | 90 max HRB |
| ASTM A269/A269M-14e1 | --- | N08904 | --- | t ≥ 0.38 | t ≥ 0.015 | --- | --- | --- | --- | --- | HT | 192 max HBW/ 200 max HV; 90 max HRB |
| | | N08925 | --- | t ≥ 0.38 | t ≥ 0.015 | --- | --- | --- | --- | --- | HT | 217 max HBW; 95 max HRB |
| ASTM A358/A358M-14a* | --- | N08904 | --- | --- | --- | 220 | 31 | 490 | 71 | 35 | H, HT, HT-O or HT-SO | 90 max HRBW |
| | | N08926 | --- | --- | --- | 295 | 43 | 650 | 94 | 35 | H, HT, HT-O or HT-SO | --- |
| EN 10216-5:2013 | X1NiCrMoCu25-20-5 | --- | 1.4539 | t ≤ 60 | --- | 230 | --- | 520-720 | --- | 35 L, 30 T | SA | see standard for |
| | X1NiCrMoCuN25-20-7 | --- | 1.4529 | t ≤ 60 | --- | 270 | --- | 600-800 | --- | 35 L, 30 T | SA | impact data |
| EN 10217-7:2014 | X1NiCrMoCu25-20-5 | --- | 1.4539 | t ≤ 60 | --- | 220 | --- | 520-720 | --- | 35 L, 30 T | SA | see standard for |
| | X1NiCrMoCuN25-20-7 | --- | 1.4529 | t ≤ 60 | --- | 300 | --- | 600-800 | --- | 40 L, 40 T | SA | impact data |
| JIS G 3459:2012 | Symbol SUS890LTP | --- | --- | d ≥ 40 | --- | 215 | --- | 490 | --- | 35 L; 25 T | ST | --- |
| JIS G 3463:2012 | Symbol SUS890LTB | --- | --- | d < 10 | --- | 215 | --- | 490 | --- | 27 L | ST | --- |
| | | | | 10 ≤ d < 20 | --- | 215 | --- | 490 | --- | 30 L | ST | --- |
| | | | | d ≥ 20 | --- | 215 | --- | 490 | --- | 35 L | ST | --- |

*: See "List of Standards" at the beginning of the chapter.

## 5.10 Line Pipe Steels

### 5.10.1A Mechanical Properties of Line Pipe Steels Without Notch Toughness Requirements

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter | | Yield Strength | | Tensile Strength | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | %, min. | | |
| API 5L - 2012 | L175 or A25 | --- | 1.8700 | t ≤ 25.0 | t ≤ 0.984 | 175 | 25.4 | 310 | 45 | see standard | see standard | --- |
| | L175P or A25P | --- | 1.8707 | t ≤ 25.0 | t ≤ 0.984 | 175 | 25.4 | 310 | 45 | see standard | see standard | --- |
| EN ISO 3183:2012 | L175 or A25 | --- | 1.8700 | t ≤ 25.0 | t ≤ 0.984 | 175 | 25.4 | 310 | 45 | see standard | see standard | --- |
| | L175P or A25P | --- | 1.8707 | t ≤ 25.0 | t ≤ 0.984 | 175 | 25.4 | 310 | 45 | see standard | see standard | --- |
| API 5L - 2012 | L210 or A | --- | 1.8713 | t ≤ 25.0 | t ≤ 0.984 | 210 | 30.5 | 335 | 48.6 | see standard | see standard | --- |
| EN ISO 3183:2012 | L210 or A | --- | 1.8713 | t ≤ 25.0 | t ≤ 0.984 | 210 | 30.5 | 335 | 48.6 | see standard | see standard | --- |
| GB/T 14164-2005 | Grade S210 - PSL1 | --- | --- | --- | --- | 210 | --- | 335 T | --- | 25 T | HR or CtR | --- |
| API 5L - 2012 | L245 or B | --- | 1.8723 | t ≤ 25.0 | t ≤ 0.984 | 245 | 35.5 | 415 | 60.2 | see standard | see standard | --- |
| CSA Z245.1-14 | 241 - Category 1 | --- | --- | --- | --- | 241-495 | --- | 414-760 | --- | see standard | see standard | --- |
| EN ISO 3183:2012 | L245 or B | --- | 1.8723 | t ≤ 25.0 | t ≤ 0.984 | 245 | 35.5 | 415 | 60.2 | see standard | see standard | --- |
| GB/T 14164-2005 | Grade S245 - PSL1 | --- | --- | --- | --- | 245 | --- | 415 T | --- | 21 T | HR or CtR | --- |
| | Grade S290 - PSL1 | --- | --- | --- | --- | 290 | --- | 415 T | --- | 21 T | HR or CtR | --- |
| API 5L - 2012 | L290 or X42 | --- | 1.8728 | t ≤ 25.0 | t ≤ 0.984 | 290 | 42.1 | 415 | 60.2 | see standard | see standard | --- |
| CSA Z245.1-14 | 290 - Category 1 | --- | --- | --- | --- | 290-495 | --- | 414-760 | --- | see standard | see standard | --- |
| EN ISO 3183:2012 | L290 or X42 | --- | 1.8728 | t ≤ 25.0 | t ≤ 0.984 | 290 | 42.1 | 415 | 60.2 | see standard | see standard | --- |
| API 5L - 2012 | L320 or X46 | --- | 1.8729 | t ≤ 25.0 | t ≤ 0.984 | 320 | 46.4 | 435 | 63.1 | see standard | see standard | --- |
| EN ISO 3183:2012 | L320 or X46 | --- | 1.8729 | t ≤ 25.0 | t ≤ 0.984 | 320 | 46.4 | 435 | 63.1 | see standard | see standard | --- |
| GB/T 14164-2005 | Grade S320 - PSL1 | --- | --- | --- | --- | 320 | --- | 435 T | --- | 20 T | HR or CtR | --- |
| API 5L - 2012 | L360 or X52 | --- | 1.8730 | t ≤ 25.0 | t ≤ 0.984 | 360 | 52.2 | 460 | 66.7 | see standard | see standard | --- |
| CSA Z245.1-14 | 359 - Category 1 | --- | --- | --- | --- | 359-530 | --- | 455-760 | --- | see standard | see standard | --- |
| EN ISO 3183:2012 | L360 or X52 | --- | 1.8730 | t ≤ 25.0 | t ≤ 0.984 | 360 | 52.2 | 460 | 66.7 | see standard | see standard | --- |
| GB/T 14164-2005 | Grade S360 - PSL1 | --- | --- | --- | --- | 360 | --- | 460 T | --- | 19 T | HR or CtR | --- |

**5.10 Line Pipe Steels**

**5.10.1A Mechanical Properties of Line Pipe Steels Without Notch Toughness Requirements (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter | | Yield Strength | | Tensile Strength | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | %, min. | | |
| API 5L - 2012 | L390 or X56 | --- | 1.8724 | t ≤ 25.0 | t ≤ 0.984 | 390 | 56.6 | 490 | 71.1 | see standard | see standard | --- |
| CSA Z245.1-14 | 386 - Category 1 | --- | --- | --- | --- | 386-540 | --- | 490-760 | --- | see standard | see standard | --- |
| EN ISO 3183:2012 | L390 or X56 | --- | 1.8724 | t ≤ 25.0 | t ≤ 0.984 | 390 | 56.6 | 490 | 71.1 | see standard | see standard | --- |
| GB/T 14164-2005 | Grade S390 - PSL1 | --- | --- | --- | --- | 390 | --- | 490 T | --- | 18 T | HR or CtR | --- |
| API 5L - 2012 | L415 or X60 | --- | 1.8725 | t ≤ 25.0 | t ≤ 0.984 | 415 | 60.2 | 520 | 75.4 | see standard | see standard | --- |
| CSA Z245.1-14 | 414 - Category 1 | --- | --- | --- | --- | 414-565 | --- | 517-760 | --- | see standard | see standard | --- |
| EN ISO 3183:2012 | L415 or X60 | --- | 1.8725 | t ≤ 25.0 | t ≤ 0.984 | 415 | 60.2 | 520 | 75.4 | see standard | see standard | --- |
| GB/T 14164-2005 | Grade S415 - PSL1 | --- | --- | --- | --- | 415 | --- | 520 T | --- | 17 T | HR or CtR | --- |
| API 5L - 2012 | L450 or X65 | --- | 1.8726 | t ≤ 25.0 | t ≤ 0.984 | 450 | 65.3 | 535 | 77.6 | see standard | see standard | --- |
| CSA Z245.1-14 | 448 - Category 1 | --- | --- | --- | --- | 448-600 | --- | 531-760 | --- | see standard | see standard | --- |
| EN ISO 3183:2012 | L450 or X65 | --- | 1.8726 | t ≤ 25.0 | t ≤ 0.984 | 450 | 65.3 | 535 | 77.6 | see standard | see standard | --- |
| GB/T 14164-2005 | Grade S450 - PSL1 | --- | --- | --- | --- | 450 | --- | 535 T | --- | 17 T | HR or CtR | --- |
| API 5L - 2012 | L485 or X70 | --- | 1.8727 | t ≤ 25.0 | t ≤ 0.984 | 485 | 70.3 | 570 | 82.7 | see standard | see standard | --- |
| CSA Z245.1-14 | 483 - Category 1 | --- | --- | --- | --- | 483-620 | --- | 565-760 | --- | see standard | see standard | --- |
| EN ISO 3183:2012 | L485 or X70 | --- | 1.8727 | t ≤ 25.0 | t ≤ 0.984 | 485 | 70.3 | 570 | 82.7 | see standard | see standard | --- |
| GB/T 14164-2005 | Grade S485 - PSL1 | --- | --- | --- | --- | 485 | --- | 570 T | --- | 16 T | HR or CtR | --- |

**5.10 Line Pipe Steels**

**5.10.1B Chemical Composition of Line Pipe Steels Without Notch Toughness Requirements**

| Specification | Designation | UNS No. | Steel No. | Weight, % max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| API 5L - 2012 | L175 or A25 Seamless | --- | 1.8700 | 0.21 | 0.60 | | 0.030 | 0.030 | 0.50 | 0.50 | 0.15 | Cu 0.50; B 0.001 |
| | L175P or A25P Seamless | --- | 1.8707 | 0.21 | 0.60 | --- | 0.045-0.080 | 0.030 | 0.50 | 0.50 | 0.15 | Cu 0.50; B 0.001 |
| | L175 or A25 Welded | --- | 1.8700 | 0.21 | 0.60 | --- | 0.030 | 0.030 | 0.50 | 0.50 | 0.15 | Cu 0.50; B 0.001 |
| | L175P or A25P Welded | --- | 1.8707 | 0.21 | 0.60 | --- | 0.045-0.080 | 0.030 | 0.50 | 0.50 | 0.15 | Cu 0.50; B 0.001 |
| EN ISO 3183:2012 | L175 or A25 Seamless | --- | 1.8700 | 0.21 | 0.60 | | 0.030 | 0.030 | 0.50 | 0.50 | 0.15 | Cu 0.50; B 0.001 |
| | L175P or A25P Seamless | --- | 1.8707 | 0.21 | 0.60 | --- | 0.045-0.080 | 0.030 | 0.50 | 0.50 | 0.15 | Cu 0.50; B 0.001 |
| | L175 or A25 Welded | --- | 1.8700 | 0.21 | 0.60 | --- | 0.030 | 0.030 | 0.50 | 0.50 | 0.15 | Cu 0.50; B 0.001 |
| | L175P or A25P Welded | --- | 1.8707 | 0.21 | 0.60 | --- | 0.045-0.080 | 0.030 | 0.50 | 0.50 | 0.15 | Cu 0.50; B 0.001 |
| API 5L - 2012 | L210 or A Seamless | --- | 1.8713 | 0.22 | 0.90 | --- | 0.030 | 0.030 | 0.50 | 0.50 | 0.15 | Cu 0.50; B 0.001 |
| | L210 or A Welded | --- | 1.8713 | 0.22 | 0.90 | --- | 0.030 | 0.030 | 0.50 | 0.50 | 0.15 | Cu 0.50; B 0.001 |
| EN ISO 3183:2012 | L210 or A Seamless | --- | 1.8713 | 0.22 | 0.90 | --- | 0.030 | 0.030 | 0.50 | 0.50 | 0.15 | Cu 0.50; B 0.001 |
| | L210 or A Welded | --- | 1.8713 | 0.22 | 0.90 | --- | 0.030 | 0.030 | 0.50 | 0.50 | 0.15 | Cu 0.50; B 0.001 |
| GB/T 14164-2005 | Grade S210 - PSL1 | --- | --- | 0.22 | 0.90 | 0.35 | 0.03 | 0.03 | --- | --- | --- | --- |
| API 5L - 2012 | L245 or B Seamless | --- | 1.8723 | 0.28 | 1.20 | --- | 0.030 | 0.030 | 0.50 | 0.50 | 0.15 | Cu 0.50; B 0.001; (Nb+V) 0.06; (Nb+V+Ti) 0.15 |
| | L245 or B Welded | --- | 1.8723 | 0.26 | 1.20 | --- | 0.30 | 0.30 | 0.50 | 0.50 | 0.15 | Cu 0.50; B 0.001; (Nb+V) 0.06; (Nb+V+Ti) 0.15 |
| CSA Z245.1-14 | 241 - Category 1 | --- | --- | 0.26 | 2.00 | 0.50 | 0.030 | 0.035 | --- | --- | --- | Nb 0.11; Ti 0.11; V 0.11; B 0.001 CE 0.40 (see standard) |
| EN ISO 3183:2012 | L245 or B Seamless | --- | 1.8723 | 0.28 | 1.20 | --- | 0.030 | 0.030 | 0.50 | 0.50 | 0.15 | Cu 0.50; B 0.001; (Nb+V) 0.06; (Nb+V+Ti) 0.15 |
| | L245 or B Welded | --- | 1.8723 | 0.26 | 1.20 | --- | 0.30 | 0.30 | 0.50 | 0.50 | 0.15 | Cu 0.50; B 0.001; (Nb+V) 0.06; (Nb+V+Ti) 0.15 |
| GB/T 14164-2005 | Grade S245 - PSL1 | --- | --- | 0.26 | 1.20 | 0.35 | 0.03 | 0.03 | --- | --- | --- | --- |
| | Grade S290 - PSL1 | --- | --- | 0.26 | 1.30 | 0.35 | 0.03 | 0.03 | --- | --- | --- | --- |
| API 5L - 2012 | L290 or X42 Seamless | --- | 1.8728 | 0.28 | 1.30 | --- | 0.030 | 0.030 | 0.50 | 0.50 | 0.15 | Cu 0.50; B 0.001; (Nb+V+Ti) 0.15 |
| | L290 or X42 Welded | --- | 1.8728 | 0.26 | 1.30 | --- | 0.030 | 0.030 | 0.50 | 0.50 | 0.15 | Cu 0.50; B 0.001; (Nb+V+Ti) 0.15 |
| CSA Z245.1-14 | 290 - Category 1 | --- | --- | 0.26 | 2.00 | 0.50 | 0.030 | 0.035 | --- | --- | --- | Nb 0.11; Ti 0.11; V 0.11; B 0.001 CE 0.40 (see standard) |
| EN ISO 3183:2012 | L290 or X42 Seamless | --- | 1.8728 | 0.28 | 1.30 | --- | 0.030 | 0.030 | 0.50 | 0.50 | 0.15 | Cu 0.50; B 0.001; (Nb+V+Ti) 0.15 |
| | L290 or X42 Welded | --- | 1.8728 | 0.26 | 1.30 | --- | 0.030 | 0.030 | 0.50 | 0.50 | 0.15 | Cu 0.50; B 0.001; (Nb+V+Ti) 0.15 |

**5.10 Line Pipe Steels**

**5.10.1B Chemical Composition of Line Pipe Steels Without Notch Toughness Requirements (Continued)**

| Specification | Designation | UNS No. | Steel No. | Weight, % max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| API 5L - 2012 | L320 or X46 Seamless | --- | 1.8729 | 0.28 | 1.40 | --- | 0.030 | 0.030 | 0.50 | 0.50 | 0.15 | Cu 0.50; B 0.001; (Nb+V+Ti) 0.15 |
| | L320 or X46 Welded | --- | 1.8729 | 0.26 | 1.40 | --- | 0.030 | 0.030 | 0.50 | 0.50 | 0.15 | Cu 0.50; B 0.001; (Nb+V+Ti) 0.15 |
| EN ISO 3183:2012 | L320 or X46 Seamless | --- | 1.8729 | 0.28 | 1.40 | --- | 0.030 | 0.030 | 0.50 | 0.50 | 0.15 | Cu 0.50; B 0.001; (Nb+V+Ti) 0.15 |
| | L320 or X46 Welded | --- | 1.8729 | 0.26 | 1.40 | --- | 0.030 | 0.030 | 0.50 | 0.50 | 0.15 | Cu 0.50; B 0.001; (Nb+V+Ti) 0.15 |
| GB/T 14164-2005 | Grade S320 - PSL1 | --- | --- | 0.26 | 1.40 | 0.35 | 0.03 | 0.03 | --- | --- | --- | --- |
| API 5L - 2012 | L360 or X52 Seamless | --- | 1.8730 | 0.28 | 1.40 | --- | 0.030 | 0.030 | 0.50 | 0.50 | 0.15 | Cu 0.50; B 0.001; (Nb+V+Ti) 0.15 |
| | L360 or X52 Welded | --- | 1.8730 | 0.26 | 1.40 | --- | 0.030 | 0.030 | 0.50 | 0.50 | 0.15 | Cu 0.50; B 0.001; (Nb+V+Ti) 0.15 |
| CSA Z245.1-14 | 359 - Category 1 | --- | --- | 0.26 | 2.00 | 0.50 | 0.030 | 0.035 | --- | --- | --- | Nb 0.11; Ti 0.11; V 0.11; B 0.001 CE 0.40 (see standard) |
| EN ISO 3183:2012 | L360 or X52 Seamless | --- | 1.8730 | 0.28 | 1.40 | --- | 0.030 | 0.030 | 0.50 | 0.50 | 0.15 | Cu 0.50; B 0.001; (Nb+V+Ti) 0.15 |
| | L360 or X52 Welded | --- | 1.8730 | 0.26 | 1.40 | --- | 0.030 | 0.030 | 0.50 | 0.50 | 0.15 | Cu 0.50; B 0.001; (Nb+V+Ti) 0.15 |
| GB/T 14164-2005 | Grade S360 - PSL1 | --- | --- | 0.26 | 1.40 | 0.35 | 0.03 | 0.03 | --- | --- | --- | --- |
| API 5L - 2012 | L390 or X56 Seamless | --- | 1.8724 | 0.28 | 1.40 | --- | 0.030 | 0.030 | 0.50 | 0.50 | 0.15 | Cu 0.50; B 0.001; (Nb+V+Ti) 0.15 |
| | L390 or X56 Welded | --- | 1.8724 | 0.26 | 1.40 | --- | 0.030 | 0.030 | 0.50 | 0.50 | 0.15 | Cu 0.50; B 0.001; (Nb+V+Ti) 0.15 |
| CSA Z245.1-14 | 386 - Category 1 | --- | --- | 0.26 | 2.00 | 0.50 | 0.030 | 0.035 | --- | --- | --- | Nb 0.11; Ti 0.11; V 0.11; B 0.001 CE 0.40 (see standard) |
| EN ISO 3183:2012 | L390 or X56 Seamless | --- | 1.8724 | 0.28 | 1.40 | --- | 0.030 | 0.030 | 0.50 | 0.50 | 0.15 | Cu 0.50; B 0.001; (Nb+V+Ti) 0.15 |
| | L390 or X56 Welded | --- | 1.8724 | 0.26 | 1.40 | --- | 0.030 | 0.030 | 0.50 | 0.50 | 0.15 | Cu 0.50; B 0.001; (Nb+V+Ti) 0.15 |
| GB/T 14164-2005 | Grade S390 - PSL1 | --- | --- | 0.26 | 1.40 | 0.40 | 0.03 | 0.03 | --- | --- | --- | --- |
| API 5L - 2012 | L415 or X60 Seamless | --- | 1.8725 | 0.28 | 1.40 | --- | 0.030 | 0.030 | 0.50 | 0.50 | 0.15 | Cu 0.50; B 0.001; (Nb+V+Ti) 0.15 |
| | L415 or X60 Welded | --- | 1.8725 | 0.26 | 1.40 | --- | 0.030 | 0.030 | 0.50 | 0.50 | 0.15 | Cu 0.50; B 0.001; (Nb+V+Ti) 0.15 |
| CSA Z245.1-14 | 414 - Category 1 | --- | --- | 0.26 | 2.00 | 0.50 | 0.030 | 0.035 | --- | --- | --- | Nb 0.11; Ti 0.11; V 0.11; B 0.001 CE 0.40 (see standard) |
| EN ISO 3183:2012 | L415 or X60 Seamless | --- | 1.8725 | 0.28 | 1.40 | --- | 0.030 | 0.030 | 0.50 | 0.50 | 0.15 | Cu 0.50; B 0.001; (Nb+V+Ti) 0.15 |
| | L415 or X60 Welded | --- | 1.8725 | 0.26 | 1.40 | --- | 0.030 | 0.030 | 0.50 | 0.50 | 0.15 | Cu 0.50; B 0.001; (Nb+V+Ti) 0.15 |
| GB/T 14164-2005 | Grade S415 - PSL1 | --- | --- | 0.26 | 1.40 | 0.40 | 0.03 | 0.03 | --- | --- | --- | --- |

**5.10 Line Pipe Steels**

**5.10.1B Chemical Composition of Line Pipe Steels Without Notch Toughness Requirements (Continued)**

| Specification | Designation | UNS No. | Steel No. | Weight, % max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| API 5L - 2012 | L450 or X65 Seamless | --- | 1.8726 | 0.28 | 1.40 | --- | 0.030 | 0.030 | 0.50 | 0.50 | 0.15 | Cu 0.50; B 0.001; (Nb+V+Ti) 0.15 |
| | L450 or X65 Welded | --- | 1.8726 | 0.26 | 1.45 | --- | 0.030 | 0.030 | 0.50 | 0.50 | 0.15 | Cu 0.50; B 0.001; (Nb+V+Ti) 0.15 |
| CSA Z245.1-14 | 448 - Category 1 | --- | --- | 0.26 | 2.00 | 0.50 | 0.030 | 0.035 | --- | --- | --- | Nb 0.11; Ti 0.11; V 0.11; B 0.001 CE 0.40 (see standard) |
| EN ISO 3183:2012 | L450 or X65 Seamless | --- | 1.8726 | 0.28 | 1.40 | --- | 0.030 | 0.030 | 0.50 | 0.50 | 0.15 | Cu 0.50; B 0.001; (Nb+V+Ti) 0.15 |
| | L450 or X65 Welded | --- | 1.8726 | 0.26 | 1.45 | --- | 0.030 | 0.030 | 0.50 | 0.50 | 0.15 | Cu 0.50; B 0.001; (Nb+V+Ti) 0.15 |
| GB/T 14164-2005 | Grade S450 - PSL1 | --- | --- | 0.26 | 1.45 | 0.40 | 0.03 | 0.03 | --- | --- | --- | --- |
| API 5L - 2012 | L485 or X70 Seamless | --- | 1.8727 | 0.28 | 1.40 | --- | 0.030 | 0.030 | 0.50 | 0.50 | 0.15 | Cu 0.50; B 0.001; (Nb+V+Ti) 0.15 |
| | L485 or X70 Welded | --- | 1.8727 | 0.26 | 1.65 | --- | 0.030 | 0.030 | 0.50 | 0.50 | 0.15 | Cu 0.50; B 0.001; (Nb+V+Ti) 0.15 |
| CSA Z245.1-14 | 483 - Category 1 | --- | --- | 0.26 | 2.00 | 0.50 | 0.030 | 0.035 | --- | --- | --- | Nb 0.11; Ti 0.11; V 0.11; B 0.001 CE 0.40 (see standard) |
| EN ISO 3183:2012 | L485 or X70 Seamless | --- | 1.8727 | 0.28 | 1.40 | --- | 0.030 | 0.030 | 0.50 | 0.50 | 0.15 | Cu 0.50; B 0.001; (Nb+V+Ti) 0.15 |
| | L485 or X70 Welded | --- | 1.8727 | 0.26 | 1.65 | --- | 0.030 | 0.030 | 0.50 | 0.50 | 0.15 | Cu 0.50; B 0.001; (Nb+V+Ti) 0.15 |
| GB/T 14164-2005 | Grade S485 - PSL1 | --- | --- | 0.26 | 1.65 | 0.40 | 0.03 | 0.03 | --- | --- | --- | --- |

**5.10 Line Pipe Steels**

**5.10.2A Mechanical Properties of Line Pipe Steels With Notch Toughness Requirements**

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter mm | Section Thickness/Diameter in. | Yield Strength MPa | Yield Strength ksi | Tensile Strength MPa | Tensile Strength ksi | Elongation %, min. | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| API 5L - 2012 | L175 or A25 | --- | 1.8700 | t ≤ 25.0 | t ≤ 0.984 | 175 | 25.4 | 310 | 45 | see standard | see standard | --- |
| | L175P or A25P | --- | 1.8707 | t ≤ 25.0 | t ≤ 0.984 | 175 | 25.4 | 310 | 45 | see standard | see standard | --- |
| EN ISO 3183:2012 | L175 or A25 | --- | 1.8700 | t ≤ 25.0 | t ≤ 0.984 | 175 | 25.4 | 310 | 45 | see standard | see standard | --- |
| | L175P or A25P | --- | 1.8707 | t ≤ 25.0 | t ≤ 0.984 | 175 | 25.4 | 310 | 45 | see standard | see standard | --- |
| GB/T 14164-2005 | Grade S175 I - PSL1 | --- | --- | --- | --- | 175 | --- | 315 T | --- | 27 T | HR or CtR | --- |
| | Grade S175 II - PSL1 | --- | --- | --- | --- | 175 | --- | 315 T | --- | 27 T | HR or CtR | --- |
| API 5L - 2012 | L245R or BR | --- | 1.8788 | t ≤ 25.0 | t ≤ 0.984 | 245-450 | 35.5-65.3 | 415-655 | 60.2-95 | see standard | see standard | see standard |
| | L245N or BN | --- | 1.8790 | t ≤ 25.0 | t ≤ 0.984 | 245-450 | 35.5-65.3 | 415-655 | 60.2-95 | see standard | see standard | see standard |
| | L245Q or BQ | --- | 1.8737 | t ≤ 25.0 | t ≤ 0.984 | 245-450 | 35.5-65.3 | 415-655 | 60.2-95 | see standard | see standard | see standard |
| | L245M or BM | --- | 1.8746 | t ≤ 25.0 | t ≤ 0.984 | 245-450 | 35.5-65.3 | 415-655 | 60.2-95 | see standard | see standard | see standard |
| CSA Z245.1-14 | Grade 241 - Category 2 | --- | --- | --- | --- | 241-495 | --- | 414-760 | --- | see standard | see standard | see standard |
| | Grade 241 - Category 3 | --- | --- | --- | --- | 241-495 | --- | 414-760 | --- | see standard | see standard | see standard |
| EN ISO 3183:2012 | L245R or BR | --- | 1.8788 | t ≤ 25.0 | t ≤ 0.984 | 245-450 | 35.5-65.3 | 415-655 | 60.2-95 | see standard | see standard | see standard |
| | L245N or BN | --- | 1.8790 | t ≤ 25.0 | t ≤ 0.984 | 245-450 | 35.5-65.3 | 415-655 | 60.2-95 | see standard | see standard | see standard |
| | L245Q or BQ | --- | 1.8737 | t ≤ 25.0 | t ≤ 0.984 | 245-450 | 35.5-65.3 | 415-655 | 60.2-95 | see standard | see standard | see standard |
| | L245M or BM | --- | 1.8746 | t ≤ 25.0 | t ≤ 0.984 | 245-450 | 35.5-65.3 | 415-655 | 60.2-95 | see standard | see standard | see standard |
| GB/T 14164-2005 | Grade S245 - PSL2 | --- | --- | --- | --- | 245-445 | --- | 415-755 T | --- | 21 T | HR or CtR | T: 40 J @ 0°C |
| API 5L - 2012 | L290R or X42R | --- | 1.8789 | t ≤ 25.0 | t ≤ 0.984 | 290-495 | 42.1-71.8 | 415-655 | 60.2-95 | see standard | see standard | see standard |
| | L290N or X42N | --- | 1.8791 | t ≤ 25.0 | t ≤ 0.984 | 290-495 | 42.1-71.8 | 415-655 | 60.2-95 | see standard | see standard | see standard |
| | L290Q or X42Q | --- | 1.8738 | t ≤ 25.0 | t ≤ 0.984 | 290-495 | 42.1-71.8 | 415-655 | 60.2-95 | see standard | see standard | see standard |
| | L290M or X42M | --- | 1.8747 | t ≤ 25.0 | t ≤ 0.984 | 290-495 | 42.1-71.8 | 415-655 | 60.2-95 | see standard | see standard | see standard |
| CSA Z245.1-14 | Grade 290 - Category 2 | --- | --- | --- | --- | 290-495 | --- | 414-760 | --- | see standard | see standard | see standard |
| | Grade 290 - Category 3 | --- | --- | --- | --- | 290-495 | --- | 414-760 | --- | see standard | see standard | see standard |
| EN ISO 3183:2012 | L290R or X42R | --- | 1.8789 | t ≤ 25.0 | t ≤ 0.984 | 290-495 | 42.1-71.8 | 415-655 | 60.2-95 | see standard | see standard | see standard |
| | L290N or X42N | --- | 1.8791 | t ≤ 25.0 | t ≤ 0.984 | 290-495 | 42.1-71.8 | 415-655 | 60.2-95 | see standard | see standard | see standard |
| | L290Q or X42Q | --- | 1.8738 | t ≤ 25.0 | t ≤ 0.984 | 290-495 | 42.1-71.8 | 415-655 | 60.2-95 | see standard | see standard | see standard |
| | L290M or X42M | --- | 1.8747 | t ≤ 25.0 | t ≤ 0.984 | 290-495 | 42.1-71.8 | 415-655 | 60.2-95 | see standard | see standard | see standard |
| GB/T 14164-2005 | Grade S290 - PSL2 | --- | --- | --- | --- | 290-495 | --- | 415-755 T | --- | 21 T | HR or CtR | T: 42 J @ 0°C |

**5.10 Line Pipe Steels**

**5.10.2A Mechanical Properties of Line Pipe Steels With Notch Toughness Requirements (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter | | Yield Strength | | Tensile Strength | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | %, min. | | |
| API 5L - 2012 | L320N or X46N | --- | 1.8792 | t ≤ 25.0 | t ≤ 0.984 | 320-525 | 46.4-76.1 | 435-655 | 63.1-95 | see standard | see standard | see standard |
| | L320Q or X46Q | --- | 1.8739 | t ≤ 25.0 | t ≤ 0.984 | 320-525 | 46.4-76.1 | 435-655 | 63.1-95 | see standard | see standard | see standard |
| | L320M or X46M | --- | 1.8748 | t ≤ 25.0 | t ≤ 0.984 | 320-525 | 46.4-76.1 | 435-655 | 63.1-95 | see standard | see standard | see standard |
| EN ISO 3183:2012 | L320N or X46N | --- | 1.8792 | t ≤ 25.0 | t ≤ 0.984 | 320-525 | 46.4-76.1 | 435-655 | 63.1-95 | see standard | see standard | see standard |
| | L320Q or X46Q | --- | 1.8739 | t ≤ 25.0 | t ≤ 0.984 | 320-525 | 46.4-76.1 | 435-655 | 63.1-95 | see standard | see standard | see standard |
| | L320M or X46M | --- | 1.8748 | t ≤ 25.0 | t ≤ 0.984 | 320-525 | 46.4-76.1 | 435-655 | 63.1-95 | see standard | see standard | see standard |
| GB/T 14164-2005 | Grade S320 - PSL2 | --- | --- | --- | --- | 320-525 | --- | 435-755 T | --- | 20 T | HR or CtR | T: 42 J @ 0°C |
| API 5L - 2012 | L360N or X52N | --- | 1.8793 | t ≤ 25.0 | t ≤ 0.984 | 360-530 | 52.2-76.9 | 460-760 | 66.7-110.2 | see standard | see standard | see standard |
| | L360Q or X52Q | --- | 1.8741 | t ≤ 25.0 | t ≤ 0.984 | 360-530 | 52.2-76.9 | 460-760 | 66.7-110.2 | see standard | see standard | see standard |
| | L360M or X52M | --- | 1.8749 | t ≤ 25.0 | t ≤ 0.984 | 360-530 | 52.2-76.9 | 460-760 | 66.7-110.2 | see standard | see standard | see standard |
| CSA Z245.1-14 | Grade 359 - Category 2 | --- | --- | --- | --- | 359-530 | --- | 455-760 | --- | see standard | see standard | see standard |
| | Grade 359 - Category 3 | --- | --- | --- | --- | 359-530 | --- | 455-760 | --- | see standard | see standard | see standard |
| EN ISO 3183:2012 | L360N or X52N | --- | 1.8793 | t ≤ 25.0 | t ≤ 0.984 | 360-530 | 52.2-76.9 | 460-760 | 66.7-110.2 | see standard | see standard | see standard |
| | L360Q or X52Q | --- | 1.8741 | t ≤ 25.0 | t ≤ 0.984 | 360-530 | 52.2-76.9 | 460-760 | 66.7-110.2 | see standard | see standard | see standard |
| | L360M or X52M | --- | 1.8749 | t ≤ 25.0 | t ≤ 0.984 | 360-530 | 52.2-76.9 | 460-760 | 66.7-110.2 | see standard | see standard | see standard |
| GB/T 14164-2005 | Grade S360 - PSL2 | --- | --- | --- | --- | 360-530 | --- | 460-755 T | --- | 19 T | HR or CtR | T: 42 J @ 0°C |
| API 5L - 2012 | L390N or X56N | --- | 1.8970 | t ≤ 25.0 | t ≤ 0.984 | 390-545 | 56.6-79 | 490-760 | 71.1-110.2 | see standard | see standard | see standard |
| | L390Q or X56Q | --- | 1.8740 | t ≤ 25.0 | t ≤ 0.984 | 390-545 | 56.6-79 | 490-760 | 71.1-110.2 | see standard | see standard | see standard |
| | L390M or X56M | --- | 1.8971 | t ≤ 25.0 | t ≤ 0.984 | 390-545 | 56.6-79 | 490-760 | 71.1-110.2 | see standard | see standard | see standard |
| CSA Z245.1-14 | Grade 386 - Category 2 | --- | --- | --- | --- | 386-540 | --- | 490-760 | --- | see standard | see standard | see standard |
| | Grade 386 - Category 3 | --- | --- | --- | --- | 386-540 | --- | 490-760 | --- | see standard | see standard | see standard |
| EN ISO 3183:2012 | L390N or X56N | --- | 1.8970 | t ≤ 25.0 | t ≤ 0.984 | 390-545 | 56.6-79 | 490-760 | 71.1-110.2 | see standard | see standard | see standard |
| | L390Q or X56Q | --- | 1.8740 | t ≤ 25.0 | t ≤ 0.984 | 390-545 | 56.6-79 | 490-760 | 71.1-110.2 | see standard | see standard | see standard |
| | L390M or X56M | --- | 1.8971 | t ≤ 25.0 | t ≤ 0.984 | 390-545 | 56.6-79 | 490-760 | 71.1-110.2 | see standard | see standard | see standard |
| GB/T 14164-2005 | Grade S390 - PSL2 | --- | --- | --- | --- | 390-545 | --- | 490-755 T | --- | 18 T | HR or CtR | T: 42 J @ 0°C |

**5.10 Line Pipe Steels**

**5.10.2A Mechanical Properties of Line Pipe Steels With Notch Toughness Requirements (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter | | Yield Strength | | Tensile Strength | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | %, min. | | |
| API 5L - 2012 | L415N or X60N | --- | 1.8736 | t ≤ 25.0 | t ≤ 0.984 | 415-565 | 60.2-81.9 | 520-760 | 75.4-110.2 | see standard | see standard | see standard |
| | L415Q or X60Q | --- | 1.8742 | t ≤ 25.0 | t ≤ 0.984 | 415-565 | 60.2-81.9 | 520-760 | 75.4-110.2 | see standard | see standard | see standard |
| | L415M or X60M | --- | 1.8752 | t ≤ 25.0 | t ≤ 0.984 | 415-565 | 60.2-81.9 | 520-760 | 75.4-110.2 | see standard | see standard | see standard |
| CSA Z245.1-14 | Grade 414 - Category 2 | --- | --- | --- | --- | 414-565 | --- | 517-760 | --- | see standard | see standard | see standard |
| | Grade 414 - Category 3 | --- | --- | --- | --- | 414-565 | --- | 517-760 | --- | see standard | see standard | see standard |
| EN ISO 3183:2012 | L415N or X60N | --- | 1.8736 | t ≤ 25.0 | t ≤ 0.984 | 415-565 | 60.2-81.9 | 520-760 | 75.4-110.2 | see standard | see standard | see standard |
| | L415Q or X60Q | --- | 1.8742 | t ≤ 25.0 | t ≤ 0.984 | 415-565 | 60.2-81.9 | 520-760 | 75.4-110.2 | see standard | see standard | see standard |
| | L415M or X60M | --- | 1.8752 | t ≤ 25.0 | t ≤ 0.984 | 415-565 | 60.2-81.9 | 520-760 | 75.4-110.2 | see standard | see standard | see standard |
| GB/T 14164-2005 | Grade S415 - PSL2 | --- | --- | --- | --- | 415-565 | --- | 520-755 T | --- | 17 T | HR or CtR | T: 42 J @ 0°C |
| API 5L - 2012 | L450Q or X65Q | --- | 1.8743 | t ≤ 25.0 | t ≤ 0.984 | 450-600 | 65.3-87 | 535-760 | 77.6-110.2 | see standard | see standard | see standard |
| | L450M or X65M | --- | 1.8754 | t ≤ 25.0 | t ≤ 0.984 | 450-600 | 65.3-87 | 535-760 | 77.6-110.2 | see standard | see standard | see standard |
| CSA Z245.1-14 | Grade 448 - Category 2 | --- | --- | --- | --- | 448-600 | --- | 531-760 | --- | see standard | see standard | see standard |
| | Grade 448 - Category 3 | --- | --- | --- | --- | 448-600 | --- | 531-760 | --- | see standard | see standard | see standard |
| EN ISO 3183:2012 | L450Q or X65Q | --- | 1.8743 | t ≤ 25.0 | t ≤ 0.984 | 450-600 | 65.3-87 | 535-760 | 77.6-110.2 | see standard | see standard | see standard |
| | L450M or X65M | --- | 1.8754 | t ≤ 25.0 | t ≤ 0.984 | 450-600 | 65.3-87 | 535-760 | 77.6-110.2 | see standard | see standard | see standard |
| GB/T 14164-2005 | Grade S450 - PSL2 | --- | --- | --- | --- | 450-600 | --- | 535-755 T | --- | 17 T | HR or CtR | T: 47 J @ 0°C |
| API 5L - 2012 | L485Q or X70Q | --- | 1.8744 | t ≤ 25.0 | t ≤ 0.984 | 485-635 | 70.3-92.1 | 570-760 | 82.7-110.2 | see standard | see standard | see standard |
| | L485M or X70M | --- | 1.8756 | t ≤ 25.0 | t ≤ 0.984 | 485-635 | 70.3-92.1 | 570-760 | 82.7-110.2 | see standard | see standard | see standard |
| CSA Z245.1-14 | Grade 483 - Category 2 | --- | --- | --- | --- | 483-620 | --- | 565-760 | --- | see standard | see standard | see standard |
| | Grade 483 - Category 3 | --- | --- | --- | --- | 483-620 | --- | 565-760 | --- | see standard | see standard | see standard |
| EN ISO 3183:2012 | L485Q or X70Q | --- | 1.8744 | t ≤ 25.0 | t ≤ 0.984 | 485-635 | 70.3-92.1 | 570-760 | 82.7-110.2 | see standard | see standard | see standard |
| | L485M or X70M | --- | 1.8756 | t ≤ 25.0 | t ≤ 0.984 | 485-635 | 70.3-92.1 | 570-760 | 82.7-110.2 | see standard | see standard | see standard |
| GB/T 14164-2005 | Grade S485 - PSL2 | --- | --- | --- | --- | 485-620 | --- | 570-755 T | --- | 16 T | HR or CtR | T: 63 J @ 0°C |
| API 5L - 2012 | L555Q or X80Q | --- | 1.8745 | t ≤ 25.0 | t ≤ 0.984 | 555-705 | 80.5-102.3 | 625-825 | 90.6-119.7 | see standard | see standard | see standard |
| | L555M or X80M | --- | 1.8758 | t ≤ 25.0 | t ≤ 0.984 | 555-705 | 80.5-102.3 | 625-825 | 90.6-119.7 | see standard | see standard | see standard |
| CSA Z245.1-14 | Grade 550 - Category 2 | --- | --- | --- | --- | 550-690 | --- | 620-830 | --- | see standard | see standard | see standard |
| | Grade 550 - Category 3 | --- | --- | --- | --- | 550-690 | --- | 620-830 | --- | see standard | see standard | see standard |
| EN ISO 3183:2012 | L555Q or X80Q | --- | 1.8745 | t ≤ 25.0 | t ≤ 0.984 | 555-705 | 80.5-102.3 | 625-825 | 90.6-119.7 | see standard | see standard | see standard |
| | L555M or X80M | --- | 1.8758 | t ≤ 25.0 | t ≤ 0.984 | 555-705 | 80.5-102.3 | 625-825 | 90.6-119.7 | see standard | see standard | see standard |
| GB/T 14164-2005 | Grade S555 - PSL2 | --- | --- | --- | --- | 555-690 | --- | 625-825 T | --- | 15 T | HR or CtR | T: 96 J @ 0°C |

**5.10 Line Pipe Steels**

**5.10.2B Chemical Composition of Line Pipe Steels With Notch Toughness Requirements**

| Specification | Designation | UNS No. | Steel No. | Weight, % max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| API 5L - 2012 | L175 or A25 Seamless | --- | 1.8700 | 0.21 | 0.60 | | 0.030 | 0.030 | 0.50 | 0.50 | 0.15 | Cu 0.50; B 0.001 |
| | L175P or A25P Seamless | --- | 1.8707 | 0.21 | 0.60 | --- | 0.045-0.080 | 0.030 | 0.50 | 0.50 | 0.15 | Cu 0.50; B 0.001 |
| | L175 or A25 Welded | --- | 1.8700 | 0.21 | 0.60 | --- | 0.030 | 0.030 | 0.50 | 0.50 | 0.15 | Cu 0.50; B 0.001 |
| | L175P or A25P Welded | --- | 1.8707 | 0.21 | 0.60 | --- | 0.045-0.080 | 0.030 | 0.50 | 0.50 | 0.15 | Cu 0.50; B 0.001 |
| EN ISO 3183:2012 | L175 or A25 Seamless | --- | 1.8700 | 0.21 | 0.60 | | 0.030 | 0.030 | 0.50 | 0.50 | 0.15 | Cu 0.50; B 0.001 |
| | L175P or A25P Seamless | --- | 1.8707 | 0.21 | 0.60 | --- | 0.045-0.080 | 0.030 | 0.50 | 0.50 | 0.15 | Cu 0.50; B 0.001 |
| | L175 or A25 Welded | --- | 1.8700 | 0.21 | 0.60 | --- | 0.030 | 0.030 | 0.50 | 0.50 | 0.15 | Cu 0.50; B 0.001 |
| | L175P or A25P Welded | --- | 1.8707 | 0.21 | 0.60 | --- | 0.045-0.080 | 0.030 | 0.50 | 0.50 | 0.15 | Cu 0.50; B 0.001 |
| GB/T 14164-2005 | Grade S175 I - PSL1 | --- | --- | 0.21 | 0.60 | 0.35 | 0.03 | 0.03 | --- | --- | --- | --- |
| | Grade S175 II - PSL1 | --- | --- | 0.21 | 0.60 | 0.35 | 0.045-0.080 | 0.03 | --- | --- | --- | --- |
| API 5L - 2012 | L245R or BR | --- | 1.8788 | 0.24 | 1.20 | 0.40 | 0.025 | 0.015 | 0.30 | 0.30 | 0.15 | Cu 0.50; B 0.001; Ti 0.04 (Nb+V) 0.06 |
| | L245N or BN | --- | 1.8790 | 0.24 | 1.20 | 0.40 | 0.025 | 0.015 | 0.30 | 0.30 | 0.15 | Cu 0.50; B 0.001; Ti 0.04 (Nb+V) 0.06 |
| | L245Q or BQ | --- | 1.8737 | 0.18 | 1.40 | 0.45 | 0.025 | 0.015 | 0.30 | 0.30 | 0.15 | Cu 0.50; B 0.001; Ti 0.04; Nb 0.05; V 0.05 |
| | L245M or BM | --- | 1.8746 | 0.22 | 1.20 | 0.45 | 0.025 | 0.015 | 0.30 | 0.30 | 0.15 | Cu 0.50; B 0.001; Ti 0.04; Nb 0.05; V 0.05 |
| CSA Z245.1-14 | Grade 241 - Category 2 | --- | --- | 0.26 | 2.00 | 0.50 | 0.030 | 0.035 | --- | --- | --- | Nb 0.11; Ti 0.11; V 0.11; B 0.001 CE 0.40 (see standard) |
| | Grade 241 - Category 3 | --- | --- | 0.26 | 2.00 | 0.50 | 0.030 | 0.035 | --- | --- | --- | Nb 0.11; Ti 0.11; V 0.11; B 0.001 CE 0.40 (see standard) |
| EN ISO 3183:2012 | L245R or BR | --- | 1.8788 | 0.24 | 1.20 | 0.40 | 0.025 | 0.015 | 0.30 | 0.30 | 0.15 | Cu 0.50; B 0.001; Ti 0.04 (Nb+V) 0.06 |
| | L245N or BN | --- | 1.8790 | 0.24 | 1.20 | 0.40 | 0.025 | 0.015 | 0.30 | 0.30 | 0.15 | Cu 0.50; B 0.001; Ti 0.04 (Nb+V) 0.06 |
| | L245Q or BQ | --- | 1.8737 | 0.18 | 1.40 | 0.45 | 0.025 | 0.015 | 0.30 | 0.30 | 0.15 | Cu 0.50; B 0.001; Ti 0.04; Nb 0.05; V 0.05 |
| | L245M or BM | --- | 1.8746 | 0.22 | 1.20 | 0.45 | 0.025 | 0.015 | 0.30 | 0.30 | 0.15 | Cu 0.50; B 0.001; Ti 0.04; Nb 0.05; V 0.05 |
| GB/T 14164-2005 | Grade S245 - PSL2 | --- | --- | 0.22 | 1.20 | 0.35 | 0.025 | 0.015 | --- | --- | --- | --- |

**5.10 Line Pipe Steels**

**5.10.2B Chemical Composition of Line Pipe Steels With Notch Toughness Requirements (Continued)**

| Specification | Designation | UNS No. | Steel No. | Weight, % max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| API 5L - 2012 | L290R or X42R | --- | 1.8789 | 0.24 | 1.20 | 0.40 | 0.025 | 0.015 | 0.30 | 0.30 | 0.15 | Cu 0.50; B 0.001; Ti 0.04; Nb 0.05; V 0.06 |
| | L290N or X42N | --- | 1.8791 | 0.24 | 1.20 | 0.40 | 0.025 | 0.015 | 0.30 | 0.30 | 0.15 | Cu 0.50; B 0.001; Ti 0.04; Nb 0.05; V 0.06 |
| | L290Q or X42Q | --- | 1.8738 | 0.18 | 1.40 | 0.45 | 0.025 | 0.015 | 0.30 | 0.30 | 0.15 | Cu 0.50; B 0.001; Ti 0.04; Nb 0.05; V 0.05 |
| | L290M or X42M | --- | 1.8747 | 0.22 | 1.30 | 0.45 | 0.025 | 0.015 | 0.30 | 0.30 | 0.15 | Cu 0.50; B 0.001; Ti 0.04; Nb 0.05; V 0.05 |
| CSA Z245.1-14 | Grade 290 - Category 2 | --- | --- | 0.26 | 2.00 | 0.50 | 0.030 | 0.035 | --- | --- | --- | Nb 0.11; Ti 0.11; V 0.11; B 0.001 CE 0.40 (see standard) |
| | Grade 290 - Category 3 | --- | --- | 0.26 | 2.00 | 0.50 | 0.030 | 0.035 | --- | --- | --- | Nb 0.11; Ti 0.11; V 0.11; B 0.001 CE 0.40 (see standard) |
| EN ISO 3183:2012 | L290R or X42R | --- | 1.8789 | 0.24 | 1.20 | 0.40 | 0.025 | 0.015 | 0.30 | 0.30 | 0.15 | Cu 0.50; B 0.001; Ti 0.04; Nb 0.05; V 0.06 |
| | L290N or X42N | --- | 1.8791 | 0.24 | 1.20 | 0.40 | 0.025 | 0.015 | 0.30 | 0.30 | 0.15 | Cu 0.50; B 0.001; Ti 0.04; Nb 0.05; V 0.06 |
| | L290Q or X42Q | --- | 1.8738 | 0.18 | 1.40 | 0.45 | 0.025 | 0.015 | 0.30 | 0.30 | 0.15 | Cu 0.50; B 0.001; Ti 0.04; Nb 0.05; V 0.05 |
| | L290M or X42M | --- | 1.8747 | 0.22 | 1.30 | 0.45 | 0.025 | 0.015 | 0.30 | 0.30 | 0.15 | Cu 0.50; B 0.001; Ti 0.04; Nb 0.05; V 0.05 |
| GB/T 14164-2005 | Grade S290 - PSL2 | --- | --- | 0.20 | 1.30 | 0.35 | 0.025 | 0.015 | --- | --- | --- | --- |
| API 5L - 2012 | L320N or X46N | --- | 1.8792 | 0.24 | 1.40 | 0.40 | 0.025 | 0.015 | 0.30 | 0.30 | 0.15 | Cu 0.50; B 0.001; Ti 0.04; Nb 0.05; V 0.07; (Nb+V+Ti) 0.15 |
| | L320Q or X46Q | --- | 1.8739 | 0.18 | 1.40 | 0.45 | 0.025 | 0.015 | 0.30 | 0.30 | 0.15 | Cu 0.50; B 0.001; Ti 0.04; Nb 0.05; V 0.05 |
| | L320M or X46M | --- | 1.8748 | 0.22 | 1.30 | 0.45 | 0.025 | 0.015 | 0.30 | 0.30 | 0.15 | Cu 0.50; B 0.001; Ti 0.04; Nb 0.05; V 0.05 |
| EN ISO 3183:2012 | L320N or X46N | --- | 1.8792 | 0.24 | 1.40 | 0.40 | 0.025 | 0.015 | 0.30 | 0.30 | 0.15 | Cu 0.50; B 0.001; Ti 0.04; Nb 0.05; V 0.07; (Nb+V+Ti) 0.15 |
| | L320Q or X46Q | --- | 1.8739 | 0.18 | 1.40 | 0.45 | 0.025 | 0.015 | 0.30 | 0.30 | 0.15 | Cu 0.50; B 0.001; Ti 0.04; Nb 0.05; V 0.05 |
| | L320M or X46M | --- | 1.8748 | 0.22 | 1.30 | 0.45 | 0.025 | 0.015 | 0.30 | 0.30 | 0.15 | Cu 0.50; B 0.001; Ti 0.04; Nb 0.05; V 0.05 |
| GB/T 14164-2005 | Grade S320 - PSL2 | --- | --- | 0.20 | 1.40 | 0.35 | 0.025 | 0.015 | --- | --- | --- | --- |

**5.10 Line Pipe Steels**

**5.10.2B Chemical Composition of Line Pipe Steels With Notch Toughness Requirements (Continued)**

| Specification | Designation | UNS No. | Steel No. | Weight, % max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| API 5L - 2012 | L360N or X52N | --- | 1.8793 | 0.24 | 1.40 | 0.45 | 0.025 | 0.015 | 0.30 | 0.30 | 0.15 | Cu 0.50; B 0.001; Ti 0.04; Nb 0.05; V 0.10; (Nb+V+Ti) 0.15 |
| | L360Q or X52Q | --- | 1.8741 | 0.18 | 1.50 | 0.45 | 0.025 | 0.015 | 0.30 | 0.30 | 0.15 | Cu 0.50; B 0.001; Ti 0.04; Nb 0.05; V 0.05 |
| | L360M or X52M | --- | 1.8749 | 0.22 | 1.40 | 0.45 | 0.025 | 0.015 | 0.30 | 0.30 | 0.15 | Cu 0.50; B 0.001; (Nb+V+Ti) 0.15 |
| CSA Z245.1-14 | Grade 359 - Category 2 | --- | --- | 0.26 | 2.00 | 0.50 | 0.030 | 0.035 | --- | --- | --- | Nb 0.11; Ti 0.11; V 0.11; B 0.001 CE 0.40 (see standard) |
| | Grade 359 - Category 3 | --- | --- | 0.26 | 2.00 | 0.50 | 0.030 | 0.035 | --- | --- | --- | Nb 0.11; Ti 0.11; V 0.11; B 0.001 CE 0.40 (see standard) |
| EN ISO 3183:2012 | L360N or X52N | --- | 1.8793 | 0.24 | 1.40 | 0.45 | 0.025 | 0.015 | 0.30 | 0.30 | 0.15 | Cu 0.50; B 0.001; Ti 0.04; Nb 0.05; V 0.10; (Nb+V+Ti) 0.15 |
| | L360Q or X52Q | --- | 1.8741 | 0.18 | 1.50 | 0.45 | 0.025 | 0.015 | 0.30 | 0.30 | 0.15 | Cu 0.50; B 0.001; Ti 0.04; Nb 0.05; V 0.05 |
| | L360M or X52M | --- | 1.8749 | 0.22 | 1.40 | 0.45 | 0.025 | 0.015 | 0.30 | 0.30 | 0.15 | Cu 0.50; B 0.001; (Nb+V+Ti) 0.15 |
| GB/T 14164-2005 | Grade S360 - PSL2 | --- | --- | 0.20 | 1.40 | 0.35 | 0.025 | 0.015 | --- | --- | --- | --- |
| API 5L - 2012 | L390N or X56N | --- | 1.8970 | 0.24 | 1.40 | 0.45 | 0.025 | 0.015 | 0.30 | 0.30 | 0.15 | Cu 0.50; B 0.001; Ti 0.04; Nb 0.05; V 0.10; (Nb+V+Ti) 0.15 |
| | L390Q or X56Q | --- | 1.8740 | 0.18 | 1.50 | 0.45 | 0.025 | 0.015 | 0.30 | 0.30 | 0.15 | Cu 0.50; B 0.001; Ti 0.04; Nb 0.05; V 0.07; (Nb+V+Ti) 0.15 |
| | L390M or X56M | --- | 1.8971 | 0.22 | 1.40 | 0.45 | 0.025 | 0.015 | 0.30 | 0.30 | 0.15 | Cu 0.50; B 0.001; (Nb+V+Ti) 0.15 |
| CSA Z245.1-14 | Grade 386 - Category 2 | --- | --- | 0.26 | 2.00 | 0.50 | 0.030 | 0.035 | --- | --- | --- | Nb 0.11; Ti 0.11; V 0.11; B 0.001 CE 0.40 (see standard) |
| | Grade 386 - Category 3 | --- | --- | 0.26 | 2.00 | 0.50 | 0.030 | 0.035 | --- | --- | --- | Nb 0.11; Ti 0.11; V 0.11; B 0.001 CE 0.40 (see standard) |
| EN ISO 3183:2012 | L390N or X56N | --- | 1.8970 | 0.24 | 1.40 | 0.45 | 0.025 | 0.015 | 0.30 | 0.30 | 0.15 | Cu 0.50; B 0.001; Ti 0.04; Nb 0.05; V 0.10; (Nb+V+Ti) 0.15 |
| | L390Q or X56Q | --- | 1.8740 | 0.18 | 1.50 | 0.45 | 0.025 | 0.015 | 0.30 | 0.30 | 0.15 | Cu 0.50; B 0.001; Ti 0.04; Nb 0.05; V 0.07; (Nb+V+Ti) 0.15 |
| | L390M or X56M | --- | 1.8971 | 0.22 | 1.40 | 0.45 | 0.025 | 0.015 | 0.30 | 0.30 | 0.15 | Cu 0.50; B 0.001; (Nb+V+Ti) 0.15 |
| GB/T 14164-2005 | Grade S390 - PSL2 | --- | --- | 0.20 | 1.40 | 0.40 | 0.025 | 0.015 | --- | --- | --- | --- |

**5.10 Line Pipe Steels**

**5.10.2B Chemical Composition of Line Pipe Steels With Notch Toughness Requirements (Continued)**

| Specification | Designation | UNS No. | Steel No. | Weight, % max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| API 5L - 2012 | L415N or X60N | --- | 1.8736 | 0.24 | 1.40 | 0.45 | 0.025 | 0.015 | 0.50 | 0.50 | 0.50 | Cu 0.50; B 0.001; Ti 0.04; Nb 0.05; V 0.10; (Nb+V+Ti) 0.15 |
| | L415Q or X60Q | --- | 1.8742 | 0.18 | 1.70 | 0.45 | 0.025 | 0.025 | 0.50 | 0.50 | 0.50 | Cu 0.50; B 0.001; (Nb+V+Ti) 0.15 |
| | L415M or X60M | --- | 1.8752 | 0.12 | 1.60 | 0.45 | 0.025 | 0.015 | 0.50 | 0.50 | 0.50 | Cu 0.50; B 0.001; (Nb+V+Ti) 0.15 |
| CSA Z245.1-14 | Grade 414 - Category 2 | --- | --- | 0.26 | 2.00 | 0.50 | 0.030 | 0.035 | --- | --- | --- | Nb 0.11; Ti 0.11; V 0.11; B 0.001 CE 0.40 (see standard) |
| | Grade 414 - Category 3 | --- | --- | 0.26 | 2.00 | 0.50 | 0.030 | 0.035 | --- | --- | --- | Nb 0.11; Ti 0.11; V 0.11; B 0.001 CE 0.40 (see standard) |
| EN ISO 3183:2012 | L415N or X60N | --- | 1.8736 | 0.24 | 1.40 | 0.45 | 0.025 | 0.015 | 0.50 | 0.50 | 0.50 | Cu 0.50; B 0.001; Ti 0.04; Nb 0.05; V 0.10; (Nb+V+Ti) 0.15 |
| | L415Q or X60Q | --- | 1.8742 | 0.18 | 1.70 | 0.45 | 0.025 | 0.025 | 0.50 | 0.50 | 0.50 | Cu 0.50; B 0.001; (Nb+V+Ti) 0.15 |
| | L415M or X60M | --- | 1.8752 | 0.12 | 1.60 | 0.45 | 0.025 | 0.015 | 0.50 | 0.50 | 0.50 | Cu 0.50; B 0.001; (Nb+V+Ti) 0.15 |
| GB/T 14164-2005 | Grade S415 - PSL2 | --- | --- | 0.20 | 1.40 | 0.40 | 0.025 | 0.015 | --- | --- | --- | --- |
| API 5L - 2012 | L450Q or X65Q | --- | 1.8743 | 0.18 | 1.70 | 0.45 | 0.025 | 0.015 | 0.50 | 0.50 | 0.50 | Cu 0.50; B 0.001; (Nb+V+Ti) 0.15 |
| | L450M or X65M | --- | 1.8754 | 0.12 | 1.60 | 0.45 | 0.025 | 0.015 | 0.50 | 0.50 | 0.50 | Cu 0.50; B 0.001; (Nb+V+Ti) 0.15 |
| CSA Z245.1-14 | Grade 448 - Category 2 | --- | --- | 0.26 | 2.00 | 0.50 | 0.030 | 0.035 | --- | --- | --- | Nb 0.11; Ti 0.11; V 0.11; B 0.001 CE 0.40 (see standard) |
| | Grade 448 - Category 3 | --- | --- | 0.26 | 2.00 | 0.50 | 0.030 | 0.035 | --- | --- | --- | Nb 0.11; Ti 0.11; V 0.11; B 0.001 CE 0.40 (see standard) |
| EN ISO 3183:2012 | L450Q or X65Q | --- | 1.8743 | 0.18 | 1.70 | 0.45 | 0.025 | 0.015 | 0.50 | 0.50 | 0.50 | Cu 0.50; B 0.001; (Nb+V+Ti) 0.15 |
| | L450M or X65M | --- | 1.8754 | 0.12 | 1.60 | 0.45 | 0.025 | 0.015 | 0.50 | 0.50 | 0.50 | Cu 0.50; B 0.001; (Nb+V+Ti) 0.15 |
| GB/T 14164-2005 | Grade S450 - PSL2 | --- | --- | 0.20 | 1.45 | 0.40 | 0.025 | 0.015 | --- | --- | --- | --- |
| API 5L - 2012 | L485Q or X70Q | --- | 1.8744 | 0.18 | 1.80 | 0.45 | 0.025 | 0.015 | 0.50 | 0.50 | 0.50 | Cu 0.50; B 0.001; (Nb+V+Ti) 0.15 |
| | L485M or X70M | --- | 1.8756 | 0.12 | 1.70 | 0.45 | 0.025 | 0.015 | 0.50 | 0.50 | 0.50 | Cu 0.50; B 0.001; (Nb+V+Ti) 0.15 |
| CSA Z245.1-14 | Grade 483 - Category 2 | --- | --- | 0.26 | 2.00 | 0.50 | 0.030 | 0.035 | --- | --- | --- | Nb 0.11; Ti 0.11; V 0.11; B 0.001 CE 0.40 (see standard) |
| | Grade 483 - Category 3 | --- | --- | 0.26 | 2.00 | 0.50 | 0.030 | 0.035 | --- | --- | --- | Nb 0.11; Ti 0.11; V 0.11; B 0.001 CE 0.40 (see standard) |
| EN ISO 3183:2012 | L485Q or X70Q | --- | 1.8744 | 0.18 | 1.80 | 0.45 | 0.025 | 0.015 | 0.50 | 0.50 | 0.50 | Cu 0.50; B 0.001; (Nb+V+Ti) 0.15 |
| | L485M or X70M | --- | 1.8756 | 0.12 | 1.70 | 0.45 | 0.025 | 0.015 | 0.50 | 0.50 | 0.50 | Cu 0.50; B 0.001; (Nb+V+Ti) 0.15 |
| GB/T 14164-2005 | Grade S485 - PSL2 | --- | --- | 0.20 | 1.65 | 0.40 | 0.025 | 0.015 | --- | --- | --- | --- |
| API 5L - 2012 | L555Q or X80Q | --- | 1.8745 | 0.18 | 1.90 | 0.45 | 0.025 | 0.015 | 0.50 | 1.00 | 0.50 | Cu 0.50; B 0.004; (Nb+V+Ti) 0.15 |
| | L555M or X80M | --- | 1.8758 | 0.12 | 1.85 | 0.45 | 0.025 | 0.015 | 0.50 | 1.00 | 0.50 | Cu 0.50; B 0.001; (Nb+V+Ti) 0.15 |
| CSA Z245.1-14 | Grade 550 - Category 2 | --- | --- | 0.26 | 2.00 | 0.50 | 0.030 | 0.035 | --- | --- | --- | Nb 0.11; Ti 0.11; V 0.11; B 0.001 CE 0.40 (see standard) |
| | Grade 550 - Category 3 | --- | --- | 0.26 | 2.00 | 0.50 | 0.030 | 0.035 | --- | --- | --- | Nb 0.11; Ti 0.11; V 0.11; B 0.001 CE 0.40 (see standard) |
| EN ISO 3183:2012 | L555Q or X80Q | --- | 1.8745 | 0.18 | 1.90 | 0.45 | 0.025 | 0.015 | 0.50 | 1.00 | 0.50 | Cu 0.50; B 0.004; (Nb+V+Ti) 0.15 |
| | L555M or X80M | --- | 1.8758 | 0.12 | 1.85 | 0.45 | 0.025 | 0.015 | 0.50 | 1.00 | 0.50 | Cu 0.50; B 0.001; (Nb+V+Ti) 0.15 |
| GB/T 14164-2005 | Grade S555 - PSL2 | --- | --- | 0.20 | 1.85 | 0.40 | 0.025 | 0.015 | --- | --- | --- | --- |

# Chapter 6

# *STEEL FORGINGS*

### ASME Standards

| | |
|---|---|
| ASME SA-105/SA-105M | Carbon Steel Forgings, for Piping Applications |
| ASME SA-181/SA-181M | Carbon Steel Forgings, for General-Purpose Piping |
| ASME SA-182/SA-182M | Forged or Rolled Alloy and Stainless Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service |
| ASME SA-266/SA-266M | Carbon Steel Forgings for Pressure Vessel Components |
| ASME SA-336/SA-336M | Alloy Steel Forgings for Pressure and High-Temperature Parts |
| ASME SA-350/SA-350M | Carbon and Low-Alloy Steel Forgings, Requiring Notch Toughness Testing for Piping Components |
| ASME SA-403/SA-403M | Wrought Austenitic Stainless Steel Piping Fittings |
| ASME SA-508/SA-508M | Quenched and Tempered Vacuum-Treated Carbon and Alloy Steel Forgings for Pressure Vessels |
| ASME SA-541/SA-541M | Quenched and Tempered Carbon and Alloy Steel Forgings for Pressure Vessel Components |
| ASME SA-705/SA-705M | Age-Hardening Stainless Steel Forgings |
| ASME SA-815/SA-815M | Wrought Ferritic, Ferritic/Austenitic, and Martensitic Stainless Steel Piping Fittings |

### ASTM Standards

| | |
|---|---|
| ASTM A105/A105M-14 | Carbon Steel Forgings for Piping Applications |
| ASTM A181/A181M-14 | Carbon Steel Forgings, for General-Purpose Piping |
| ASTM A182/A182M-15 | Forged or Rolled Alloy and Stainless Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service |
| ASTM A266/A266M-13 | Carbon Steel Forgings for Pressure Vessel Components |
| ASTM A336/A336M-10a | Alloy Steel Forgings for Pressure and High-Temperature Parts |
| ASTM A350/A350M-15 | Carbon and Low-Alloy Steel Forgings, Requiring Notch Toughness Testing for Piping Components |
| ASTM A403/A403M-15 | Wrought Austenitic Stainless Steel Piping Fittings |
| ASTM A473-15 | Stainless Steel Forgings |
| ASTM A508/A508M-14 | Quenched and Tempered Vacuum-Treated Carbon and Alloy Steel Forgings for Pressure Vessels |
| ASTM A541/A541M-05 (2015) | Quenched and Tempered Carbon and Alloy Steel Forgings for Pressure Vessel Components |
| ASTM A668/A668M-15 | Steel Forgings, Carbon and Alloy, for General Industrial Use |
| ASTM A705/A705M-13 | Age-Hardening Stainless Steel Forgings |
| ASTM A774/A774M-14 | As-Welded Wrought Austenitic Stainless Steel Fittings for General Corrosive Service at Low and Moderate Temperatures |
| ASTM A815/A815M-14 | Wrought Ferritic, Ferritic/Austenitic, and Martensitic Stainless Steel Piping Fittings |
| ASTM A965/A965M-14 | Steel Forgings, Austenitic, for Pressure and High Temperature Parts |
| ASTM A1021-05 (2015) | Martensitic Stainless Steel Forgings and Forging Stock for High-Temperature Service |

### EN Standards

| | |
|---|---|
| EN 10222-2:1999 | Steel forgings for pressure purposes - Part 2: Ferritic and martensitic steels with specified elevated temperature properties |
| EN 10222-3:1998 | Steel forgings for pressure purposes - Part 3: Nickel steels with specified low-temperature properties |
| EN 10222-4:1998 A1:2001 | Steel forgings for pressure purposes - Part 4: Weldable fine-grain steels with high proof strength |
| EN 10222-5:1999 | Steel forgings for pressure purposes - Part 5: Martensitic, austenitic and austenitic-ferritic stainless steels |
| EN 10250-2:1999 C1:2000 | Open die steel forgings for general engineering purposes - Part 2: Non-alloy quality and special steels |
| EN 10250-3:1999 | Open die steel forgings for general engineering purposes - Part 3: Alloy special steels |
| EN 10250-4:1999 | Open die steel forgings for general engineering purposes - Part 4: Stainless steels |

### GB Standards

| | |
|---|---|
| GB/T 15712-1995 | Ferritic Pearlitic Engineering Steels for Precipitation Hardening from Hot-Working Temperature |
| GB/T 17107-1997 | Structural Steel Grades and Mechanical Property for Forgings |

### ISO Standards

| | |
|---|---|
| ISO 9327-2:1999 | Steel Forgings and Rolled or Forged Bars for Pressure Purposes. Technical Delivery Conditions.<br>Part 2: Non-Alloy and Alloy (Mo, Cr and CrMo) Steels with Specified Elevated Temperature Properties |
| ISO 9327-3:1999 | Steel Forgings and Rolled or Forged Bars for Pressure Purposes. Technical Delivery Conditions.<br>Part 3 : Nickel Steels with Specified Low Temperature Properties |
| ISO 9327-4:1999 | Steel Forgings and Rolled or Forged Bars for Pressure Purposes. Technical Delivery Conditions.<br>Part 4 : Weldable Fine Grain Steels with High Proof Strength |
| ISO 9327-5:1999 | Steel Forgings and Rolled or Forged Bars for Pressure Purposes. Technical Delivery Conditions.<br>Part 5 : Stainless Steels |

### JIS Standards

| | |
|---|---|
| JIS G 3201:1988 A1:2008 | Carbon steel forgings for general use |
| JIS G 3202:1988 A1:2008 | Carbon steel forgings for pressure vessels |
| JIS G 3203:1988 A1:2008 | Alloy steel forgings for pressure vessels for high-temperature service |
| JIS G 3204:1988 A1:2008 | Quenched and tempered alloy steel forgings for pressure vessels |
| JIS G 3205:1988 A1:2008 | Carbon and alloy steel forgings for pressure vessels for low-temperature service |
| JIS G 3206:1993 A1:2008 | High strength chromium-molybdenum alloy steel forgings for pressure vessels under high-temperature service |
| JIS G 3214:1991 A1:2009 | Stainless steel forgings for pressure vessels |
| JIS G 3221:1988 A1:2008 | Chromium molybdenum steel forgings for general use |

### Heat Treatment Terms Applicable to this Chapter

| Standard | Heat Treatment Terms |
|---|---|
| ASME SA-105/SA-105M | A: annealed; N: normalized; N+T: normalized and tempered; Q+T: quenched and tempered |
| ASME SA-181/SA-181M | AM: as manufactured; A: annealed; N: normalized; N+T: normalized and tempered |
| ASME SA-182/SA-182M | A: annealed; N+T: normalized and tempered; Q+T: quenched and tempered; ST+Q: solution treated and quenched; N: normalized; T: tempered |
| ASME SA-266/SA-266M | A: annealed; N: normalized; N+T: normalized and tempered;<br>BA: liquid quenched if agreed upon at the time of enquiry and order |
| ASME SA-336/SA-336M | A: annealed; N: normalized; N+T: normalized and tempered; Q+T: quenched and tempered |
| ASME SA-350/SA-350M | N: normalized; N+T: normalized and tempered; Q+T: quenched and tempered |
| ASME SA-403/SA-403M | SA: solution annealed |
| ASME SA-508/SA-508M | Q: quenched |
| ASME SA-541/SA-541M | Q+T: quenched and tempered |
| ASME SA-705/SA-705M | ST: solution treated; AH: age hardened |
| ASME SA-815/SA-815M | HT+Q: heat treated then quenched; RC: rapidly cooled |
| ASTM A105/A105M-14 | A: annealed; N: normalized; N+T: normalized and tempered; Q+T: quenched and tempered |
| ASTM A181/A181M-14 | AM: as manufactured; A: annealed; N: normalized; N+T: normalized and tempered |
| ASTM A182/A182M-15 | A: annealed; N+T: normalized and tempered; Q+T: quenched and tempered; ST+Q: solution treated and quenched; N: normalized; T: tempered |
| ASTM A266/A266M-13 | A: annealed; N: normalized; N+T: normalized and tempered; Q+T: quenched and tempered |
| ASTM A336/A336M-10a | A: annealed; N+T: normalized and tempered; Q+T: liquid quenched and tempered |
| ASTM A350/A350M-15 | N: normalized; N+T: normalized and tempered; Q+T: quenched and tempered |
| ASTM A403/A403M-15 | SA+Q: solution annealed then quenched; RC: rapidly cooled |
| ASTM A473-15 | N+T: normalized and tempered; A: annealed; SHT: solution heat treated; A+Q: annealed and water quenched; RC: rapidly cooled |
| ASTM A508/A508M-14 | Q+T: quenched and tempered |
| ASTM A541/A541M-05 (2015) | Q+T: quenched and tempered |
| ASTM A668/A668M-15 | A: annealed; N: normalized; N+T: normalized and tempered; NN+T: double-normalized and tempered;<br>Q+T: quenched and tempered; N+Q+T: normalized, quenched and tempered |
| ASTM A705/A705M-13 | ST: solution treated; AH: age hardened |
| ASTM A774/A774M-14 | ---: heat treatment is not required |
| ASTM A815/A815M-14 | HT+Q: heat treated then quenched; RC: rapidly cooled |
| ASTM A965/A965M-14 | SA+Q: solution annealed and quenched |
| ASTM A1021-05 (2015) | HT+Q+T: heat treated and quenched, then tempered |
| EN 10222-2:1999 | A: annealed; N: normalized; N+T: normalized and tempered; Q+T: quenched and tempered |
| EN 10222-3:1998 | N: normalized; N+T: normalized and tempered; Q+T: quenched and tempered;<br>NN+T: double normalized and tempered |
| EN 10222-4:1998 A1:2001 | Q+T: quenched and tempered; N: normalized |
| EN 10222-5:1999 | Q+T: quenched and tempered; QT+T: quenched and double tempered; ST: solution treated |
| EN 10250-2:1999 C1:2000 | N: normalized; N+T: normalized and tempered; Q+T: quenched and tempered; A: annealed |
| EN 10250-3:1999 | Q+T: quenched and tempered |
| EN 10250-4:1999 | A: annealed; Q+T: quenched and tempered; SA: solution annealed; PH: precipitation hardened |
| GB/T 15712-1995 | HR: hot-rolled |
| GB/T 17107-1997 | N+T: normalized and tempered; N: normalized; H+T: hardened and tempered |
| ISO 9327-2:1999 | A: annealed; N: normalized; N+T: normalized and tempered; Q+T: quenched and tempered |
| ISO 9327-3:1999 | N: normalized; N+T: normalized and tempered; Q+T: quenched and tempered |
| ISO 9327-4:1999 | N: normalized; Q+T: quenched and tempered |
| ISO 9327-5:1999 | Q+T: quenched and tempered |
| JIS G 3201:1988 A1:2008 | A: annealed; N: normalized; N+T: normalized and tempered; Q+T: quenched and tempered |
| JIS G 3202:1988 A1:2008 | A: annealed; N: normalized; N+T: normalized and tempered; Q+T: quenched and tempered |
| JIS G 3203:1988 A1:2008 | A: annealed; N+T: normalized and tempered |
| JIS G 3204:1988 A1:2008 | Q+T: quenched and tempered |
| JIS G 3205:1988 A1:2008 | A: annealed; N+T: normalized and tempered; Q+T: quenched and tempered |
| JIS G 3206:1993 A1:2008 | N+T: normalized and tempered; Q+T: quenched and tempered |
| JIS G 3214:1991 A1:2009 | Q+T: quenched and tempered; ST: solution treated; HT: heat treated |
| JIS G 3221:1988 A1:2008 | H+T: hardening and tempering |

### Impact Testing Notes Applicable to this Chapter

see standard for impact data: impact testing requirements are listed in the standard for multiple test temperatures.

## 6.1 Carbon Steel Forgings

### 6.1.1A Mechanical Properties of Carbon Steel Forgings for General Use

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | % min. | | |
| GB/T 17107-1997 | Grade 15 | --- | --- | t ≤ 100 | --- | 195 | --- | 320 L | --- | 27 L | N+T | 97-143 HB; L: 47 J @ RT |
| | | | | 100 < t ≤ 300 | --- | 165 | --- | 310 L | --- | 25 L | N+T | 97-143 HB; L: 47 J @ RT |
| | | | | 300 < t ≤ 500 | --- | 145 | --- | 300 L | --- | 24 L | N+T | 97-143 HB; L: 43 J @ RT |
| ASTM A668/A668M-15 | Class A (AH) | --- | --- | d ≤ 500 | d ≤ 20 | --- | --- | 325 | 47 | --- | --- | 183 max HBW |
| GB/T 17107-1997 | Grade Q235 | --- | --- | t ≤ 100 | --- | 210 | --- | 330 L | --- | 23 L | --- | --- |
| | | | | 100 < t ≤ 300 | --- | 195 | --- | 320 L | --- | 22 L | --- | --- |
| | | | | 300 < t ≤ 500 | --- | 185 | --- | 310 L | --- | 21 L | --- | --- |
| | | | | 500 < t ≤ 700 | --- | 175 | --- | 300 L | --- | 20 L | --- | --- |
| EN 10250-2:1999 C1:2000 | S235JRG2 | --- | 1.0038 | t ≤ 100 | --- | 215 | --- | 340 | --- | 24 L | N or N+T | L: 35 J @ RT |
| | | | | 100 < t ≤ 250 | --- | 175 | --- | 340 | --- | 23 L, 17 T | N or N+T | see standard for impact data |
| | | | | 250 < t ≤ 500 | --- | 165 | --- | 340 | --- | 23 L, 17 T | N or N+T | |
| | S235J2G3 | --- | 1.0116 | t ≤ 100 | --- | 215 | --- | 340 | --- | 24 L | N or N+T | L: 35 J @ -20°C |
| | | | | 100 < t ≤ 250 | --- | 175 | --- | 340 | --- | 23 L, 17 T | N or N+T | see standard for impact data |
| | | | | 250 < t ≤ 500 | --- | 165 | --- | 340 | --- | 23 L, 17 T | N or N+T | |
| GB/T 17107-1997 | Grade 20 | --- | --- | t ≤ 100 | --- | 215 | --- | 340 L | --- | 24 L | N or N+T | 103-156 HB; L: 43 J @ RT |
| | | | | 100 < t ≤ 250 | --- | 195 | --- | 330 L | --- | 23 L | N or N+T | 103-156 HB; L: 39 J @ RT |
| | | | | 250 < t ≤ 500 | --- | 185 | --- | 320 L | --- | 22 L | N or N+T | 103-156 HB; L: 39 J @ RT |
| | | | | 500 < t ≤ 1000 | --- | 175 | --- | 300 L | --- | 20 L | N or N+T | 103-156 HB; L: 35 J @ RT |
| JIS G 3201:1988 A1:2008 | Symbol SF 340 A | --- | --- | --- | --- | 175 | --- | 340-440 | --- | 27 L, 23 T | A, N or N+T | 90 min. HB |
| | Symbol SF 390 A | --- | --- | --- | --- | 195 | --- | 390-490 | --- | 25 L, 21 T | A, N or N+T | 105 min. HB |

**6.1 Carbon Steel Forgings**

**6.1.1A Mechanical Properties of Carbon Steel Forgings for General Use (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | % min. | | |
| EN 10250-2:1999 C1:2000 | C22 | --- | 1.0402 | t ≤ 100 | --- | 210 | --- | 410 | --- | 25 L | N or N+T | --- |
| ISO 9327-2:1999 | Type PH 26 | --- | --- | t ≤ 16 | --- | 265 | --- | 410-530 | --- | 26 L, 24 T | N or Q+T | see standard for impact data |
| | | | | 16 < t ≤ 40 | --- | 255 | --- | 410-530 | --- | 26 L, 24 T | N or Q+T | |
| | | | | 40 < t ≤ 60 | --- | 245 | --- | 410-530 | --- | 25 L, 23 T | N or Q+T | |
| | | | | 60 < t ≤ 100 | --- | 215 | --- | 410-530 | --- | 24 L, 22 T | N or Q+T | |
| | | | | 100 < t ≤ 150 | --- | 200 | --- | 390-520 | --- | 24 L, 22 T | N or Q+T | |
| | | | | 150 < t ≤ 250 | --- | 200 | --- | 390-520 | --- | 23 L, 21 T | N or Q+T | |
| ASTM A668/A668M-15 | Class B (BH) | --- | --- | d ≤ 500 | d ≤ 20 | 205 | 30 | 415 | 60 | 24 | A, N or N+T | 120-174 HBW |
| GB/T 17107-1997 | Grade 25 | --- | --- | t ≤ 100 | --- | 235 | --- | 420 L | --- | 22 L | N or N+T | 112-170 HB; L: 39 J @ RT |
| | | | | 100 < t ≤ 250 | --- | 215 | --- | 390 L | --- | 20 L | N or N+T | 112-170 HB; L: 31 J @ RT |
| | | | | 250 < t ≤ 500 | --- | 205 | --- | 380 L | --- | 18 L | N or N+T | 112-170 HB; L: 31 J @ RT |
| JIS G 3201:1988 A1:2008 | Symbol SF 440 A | --- | --- | --- | --- | 225 | --- | 440-540 | --- | 24 L, 19 T | A, N or N+T | 121 min. HB |
| EN 10250-2:1999 C1:2000 | C25 | --- | 1.0406 | t ≤ 100 | --- | 230 | --- | 440 | --- | 23 L | N or N+T | L: 35 J @ RT |
| | | | | 100 < t ≤ 250 | --- | 210 | --- | 420 | --- | 23 L, 17 T | N or N+T | see standard for impact data |
| | | | | 250 < t ≤ 500 | --- | 190 | --- | 400 | --- | 23 L, 17 T | N or N+T | |
| | | | | 500 < t ≤ 1000 | --- | 180 | --- | 390 | --- | 22 L, 16 T | N or N+T | |
| | C25E | --- | 1.1158 | t ≤ 70 | --- | 270 | --- | 450 | --- | 25 L | Q+T | L: 45 J @ RT |
| | | | | t ≤ 100 | --- | 230 | --- | 440 | --- | 23 L | N or N+T | L: 35 J @ RT |
| | | | | 70 < t ≤ 160 | --- | 220 | --- | 410 | --- | 25 L, 18 T | Q+T | see standard for impact data |
| | | | | 100 < t ≤ 250 | --- | 210 | --- | 420 | --- | 23 L, 17 T | N or N+T | |
| | | | | 160 < t ≤ 330 | --- | 210 | --- | 390 | --- | 24 L, 16 T | Q+T | |
| | | | | 250 < t ≤ 500 | --- | 190 | --- | 400 | --- | 23 L, 17 T | N or N+T | |
| | | | | 500 < t ≤ 1000 | --- | 180 | --- | 390 | --- | 22 L, 16 T | N or N+T | |

**6.1 Carbon Steel Forgings**

**6.1.1A Mechanical Properties of Carbon Steel Forgings for General Use (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter mm | Section Thickness/Diameter in. | Yield Strength, min. MPa | Yield Strength, min. ksi | Tensile Strength, min. MPa | Tensile Strength, min. ksi | Elongation % min. | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ASTM A668/A668M-15 | Class C (CH) | --- | --- | d ≤ 300 | d ≤ 12 | 230 | 33 | 455 | 66 | 23 | A, N or N+T | 137-183 HBW |
| | | | | 300 < d ≤ 500 | 12 < d ≤ 20 | 230 | 33 | 455 | 66 | 22 | A, N or N+T | 137-183 HBW |
| ISO 9327-2:1999 | Type PH 29 | --- | --- | t ≤ 16 | --- | 290 | --- | 460-580 | --- | 24 L, 22 T | N or Q+T | see standard for impact data |
| | | | | 16 < t ≤ 40 | --- | 285 | --- | 460-580 | --- | 24 L, 22 T | N or Q+T | |
| | | | | 40 < t ≤ 60 | --- | 280 | --- | 460-580 | --- | 24 L, 22 T | N or Q+T | |
| | | | | 60 < t ≤ 100 | --- | 255 | --- | 460-580 | --- | 23 L, 21 T | N or Q+T | |
| | | | | 100 < t ≤ 150 | --- | 230 | --- | 440-570 | --- | 23 L, 21 T | N or Q+T | |
| | | | | 150 < t ≤ 250 | --- | 220 | --- | 440-570 | --- | 22 L, 20 T | N or Q+T | |
| GB/T 17107-1997 | Grade 30 | --- | --- | t ≤ 100 | --- | 245 | --- | 470 L | --- | 19 L | N or N+T | 126-179 HB; L: 31 J @ RT |
| | | | | 100 < t ≤ 300 | --- | 235 | --- | 460 L | --- | 19 L | N or N+T | 126-179 HB; L: 27 J @ RT |
| | | | | 300 < t ≤ 500 | --- | 225 | --- | 450 L | --- | 18 L | N or N+T | 126-179 HB; L: 27 J @ RT |
| | | | | 500 < t ≤ 800 | --- | 215 | --- | 440 L | --- | 17 L | N or N+T | 126-179 HB; L: 28 J @ RT |
| EN 10250-2:1999 C1:2000 | C30 | --- | 1.0528 | t ≤ 100 | --- | 250 | --- | 480 | --- | 21 L | N or N+T | --- |
| | | | | 100 < t ≤ 250 | --- | 230 | --- | 460 | --- | 21 L | N or N+T | --- |
| JIS G 3201:1988 A1:2008 | Symbol SF 490 A | --- | --- | --- | --- | 245 | --- | 490-590 | --- | 22 L, 17 T | A, N or N+T | 134 min. HB |
| ISO 9327-2:1999 | Type PH 31 | --- | --- | t ≤ 16 | --- | 315 | --- | 490-610 | --- | 23 L, 21 T | N or Q+T | see standard for impact data |
| | | | | 16 < t ≤ 40 | --- | 310 | --- | 490-610 | --- | 23 L, 21 T | N or Q+T | |
| | | | | 40 < t ≤ 60 | --- | 305 | --- | 490-610 | --- | 23 L, 21 T | N or Q+T | |
| | | | | 60 < t ≤ 100 | --- | 280 | --- | 490-610 | --- | 22 L, 20 T | N or Q+T | |
| | | | | 100 < t ≤ 150 | --- | 255 | --- | 470-600 | --- | 22 L, 20 T | N or Q+T | |
| | | | | 150 < t ≤ 250 | --- | 245 | --- | 460-590 | --- | 21 L, 19 T | N or Q+T | |
| GB/T 17107-1997 | Grade 35 | --- | --- | t ≤ 100 | --- | 265 | --- | 510 L | --- | 18 L | N or N+T | 149-187 HB; L: 28 J @ RT |
| | | | | t ≤ 100 | --- | 295 | --- | 550 L | --- | 19 L | H+T | 156-207 HB; L: 47 J @ RT |
| | | | | 100 < t ≤ 300 | --- | 255 | --- | 490 L | --- | 18 L | N or N+T | 149-187 HB; L: 24 J @ RT |
| | | | | 100 < t ≤ 300 | --- | 275 | --- | 530 L | --- | 18 L | H+T | 156-207 HB; L: 39 J @ RT |
| | | | | 100 < t ≤ 300 | --- | 245 | --- | 470 TN | --- | 13 TN | N+T | TN: 20 J @ RT |
| | | | | 300 < t ≤ 500 | --- | 235 | --- | 470 L | --- | 17 L | N or N+T | 143-187 HB; L: 24 J @ RT |
| | | | | 300 < t ≤ 500 | --- | 225 | --- | 450 TN | --- | 12 TN | N+T | TN: 20 J @ RT |
| | | | | 500 < t ≤ 750 | --- | 225 | --- | 450 L | --- | 16 L | N or N+T | 137-187 HB; L: 20 J @ RT |
| | | | | 500 < t ≤ 750 | --- | 215 | --- | 430 TN | --- | 11 TN | N+T | TN: 16 J @ RT |
| | | | | 750 < t ≤ 1000 | --- | 215 | --- | 430 L | --- | 15 L | N or N+T | 137-187 HB; L: 20 J @ RT |
| | | | | 750 < t ≤ 1000 | --- | 205 | --- | 410 TN | --- | 10 TN | N+T | TN: 16 J @ RT |
| ASTM A668/A668M-15 | Class D (DH) | --- | --- | d ≤ 200 | d ≤ 8 | 260 | 37.5 | 515 | 75 | 24 | A, N or N+T | 149-207 HBW |
| | | | | 200 < d ≤ 300 | 8 < d ≤ 12 | 260 | 37.5 | 515 | 75 | 22 | A, N or N+T | 149-207 HBW |
| | | | | 300 < d ≤ 500 | 12 < d ≤ 20 | 260 | 37.5 | 515 | 75 | 20 | A, N or N+T | 149-207 HBW |
| | | | | d > 500 | d > 20 | 260 | 37.5 | 515 | 75 | 19 | A, N or N+T | 149-207 HBW |

Note: This section continued on next page.

**6.1 Carbon Steel Forgings**

**6.1.1A Mechanical Properties of Carbon Steel Forgings for General Use (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | % min. | | |
| EN 10250-2:1999 C1:2000 | C35 | --- | 1.0501 | t ≤ 100 | --- | 270 | --- | 520 | --- | 19 L | N or N+T | L: 30 J @ RT |
| | | | | 100 < t ≤ 250 | --- | 245 | --- | 500 | --- | 19 L, 15 T | N or N+T | see standard for impact data |
| | | | | 250 < t ≤ 500 | --- | 220 | --- | 480 | --- | 19 L, 15 T | N or N+T | |
| | | | | 500 < t ≤ 1000 | --- | 210 | --- | 470 | --- | 18 L, 14 T | N or N+T | |
| JIS G 3201:1988 A1:2008 | Symbol SF 540 B | --- | --- | t < 100 | --- | 335 | --- | 540-690 | --- | 21 L, 17 T | Q+T | see standard for impact data; 152 min. HB |
| | | | | 100 ≤ t < 250 | --- | 315 | --- | 540-690 | --- | 21 L, 17 T | Q+T | see standard for impact data; 152 min. HB |
| | | | | 250 ≤ t < 400 | --- | 295 | --- | 540-690 | --- | 20 L, 16 T | Q+T | see standard for impact data; 152 min. HB |
| | Symbol SF 540 A | --- | --- | --- | --- | 275 | --- | 540-640 | --- | 20 L, 16 T | A, N or N+T | 152 min. HB |
| GB/T 17107-1997 | Grade 40 | --- | --- | t ≤ 100 | --- | 275 | --- | 550 L | --- | 17 L | N+T | 143-207 HB; L: 24 J @ RT |
| | | | | t ≤ 100 | --- | 340 | --- | 615 L | --- | 18 L | H+T | 196-241 HB; L: 39 J @ RT |
| | | | | 100 < t ≤ 250 | --- | 265 | --- | 530 L | --- | 17 L | N+T | 143-207 HB; L: 24 J @ RT |
| | | | | 100 < t ≤ 250 | --- | 295 | --- | 590 L | --- | 17 L | H+T | 189-229 HB; L: 31 J @ RT |
| | | | | 250 < t ≤ 500 | --- | 255 | --- | 510 L | --- | 16 L | N+T | 143-207 HB; L: 20 J @ RT |
| | | | | 250 < t ≤ 500 | --- | 275 | --- | 560 L | --- | 17 L | H+T | 163-219 HB |
| | | | | 500 < t ≤ 1000 | --- | 245 | --- | 490 L | --- | 15 L | N+T | 143-207 HB; L: 20 J @ RT |
| EN 10250-2:1999 C1:2000 | C40 | --- | 1.0511 | t ≤ 100 | --- | 290 | --- | 550 | --- | 17 L | N or N+T | --- |
| | | | | 100 < t ≤ 250 | --- | 260 | --- | 530 | --- | 17 L | N or N+T | --- |
| | C35E | --- | 1.1181 | t ≤ 70 | --- | 320 | --- | 550 | --- | 20 L | Q+T | L: 35 J @ RT |
| | | | | t ≤ 100 | --- | 270 | --- | 520 | --- | 19 L | N or N+T | L: 30 J @ RT |
| | | | | 70 < t ≤ 160 | --- | 290 | --- | 490 | --- | 22 L, 15 T | Q+T | see standard for impact data |
| | | | | 100 < t ≤ 250 | --- | 245 | --- | 500 | --- | 19 L, 15 T | N or N+T | |
| | | | | 160 < t ≤ 330 | --- | 270 | --- | 470 | --- | 21 L, 14 T | Q+T | |
| | | | | 250 < t ≤ 500 | --- | 220 | --- | 480 | --- | 19 L, 15 T | N or N+T | |
| | | | | 500 < t ≤ 1000 | --- | 210 | --- | 470 | --- | 18 L, 14 T | N or N+T | |

**6.1 Carbon Steel Forgings**

**6.1.1A Mechanical Properties of Carbon Steel Forgings for General Use (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | % min. | | |
| EN 10250-2:1999 C1:2000 | C45 | --- | 1.0503 | --- | --- | --- | --- | --- | --- | --- | A | 207 max HB |
| | | | | t ≤ 100 | --- | 305 | --- | 580 | --- | 16L | N or N+T | --- |
| | | | | 100 < t ≤ 250 | --- | 275 | --- | 560 | --- | 16 L, 12 T | N or N+T | see standard for impact data |
| | | | | 250 < t ≤ 500 | --- | 240 | --- | 540 | --- | 16 L, 12 T | N or N+T | |
| | | | | 500 < t ≤ 1000 | --- | 230 | --- | 530 | --- | 15 L, 11 T | N or N+T | |
| ASTM A668/A668M-15 | Class E (EH) | --- | --- | d ≤ 200 | d ≤ 8 | 305 | 44 | 585 | 85 | 25 | N+T or NN+T | 174-217 HBW |
| | | | | 200 < d ≤ 300 | 8 < d ≤ 12 | 295 | 43 | 570 | 83 | 23 | N+T or NN+T | 174-217 HBW |
| | | | | 300 < d ≤ 500 | 12 < d ≤ 20 | 295 | 43 | 570 | 83 | 22 | N+T or NN+T | 174-217 HBW |
| GB/T 17107-1997 | Grade 45 | --- | --- | t ≤ 100 | --- | 295 | --- | 590 L | --- | 15 L | N or N+T | 170-217 HB; L: 23 J @ RT |
| | | | | t ≤ 100 | --- | 370 | --- | 630 L | --- | 17 L | H+T | 207-302 HB; L: 31 J @ RT |
| | | | | 100 < t ≤ 250 | --- | 345 | --- | 590 L | --- | 18 L | H+T | 197-286 HB; L: 31 J @ RT |
| | | | | 100 < t ≤ 300 | --- | 285 | --- | 570 L | --- | 15 L | N or N+T | 163-217 HB; L: 19 J @ RT |
| | | | | 100 < t ≤ 300 | --- | 275 | --- | 540 TN | --- | 10 TN | N+T | TN: 16 J @ RT |
| | | | | 300 < t ≤ 500 | --- | 275 | --- | 550 L | --- | 14 L | N or N+T | 163-217 HB; L: 19 J @ RT |
| | | | | 250 < t ≤ 500 | --- | 345 | --- | 590 L | --- | 17 L | H+T | 187-255 HB |
| | | | | 300 < t ≤ 500 | --- | 265 | --- | 520 TN | --- | 10 TN | N+T | TN: 16 J @ RT |
| | | | | 500 < t ≤ 750 | --- | 255 | --- | 500 TN | --- | 9 TN | N+T | TN: 12 J @ RT |
| | | | | 500 < t ≤ 1000 | --- | 265 | --- | 530 L | --- | 13 L | N or N+T | 156-217 HB; L: 15 J @ RT |
| | | | | 750 < t ≤ 1000 | --- | 245 | --- | 480 TN | --- | 8 TN | N+T | TN: 12 J @ RT |
| JIS G 3201:1988 A1:2008 | Symbol SF 590 B | --- | --- | t < 100 | --- | 360 | --- | 590-740 | --- | 19 L, 15 T | Q+T | see standard for impact data; 167 min. HB |
| | | | | 100 ≤ t < 250 | --- | 335 | --- | 590-740 | --- | 19 L, 14 T | Q+T | see standard for impact data; 167 min. HB |
| | | | | 250 ≤ t ≤ 400 | --- | 325 | --- | 590-740 | --- | 18 L, 14 T | Q+T | see standard for impact data; 167 min. HB |
| | Symbol SF 590 A | --- | --- | --- | --- | 295 | --- | 590-690 | --- | 18 L, 14 T | A, N or N+T | 167 min. HB |
| GB/T 15712-1995 | Grade YF35V | --- | --- | t ≤ 40 | --- | 390 | --- | 590 | --- | 18 | HR | 229 max HB; 47 J @ RT |

**6.1 Carbon Steel Forgings**

**6.1.1A Mechanical Properties of Carbon Steel Forgings for General Use (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | % min. | | |
| EN 10250-2:1999 C1:2000 | C50 | --- | 1.0540 | t ≤ 100 | --- | 320 | --- | 610 | --- | 14 L | N or N+T | --- |
| | | | | 100 < t ≤ 250 | --- | 290 | --- | 590 | --- | 14 L | N or N+T | --- |
| ASTM A668/A668M-15 | Class F (FH) | --- | --- | d ≤ 100 | d ≤ 4 | 380 | 55 | 620 | 90 | 20 | Q+T or N+Q+T | 187-235 HBW |
| | | | | 100 < d ≤ 175 | 4 < d ≤ 7 | 345 | 50 | 585 | 85 | 20 | Q+T or N+Q+T | 174-217 HBW |
| | | | | 175 < d ≤ 254 | 7 < d ≤ 10 | 345 | 50 | 585 | 85 | 19 | Q+T or N+Q+T | 174-217 HBW |
| | | | | 254 < d ≤ 500 | 10 < d ≤ 20 | 330 | 48 | 565 | 82 | 19 | Q+T or N+Q+T | 174-217 HBW |
| EN 10250-2:1999 C1:2000 | C45E | --- | 1.1191 | t ≤ 70 | --- | 370 | --- | 630 | --- | 17 L | Q+T | L: 25 J @ RT |
| | | | | t ≤ 100 | --- | 305 | --- | 580 | --- | 16 L | N or N+T | --- |
| | | | | 70 < t ≤ 160 | --- | 340 | --- | 590 | --- | 18 L, 12 T | Q+T | see standard for impact data |
| | | | | 100 < t ≤ 250 | --- | 275 | --- | 560 | --- | 16 L, 12 T | N or N+T | |
| | | | | 160 < t ≤ 330 | --- | 320 | --- | 540 | --- | 17 L, 11 T | Q+T | |
| | | | | 250 < t ≤ 500 | --- | 240 | --- | 540 | --- | 16 L, 12 T | N or N+T | |
| | | | | 500 < t ≤ 1000 | --- | 230 | --- | 530 | --- | 15 L, 11 T | N or N+T | |
| | C55 | --- | 1.0535 | --- | --- | --- | --- | --- | --- | --- | A | 229 max HB |
| | | | | t ≤ 100 | --- | 330 | --- | 640 | --- | 12 L | N or N+T | --- |
| | | | | 100 < t ≤ 250 | --- | 300 | --- | 620 | --- | 12 L, 9 T | N or N+T | --- |
| | | | | 250 < t ≤ 500 | --- | 260 | --- | 600 | --- | 12 L, 9 T | N or N+T | --- |
| | | | | 500 < t ≤ 1000 | --- | 250 | --- | 590 | --- | 11 L, 8 T | N or N+T | --- |
| JIS G 3201:1988 A1:2008 | Symbol SF 640 B | --- | --- | t < 100 | --- | 390 | --- | 640-780 | --- | 16 L, 11 T | Q+T | see standard for impact data; 183 min. HB |
| | | | | 100 ≤ t < 250 | --- | 360 | --- | 640-780 | --- | 16 L, 11 T | Q+T | see standard for impact data; 183 min. HB |
| | | | | 250 ≤ t ≤ 400 | --- | 345 | --- | 640-780 | --- | 15 L, 10 T | Q+T | see standard for impact data; 183 min. HB |
| GB/T 15712-1995 | Grade YF40V | --- | --- | t ≤ 40 | --- | 420 | --- | 640 | --- | 16 | HR | 255 max HB; 37 J @ RT |
| GB/T 17107-1997 | Grade 55 | --- | --- | t ≤ 100 | --- | 320 | --- | 645 L | --- | 12 L | N+T | 187-229 HB; L: 23 J @ RT |
| | | | | 100 < t ≤ 300 | --- | 310 | --- | 625 L | --- | 11 L | N+T | 187-229 HB; L: 19 J @ RT |
| | | | | 300 < t ≤ 500 | --- | 305 | --- | 610 L | --- | 10 L | N+T | 187-229 HB; L: 19 J @ RT |
| | Grade 50 | --- | --- | t ≤ 16 | --- | 500 | --- | 700 L | --- | 14 L | H+T | L: 31 J @ RT |
| | | | | 16 < t ≤ 40 | --- | 430 | --- | 650 L | --- | 16 L | H+T | L: 31 J @ RT |
| | | | | t ≤ 100 | --- | 310 | --- | 610 L | --- | 13 L | N+T | L: 23 J @ RT |
| | | | | 40 < t ≤ 100 | --- | 370 | --- | 630 L | --- | 17 L | H+T | L: 31 J @ RT |
| | | | | 100 < t ≤ 250 | --- | 345 | --- | 590 L | --- | 17 L | H+T | L: 31 J @ RT |
| | | | | 100 < t ≤ 300 | --- | 295 | --- | 590 L | --- | 12 L | N+T | L: 19 J @ RT |
| | | | | 300 < t ≤ 500 | --- | 285 | --- | 570 L | --- | 12 L | N+T | L: 19 J @ RT |
| | | | | 250 < t ≤ 500 | --- | 345 | --- | 590 L | --- | 17 L | H+T | --- |
| | | | | 500 < t ≤ 750 | --- | 265 | --- | 550 L | --- | 12 L | N+T | L: 15 J @ RT |

**6.1 Carbon Steel Forgings**

**6.1.1B Chemical Composition of Carbon Steel Forgings for General Use**

| Specification | Designation | UNS No. | Steel No. | Weight, %, max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| GB/T 17107-1997 | Grade 15 | --- | --- | 0.12-0.19 | 0.35-0.65 | 0.17-0.37 | 0.035 | 0.035 | 0.25 | 0.25 | --- | Cu 0.25 |
| ASTM A668/A668M-15 | Class A (AH) | --- | --- | --- | 1.35 | --- | 0.050 | 0.025 | --- | --- | --- | --- |
| GB/T 17107-1997 | Grade Q235 | --- | --- | 0.14-0.22 | 0.30-0.65 | 0.30 | 0.045 | 0.050 | 0.30 | 0.30 | --- | Cu 0.30 |
| EN 10250-2:1999 C1:2000 | S235JRG2 | --- | 1.0038 | 0.20 | 1.40 | 0.55 | 0.045 | 0.045 | 0.30 | 0.30 | 0.08 | Al 0.020 min.; (Cr+Mo+Ni) 0.48 |
| | S235J2G3 | --- | 1.0116 | 0.17 | 1.40 | 0.55 | 0.035 | 0.035 | 0.30 | 0.30 | 0.08 | Al 0.020 min.; (Cr+Mo+Ni) 0.48 |
| GB/T 17107-1997 | Grade 20 | --- | --- | 0.17-0.24 | 0.35-0.65 | 0.17-0.37 | 0.035 | 0.035 | 0.25 | 0.25 | --- | Cu 0.25 |
| JIS G 3201:1988 A1:2008 | Symbol SF 340 A | --- | --- | 0.60 | 0.30-1.20 | 0.15-0.50 | 0.030 | 0.035 | --- | --- | --- | --- |
| | Symbol SF 390 A | --- | --- | 0.60 | 0.30-1.20 | 0.15-0.50 | 0.030 | 0.035 | --- | --- | --- | --- |
| EN 10250-2:1999 C1:2000 | C22 | --- | 1.0402 | 0.17-0.24 | 0.40-0.70 | 0.40 | 0.045 | 0.045 | 0.40 | 0.40 | 0.10 | (Cr+Mo+Ni) 0.63 |
| ISO 9327-2:1999 | Type PH 26 | --- | --- | 0.20 | 0.50-1.40 | 0.35 | 0.035 | 0.030 | 0.30 | 0.30 | 0.08 | Al 0.02 min.; Cu 0.30; (Cr+Cu+Mo+Ni) 0.70 |
| ASTM A668/A668M-15 | Class B (BH) | --- | --- | --- | 1.35 | --- | 0.050 | 0.025 | --- | --- | --- | --- |
| GB/T 17107-1997 | Grade 25 | --- | --- | 0.22-0.30 | 0.50-0.80 | 0.17-0.37 | 0.035 | 0.035 | 0.25 | 0.25 | --- | Cu 0.25 |
| JIS G 3201:1988 A1:2008 | Symbol SF 440 A | --- | --- | 0.60 | 0.30-1.20 | 0.15-0.50 | 0.030 | 0.035 | --- | --- | --- | --- |
| EN 10250-2:1999 C1:2000 | C25 | --- | 1.0406 | 0.22-0.29 | 0.40-0.70 | 0.40 | 0.045 | 0.045 | 0.40 | 0.40 | 0.10 | (Cr+Mo+Ni) 0.63 |
| | C25E | --- | 1.1158 | 0.22-0.29 | 0.40-0.70 | 0.40 | 0.035 | 0.035 | 0.40 | 0.40 | 0.10 | (Cr+Mo+Ni) 0.63 |
| ASTM A668/A668M-15 | Class C (CH) | --- | --- | --- | 1.35 | --- | 0.050 | 0.025 | --- | --- | --- | --- |
| ISO 9327-2:1999 | Type PH 29 | --- | --- | 0.20 | 0.90-1.50 | 0.40 | 0.035 | 0.030 | 0.30 | 0.30 | 0.08 | Al 0.02 min.; Cu 0.30; (Cr+Cu+Mo+Ni) 0.70 |
| GB/T 17107-1997 | Grade 30 | --- | --- | 0.27-0.35 | 0.50-0.80 | 0.17-0.37 | 0.035 | 0.035 | 0.25 | 0.25 | --- | Cu 0.25 |
| EN 10250-2:1999 C1:2000 | C30 | --- | 1.0528 | 0.27-0.34 | 0.50-0.80 | 0.40 | 0.045 | 0.045 | 0.40 | 0.40 | 0.10 | (Cr+Mo+Ni) 0.63 |
| JIS G 3201:1988 A1:2008 | Symbol SF 490 A | --- | --- | 0.60 | 0.30-1.20 | 0.15-0.50 | 0.030 | 0.035 | --- | --- | --- | --- |
| ISO 9327-2:1999 | Type PH 31 | --- | --- | 0.20 | 0.90-1.60 | 0.10-0.50 | 0.035 | 0.030 | 0.30 | 0.30 | 0.08 | Al 0.02 min.; Cu 0.30; (Cr+Cu+Mo+Ni) 0.70 |
| GB/T 17107-1997 | Grade 35 | --- | --- | 0.32-0.40 | 0.50-0.80 | 0.17-0.37 | 0.035 | 0.035 | 0.25 | 0.25 | --- | Cu 0.25 |
| ASTM A668/A668M-15 | Class D (DH) | --- | --- | --- | 1.35 | --- | 0.050 | 0.025 | --- | --- | --- | --- |
| EN 10250-2:1999 C1:2000 | C35 | --- | 1.0501 | 0.32-0.39 | 0.50-0.80 | 0.40 | 0.045 | 0.045 | 0.40 | 0.40 | 0.10 | (Cr+Mo+Ni) 0.63 |
| JIS G 3201:1988 A1:2008 | Symbol SF 540 B | --- | --- | 0.60 | 0.30-1.20 | 0.15-0.50 | 0.030 | 0.035 | --- | --- | --- | --- |
| | Symbol SF 540 A | --- | --- | 0.60 | 0.30-1.20 | 0.15-0.50 | 0.030 | 0.035 | --- | --- | --- | --- |
| GB/T 17107-1997 | Grade 40 | --- | --- | 0.37-0.45 | 0.50-0.80 | 0.17-0.37 | 0.035 | 0.035 | 0.25 | 0.25 | --- | Cu 0.25 |
| EN 10250-2:1999 C1:2000 | C40 | --- | 1.0511 | 0.37-0.44 | 0.50-0.80 | 0.40 | 0.045 | 0.045 | 0.40 | 0.40 | 0.10 | (Cr+Mo+Ni) 0.63 |
| | C35E | --- | 1.1181 | 0.32-0.39 | 0.50-0.80 | 0.40 | 0.035 | 0.035 | 0.40 | 0.40 | 0.10 | (Cr+Mo+Ni) 0.63 |
| EN 10250-2:1999 C1:2000 | C45 | --- | 1.0503 | 0.42-0.50 | 0.50-0.80 | 0.40 | 0.045 | 0.045 | 0.40 | 0.40 | 0.10 | (Cr+Mo+Ni) 0.63 |
| ASTM A668/A668M-15 | Class E (EH) | --- | --- | --- | 1.35 | --- | 0.050 | 0.025 | --- | --- | --- | --- |
| GB/T 17107-1997 | Grade 45 | --- | --- | 0.42-0.50 | 0.50-0.80 | 0.17-0.37 | 0.035 | 0.035 | 0.25 | 0.25 | --- | Cu 0.25 |
| JIS G 3201:1988 A1:2008 | Symbol SF 590 B | --- | --- | 0.60 | 0.30-1.20 | 0.15-0.50 | 0.030 | 0.035 | --- | --- | --- | --- |
| | Symbol SF 590 A | --- | --- | 0.60 | 0.30-1.20 | 0.15-0.50 | 0.030 | 0.035 | --- | --- | --- | --- |
| GB/T 15712-1995 | Grade YF35V | --- | --- | 0.32-0.39 | 0.60-1.00 | 0.20-0.40 | 0.035 | 0.035-0.075 | 0.30 | 0.30 | --- | V 0.06-0.13; Cu 0.30 |

**6.1 Carbon Steel Forgings**

**6.1.1B Chemical Composition of Carbon Steel Forgings for General Use (Continued)**

| Specification | Designation | UNS No. | Steel No. | Weight, %, max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASTM A668/A668M-15 | Class F (FH) | --- | --- | --- | 1.35 | --- | 0.050 | 0.025 | --- | --- | --- | --- |
| EN 10250-2:1999 C1:2000 | C45E | --- | 1.1191 | 0.42-0.50 | 0.50-0.80 | 0.40 | 0.035 | 0.035 | 0.40 | 0.40 | 0.10 | (Cr+Mo+Ni) 0.63 |
| | C50 | --- | 1.0540 | 0.47-0.55 | 0.60-0.90 | 0.40 | 0.045 | 0.045 | 0.40 | 0.40 | 0.10 | (Cr+Mo+Ni) 0.63 |
| | C55 | --- | 1.0535 | 0.52-0.60 | 0.60-0.90 | 0.40 | 0.045 | 0.045 | 0.40 | 0.40 | 0.10 | --- |
| JIS G 3201:1988 A1:2008 | Symbol SF 640 B | --- | --- | 0.60 | 0.30-1.20 | 0.15-0.50 | 0.030 | 0.035 | --- | --- | --- | --- |
| GB/T 15712-1995 | Grade YF40V | --- | --- | 0.37-0.44 | 0.60-1.00 | 0.20-0.40 | 0.035 | 0.035-0.075 | 0.30 | 0.30 | --- | V 0.06-0.13; Cu 0.30 |
| GB/T 17107-1997 | Grade 55 | --- | --- | 0.52-0.60 | 0.50-0.80 | 0.17-0.37 | 0.035 | 0.035 | 0.25 | 0.25 | --- | Cu 0.25 |
| | Grade 50 | --- | --- | 0.47-0.55 | 0.50-0.80 | 0.17-0.37 | 0.035 | 0.035 | 0.25 | 0.25 | --- | Cu 0.25 |

## 6.1 Carbon Steel Forgings

### 6.1.2A Mechanical Properties of Carbon Steel Forgings for Piping, Pressure Vessel and Components

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | % min. | | |
| EN 10222-4:1998 A1:2001 | P285QH | --- | 1.0478 | t ≤ 16 | --- | 275 | --- | 370-510 | --- | 22 L, 21 T | Q+T | see standard for impact data |
| | | | | 16 < t ≤ 35 | --- | 275 | --- | 370-510 | --- | 22 L, 21 T | Q+T | |
| | | | | 35 < t ≤ 70 | --- | 255 | --- | 370-510 | --- | 22 L, 21 T | Q+T | |
| | | | | 70 < t ≤ 100 | --- | 235 | --- | 370-510 | --- | 22 L, 21 T | Q+T | |
| | | | | 100 < t ≤ 250 | --- | 215 | --- | 370-510 | --- | 22 L, 21 T | Q+T | |
| | | | | 250 < t ≤ 400 | --- | 195 | --- | 370-510 | --- | 22 L, 21 T | Q+T | |
| | P285NH | --- | 1.0477 | t ≤ 16 | --- | 275 | --- | 390-510 | --- | 24 L, 23 T | N | see standard for impact data |
| | | | | 16 < t ≤ 35 | --- | 275 | --- | 390-510 | --- | 24 L, 23 T | N | |
| | | | | 35 < t ≤ 70 | --- | 255 | --- | 390-510 | --- | 24 L, 23 T | N | |
| | | | | 70 < t ≤ 100 | --- | 235 | --- | 390-510 | --- | 24 L, 23 T | N | |
| | | | | 100 < t ≤ 250 | --- | 215 | --- | 390-510 | --- | 24 L, 23 T | N | |
| | | | | 250 < t ≤ 400 | --- | 195 | --- | 390-510 | --- | 24 L, 23 T | N | |
| ISO 9327-4:1999 | Type P 28 | --- | --- | t ≤ 16 | --- | 285 | --- | 390-510 | --- | 26 L, 24 T | N or Q+T | see standard for impact data |
| | | | | 16 < t ≤ 35 | --- | 285 | --- | 390-510 | --- | 26 L, 24 T | N or Q+T | |
| | | | | 35 < t ≤ 50 | --- | 275 | --- | 390-510 | --- | 26 L, 24 T | N or Q+T | |
| | | | | 50 < t ≤ 70 | --- | 265 | --- | 390-510 | --- | 26 L, 24 T | N or Q+T | |
| | | | | 70 < t ≤ 100 | --- | 245 | --- | 370-510 | --- | 25 L, 23 T | N or Q+T | |
| | | | | 100 < t ≤ 250 | --- | 225 | --- | 370-510 | --- | 24 L, 22 T | N or Q+T | |
| | Type PH 28 | --- | --- | t ≤ 16 | --- | 285 | --- | 390-510 | --- | 26 L, 24 T | N or Q+T | see standard for impact data |
| | | | | 16 < t ≤ 35 | --- | 285 | --- | 390-510 | --- | 26 L, 24 T | N or Q+T | |
| | | | | 35 < t ≤ 50 | --- | 275 | --- | 390-510 | --- | 26 L, 24 T | N or Q+T | |
| | | | | 50 < t ≤ 70 | --- | 265 | --- | 390-510 | --- | 26 L, 24 T | N or Q+T | |
| | | | | 70 < t ≤ 100 | --- | 245 | --- | 370-510 | --- | 25 L, 23 T | N or Q+T | |
| | | | | 100 < t ≤ 250 | --- | 225 | --- | 370-510 | --- | 24 L, 22 T | N or Q+T | |
| | Type PL 28 | --- | --- | t ≤ 16 | --- | 285 | --- | 390-510 | --- | 26 L, 24 T | N or Q+T | see standard for impact data |
| | | | | 16 < t ≤ 35 | --- | 285 | --- | 390-510 | --- | 26 L, 24 T | N or Q+T | |
| | | | | 35 < t ≤ 50 | --- | 275 | --- | 390-510 | --- | 26 L, 24 T | N or Q+T | |
| | | | | 50 < t ≤ 70 | --- | 265 | --- | 390-510 | --- | 26 L, 24 T | N or Q+T | |
| | | | | 70 < t ≤ 100 | --- | 245 | --- | 370-510 | --- | 25 L, 23 T | N or Q+T | |
| | | | | 100 < t ≤ 250 | --- | 225 | --- | 370-510 | --- | 24 L, 22 T | N or Q+T | |

**6.1 Carbon Steel Forgings**

**6.1.2A Mechanical Properties of Carbon Steel Forgings for Piping, Pressure Vessel and Components (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | % min. | | |
| EN 10222-2:1999 | P245GH | --- | 1.0352 | t ≤ 35 | --- | 235 | --- | 410-530 | --- | 25 L, 23 T | A, N, N+T or Q+T | see standard for impact data |
| | | | | 35 < t ≤ 160 | --- | 210 | --- | 410-530 | --- | 25 L, 23 T | A, N, N+T or Q+T | |
| JIS G 3202:1988 A1:2008 | Symbol SFVC 1 | --- | --- | --- | --- | 205 | --- | 410-560 | --- | 21 L | A, N, N+T or Q+T | --- |
| ASME SA-181/SA-181M | Class 60 | --- | --- | --- | --- | 205 | 30 | 415 | 60 | 22 | AM, A, N or N+T | --- |
| ASME SA-266/SA-266M | Grade 1 | --- | --- | --- | --- | 205 | 30 | 415-585 | 60-85 | 23 L | A, N, N+T or BA | --- |
| ASME SA-350/SA-350M | Grade LF1, Class 1 | K03009 | --- | --- | --- | 205 | 30 | 415-585 | 60-85 | 25 | N, N+T, or Q+T | see standard for impact data 197 max HB |
| ASTM A181/A181M-14 | Class 60 | --- | --- | --- | --- | 205 | 30 | 415 | 60 | 22 | AM, A, N or N+T | --- |
| ASTM A266/A266M-13 | Grade 1 | --- | --- | --- | --- | 205 | 30 | 415-585 | 60-85 | 23 L | A, N, N+T or Q+T | --- |
| ASTM A350/A350M-15 | Grade LF1, Class 1 | K03009 | --- | --- | --- | 205 | 30 | 415-585 | 60-85 | 25 | N, N+T or Q+T | see standard for impact data 197 max HBW |
| JIS G 3205:1988 A1:2008 | Symbol SFL 1 | --- | --- | --- | --- | 225 | --- | 440-590 | --- | 22 L | A, N+T or Q+T | 21 J @ -30°C |
| EN 10222-2:1999 | P280GH | --- | 1.0426 | t ≤ 35 | --- | 270 | --- | 460-580 | --- | 23 L, 21 T | N, N+T or Q+T | see standard for impact data |
| | | | | 35 < t ≤ 160 | --- | 245 | --- | 460-580 | --- | 23 L, 21 T | N, N+T or Q+T | |
| EN 10222-4:1998 A1:2001 | P355QH | --- | 1.0571 | t ≤ 16 | --- | 345 | --- | 470-630 | --- | 21 L, 19 T | Q+T | see standard for impact data |
| | | | | 16 < t ≤ 35 | --- | 345 | --- | 470-630 | --- | 21 L, 19 T | Q+T | |
| | | | | 35 < t ≤ 70 | --- | 325 | --- | 470-630 | --- | 21 L, 19 T | Q+T | |
| | | | | 70 < t ≤ 100 | --- | 305 | --- | 470-630 | --- | 21 L, 19 T | Q+T | |
| | | | | 100 < t ≤ 250 | --- | 285 | --- | 470-630 | --- | 21 L, 19 T | Q+T | |
| | | | | 250 < t ≤ 400 | --- | 265 | --- | 470-630 | --- | 21 L, 19 T | Q+T | |
| ASME SA-541/SA-541M | Grade 1 | K03506 | --- | --- | --- | 250 | 36 | 485-655 | 70-95 | 20 | Q+T | see standard for impact data |
| | Grade 1A | K03020 | --- | --- | --- | 250 | 36 | 485-655 | 70-95 | 20 | Q+T | see standard for impact data |
| ASTM A541/A541M-05 | Grade 1 | K03506 | --- | --- | --- | 250 | 36 | 485-655 | 70-95 | 20 | Q+T | see standard for impact data |
| (2015) | Grade 1A | K03020 | --- | --- | --- | 250 | 36 | 485-655 | 70-95 | 20 | Q+T | see standard for impact data |
| ASME SA-105/SA-105M | --- | K03504 | --- | --- | --- | 250 | 36 | 485 | 70 | 30 | A, N, N+T or Q+T | 187 max HB |
| ASME SA-181/SA-181M | Class 70 | --- | --- | --- | --- | 250 | 36 | 485 | 70 | 18 | AM, A, N or N+T | --- |
| ASME SA-266/SA-266M | Grade 2 | --- | --- | --- | --- | 250 | 36 | 485-655 | 70-95 | 20 L | A, N, N+T or BA | --- |
| | Grade 4 | K03017 | --- | --- | --- | 250 | 36 | 485-655 | 70-95 | 20 L | A, N, N+T or BA | --- |
| ASME SA-350/SA-350M | Grade LF2, Class 1 | K03011 | --- | --- | --- | 250 | 36 | 485-655 | 70-95 | 22 | N, N+T or Q+T | see standard for impact data 197 max HB |
| | Grade LF2, Class 2 | K03011 | --- | --- | --- | 250 | 36 | 485-655 | 70-95 | 22 | N, N+T or Q+T | see standard for impact data 197 max HB |
| ASME SA-508/SA-508M | Grade 1 | K13502 | --- | --- | --- | 250 | 36 | 485-655 | 70-95 | 20 | Q | 20 J @ 4.4°C |
| | Grade 1A | K13502 | --- | --- | --- | 250 | 36 | 485-655 | 70-95 | 20 | Q | 20 J @ 4.4°C |
| ASTM A105/A105M-14 | --- | K03504 | --- | --- | --- | 250 | 36 | 485 | 70 | 30 | A, N, N+T or Q+T | 187 max HBW |
| ASTM A181/A181M-14 | Class 70 | --- | --- | --- | --- | 250 | 36 | 485 | 70 | 18 | AM, A, N or N+T | --- |
| ASTM A266/A266M-13 | Grade 2 | --- | --- | --- | --- | 250 | 36 | 485-655 | 70-95 | 20 L | A, N, N+T or Q+T | --- |
| | Grade 4 | K03017 | --- | --- | --- | 250 | 36 | 485-655 | 70-95 | 20 L | A, N, N+T or Q+T | --- |

Note: This section continued on next page

**6.1 Carbon Steel Forgings**

**6.1.2A Mechanical Properties of Carbon Steel Forgings for Piping, Pressure Vessel and Components (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter mm | Section Thickness/Diameter in. | Yield Strength, min. MPa | Yield Strength, min. ksi | Tensile Strength, min. MPa | Tensile Strength, min. ksi | Elongation % min. | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ASTM A350/A350M-15 | Grade LF2, Class 1 | K03011 | --- | --- | --- | 250 | 36 | 485-655 | 70-95 | 22 | N, N+T or Q+T | see standard for impact data 197 max HBW |
| | Grade LF2, Class 2 | K03011 | --- | --- | --- | 250 | 36 | 485-655 | 70-95 | 22 | N, N+T or Q+T | see standard for impact data 197 max HBW |
| ASTM A508/A508M-14 | Grade 1 | K13502 | --- | --- | --- | 250 | 36 | 485-655 | 70-95 | 20 | Q+T | 20 J @ 4.4°C |
| | Grade 1A | K13502 | --- | --- | --- | 250 | 36 | 485-655 | 70-95 | 20 | Q+T | 20 J @ 4.4°C |
| JIS G 3202:1988 A1:2008 | Symbol SFVC 2 A | --- | --- | --- | --- | 245 | --- | 490-640 | --- | 18 L | A, N, N+T or Q+T | --- |
| | Symbol SFVC 2 B | --- | --- | --- | --- | 245 | --- | 490-640 | --- | 18 L | A, N, N+T or Q+T | 27 J @ 0°C |
| JIS G 3205:1988 A1:2008 | Symbol SFL 2 | --- | --- | --- | --- | 245 | --- | 490-640 | --- | 19 L | A, N+T or Q+T | 27 J @ -45°C |
| EN 10222-2:1999 | P305GH | --- | 1.0436 | t ≤ 35 | --- | 295 | --- | 490-610 | --- | 22 L, 20 T | N or N+T | see standard for impact data |
| | | | | t ≤ 70 | --- | 275 | --- | 510-630 | --- | 22 L, 20 T | Q+T | |
| | | | | 35 < t ≤ 160 | --- | 270 | --- | 490-610 | --- | 22 L, 20 T | N or N+T | |
| EN 10222-4:1998 A1:2001 | P355NH | --- | 1.0565 | t ≤ 16 | --- | 345 | --- | 490-630 | --- | 23 L, 21 T | N | see standard for impact data |
| | | | | 16 < t ≤ 35 | --- | 345 | --- | 490-630 | --- | 23 L, 21 T | N | |
| | | | | 35 < t ≤ 70 | --- | 325 | --- | 490-630 | --- | 23 L, 21 T | N | |
| | | | | 70 < t ≤ 100 | --- | 305 | --- | 490-630 | --- | 23 L, 21 T | N | |
| | | | | 100 < t ≤ 250 | --- | 285 | --- | 490-630 | --- | 23 L, 21 T | N | |
| | | | | 250 < t ≤ 400 | --- | 265 | --- | 490-630 | --- | 23 L, 21 T | N | |
| ISO 9327-4:1999 | Type P 35 | --- | --- | t ≤ 16 | --- | 355 | --- | 490-610 | --- | 24 L, 22 T | N or Q+T | see standard for impact data |
| | | | | 16 < t ≤ 35 | --- | 355 | --- | 490-610 | --- | 24 L, 22 T | N or Q+T | |
| | | | | 35 < t ≤ 50 | --- | 345 | --- | 490-610 | --- | 24 L, 22 T | N or Q+T | |
| | | | | 50 < t ≤ 70 | --- | 325 | --- | 490-610 | --- | 24 L, 22 T | N or Q+T | |
| | | | | 70 < t ≤ 100 | --- | 315 | --- | 470-610 | --- | 23 L, 21 T | N or Q+T | |
| | | | | 100 < t ≤ 250 | --- | 295 | --- | 470-610 | --- | 22 L, 20 T | N or Q+T | |
| | Type PH 35 | --- | --- | t ≤ 16 | --- | 355 | --- | 490-610 | --- | 24 L, 22 T | N or Q+T | see standard for impact data |
| | | | | 16 < t ≤ 35 | --- | 355 | --- | 490-610 | --- | 24 L, 22 T | N or Q+T | |
| | | | | 35 < t ≤ 50 | --- | 345 | --- | 490-610 | --- | 24 L, 22 T | N or Q+T | |
| | | | | 50 < t ≤ 70 | --- | 325 | --- | 490-610 | --- | 24 L, 22 T | N or Q+T | |
| | | | | 70 < t ≤ 100 | --- | 315 | --- | 470-610 | --- | 23 L, 21 T | N or Q+T | |
| | | | | 100 < t ≤ 250 | --- | 295 | --- | 470-610 | --- | 22 L, 20 T | N or Q+T | |
| | Type PL 35 | --- | --- | t ≤ 16 | --- | 355 | --- | 490-610 | --- | 24 L, 22 T | N or Q+T | see standard for impact data |
| | | | | 16 < t ≤ 35 | --- | 355 | --- | 490-610 | --- | 24 L, 22 T | N or Q+T | |
| | | | | 35 < t ≤ 50 | --- | 345 | --- | 490-610 | --- | 24 L, 22 T | N or Q+T | |
| | | | | 50 < t ≤ 70 | --- | 325 | --- | 490-610 | --- | 24 L, 22 T | N or Q+T | |
| | | | | 70 < t ≤ 100 | --- | 315 | --- | 470-610 | --- | 23 L, 21 T | N or Q+T | |
| | | | | 100 < t ≤ 250 | --- | 295 | --- | 470-610 | --- | 22 L, 20 T | N or Q+T | |

Note: This section continued on next page

### 6.1 Carbon Steel Forgings

#### 6.1.2A Mechanical Properties of Carbon Steel Forgings for Piping, Pressure Vessel and Components (Continued)

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | % min. | | |
| ISO 9327-4:1999 | Type PLH 35 | --- | --- | t ≤ 16 | --- | 355 | --- | 490-610 | --- | 24 L, 22 T | N or Q+T | see standard for impact data |
| | | | | 16 < t ≤ 35 | --- | 355 | --- | 490-610 | --- | 24 L, 22 T | N or Q+T | |
| | | | | 35 < t ≤ 50 | --- | 345 | --- | 490-610 | --- | 24 L, 22 T | N or Q+T | |
| | | | | 50 < t ≤ 70 | --- | 325 | --- | 490-610 | --- | 24 L, 22 T | N or Q+T | |
| | | | | 70 < t ≤ 100 | --- | 315 | --- | 470-610 | --- | 23 L, 21 T | N or Q+T | |
| | | | | 100 < t ≤ 250 | --- | 295 | --- | 470-610 | --- | 22 L, 20 T | N or Q+T | |

#### 6.1.2B Chemical Composition of Carbon Steel Forgings for Piping, Pressure Vessel and Components

| Specification | Designation | UNS No. | Steel No. | Weight, %, max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| EN 10222-4:1998 A1:2001 | P285QH | --- | 1.0478 | 0.18 | 0.60-1.40 | 0.40 | 0.025 | 0.015 | 0.30 | 0.30 | 0.08 | V 0.05; Al 0.020-0.060; Cu 0.20; Nb 0.03; N 0.020; (Nb+V) 0.05 |
| | P285NH | --- | 1.0477 | 0.18 | 0.60-1.40 | 0.40 | 0.025 | 0.015 | 0.30 | 0.30 | 0.08 | V 0.05; Al 0.020-0.060; Cu 0.20; Nb 0.03; N 0.020; (Nb+V) 0.05 |
| ISO 9327-4:1999 | Type P 28 | --- | --- | 0.18 | 0.50-1.40 | 0.10-0.40 | 0.035 | 0.030 | 0.30 | 0.30 | 0.08 | V 0.05; Al 0.020 min.; Cu 0.30; Ti 0.03; Nb 0.05; N 0.020; (Cr+Cu+Mo) 0.45; (Nb+Ti+V) 0.05 |
| | Type PH 28 | --- | --- | 0.18 | 0.50-1.40 | 0.10-0.40 | 0.035 | 0.030 | 0.30 | 0.30 | 0.08 | V 0.05; Al 0.020 min.; Cu 0.30; Ti 0.03; Nb 0.05; N 0.020; (Cr+Cu+Mo) 0.45; (Nb+Ti+V) 0.05 |
| | Type PL 28 | --- | --- | 0.16 | 0.50-1.40 | 0.10-0.40 | 0.025 | 0.020 | 0.30 | 0.30 | 0.08 | V 0.05; Al 0.020 min.; Cu 0.30; Ti 0.03; Nb 0.05; N 0.020; (Cr+Cu+Mo) 0.45; (Nb+Ti+V) 0.05 |

**6.1 Carbon Steel Forgings**

**6.1.2B Chemical Properties of Carbon Steel Forgings for Piping, Pressure Vessel and Components (Continued)**

| Specification | Designation | UNS No. | Steel No. | Weight, %, max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| EN 10222-2:1999 | P245GH | --- | 1.0352 | 0.08-0.20 | 0.50-1.30 | 0.40 | 0.025 | 0.015 | 0.30 | 0.30 | 0.08 | V 0.02; Cu 0.30; Nb 0.01; (Cr+Cu+Mo) 0.50 |
| JIS G 3202:1988 A1:2008 | Symbol SFVC 1 | --- | --- | 0.30 | 0.40-1.35 | 0.35 | 0.030 | 0.030 | --- | --- | --- | --- |
| ASME SA-181/SA-181M | Class 60 | --- | --- | 0.35 | 1.10 | 0.10-0.35 | 0.05 | 0.05 | --- | --- | --- | --- |
| ASME SA-266/SA-266M | Grade 1 | --- | --- | 0.30 | 0.40-1.05 | 0.15-0.35 | 0.025 | 0.025 | --- | --- | --- | --- |
| ASME SA-350/SA-350M | Grade LF1, Class 1 | K03009 | --- | 0.30 | 0.60-1.35 | 0.15-0.30 | 0.035 | 0.040 | 0.30 | 0.40 | 0.12 | V 0.08; Cu 0.40; Cb 0.02; (Cu+Ni+Cr+V+Mo) 1.00; (Cr+Mo) 0.32 |
| ASTM A181/A181M-14 | Class 60 | --- | --- | 0.35 | 1.10 | 0.10-0.35 | 0.05 | 0.05 | --- | --- | --- | --- |
| ASTM A266/A266M-13 | Grade 1 | --- | --- | 0.30 | 0.40-1.05 | 0.15-0.35 | 0.025 | 0.025 | --- | --- | --- | --- |
| ASTM A350/A350M-15 | Grade LF1, Class 1 | K03009 | --- | 0.30 | 0.60-1.35 | 0.15-0.30 | 0.035 | 0.040 | 0.30 | 0.40 | 0.12 | V 0.08; Cu 0.40; Cb 0.02; (Cu+Ni+Cr+V+Mo) 1.00; (Cr+Mo) 0.32 |
| JIS G 3205:1988 A1:2008 | Symbol SFL 1 | --- | --- | 0.30 | 1.35 | 0.35 | 0.030 | 0.030 | --- | --- | --- | --- |
| EN 10222-2:1999 | P280GH | --- | 1.0426 | 0.08-0.20 | 0.90-1.50 | 0.40 | 0.025 | 0.015 | 0.30 | 0.30 | 0.08 | V 0.02; Cu 0.30; Nb 0.01; (Cr+Cu+Mo) 0.50 |
| EN 10222-4:1998 A1:2001 | P355QH | --- | 1.0571 | 0.20 | 0.90-1.65 | 0.10-0.50 | 0.025 | 0.015 | 0.30 | 0.30 | 0.08 | V 0.10; Al 0.020-0.060; Cu 0.20; Nb 0.05; N 0.020; (Nb+V) 0.12 |
| ASME SA-541/SA-541M | Grade 1 | K03506 | --- | 0.35 | 0.40-0.90 | 0.35 | 0.025 | 0.025 | 0.25 | 0.40 | 0.10 | V 0.05 |
| | Grade 1A | K03020 | --- | 0.30 | 0.70-1.35 | 0.40 | 0.025 | 0.025 | 0.25 | 0.40 | 0.10 | V 0.05 |
| ASTM A541/A541M-05 | Grade 1 | K03506 | --- | 0.35 | 0.40-0.90 | 0.35 | 0.025 | 0.025 | 0.25 | 0.40 | 0.10 | V 0.05 |
| (2015) | Grade 1A | K03020 | --- | 0.30 | 0.70-1.35 | 0.40 | 0.025 | 0.025 | 0.25 | 0.40 | 0.10 | V 0.05 |
| ASME SA-105/SA-105M | --- | K03504 | --- | 0.35 | 0.60-1.05 | 0.10-0.35 | 0.035 | 0.040 | 0.30 | 0.40 | 0.12 | V 0.08; Cu 0.40; (Cr+Mo) 0.32; (Cu+Ni+Cr+Mo+V) 1.00 |
| ASME SA-181/SA-181M | Class 70 | --- | --- | 0.35 | 1.10 | 0.10-0.35 | 0.05 | 0.05 | --- | --- | --- | --- |
| ASME SA-266/SA-266M | Grade 2 | --- | --- | 0.30 | 0.40-1.05 | 0.15-0.35 | 0.025 | 0.025 | --- | --- | --- | --- |
| | Grade 4 | K03017 | --- | 0.30 | 0.80-1.35 | 0.15-0.35 | 0.025 | 0.025 | --- | --- | --- | --- |
| ASME SA-350/SA-350M | Grade LF2, Class 1 | K03011 | --- | 0.30 | 0.60-1.35 | 0.15-0.30 | 0.035 | 0.040 | 0.30 | 0.40 | 0.12 | V 0.08; Cu 0.40; Cb 0.02; (Cu+Ni+Cr+V+Mo) 1.00; (Cr+Mo) 0.32 |
| | Grade LF2, Class 2 | K03011 | --- | 0.30 | 0.60-1.35 | 0.15-0.30 | 0.035 | 0.040 | 0.30 | 0.40 | 0.12 | V 0.08; Cu 0.40; Cb 0.02; (Cu+Ni+Cr+V+Mo) 1.00; (Cr+Mo) 0.32 |
| ASME SA-508/SA-508M | Grade 1 | K13502 | --- | 0.35 | 0.40-1.05 | 0.40 | 0.025 | 0.025 | 0.25 | 0.40 | 0.10 | V 0.05; B 0.003; Cu 0.20; Cb 0.01; Ca 0.015; Ti 0.015; Al 0.025 |
| | Grade 1A | K13502 | --- | 0.30 | 0.70-1.35 | 0.40 | 0.025 | 0.025 | 0.25 | 0.40 | 0.10 | V 0.05; B 0.003; Cu 0.20; Cb 0.01; Ca 0.015; Ti 0.015; Al 0.025 |

Note: This section continued on next page

**6.1 Carbon Steel Forgings**

**6.1.2B Chemical Properties of Carbon Steel Forgings for Piping, Pressure Vessel and Components (Continued)**

| Specification | Designation | UNS No. | Steel No. | Weight, %, max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASTM A105/A105M-14 | --- | K03504 | --- | 0.35 | 0.60-1.05 | 0.10-0.35 | 0.035 | 0.040 | 0.30 | 0.40 | 0.12 | V 0.08; Cu 0.40; (Cr+Mo) 0.32; (Cu+Ni+Cr+Mo+V) 1.00 |
| ASTM A181/A181M-14 | Class 70 | --- | --- | 0.35 | 1.10 | 0.10-0.35 | 0.05 | 0.05 | --- | --- | --- | --- |
| ASTM A266/A266M-13 | Grade 2 | --- | --- | 0.30 | 0.40-1.05 | 0.15-0.35 | 0.025 | 0.025 | --- | --- | --- | --- |
| | Grade 4 | K03017 | --- | 0.30 | 0.80-1.35 | 0.15-0.35 | 0.025 | 0.025 | --- | --- | --- | --- |
| ASTM A350/A350M-15 | Grade LF2, Class 1 | K03011 | --- | 0.30 | 0.60-1.35 | 0.15-0.30 | 0.035 | 0.040 | 0.30 | 0.40 | 0.12 | V 0.08; Cu 0.40; Cb 0.02; (Cu+Ni+Cr+V+Mo) 1.00; (Cr+Mo) 0.32 |
| | Grade LF2, Class 2 | K03011 | --- | 0.30 | 0.60-1.35 | 0.15-0.30 | 0.035 | 0.040 | 0.30 | 0.40 | 0.12 | V 0.08; Cu 0.40; Cb 0.02; (Cu+Ni+Cr+V+Mo) 1.00; (Cr+Mo) 0.32 |
| ASTM A508/A508M-14 | Grade 1 | K13502 | --- | 0.35 | 0.40-1.05 | 0.40 | 0.025 | 0.025 | 0.25 | 0.40 | 0.10 | V 0.05; Cu 0.20; B 0.003; Cb 0.01; Ca 0.015; Ti 0.015; Al 0.025 |
| | Grade 1A | K13502 | --- | 0.30 | 0.70-1.35 | 0.40 | 0.025 | 0.025 | 0.25 | 0.40 | 0.10 | V 0.05; Cu 0.20; B 0.003; Cb 0.01; Ca 0.015; Ti 0.015; Al 0.025 |
| JIS G 3202:1988 A1:2008 | Symbol SFVC 2 A | --- | --- | 0.35 | 0.40-1.10 | 0.35 | 0.030 | 0.030 | --- | --- | --- | --- |
| | Symbol SFVC 2 B | --- | --- | 0.30 | 0.70-1.35 | 0.35 | 0.030 | 0.030 | --- | --- | --- | --- |
| JIS G 3205:1988 A1:2008 | Symbol SFL 2 | --- | --- | 0.30 | 1.35 | 0.35 | 0.030 | 0.030 | --- | --- | --- | --- |
| EN 10222-2:1999 | P305GH | --- | 1.0436 | 0.15-0.20 | 0.90-1.60 | 0.40 | 0.025 | 0.015 | 0.30 | 0.30 | 0.08 | V 0.02; Cu 0.30; Nb 0.01; (Cr+Cu+Mo) 0.50 |
| EN 10222-4:1998 A1:2001 | P355NH | --- | 1.0565 | 0.20 | 0.90-1.65 | 0.10-0.50 | 0.025 | 0.015 | 0.30 | 0.30 | 0.08 | V 0.10; Al 0.020-0.060; Cu 0.20; Nb 0.05; N 0.020; (Nb+V) 0.12 |
| ISO 9327-4:1999 | Type P 35 | --- | --- | 0.20 | 0.90-1.70 | 0.10-0.50 | 0.035 | 0.030 | 0.30 | 0.30 | 0.08 | V 0.10; Al 0.020 min.; Cu 0.30; Ti 0.03; Nb 0.05; N 0.020; (Cr+Cu+Mo) 0.45; (Nb+Ti+V) 0.12 |
| | Type PH 35 | --- | --- | 0.20 | 0.90-1.70 | 0.10-0.50 | 0.035 | 0.030 | 0.30 | 0.30 | 0.08 | V 0.10; Al 0.020 min.; Cu 0.30; Ti 0.03; Nb 0.05; N 0.020; (Cr+Cu+Mo) 0.45; (Nb+Ti+V) 0.12 |
| | Type PL 35 | --- | --- | 0.18 | 0.90-1.70 | 0.10-0.50 | 0.025 | 0.020 | 0.30 | 0.30 | 0.08 | V 0.10; Al 0.020 min.; Cu 0.30; Ti 0.03; Nb 0.05; N 0.020; (Cr+Cu+Mo) 0.45; (Nb+Ti+V) 0.12 |
| | Type PLH 35 | --- | --- | 0.18 | 0.90-1.70 | 0.10-0.50 | 0.025 | 0.020 | 0.30 | 0.30 | 0.08 | V 0.10; Al 0.020 min.; Cu 0.30; Ti 0.03; Nb 0.05; N 0.020; (Cr+Cu+Mo) 0.45; (Nb+Ti+V) 0.12 |

### 6.2 Alloy Steel Forgings

#### 6.2.1A Chemical Composition of 1¼Cr–¼Mo Alloy Steel Forgings for General Use

| Specification | Designation | UNS No. | Steel No. | Weight, %, max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| EN 10250-3:1999 | 25CrMo4 | --- | 1.7218 | 0.22-0.29 | 0.60-0.90 | 0.40 | 0.035 | 0.035 | 0.90-1.20 | --- | 0.15-0.30 | --- |
| JIS G 3221:1988 A1:2008 | Symbol SFCM 690 S | --- | --- | 0.48 | 0.30-0.85 | 0.15-0.35 | 0.030 | 0.030 | 0.90-1.50 | --- | 0.15-0.30 | Cu 0.30 |
| EN 10250-3:1999 | 42CrMo4 | --- | 1.7225 | 0.38-0.45 | 0.60-0.90 | 0.40 | 0.035 | 0.035 | 0.90-1.20 | --- | 0.15-0.30 | --- |
| JIS G 3221:1988 A1:2008 | Symbol SFCM 740 S | --- | --- | 0.48 | 0.30-0.85 | 0.15-0.35 | 0.030 | 0.030 | 0.90-1.50 | --- | 0.15-0.30 | Cu 0.30 |
| EN 10250-3:1999 | 34CrMo4 | --- | 1.7220 | 0.30-0.37 | 0.60-0.90 | 0.40 | 0.035 | 0.035 | 0.90-1.20 | --- | 0.15-0.30 | --- |
| | 50CrMo4 | --- | 1.7228 | 0.46-0.54 | 0.50-0.80 | 0.40 | 0.035 | 0.035 | 0.90-1.20 | --- | 0.15-0.30 | --- |
| JIS G 3221:1988 A1:2008 | Symbol SFCM 780 S | --- | --- | 0.48 | 0.30-0.85 | 0.15-0.35 | 0.030 | 0.030 | 0.90-1.50 | --- | 0.15-0.30 | Cu 0.30 |

#### 6.2.1B Mechanical Properties of 1¼Cr–¼Mo Alloy Steel Forgings for General Use

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | % min. | | |
| EN 10250-3:1999 | 25CrMo4 | --- | 1.7218 | t ≤ 70 | --- | 450 | --- | 700 | --- | 15 L | Q+T | L: 50 J @ RT |
| | | | | 70 < t ≤ 160 | --- | 400 | --- | 650 | --- | 17 L, 13 T | Q+T | see standard for impact data |
| | | | | 160 < t ≤ 330 | --- | 380 | --- | 600 | --- | 18 L, 14 T | Q+T | |
| JIS G 3221:1988 A1:2008 | Symbol SFCM 690 S | --- | --- | t < 200 | --- | 460 | --- | 690-830 | --- | 17 L | H+T | see standard for impact data; 201 min. HB |
| | | | | 200 ≤ t < 400 | --- | 450 | --- | 690-830 | --- | 16 L, 12 T | H+T | see standard for impact data; 201 min. HB |
| | | | | 400 ≤ t < 700 | --- | 450 | --- | 690-830 | --- | 15 L, 11 T | H+T | see standard for impact data; 201 min. HB |
| EN 10250-3:1999 | 42CrMo4 | --- | 1.7225 | t ≤ 160 | --- | 500 | --- | 750 | --- | 14 L, 10 T | Q+T | see standard for impact data |
| | | | | 160 < t ≤ 330 | --- | 460 | --- | 700 | --- | 15 L, 11 T | Q+T | |
| | | | | 330 < t ≤ 500 | --- | 390 | --- | 600 | --- | 16 L, 12 T | Q+T | |
| JIS G 3221:1988 A1:2008 | Symbol SFCM 740 S | --- | --- | t < 200 | --- | 510 | --- | 740-880 | --- | 16 L | H+T | see standard for impact data; 217 min. HB |
| | | | | 200 ≤ t < 400 | --- | 500 | --- | 740-880 | --- | 15 L, 11 T | H+T | see standard for impact data; 217 min. HB |
| | | | | 400 ≤ t < 700 | --- | 490 | --- | 740-880 | --- | 14 L, 10 T | H+T | see standard for impact data; 217 min. HB |
| EN 10250-3:1999 | 34CrMo4 | --- | 1.7220 | t ≤ 70 | --- | 550 | --- | 800 | --- | 14 L | Q+T | L: 45 J @ RT |
| | | | | 70 < t ≤ 160 | --- | 450 | --- | 700 | --- | 15 L, 10 T | Q+T | see standard for impact data |
| | | | | 160 < t ≤ 330 | --- | 410 | --- | 650 | --- | 16 L, 12 T | Q+T | |
| | 50CrMo4 | --- | 1.7228 | t ≤ 160 | --- | 550 | --- | 800 | --- | 13 L, 9 T | Q+T | see standard for impact data |
| | | | | 160 < t ≤ 330 | --- | 540 | --- | 750 | --- | 14 L, 10 T | Q+T | |
| | | | | 330 < t ≤ 500 | --- | 490 | --- | 700 | --- | 15 L, 11 T | Q+T | |
| JIS G 3221:1988 A1:2008 | Symbol SFCM 780 S | --- | --- | t < 200 | --- | 560 | --- | 780-930 | --- | 15 L | H+T | see standard for impact data; 229 min. HB |
| | | | | 200 ≤ t < 400 | --- | 550 | --- | 780-930 | --- | 14 L, 10 T | H+T | see standard for impact data; 229 min. HB |
| | | | | 400 ≤ t < 700 | --- | 540 | --- | 780-930 | --- | 13 L, 9 T | H+T | see standard for impact data; 229 min. HB |

### 6.2.2 Alloy Steel Forgings for Piping, Pressure Vessel and Components

#### 6.2.2.1A Chemical Composition of Mo Alloy Steel Forgings for Piping, Pressure Vessel and Components

| Specification | Designation | UNS No. | Steel No. | Weight, %, max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| EN 10222-2:1999 | 16Mo3 | --- | 1.5415 | 0.12-0.20 | 0.40-0.90 | 0.35 | 0.025 | 0.015 | 0.30 | 0.30 | 0.25-0.35 | V 0.02; Cu 0.30; Nb 0.01; (Cr+Cu) 0.50 |
| ISO 9327-2:1999 | Type 16Mo3 | --- | --- | 0.12-0.20 | 0.40-0.90 | 0.35 | 0.035 | 0.030 | 0.30 | --- | 0.25-0.35 | Cu 0.30 |
| ASME SA-182/SA-182M | Grade F 1 | K12822 | --- | 0.28 | 0.60-0.90 | 0.15-0.35 | 0.045 | 0.045 | --- | --- | 0.44-0.65 | --- |
| ASME SA-336/SA-336M | Grade F1 | K12520 | --- | 0.20-0.30 | 0.60-0.80 | 0.20-0.35 | 0.025 | 0.025 | --- | --- | 0.40-0.60 | --- |
| ASTM A182/A182M-15 | Grade F 1 | K12822 | --- | 0.28 | 0.60-0.90 | 0.15-0.35 | 0.045 | 0.045 | --- | --- | 0.44-0.65 | --- |
| ASTM A336/A336M-10a | Grade F1 | K12520 | --- | 0.20-0.30 | 0.60-0.80 | 0.20-0.35 | 0.025 | 0.025 | --- | --- | 0.40-0.60 | --- |
| JIS G 3203:1988 A1:2008 | Grade SFVA F 1 | --- | --- | 0.30 | 0.60-0.90 | 0.35 | 0.030 | 0.030 | --- | --- | 0.45-0.65 | --- |

#### 6.2.2.1B Mechanical Properties of Mo Alloy Steel Forgings for Piping, Pressure Vessel and Components

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | % min. | | |
| EN 10222-2:1999 | 16Mo3 | --- | 1.5415 | t ≤ 35 | --- | 285 | --- | 440-570 | --- | 23 L, 21 T | N or Q+T | see standard for impact data |
| | | | | 35 < t ≤ 70 | --- | 275 | --- | 440-570 | --- | 23 L, 21 T | N or Q+T | |
| | | | | 70 < t ≤ 100 | --- | 265 | --- | 440-570 | --- | 23 L, 21 T | N or Q+T | |
| | | | | t ≤ 250 | --- | 255 | --- | 440-570 | --- | 23 L, 21 T | Q+T | |
| | | | | 250 < t ≤ 500 | --- | 240 | --- | 420-550 | --- | 23 L, 21 T | Q+T | |
| ISO 9327-2:1999 | Type 16Mo3 | --- | --- | t ≤ 40 | --- | 270 | --- | 450-600 | --- | 26 L, 24 T | N, N+T or Q+T | see standard for impact data |
| | | | | 40 < t ≤ 60 | --- | 260 | --- | 450-600 | --- | 25 L, 23 T | N, N+T or Q+T | |
| | | | | 60 < t ≤ 100 | --- | 240 | --- | 430-580 | --- | 24 L, 22 T | N, N+T or Q+T | |
| | | | | 100 < t ≤ 250 | --- | 220 | --- | 420-570 | --- | 21 L, 19 T | N, N+T or Q+T | |
| ASME SA-182/SA-182M | Grade F 1 | K12822 | --- | --- | --- | 275 | 40 | 485 | 70 | 20 | A, N+T | 143-192 HBW |
| ASME SA-336/SA-336M | Grade F1 | K12520 | --- | --- | --- | 275 | 40 | 485-660 L | 70-95 L | 20 L | A, N, N+T or Q+T | --- |
| ASTM A182/A182M-15 | Grade F 1 | K12822 | --- | --- | --- | 275 | 40 | 485 | 70 | 20 | A, N+T | 143-192 HBW |
| ASTM A336/A336M-10a | Grade F1 | K12520 | --- | --- | --- | 275 | 40 | 485-660 L | 70-95 L | 20 L | A, N+T or Q+T | --- |
| JIS G 3203:1988 A1:2008 | Grade SFVA F 1 | --- | --- | --- | --- | 275 | --- | 480-660 | --- | 18 L | A or N+T | --- |

### 6.2.2 Alloy Steel Forgings for Piping, Pressure Vessel and Components

#### 6.2.2.2A Chemical Composition of ½Cr-½Mo Alloy Steel Forgings for Piping, Pressure Vessel and Components

| Specification | Designation | UNS No. | Steel No. | Weight, %, max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASME SA-182/SA-182M | Grade F 2 | K12122 | --- | 0.05-0.21 | 0.30-0.80 | 0.10-0.60 | 0.040 | 0.040 | 0.50-0.81 | --- | 0.44-0.65 | --- |
| ASTM A182/A182M-15 | Grade F 2 | K12122 | --- | 0.05-0.21 | 0.30-0.80 | 0.10-0.60 | 0.040 | 0.040 | 0.50-0.81 | --- | 0.44-0.65 | --- |
| JIS G 3203:1988 A1:2008 | Grade SFVA F 2 | --- | --- | 0.20 | 0.30-0.80 | 0.60 | 0.030 | 0.030 | 0.50-0.80 | --- | 0.45-0.65 | --- |

#### 6.2.2.2B Mechanical Properties of ½Cr–½Mo Alloy Steel Forgings for Piping, Pressure Vessel and Components

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | % min. | | |
| ASME SA-182/SA-182M | Grade F 2 | K12122 | --- | --- | --- | 275 | 40 | 485 | 70 | 20 | A, N+T | 143-192 HBW |
| ASTM A182/A182M-15 | Grade F 2 | K12122 | --- | --- | --- | 275 | 40 | 485 | 70 | 20 | A, N+T | 143-192 HBW |
| JIS G 3203:1988 A1:2008 | Grade SFVA F 2 | --- | --- | --- | --- | 275 | --- | 480-660 | --- | 18 L | A or N+T | --- |

### 6.2.2 Alloy Steel Forgings for Piping, Pressure Vessel and Components

#### 6.2.2.3A Chemical Composition of 1Cr–½Mo Alloy Steel Forgings for Piping, Pressure Vessel and Components

| Specification | Designation | UNS No. | Steel No. | Weight, %, max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASME SA-182/SA-182M | Grade F 12, Class 2 | K11564 | --- | 0.10-0.20 | 0.30-0.80 | 0.10-0.60 | 0.040 | 0.040 | 0.80-1.25 | --- | 0.44-0.65 | --- |
| ASME SA-336/SA-336M | Grade F12 | K11564 | --- | 0.10-0.20 | 0.30-0.80 | 0.10-0.60 | 0.025 | 0.025 | 0.80-1.10 | --- | 0.45-0.65 | --- |
| ASTM A182/A182M-15 | Grade F 12, Class 2 | K11564 | --- | 0.10-0.20 | 0.30-0.80 | 0.10-0.60 | 0.040 | 0.040 | 0.80-1.25 | --- | 0.44-0.65 | --- |
| ASTM A336/A336M-10a | Grade F12 | K11564 | --- | 0.10-0.20 | 0.30-0.80 | 0.10-0.60 | 0.025 | 0.025 | 0.80-1.10 | --- | 0.45-0.65 | --- |
| EN 10222-2:1999 | 13CrMo4-5 | --- | 1.7335 | 0.08-0.18 | 0.40-1.00 | 0.35 | 0.025 | 0.015 | 0.70-1.15 | 0.30 | 0.40-0.60 | V 0.02; Cu 0.30; Nb 0.01 |
| ISO 9327-2:1999 | Type 14CrMo4-5 | --- | --- | 0.08-0.18 | 0.40-1.00 | 0.35 | 0.035 | 0.030 | 0.70-1.15 | --- | 0.40-0.60 | Cu 0.30 |
| JIS G 3203:1988 A1:2008 | Grade SFVA F 12 | --- | --- | 0.20 | 0.30-0.80 | 0.60 | 0.030 | 0.030 | 0.80-1.25 | --- | 0.45-0.65 | --- |

#### 6.2.2.3B Mechanical Properties of 1Cr-½Mo Alloy Steel Forgings for Piping, Pressure Vessel and Components

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | % min. | | |
| ASME SA-182/SA-182M | Grade F 12, Class 2 | K11564 | --- | --- | --- | 275 | 40 | 485 | 70 | 20 | A, N+T | 143-207 HBW |
| ASME SA-336/SA-336M | Grade F12 | K11564 | --- | --- | --- | 275 | 40 | 485-660 L | 70-95 L | 20 L | A, N, N+T or Q+T | --- |
| ASTM A182/A182M-15 | Grade F 12, Class 2 | K11564 | --- | --- | --- | 275 | 40 | 485 | 70 | 20 | A, N+T | 143-207 HBW |
| ASTM A336/A336M-10a | Grade F12 | K11564 | --- | --- | --- | 275 | 40 | 485-660 L | 70-95 L | 20 L | A, N+T or Q+T | --- |
| EN 10222-2:1999 | 13CrMo4-5 | --- | 1.7335 | t ≤ 35 | --- | 285 | --- | 440-590 | --- | 20 L, 18 T | N+T | see standard for impact data |
| | | | | 35 < t ≤ 70 | --- | 275 | --- | 440-590 | --- | 20 L, 18 T | N+T | |
| | | | | 70 < t ≤ 100 | --- | 265 | --- | 440-590 | --- | 20 L, 18 T | N+T or Q+T | |
| | | | | 100 < t ≤ 250 | --- | 255 | --- | 440-590 | --- | 20 L, 18 T | N+T or Q+T | |
| | | | | 250 < t ≤ 500 | --- | 230 | --- | 420-570 | --- | 20 L, 18 T | N+T or Q+T | |
| ISO 9327-2:1999 | Type 14CrMo4-5 | --- | --- | t ≤ 40 | --- | 300 | --- | 450-600 | --- | 22 L, 20 T | N+T or Q+T | see standard for impact data |
| | | | | 40 < t ≤ 60 | --- | 300 | --- | 450-600 | --- | 21 L, 19 T | N+T or Q+T | |
| | | | | 60 < t ≤ 100 | --- | 275 | --- | 440-590 | --- | 20 L, 18 T | N+T or Q+T | |
| | | | | 100 < t ≤ 250 | --- | 255 | --- | 430-580 | --- | 20 L, 18 T | N+T or Q+T | |
| JIS G 3203:1988 A1:2008 | Grade SFVA F 12 | --- | --- | --- | --- | 275 | --- | 480-660 | --- | 18 L | A or N+T | --- |

### 6.2.2 Alloy Steel Forgings for Piping, Pressure Vessel and Components

#### 6.2.2.4A Chemical Composition of 1¼Cr–½Mo Alloy Steel Forgings for Piping, Pressure Vessel and Components

| Specification | Designation | UNS No. | Steel No. | Weight, %, max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASME SA-182/SA-182M | Grade F 11, Class 2 | K11572 | --- | 0.10-0.20 | 0.30-0.80 | 0.50-1.00 | 0.040 | 0.040 | 1.00-1.50 | --- | 0.44-0.65 | --- |
| | Grade F 11, Class 3 | K11572 | --- | 0.10-0.20 | 0.30-0.80 | 0.50-1.00 | 0.040 | 0.040 | 1.00-1.50 | --- | 0.44-0.65 | --- |
| ASME SA-336/SA-336M | Grade F11, Class 2 | K11572 | --- | 0.10-0.20 | 0.30-0.80 | 0.50-1.00 | 0.025 | 0.025 | 1.00-1.50 | --- | 0.45-0.65 | --- |
| | Grade F11, Class 3 | K11572 | --- | 0.10-0.20 | 0.30-0.80 | 0.50-1.00 | 0.025 | 0.025 | 1.00-1.50 | --- | 0.45-0.65 | --- |
| ASTM A182/A182M-15 | Grade F 11, Class 2 | K11572 | --- | 0.10-0.20 | 0.30-0.80 | 0.50-1.00 | 0.040 | 0.040 | 1.00-1.50 | --- | 0.44-0.65 | --- |
| | Grade F 11, Class 3 | K11572 | --- | 0.10-0.20 | 0.30-0.80 | 0.50-1.00 | 0.040 | 0.040 | 1.00-1.50 | --- | 0.44-0.65 | --- |
| ASTM A336/A336M-10a | Grade F11, Class 2 | K11572 | --- | 0.10-0.20 | 0.30-0.80 | 0.50-1.00 | 0.025 | 0.025 | 1.00-1.50 | --- | 0.45-0.65 | --- |
| | Grade F11, Class 3 | K11572 | --- | 0.10-0.20 | 0.30-0.80 | 0.50-1.00 | 0.025 | 0.025 | 1.00-1.50 | --- | 0.45-0.65 | --- |
| JIS G 3203:1988 A1:2008 | Grade SFVA F 11 A | --- | --- | 0.20 | 0.30-0.80 | 0.50-1.00 | 0.030 | 0.030 | 1.00-1.50 | --- | 0.45-0.65 | --- |
| | Grade SFVA F 11 B | --- | --- | 0.20 | 0.30-0.80 | 0.50-1.00 | 0.030 | 0.030 | 1.00-1.50 | --- | 0.45-0.65 | --- |

#### 6.2.2.4B Mechanical Properties of 1¼Cr–½Mo Alloy Steel Forgings for Piping, Pressure Vessel and Components

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | % min. | | |
| ASME SA-182/SA-182M | Grade F 11, Class 2 | K11572 | --- | --- | --- | 275 | 40 | 485 | 70 | 20 | A, N+T | 143-207 HBW |
| | Grade F 11, Class 3 | K11572 | --- | --- | --- | 310 | 45 | 515 | 75 | 20 | A, N+T | 156-207 HBW |
| ASME SA-336/SA-336M | Grade F11, Class 2 | K11572 | --- | --- | --- | 275 | 40 | 485-660 L | 70-95 L | 20 L | A, N, N+T or Q+T | --- |
| | Grade F11, Class 3 | K11572 | --- | --- | --- | 310 | 45 | 515-690 L | 75-100 L | 18 L | A, N, N+T or Q+T | --- |
| ASTM A182/A182M-15 | Grade F 11, Class 2 | K11572 | --- | --- | --- | 275 | 40 | 485 | 70 | 20 | A, N+T | 143-207 HBW |
| | Grade F 11, Class 3 | K11572 | --- | --- | --- | 310 | 45 | 515 | 75 | 20 | A, N+T | 156-207 HBW |
| ASTM A336/A336M-10a | Grade F11, Class 2 | K11572 | --- | --- | --- | 275 | 40 | 485-660 L | 70-95 L | 20 L | A, N+T or Q+T | --- |
| | Grade F11, Class 3 | K11572 | --- | --- | --- | 310 | 45 | 515-690 L | 75-100 L | 18 L | A, N+T or Q+T | --- |
| JIS G 3203:1988 A1:2008 | Grade SFVA F 11 A | --- | --- | --- | --- | 275 | --- | 480-660 | --- | 18 L | A or N+T | --- |
| | Grade SFVA F 11 B | --- | --- | --- | --- | 315 | --- | 520-690 | --- | 18 L | A or N+T | --- |

### 6.2.2 Alloy Steel Forgings for Piping, Pressure Vessel and Components

#### 6.2.2.5A Chemical Composition of 2¼Cr–1Mo Alloy Steel Forgings for Piping, Pressure Vessel and Components

| Specification | Designation | UNS No. | Steel No. | Weight, %, max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASME SA-182/SA-182M | Grade F 22, Class 1 | K21590 | --- | 0.05-0.15 | 0.30-0.60 | 0.50 | 0.040 | 0.040 | 2.00-2.50 | --- | 0.87-1.13 | --- |
| | Grade F 22, Class 3 | K21590 | --- | 0.05-0.15 | 0.30-0.60 | 0.50 | 0.040 | 0.040 | 2.00-2.50 | --- | 0.87-1.13 | --- |
| ASME SA-336/SA-336M | Grade F22, Class 1 | K21590 | --- | 0.05-0.15 | 0.30-0.60 | 0.50 | 0.025 | 0.025 | 2.00-2.50 | --- | 0.90-1.10 | --- |
| | Grade F22, Class 3 | K21590 | --- | 0.05-0.15 | 0.30-0.60 | 0.50 | 0.025 | 0.025 | 2.00-2.50 | --- | 0.90-1.10 | --- |
| ASTM A182/A182M-15 | Grade F 22, Class 1 | K21590 | --- | 0.05-0.15 | 0.30-0.60 | 0.50 | 0.040 | 0.040 | 2.00-2.50 | --- | 0.87-1.13 | --- |
| | Grade F 22, Class 3 | K21590 | --- | 0.05-0.15 | 0.30-0.60 | 0.50 | 0.040 | 0.040 | 2.00-2.50 | --- | 0.87-1.13 | --- |
| ASTM A336/A336M-10a | Grade F22, Class 1 | K21590 | --- | 0.05-0.15 | 0.30-0.60 | 0.50 | 0.025 | 0.025 | 2.00-2.50 | --- | 0.90-1.10 | --- |
| | Grade F22, Class 3 | K21590 | --- | 0.05-0.15 | 0.30-0.60 | 0.50 | 0.025 | 0.025 | 2.00-2.50 | --- | 0.90-1.10 | --- |
| EN 10222-2:1999 | 11CrMo9-10 | --- | 1.7383 | 0.08-0.15 | 0.40-0.80 | 0.50 | 0.025 | 0.015 | 2.00-2.50 | 0.30 | 0.90-1.10 | V 0.02; Cu 0.30; Nb 0.01 |
| ISO 9327-2:1999 | Type 13CrMo9-10 | --- | --- | 0.08-0.15 | 0.40-0.70 | 0.50 | 0.035 | 0.030 | 2.00-2.50 | --- | 0.90-1.10 | Cu 0.30 |
| JIS G 3203:1988 A1:2008 | Grade SFVA F 22 A | --- | --- | 0.15 | 0.30-0.60 | 0.50 | 0.030 | 0.030 | 2.00-2.50 | --- | 0.90-1.10 | --- |
| | Grade SFVA F 22 B | --- | --- | 0.15 | 0.30-0.60 | 0.50 | 0.030 | 0.030 | 2.00-2.50 | --- | 0.90-1.10 | --- |
| ASME SA-508/SA-508M | Grade 22, Class 3 | K21590 | --- | 0.11-0.15 | 0.30-0.60 | 0.35 | 0.015 | 0.015 | 2.00-2.50 | 0.25 | 0.90-1.10 | V 0.02; Al 0.025; Cu 0.25; Cb 0.01; Ca 0.015; Ti 0.015; B 0.003 |
| ASME SA-541/SA-541M | Grade 22, Class 3 | --- | --- | 0.11-0.15 | 0.30-0.60 | 0.50 | 0.015 | 0.015 | 2.00-2.50 | 0.25 | 0.90-1.10 | V 0.02 |
| ASTM A508/A508M-14 | Grade 22, Class 3 | K21590 | --- | 0.11-0.15 | 0.30-0.60 | 0.35 | 0.015 | 0.015 | 2.00-2.50 | 0.25 | 0.90-1.10 | V 0.02; Al 0.025; Cu 0.25; Cb 0.01; Ca 0.015; Ti 0.015; B 0.003 |
| ASTM A541/A541M-05 (2015) | Grade 22, Class 3 | --- | --- | 0.11-0.15 | 0.30-0.60 | 0.50 | 0.015 | 0.015 | 2.00-2.50 | 0.25 | 0.90-1.10 | V 0.02 |
| JIS G 3206:1993 A1:2008 | Symbol SFVCM F22B | --- | --- | 0.17 | 0.30-0.60 | 0.50 | 0.015 | 0.015 | 2.00-2.50 | --- | 0.90-1.10 | V 0.03 |
| ASME SA-182/SA-182M | Grade F 22V | K31835 | --- | 0.11-0.15 | 0.30-0.60 | 0.10 | 0.015 | 0.010 | 2.00-2.50 | 0.25 | 0.90-1.10 | V 0.25-0.35; Cu 0.20; Ti 0.030; Cb 0.07; B 0.002; Ca 0.015 |
| ASME SA-336/SA-336M | Grade F22V | K31835 | --- | 0.11-0.15 | 0.30-0.60 | 0.10 | 0.015 | 0.010 | 2.00-2.50 | 0.25 | 0.90-1.10 | V 0.25-0.35; Cu 0.20; Ti 0.030; Cb 0.07; B 0.0020; Ca 0.015 |
| ASME SA-541/SA-541M | Grade 22V | K31835 | --- | 0.11-0.15 | 0.30-0.60 | 0.10 | 0.015 | 0.010 | 2.00-2.50 | 0.25 | 0.90-1.10 | V 0.25-0.35; Cu 0.20; Ti 0.030; Cb 0.07; B 0.0020; Ca 0.015 |
| ASTM A182/A182M-15 | Grade F 22V | K31835 | --- | 0.11-0.15 | 0.30-0.60 | 0.10 | 0.015 | 0.010 | 2.00-2.50 | 0.25 | 0.90-1.10 | V 0.25-0.35; Cu 0.20; Ti 0.030; Cb 0.07; B 0.002; Ca 0.015 |
| ASTM A336/A336M-10a | Grade F22V | K31835 | --- | 0.11-0.15 | 0.30-0.60 | 0.10 | 0.015 | 0.010 | 2.00-2.50 | 0.25 | 0.90-1.10 | V 0.25-0.35; Cu 0.20; Ti 0.030; Cb 0.07; B 0.0020; Ca 0.015 |
| ASTM A541/A541M-05 (2015) | Grade 22V | K31835 | --- | 0.11-0.15 | 0.30-0.60 | 0.10 | 0.015 | 0.010 | 2.00-2.50 | 0.25 | 0.90-1.10 | V 0.25-0.35; Cu 0.20; Ti 0.030; Cb 0.07; B 0.0020; Ca 0.015 |
| JIS G 3206:1993 A1:2008 | Symbol SFVCM F22V | --- | --- | 0.17 | 0.30-0.60 | 0.10 | 0.015 | 0.010 | 2.00-2.50 | --- | 0.90-1.10 | V 0.25-0.35 |

### 6.2.2 Alloy Steel Forgings for Piping, Pressure Vessel and Components

#### 6.2.2.5B Mechanical Properties of 2¼Cr–1Mo Alloy Steel Forgings for Piping, Pressure Vessel and Components

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | % min. | | |
| ASME SA-182/SA-182M | Grade F 22, Class 1 | K21590 | --- | --- | --- | 205 | 30 | 415 | 60 | 20 | A, N+T | 170 max HBW |
| | Grade F 22, Class 3 | K21590 | --- | --- | --- | 310 | 45 | 515 | 75 | 20 | A, N+T | 156-207 HBW |
| ASME SA-336/SA-336M | Grade F22, Class 1 | K21590 | --- | --- | --- | 205 | 30 | 415-585 L | 60-85 L | 20 L | A, N, N+T or Q+T | --- |
| | Grade F22, Class 3 | K21590 | --- | --- | --- | 310 | 45 | 515-690 L | 75-100 L | 19 L | A, N, N+T or Q+T | --- |
| ASTM A182/A182M-15 | Grade F 22, Class 1 | K21590 | --- | --- | --- | 205 | 30 | 415 | 60 | 20 | A, N+T | 170 max HBW |
| | Grade F 22, Class 3 | K21590 | --- | --- | --- | 310 | 45 | 515 | 75 | 20 | A, N+T | 156-207 HBW |
| ASTM A336/A336M-10a | Grade F22, Class 1 | K21590 | --- | --- | --- | 205 | 30 | 415-585 L | 60-85 L | 20 L | A, N+T or Q+T | --- |
| | Grade F22, Class 3 | K21590 | --- | --- | --- | 310 | 45 | 515-690 L | 75-100 L | 19 L | A, N+T or Q+T | --- |
| EN 10222-2:1999 | 11CrMo9-10 | --- | 1.7383 | t ≤ 200 | --- | 300 | --- | 520-670 | --- | 20 L, 20 T | N+T | see standard for impact data |
| | | | | 200 < t ≤ 500 | --- | 255 | --- | 450-600 | --- | 23 L, 21 T | N+T or Q+T | |
| ISO 9327-2:1999 | Type 13CrMo9-10 | --- | --- | t ≤ 60 | --- | 265 | --- | 480-620 | --- | 20 L, 18 T | N+T or Q+T | see standard for impact data |
| | | | | 60 < t ≤ 100 | --- | 260 | --- | 470-620 | --- | 20 L, 18 T | N+T or Q+T | |
| | | | | 100 < t ≤ 150 | --- | 250 | --- | 460-610 | --- | 20 L, 18 T | N+T or Q+T | |
| | | | | 150 < t ≤ 300 | --- | 240 | --- | 450-600 | --- | 20 L, 18 T | N+T or Q+T | |
| JIS G 3203:1988 A1:2008 | Grade SFVA F 22 A | --- | --- | --- | --- | 205 | --- | 410-590 | --- | 18 L | A or N+T | --- |
| | Grade SFVA F 22 B | --- | --- | --- | --- | 315 | --- | 520-690 | --- | 18 L | A or N+T | --- |
| ASME SA-508/SA-508M | Grade 22, Class 3 | K21590 | --- | --- | --- | 380 | 55 | 585-760 | 85-110 | 18 | Q | 54 J @ -18°C |
| ASME SA-541/SA-541M | Grade 22, Class 3 | --- | --- | --- | --- | 380 | 55 | 585-760 | 85-110 | 18 | Q+T | 54 J @ -18°C |
| ASTM A508/A508M-14 | Grade 22, Class 3 | K21590 | --- | --- | --- | 380 | 55 | 585-760 | 85-110 | 18 | Q+T | 54 J @ -18°C |
| ASTM A541/A541M-05 (2015) | Grade 22, Class 3 | --- | --- | --- | --- | 380 | 55 | 585-760 | 85-110 | 18 | Q+T | 54 J @ -18°C |
| JIS G 3206:1993 A1:2008 | Symbol SFVCM F22B | --- | --- | --- | --- | 380 | --- | 580-760 | --- | 16 L | N+T or Q+T | 54 J @ -18°C |
| ASME SA-182/SA-182M | Grade F 22V | K31835 | --- | --- | --- | 415 | 60 | 585-780 | 85-110 | 18 | N+T or Q+T | 174-237 HBW; L: 54 J @ -18°C |
| ASME SA-336/SA-336M | Grade F22V | K31835 | --- | --- | --- | 415 | 60 | 585-760 L | 85-110 L | 18 L | A, N, N+T or Q+T | L: 54 J @ -18°C |
| ASME SA-541/SA-541M | Grade 22V | K31835 | --- | --- | --- | 415 | 60 | 585-760 | 85-110 | 18 | Q+T | 54 J @ -18°C |
| ASTM A182/A182M-15 | Grade F 22V | K31835 | --- | --- | --- | 415 | 60 | 585-780 | 85-110 | 18 | N+T or Q+T | 174-237 HBW; L: 54 J @ -18°C |
| ASTM A336/A336M-10a | Grade F22V | K31835 | --- | --- | --- | 415 | 60 | 585-760 L | 85-110 L | 18 L | N+T or Q+T | L: 54 J @ -18°C |
| ASTM A541/A541M-05 (2015) | Grade 22V | K31835 | --- | --- | --- | 415 | 60 | 585-760 | 85-110 | 18 | Q+T | 54 J @ -18°C |
| JIS G 3206:1993 A1:2008 | Symbol SFVCM F22V | --- | --- | --- | --- | 415 | --- | 580-760 | --- | 16 L | N+T or Q+T | 54 J @ -18°C |

### 6.2.2 Alloy Steel Forgings for Piping, Pressure Vessel and Components

#### 6.2.2.6A Chemical Composition of 3Cr–1Mo Alloy Steel Forgings for Piping, Pressure Vessel and Components

| Specification | Designation | UNS No. | Steel No. | Weight, %, max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASME SA-336/SA-336M | Grade F21, Class 1 | K31545 | --- | 0.05-0.15 | 0.30-0.60 | 0.50 | 0.025 | 0.025 | 2.7-3.3 | --- | 0.80-1.06 | --- |
| ASTM A336/A336M-10a | Grade F21, Class 1 | K31545 | --- | 0.05-0.15 | 0.30-0.60 | 0.50 | 0.025 | 0.025 | 2.7-3.3 | --- | 0.80-1.06 | --- |
| JIS G 3203:1988 A1:2008 | Grade SFVA F 21 A | --- | --- | 0.15 | 0.30-0.60 | 0.50 | 0.030 | 0.030 | 2.65-3.35 | --- | 0.80-1.00 | --- |
| ASME SA-182/SA-182M | Grade F 21 | K31545 | --- | 0.05-0.15 | 0.30-0.60 | 0.50 | 0.040 | 0.040 | 2.7-3.3 | --- | 0.80-1.06 | --- |
| ASME SA-336/SA-336M | Grade F21, Class 3 | K31545 | --- | 0.05-0.15 | 0.30-0.60 | 0.50 | 0.025 | 0.025 | 2.7-3.3 | --- | 0.80-1.06 | --- |
| ASTM A182/A182M-15 | Grade F 21 | K31545 | --- | 0.05-0.15 | 0.30-0.60 | 0.50 | 0.040 | 0.040 | 2.7-3.3 | --- | 0.80-1.06 | --- |
| ASTM A336/A336M-10a | Grade F21, Class 3 | K31545 | --- | 0.05-0.15 | 0.30-0.60 | 0.50 | 0.025 | 0.025 | 2.7-3.3 | --- | 0.80-1.06 | --- |
| JIS G 3203:1988 A1:2008 | Grade SFVA F 21 B | --- | --- | 0.15 | 0.30-0.60 | 0.50 | 0.030 | 0.030 | 2.65-3.35 | --- | 0.80-1.00 | --- |
| ASME SA-182/SA-182M | Grade F 3V | K31830 | --- | 0.05-0.18 | 0.30-0.60 | 0.10 | 0.020 | 0.020 | 2.8-3.2 | --- | 0.90-1.10 | V 0.20-0.30; Ti 0.015-0.035; B 0.001-0.003 |
| ASME SA-336/SA-336M | Grade F3V | K31830 | --- | 0.10-0.15 | 0.30-0.60 | 0.10 | 0.020 | 0.020 | 2.7-3.3 | --- | 0.90-1.10 | V 0.20-0.30; Ti 0.015-0.035; B 0.001-0.003 |
| ASME SA-508/SA-508M | Grade 3V | K31830 | --- | 0.10-0.15 | 0.30-0.60 | 0.10 | 0.020 | 0.020 | 2.8-3.3 | --- | 0.90-1.10 | V 0.20-0.30; Cu 0.25; Cb 0.01; Ti 0.015-0.035; B 0.001-0.003; Ca 0.015; Al 0.015 |
| ASME SA-541/SA-541M | Grade 3V | K31830 | --- | 0.10-0.15 | 0.30-0.60 | 0.10 | 0.020 | 0.020 | 2.8-3.3 | --- | 0.90-1.10 | V 0.20-0.30; Ti 0.015-0.035; B 0.001-0.003 |
| ASTM A182/A182M-15 | Grade F 3V | K31830 | --- | 0.05-0.18 | 0.30-0.60 | 0.10 | 0.020 | 0.020 | 2.8-3.2 | --- | 0.90-1.10 | V 0.20-0.30; Ti 0.015-0.035; B 0.001-0.003 |
| ASTM A336/A336M-10a | Grade F3V | K31830 | --- | 0.10-0.15 | 0.30-0.60 | 0.10 | 0.020 | 0.020 | 2.7-3.3 | --- | 0.90-1.10 | V 0.20-0.30; Ti 0.015-0.035; B 0.001-0.003 |
| ASTM A508/A508M-14 | Grade 3V | K31830 | --- | 0.10-0.15 | 0.30-0.60 | 0.10 | 0.020 | 0.020 | 2.8-3.3 | --- | 0.90-1.10 | V 0.20-0.30; Cu 0.25; Cb 0.01; Ti 0.015-0.035; B 0.001-0.003; Ca 0.015; Al 0.015 |
| ASTM A541/A541M-05 (2015) | Grade 3V | K31830 | --- | 0.10-0.15 | 0.30-0.60 | 0.10 | 0.020 | 0.020 | 2.8-3.3 | --- | 0.90-1.10 | V 0.20-0.30; Ti 0.015-0.035; B 0.001-0.003 |
| JIS G 3206:1993 A1:2008 | Symbol SFVCM F3V | --- | --- | 0.17 | 0.30-0.60 | 0.10 | 0.015 | 0.010 | 2.75-3.25 | --- | 0.90-1.10 | V 0.20-0.30 |

#### 6.2.2.6B Mechanical Properties of 3Cr-1Mo Alloy Steel Forgings for Piping, Pressure Vessel and Components

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | % min. | | |
| ASME SA-336/SA-336M | Grade F21, Class 1 | K31545 | --- | --- | --- | 205 | 30 | 415-585 L | 60-85 L | 20 L | A, N, N+T or Q+T | --- |
| ASTM A336/A336M-10a | Grade F21, Class 1 | K31545 | --- | --- | --- | 205 | 30 | 415-585 L | 60-85 L | 20 L | A, N+T or Q+T | --- |
| JIS G 3203:1988 A1:2008 | Grade SFVA F 21 A | --- | --- | --- | --- | 205 | --- | 410-590 | --- | 18 L | A or N+T | --- |
| ASME SA-182/SA-182M | Grade F 21 | K31545 | --- | --- | --- | 310 | 45 | 515 | 75 | 20 | A, N+T | 156-207 HBW |
| ASME SA-336/SA-336M | Grade F21, Class 3 | K31545 | --- | --- | --- | 310 | 45 | 515-690 L | 75-100 L | 19 L | A, N, N+T or Q+T | --- |
| ASTM A182/A182M-15 | Grade F 21 | K31545 | --- | --- | --- | 310 | 45 | 515 | 75 | 20 | A, N+T | 156-207 HBW |
| ASTM A336/A336M-10a | Grade F21, Class 3 | K31545 | --- | --- | --- | 310 | 45 | 515-690 L | 75-100 L | 19 L | A, N+T or Q+T | --- |
| JIS G 3203:1988 A1:2008 | Grade SFVA F 21 B | --- | --- | --- | --- | 315 | --- | 520-690 | --- | 18 L | A or N+T | --- |

### 6.2.2 Alloy Steel Forgings for Piping, Pressure Vessel and Components

#### 6.2.2.6B Mechanical Properties of 3Cr-1Mo Alloy Steel Forgings for Piping, Pressure Vessel and Components (Continued)

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | % min. | | |
| ASME SA-182/SA-182M | Grade F 3V | K31830 | --- | --- | --- | 415 | 60 | 585-760 | 85-110 | 18 | A, N+T | 174-237 HBW; L: 54 J @ -18°C |
| ASME SA-336/SA-336M | Grade F3V | K31830 | --- | --- | --- | 415 | 60 | 585-760 L | 85-110 L | 18 L | A, N, N+T or Q+T | L: 54 J @ -18°C |
| ASME SA-508/SA-508M | Grade 3V | K31830 | --- | --- | --- | 415 | 60 | 585-760 | 85-110 | 18 | Q | 54 J @ -18°C |
| ASME SA-541/SA-541M | Grade 3V | K31830 | --- | --- | --- | 415 | 60 | 585-760 | 85-110 | 18 | Q+T | 54 J @ -18°C |
| ASTM A182/A182M-15 | Grade F 3V | K31830 | --- | --- | --- | 415 | 60 | 585-760 | 85-110 | 18 | A, N+T | 174-237 HBW; L: 54 J @ -18°C |
| ASTM A336/A336M-10a | Grade F3V | K31830 | --- | --- | --- | 415 | 60 | 585-760 L | 85-110 L | 18 L | A, N+T or Q+T | L: 54 J @ -18°C |
| ASTM A508/A508M-14 | Grade 3V | K31830 | --- | --- | --- | 415 | 60 | 585-760 | 85-110 | 18 | Q+T | 54 J @ -18°C |
| ASTM A541/A541M-05 (2015) | Grade 3V | K31830 | --- | --- | --- | 415 | 60 | 585-760 | 85-110 | 18 | Q+T | 54 J @ -18°C |
| JIS G 3206:1993 A1:2008 | Symbol SFVCM F3V | --- | --- | --- | --- | 415 | --- | 580-760 | --- | 16 L | N+T or Q+T | 54 J @ -18°C |

#### 6.2.2.7A Chemical Composition of 5Cr–½Mo Alloy Steel Forgings for Piping, Pressure Vessel and Components

| Specification | Designation | UNS No. | Steel No. | Weight, %, max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASME SA-336/SA-336M | Grade F5 | K41545 | --- | 0.15 | 0.30-0.60 | 0.50 | 0.025 | 0.025 | 4.0-6.0 | 0.50 | 0.45-0.65 | --- |
| ASTM A336/A336M-10a | Grade F5 | K41545 | --- | 0.15 | 0.30-0.60 | 0.50 | 0.025 | 0.025 | 4.0-6.0 | 0.50 | 0.45-0.65 | --- |
| ISO 9327-2:1999 | Type X12CrMo5-1 | --- | --- | 0.08-0.15 | 0.30-0.60 | 0.50 | 0.035 | 0.030 | 4.00-6.00 | --- | 0.45-0.65 | --- |
| JIS G 3203:1988 A1:2008 | Grade SFVA F 5 A | --- | --- | 0.15 | 0.30-0.60 | 0.50 | 0.030 | 0.030 | 4.00-6.00 | --- | 0.45-0.65 | --- |
| ASME SA-182/SA-182M | Grade F 5 | K41545 | --- | 0.15 | 0.30-0.60 | 0.50 | 0.030 | 0.030 | 4.0-6.0 | 0.50 | 0.44-0.65 | --- |
| ASTM A182/A182M-15 | Grade F 5 | K41545 | --- | 0.15 | 0.30-0.60 | 0.50 | 0.030 | 0.030 | 4.0-6.0 | 0.50 | 0.44-0.65 | --- |
| JIS G 3203:1988 A1:2008 | Grade SFVA F 5 B | --- | --- | 0.15 | 0.30-0.60 | 0.50 | 0.030 | 0.030 | 4.00-6.00 | --- | 0.45-0.65 | --- |
| ASME SA-336/SA-336M | Grade F5A | K42544 | --- | 0.25 | 0.60 | 0.50 | 0.025 | 0.025 | 4.0-6.0 | 0.50 | 0.45-0.65 | --- |
| ASTM A336/A336M-10a | Grade F5A | K42544 | --- | 0.25 | 0.60 | 0.50 | 0.025 | 0.025 | 4.0-6.0 | 0.50 | 0.45-0.65 | --- |
| JIS G 3203:1988 A1:2008 | Grade SFVA F 5 C | --- | --- | 0.25 | 0.30-0.60 | 0.50 | 0.030 | 0.030 | 4.00-6.00 | --- | 0.45-0.65 | --- |
| ASME SA-182/SA-182M | Grade F 5a | K42544 | --- | 0.25 | 0.60 | 0.50 | 0.040 | 0.030 | 4.0-6.0 | 0.50 | 0.44-0.65 | --- |
| ASTM A182/A182M-15 | Grade F 5a | K42544 | --- | 0.25 | 0.60 | 0.50 | 0.040 | 0.030 | 4.0-6.0 | 0.50 | 0.44-0.65 | --- |
| EN 10222-2:1999 | X16CrMo5-1 | --- | 1.7366 | 0.18 | 0.30-0.80 | 0.40 | 0.025 | 0.015 | 4.00-6.00 | 0.30 | 0.45-0.65 | V 0.02; Cu 0.30; Nb 0.01 |
| JIS G 3203:1988 A1:2008 | Grade SFVA F 5 D | --- | --- | 0.25 | 0.30-0.60 | 0.50 | 0.030 | 0.030 | 4.00-6.00 | --- | 0.45-0.65 | --- |

### 6.2.2 Alloy Steel Forgings for Piping, Pressure Vessel and Components

#### 6.2.2.7B Mechanical Properties of 5Cr-½Mo Alloy Steel Forgings for Piping, Pressure Vessel and Components

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter mm | Section Thickness/Diameter in. | Yield Strength, min. MPa | Yield Strength, min. ksi | Tensile Strength, min. MPa | Tensile Strength, min. ksi | Elongation % min. | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ASME SA-336/SA-336M | Grade F5 | K41545 | --- | --- | --- | 250 | 36 | 415-585 L | 60-85 L | 20 L | A, N, N+T or Q+T | --- |
| ASTM A336/A336M-10a | Grade F5 | K41545 | --- | --- | --- | 250 | 36 | 415-585 L | 60-85 L | 20 L | A, N+T or Q+T | --- |
| ISO 9327-2:1999 | Type X12CrMo5-1 | --- | --- | t ≤ 150 | --- | 175 | --- | 430-580 | --- | 20 L, 18 T | A | --- |
| JIS G 3203:1988 A1:2008 | Grade SFVA F 5 A | --- | --- | --- | --- | 245 | --- | 410-590 | --- | 18 L | A or N+T | --- |
| ASME SA-182/SA-182M | Grade F 5 | K41545 | --- | --- | --- | 275 | 40 | 485 | 70 | 20 | A, N+T | 143-217 HBW |
| ASTM A182/A182M-15 | Grade F 5 | K41545 | --- | --- | --- | 275 | 40 | 485 | 70 | 20 | A, N+T | 143-217 HBW |
| JIS G 3203:1988 A1:2008 | Grade SFVA F 5 B | --- | --- | --- | --- | 275 | --- | 480-660 | --- | 18 L | A or N+T | --- |
| ASME SA-336/SA-336M | Grade F5A | K42544 | --- | --- | --- | 345 | 50 | 550-725 L | 80-105 L | 19 L | A, N, N+T or Q+T | --- |
| ASTM A336/A336M-10a | Grade F5A | K42544 | --- | --- | --- | 345 | 50 | 550-725 L | 80-105 L | 19 L | A, N+T or Q+T | --- |
| JIS G 3203:1988 A1:2008 | Grade SFVA F 5 C | --- | --- | --- | --- | 345 | --- | 550-730 | --- | 18 L | A or N+T | --- |
| ASME SA-182/SA-182M | Grade F 5a | K42544 | --- | --- | --- | 450 | 65 | 620 | 90 | 22 | A, N+T | 187-248 HBW |
| ASTM A182/A182M-15 | Grade F 5a | K42544 | --- | --- | --- | 450 | 65 | 620 | 90 | 22 | A, N+T | 187-248 HBW |
| EN 10222-2:1999 | X16CrMo5-1 | --- | 1.7366 | t ≤ 300 | --- | 195 | --- | 410-510 | --- | 18 L, 16 T | A | see standard for impact data |
| | | | | t ≤ 300 | --- | 405 | --- | 640-780 | --- | 16 L, 14 T | N+T | see standard for impact data |
| JIS G 3203:1988 A1:2008 | Grade SFVA F 5 D | --- | --- | --- | --- | 450 | --- | 620-780 | --- | 18 L | A or N+T | --- |

#### 6.2.2.8A Chemical Composition of 9Cr–1Mo Alloy Steel Forgings for Piping, Pressure Vessel and Components

| Specification | Designation | UNS No. | Steel No. | Weight, %, max, Unless Otherwise Specified C | Mn | Si | P | S | Cr | Ni | Mo | Others |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ASME SA-182/SA-182M | Grade F 9 | K90941 | --- | 0.15 | 0.30-0.60 | 0.50-1.00 | 0.030 | 0.030 | 8.0-10.0 | --- | 0.90-1.10 | --- |
| ASME SA-336/SA-336M | Grade F9 | K90941 | --- | 0.15 | 0.30-0.60 | 0.50-1.00 | 0.025 | 0.025 | 8.0-10.0 | --- | 0.90-1.10 | --- |
| ASTM A182/A182M-15 | Grade F 9 | K90941 | --- | 0.15 | 0.30-0.60 | 0.50-1.00 | 0.030 | 0.030 | 8.0-10.0 | --- | 0.90-1.10 | --- |
| ASTM A336/A336M-10a | Grade F9 | K90941 | --- | 0.15 | 0.30-0.60 | 0.50-1.00 | 0.025 | 0.025 | 8.0-10.0 | --- | 0.90-1.10 | --- |
| EN 10222-2:1999 | X10CrMoVNb9-1 | --- | 1.4903 | 0.08-0.12 | 0.30-0.60 | 0.50 | 0.025 | 0.015 | 8.00-9.50 | 0.40 | 0.85-1.05 | V 0.18-0.25; Al 0.040; Cu 0.30; Nb 0.06-0.10; N 0.030-0.070 |
| JIS G 3203:1988 A1:2008 | Grade SFVA F 9 | --- | --- | 0.15 | 0.30-0.60 | 0.50-1.00 | 0.030 | 0.030 | 8.00-10.0 | --- | 0.90-1.10 | --- |

#### 6.2.2.8B Mechanical Properties of 9Cr-1Mo Alloy Steel Forgings for Piping, Pressure Vessel and Components

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter mm | Section Thickness/Diameter in. | Yield Strength, min. MPa | Yield Strength, min. ksi | Tensile Strength, min. MPa | Tensile Strength, min. ksi | Elongation % min. | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ASME SA-182/SA-182M | Grade F 9 | K90941 | --- | --- | --- | 380 | 55 | 585 | 85 | 20 | A, N+T | 179-217 HBW |
| ASME SA-336/SA-336M | Grade F9 | K90941 | --- | --- | --- | 380 | 55 | 585-760 L | 85-110 L | 20 L | A, N, N+T or Q+T | --- |
| ASTM A182/A182M-15 | Grade F 9 | K90941 | --- | --- | --- | 380 | 55 | 585 | 85 | 20 | A, N+T | 179-217 HBW |
| ASTM A336/A336M-10a | Grade F9 | K90941 | --- | --- | --- | 380 | 55 | 585-760 L | 85-110 L | 20 L | A, N+T or Q+T | --- |
| EN 10222-2:1999 | X10CrMoVNb9-1 | --- | 1.4903 | t ≤ 130 | --- | 435 | --- | 630-730 | --- | 19 L, 17 T | N+T | see standard for impact data |
| JIS G 3203:1988 A1:2008 | Grade SFVA F 9 | --- | --- | --- | --- | 380 | --- | 590-760 | --- | 18 L | A or N+T | --- |

### 6.2.2 Alloy Steel Forgings for Piping, Pressure Vessel and Components

#### 6.2.2.9A Chemical Composition of 11Cr–½Ni-1Mo Alloy Steel Forgings for Piping, Pressure Vessel and Components

| Specification | Designation | UNS No. | Steel No. | Weight, %, max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| EN 10222-2:1999 | X20CrMoV11-1 | --- | 1.4922 | 0.17-0.23 | 0.30-1.00 | 0.40 | 0.025 | 0.015 | 10.00-12.50 | 0.30-0.80 | 0.80-1.20 | V 0.20-0.35; Cu 0.30; Nb 0.01 |
| ISO 9327-2:1999 | Type X20CrMoV12-1 | --- | --- | 0.17-0.23 | 0.30-1.00 | 0.40 | 0.035 | 0.030 | 10.00-12.50 | 0.30-1.00 | 0.80-1.20 | V 0.20-0.35; Al 0.025 |

#### 6.2.2.9B Mechanical Properties of 11Cr-½Ni–1Mo Alloy Steel Forgings for Piping, Pressure Vessel and Components

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | % min. | | |
| EN 10222-2:1999 | X20CrMoV11-1 | --- | 1.4922 | t ≤ 100 | --- | 485 | --- | 700-850 | --- | 16 L, 14 T | Q+T | see standard for impact data |
| | | | | 100 < t ≤ 250 | --- | 485 | --- | 700-850 | --- | 16 L, 14 T | Q+T | |
| | | | | 250 < t ≤ 330 | --- | 485 | --- | 700-850 | --- | 16 L, 14 T | Q+T | |
| ISO 9327-2:1999 | Type X20CrMoV12-1 | --- | --- | t ≤ 100 | --- | 500 | --- | 700-850 | --- | 16 L, 14 T | N+T or Q+T | see standard for impact data |
| | | | | 100 < t ≤ 200 | --- | 500 | --- | 700-850 | --- | 16 L, 14 T | N+T or Q+T | |
| | | | | 200 < t ≤ 300 | --- | 600 | --- | 700-850 | --- | 14 L, 14 T | N+T or Q+T | |

#### 6.2.2.10A Chemical Composition of Ni Alloy Steel Forgings for Piping, Pressure Vessel and Components

| Specification | Designation | UNS No. | Steel No. | Weight, %, max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| EN 10222-3:1998 | 15NiMn6 | --- | 1.6228 | 0.18 | 0.80-1.50 | 0.35 | 0.025 | 0.015 | 0.30 | 1.30-1.70 | 0.08 | V 0.05; Cu 0.30; (Cr+Cu+Mo) 0.50 |
| ISO 9327-3:1999 | Type 15NiMn6 | --- | --- | 0.18 | 0.80-1.50 | 0.35 | 0.025 | 0.020 | --- | 1.30-1.70 | --- | V 0.05 |
| ASME SA-350/SA-350M | Grade LF3, Class 1 | K32025 | --- | 0.20 | 0.90 | 0.20-0.35 | 0.035 | 0.040 | 0.30 | 3.3-3.7 | 0.12 | V 0.03; Cu 0.40; Cb 0.02; (Cr+Mo) 0.32 |
| | Grade LF3, Class 2 | K32025 | --- | 0.20 | 0.90 | 0.20-0.35 | 0.035 | 0.040 | 0.30 | 3.3-3.7 | 0.12 | V 0.03; Cu 0.40; Cb 0.02; (Cr+Mo) 0.32 |
| ASTM A350/A350M-15 | Grade LF3, Class 1 | K32025 | --- | 0.20 | 0.90 | 0.20-0.35 | 0.035 | 0.040 | 0.30 | 3.3-3.7 | 0.12 | V 0.03; Cu 0.40; Cb 0.02; (Cr+Mo) 0.32 |
| | Grade LF3, Class 2 | K32025 | --- | 0.20 | 0.90 | 0.20-0.35 | 0.035 | 0.040 | 0.30 | 3.3-3.7 | 0.12 | V 0.03; Cu 0.40; Cb 0.02; (Cr+Mo) 0.32 |
| EN 10222-3:1998 | 12Ni14 | --- | 1.5637 | 0.15 | 0.30-0.80 | 0.35 | 0.020 | 0.010 | 0.30 | 3.25-3.75 | 0.08 | V 0.05; Cu 0.30; (Cr+Cu+Mo) 0.50 |
| ISO 9327-3:1999 | Type 12Ni14G1 | --- | --- | 0.15 | 0.30-0.80 | 0.35 | 0.025 | 0.020 | --- | 3.25-3.75 | --- | V 0.05 |
| | Type 12Ni14G2 | --- | --- | 0.15 | 0.30-0.80 | 0.35 | 0.025 | 0.020 | --- | 3.25-3.75 | --- | V 0.05 |
| JIS G 3205:1988 A1:2008 | Symbol SFL 3 | --- | --- | 0.20 | 0.90 | 0.35 | 0.030 | 0.030 | --- | 3.25-3.75 | --- | --- |
| EN 10222-3:1998 | X12Ni5 | --- | 1.5680 | 0.15 | 0.30-0.80 | 0.35 | 0.020 | 0.010 | 0.30 | 4.75-5.25 | 0.08 | V 0.05; Cu 0.30; (Cr+Cu+Mo) 0.50 |
| ISO 9327-3:1999 | Type 12Ni19 | --- | --- | 0.15 | 0.30-0.80 | 0.35 | 0.025 | 0.020 | --- | 4.50-5.30 | --- | V 0.05 |
| EN 10222-3:1998 | X8Ni9 | --- | 1.5662 | 0.10 | 0.30-0.80 | 0.35 | 0.020 | 0.010 | 0.30 | 8.50-10.00 | 0.10 | V 0.05; Cu 0.30; (Cr+Cu+Mo) 0.50 |
| ISO 9327-3:1999 | Type X8Ni9 | --- | --- | 0.10 | 0.30-0.80 | 0.35 | 0.025 | 0.020 | --- | 8.00-10.00 | 0.10 | V 0.05 |

### 6.2.2 Alloy Steel Forgings for Piping, Pressure Vessel and Components

#### 6.2.2.10B Mechanical Properties of Ni Alloy Steel Forgings for Piping, Pressure Vessel and Components

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter mm | Section Thickness/Diameter in. | Yield Strength, min. MPa | Yield Strength, min. ksi | Tensile Strength, min. MPa | Tensile Strength, min. ksi | Elongation % min. | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| EN 10222-3:1998 | 15NiMn6 | --- | 1.6228 | t ≤ 35 | --- | 355 | --- | 470-640 | --- | 20 L, 20 T | N, N+T or Q+T | see standard for impact data |
| | | | | 35 < t ≤ 50 | --- | 345 | --- | 470-640 | --- | 20 L, 20 T | N, N+T or Q+T | |
| ISO 9327-3:1999 | Type 15NiMn6 | --- | --- | t ≤ 30 | --- | 355 | --- | 490-640 | --- | 22 L, 22 T | N, N+T or Q+T | |
| | | | | 30 < t ≤ 50 | --- | 345 | --- | 490-640 | --- | 22 L, 22 T | N, N+T or Q+T | |
| ASME SA-350/SA-350M | Grade LF3, Class 1 | K32025 | --- | --- | --- | 260 | 37.5 | 485-655 | 70-95 | 22 | N, N+T or Q+T | see standard for impact data |
| | Grade LF3, Class 2 | K32025 | --- | --- | --- | 260 | 37.5 | 485-655 | 70-95 | 22 | N, N+T or Q+T | see standard for impact data |
| ASTM A350/A350M-15 | Grade LF3, Class 1 | K32025 | --- | --- | --- | 260 | 37.5 | 485-655 | 70-95 | 22 | N, N+T or Q+T | see standard for impact data |
| | Grade LF3, Class 2 | K32025 | --- | --- | --- | 260 | 37.5 | 485-655 | 70-95 | 22 | N, N+T or Q+T | see standard for impact data |
| EN 10222-3:1998 | 12Ni14 | --- | 1.5637 | t ≤ 35 | --- | 355 | --- | 470-640 | --- | 20 L, 20 T | N, N+T or Q+T | see standard for impact data |
| | | | | 35 < t ≤ 50 | --- | 345 | --- | 470-640 | --- | 20 L, 20 T | N, N+T or Q+T | |
| | | | | 50 < t ≤ 70 | --- | 335 | --- | 470-640 | --- | 20 L, 20 T | N, N+T or Q+T | |
| ISO 9327-3:1999 | Type 12Ni14G1 | --- | --- | t ≤ 30 | --- | 285 | --- | 450-600 | --- | 23 L, 23 T | N, N+T or Q+T | see standard for impact data |
| | | | | 30 < t ≤ 50 | --- | 275 | --- | 450-600 | --- | 23 L, 23 T | N, N+T or Q+T | |
| | Type 12Ni14G2 | --- | --- | t ≤ 30 | --- | 355 | --- | 470-620 | --- | 22 L, 22 T | N, N+T or Q+T | see standard for impact data |
| | | | | 30 < t ≤ 50 | --- | 345 | --- | 470-620 | --- | 22 L, 22 T | N, N+T or Q+T | |
| JIS G 3205:1988 A1:2008 | Symbol SFL 3 | --- | --- | --- | --- | 255 | --- | 490-640 | --- | 19 L | A, N+T or Q+T | 27 J @ -101°C |
| EN 10222-3:1998 | X12Ni5 | --- | 1.5680 | t ≤ 35 | --- | 390 | --- | 510-710 | --- | 19 L, 19 T | N, N+T or Q+T | see standard for impact data |
| | | | | 35 < t ≤ 50 | --- | 380 | --- | 510-710 | --- | 19 L, 19 T | N, N+T or Q+T | |
| ISO 9327-3:1999 | Type 12Ni19 | --- | --- | t ≤ 30 | --- | 390 | --- | 510-710 | --- | 19 L, 19 T | N, N+T or Q+T | see standard for impact data |
| | | | | 30 < t ≤ 50 | --- | 380 | --- | 510-710 | --- | 19 L, 19 T | N, N+T or Q+T | |
| EN 10222-3:1998 | X8Ni9 | --- | 1.5662 | t ≤ 35 | --- | 490 | --- | 640-840 | --- | 18 L, 18 T | NN+T or Q+T | see standard for impact data |
| | | | | 35 < t ≤ 50 | --- | 480 | --- | 640-840 | --- | 18 L, 18 T | NN+T or Q+T | |
| | | | | 50 < t ≤ 70 | --- | 470 | --- | 640-840 | --- | 18 L, 18 T | NN+T or Q+T | |
| ISO 9327-3:1999 | Type X8Ni9 | --- | --- | t ≤ 30 | --- | 490 | --- | 640-840 | --- | 18 L, 18 T | NN+T or Q+T | see standard for impact data |
| | | | | 30 < t ≤ 50 | --- | 480 | --- | 640-840 | --- | 18 L, 18 T | NN+T or Q+T | |

### 6.2.2 Alloy Steel Forgings for Piping, Pressure Vessel and Components

#### 6.2.2.11A Chemical Composition of Ni-Mn Alloy Steel Forgings for Piping, Pressure Vessel and Components

| Specification | Designation | UNS No. | Steel No. | Weight, %, max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| EN 10222-3:1998 | 13MnNi6-3 | --- | 1.6217 | 0.16 | 0.85-1.70 | 0.50 | 0.025 | 0.015 | 0.30 | 0.30-0.85 | 0.08 | V 0.05; Al 0.020 min.; Cu 0.30; Nb 0.05; (Cr+Cu+Mo) 0.50 |
| ISO 9327-3:1999 | Type 11MnNi5-3 | --- | --- | 0.14 | 0.70-1.50 | 0.50 | 0.025 | 0.020 | --- | 0.30-0.80 | --- | V 0.05; Al 0.020 min.; Nb 0.05 |
| | Type 13MnNi6-3 | --- | --- | 0.16 | 0.65-1.65 | 0.50 | 0.025 | 0.020 | --- | 0.30-0.85 | --- | V 0.05; Al 0.020 min.; Nb 0.05 |
| EN 10222-4:1998 A1:2001 | P420NH | --- | 1.8932 | 0.20 | 1.00-1.70 | 0.10-0.60 | 0.025 | 0.015 | 0.30 | 1.00 | 0.10 | V 0.20; Al 0.020-0.060; Cu 0.20; Nb 0.05; N 0.020; (Nb+V) 0.22 |
| | P420QH | --- | 1.8936 | 0.20 | 1.00-1.70 | 0.10-0.60 | 0.025 | 0.015 | 0.30 | 1.00 | 0.10 | V 0.20; Al 0.020-0.060; Cu 0.20; Nb 0.05; N 0.020; (Nb+V) 0.22 |
| ISO 9327-4:1999 | Type P 42 | --- | --- | 0.20 | 1.00-1.70 | 0.10-0.60 | 0.035 | 0.030 | 0.30 | 1.00 | 0.10 | V 0.20; Al 0.020 min.; Cu 0.30; Ti 0.20; Nb 0.05; N 0.020; (Nb+Ti+V) 0.22 |
| | Type PH 42 | --- | --- | 0.20 | 1.00-1.70 | 0.10-0.60 | 0.035 | 0.030 | 0.30 | 1.00 | 0.10 | V 0.20; Al 0.020 min.; Cu 0.30; Ti 0.20; Nb 0.05; N 0.020; (Nb+Ti+V) 0.22 |
| | Type PL 42 | --- | --- | 0.20 | 1.00-1.70 | 0.10-0.60 | 0.025 | 0.020 | 0.30 | 1.00 | 0.10 | V 0.20; Al 0.020 min.; Cu 0.30; Ti 0.20; Nb 0.05; N 0.020; (Nb+Ti+V) 0.22 |
| | Type PLH 42 | --- | --- | 0.20 | 1.00-1.70 | 0.10-0.60 | 0.025 | 0.020 | 0.30 | 1.00 | 0.10 | V 0.20; Al 0.020 min.; Cu 0.30; Ti 0.20; Nb 0.05; N 0.020; (Nb+Ti+V) 0.22 |

#### 6.2.2.11B Mechanical Properties of Ni-Mn Alloy Steel Forgings for Piping, Pressure Vessel and Components

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | % min. | | |
| EN 10222-3:1998 | 13MnNi6-3 | --- | 1.6217 | t ≤ 35 | --- | 285 | --- | 420-610 | --- | 22 L, 22 T | N+T | see standard for impact data |
| | | | | 35 < t ≤ 50 | --- | 275 | --- | 420-610 | --- | 22 L, 22 T | N+T | |
| | | | | 50 < t ≤ 70 | --- | 265 | --- | 420-610 | --- | 22 L, 22 T | N+T | |
| ISO 9327-3:1999 | Type 11MnNi5-3 | --- | --- | t ≤ 30 | --- | 285 | --- | 420-530 | --- | 24 L, 24 T | N+T | see standard for impact data |
| | | | | 30 < t ≤ 50 | --- | 275 | --- | 420-530 | --- | 24 L, 24 T | N+T | |
| | Type 13MnNi6-3 | --- | --- | t ≤ 30 | --- | 355 | --- | 490-610 | --- | 22 L, 22 T | N+T | see standard for impact data |
| | | | | 30 < t ≤ 50 | --- | 345 | --- | 490-610 | --- | 22 L, 22 T | N+T | |

**6.2.2 Alloy Steel Forgings for Piping, Pressure Vessel and Components**

**6.2.2.11B Mechanical Properties of Ni-Mn Alloy Steel Forgings for Piping, Pressure Vessel and Components (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | % min. | | |
| EN 10222-4:1998 A1:2001 | P420NH | --- | 1.8932 | t ≤ 16 | --- | 405 | --- | 530-680 | --- | 20 L, 19 T | N | see standard for impact data |
| | | | | 16 < t ≤ 35 | --- | 395 | --- | 530-680 | --- | 20 L, 19 T | N | |
| | | | | 35 < t ≤ 70 | --- | 370 | --- | 530-680 | --- | 20 L, 19 T | N | |
| | | | | 70 < t ≤ 100 | --- | 350 | --- | 530-680 | --- | 20 L, 19 T | N | |
| | | | | 100 < t ≤ 250 | --- | 330 | --- | 530-680 | --- | 20 L, 19 T | N | |
| | | | | 250 < t ≤ 400 | --- | 315 | --- | 530-680 | --- | 20 L, 19 T | N | |
| | P420QH | --- | 1.8936 | t ≤ 16 | --- | 405 | --- | 510-670 | --- | 18 L, 17 T | Q+T | see standard for impact data |
| | | | | 16 < t ≤ 35 | --- | 395 | --- | 510-670 | --- | 18 L, 17 T | Q+T | |
| | | | | 35 < t ≤ 70 | --- | 370 | --- | 510-670 | --- | 18 L, 17 T | Q+T | |
| | | | | 70 < t ≤ 100 | --- | 350 | --- | 510-670 | --- | 18 L, 17 T | Q+T | |
| | | | | 100 < t ≤ 250 | --- | 330 | --- | 510-670 | --- | 18 L, 17 T | Q+T | |
| | | | | 250 < t ≤ 400 | --- | 315 | --- | 510-670 | --- | 18 L, 17 T | Q+T | |
| ISO 9327-4:1999 | Type P 42 | --- | --- | t ≤ 16 | --- | 420 | --- | 540-880 | --- | 21 L, 19 T | N or Q+T | see standard for impact data |
| | | | | 16 < t ≤ 35 | --- | 410 | --- | 540-880 | --- | 21 L, 19 T | N or Q+T | |
| | | | | 35 < t ≤ 50 | --- | 400 | --- | 540-880 | --- | 21 L, 19 T | N or Q+T | |
| | | | | 50 < t ≤ 70 | --- | 380 | --- | 540-880 | --- | 21 L, 19 T | N or Q+T | |
| | | | | 70 < t ≤ 100 | --- | 365 | --- | 510-870 | --- | 20 L, 18 T | N or Q+T | |
| | | | | 100 < t ≤ 250 | --- | 345 | --- | 510-870 | --- | 19 L, 17 T | N or Q+T | |
| | Type PH 42 | --- | --- | t ≤ 16 | --- | 420 | --- | 540-880 | --- | 21 L, 19 T | N or Q+T | see standard for impact data |
| | | | | 16 < t ≤ 35 | --- | 410 | --- | 540-880 | --- | 21 L, 19 T | N or Q+T | |
| | | | | 35 < t ≤ 50 | --- | 400 | --- | 540-880 | --- | 21 L, 19 T | N or Q+T | |
| | | | | 50 < t ≤ 70 | --- | 380 | --- | 540-880 | --- | 21 L, 19 T | N or Q+T | |
| | | | | 70 < t ≤ 100 | --- | 365 | --- | 510-870 | --- | 20 L, 18 T | N or Q+T | |
| | | | | 100 < t ≤ 250 | --- | 345 | --- | 510-870 | --- | 19 L, 17 T | N or Q+T | |
| | Type PL 42 | --- | --- | t ≤ 16 | --- | 420 | --- | 540-880 | --- | 21 L, 19 T | N or Q+T | see standard for impact data |
| | | | | 16 < t ≤ 35 | --- | 410 | --- | 540-880 | --- | 21 L, 19 T | N or Q+T | |
| | | | | 35 < t ≤ 50 | --- | 400 | --- | 540-880 | --- | 21 L, 19 T | N or Q+T | |
| | | | | 50 < t ≤ 70 | --- | 380 | --- | 540-880 | --- | 21 L, 19 T | N or Q+T | |
| | | | | 70 < t ≤ 100 | --- | 365 | --- | 510-870 | --- | 20 L, 18 T | N or Q+T | |
| | | | | 100 < t ≤ 250 | --- | 345 | --- | 510-870 | --- | 19 L, 17 T | N or Q+T | |
| | Type PLH 42 | --- | --- | t ≤ 16 | --- | 420 | --- | 540-880 | --- | 21 L, 19 T | N or Q+T | see standard for impact data |
| | | | | 16 < t ≤ 35 | --- | 410 | --- | 540-880 | --- | 21 L, 19 T | N or Q+T | |
| | | | | 35 < t ≤ 50 | --- | 400 | --- | 540-880 | --- | 21 L, 19 T | N or Q+T | |
| | | | | 50 < t ≤ 70 | --- | 380 | --- | 540-880 | --- | 21 L, 19 T | N or Q+T | |
| | | | | 70 < t ≤ 100 | --- | 365 | --- | 510-870 | --- | 20 L, 18 T | N or Q+T | |
| | | | | 100 < t ≤ 250 | --- | 345 | --- | 510-870 | --- | 19 L, 17 T | N or Q+T | |

### 6.2.2 Alloy Steel Forgings for Piping, Pressure Vessel and Components

#### 6.2.2.12A Chemical Composition of ¾Ni–½Cr-Mo Alloy Steel Forgings for Piping, Pressure Vessel and Components

| Specification | Designation | UNS No. | Steel No. | Weight, %, max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASME SA-508/SA-508M | Grade 2, Class 1 | K12766 | --- | 0.27 | 0.50-1.00 | 0.40 | 0.025 | 0.025 | 0.25-0.45 | 0.50-1.00 | 0.55-0.75 | V 0.05; Cu 0.20; Cb 0.01; Ca 0.015; B 0.003; Ti 0.015; Al 0.025 |
| ASME SA-541/SA-541M | Grade 2, Class 1 | K12765 | --- | 0.27 | 0.50-0.90 | 0.35 | 0.025 | 0.025 | 0.25-0.45 | 0.50-1.00 | 0.55-0.70 | V 0.05 |
| ASTM A508/A508M-14 | Grade 2, Class 1 | K12766 | --- | 0.27 | 0.50-1.00 | 0.40 | 0.025 | 0.025 | 0.25-0.45 | 0.50-1.00 | 0.55-0.75 | V 0.05; Cu 0.20; Cb 0.01; Ca 0.015; B 0.003; Ti 0.015; Al 0.025 |
| ASTM A541/A541M-05 (2015) | Grade 2, Class 1 | K12765 | --- | 0.27 | 0.50-0.90 | 0.35 | 0.025 | 0.025 | 0.25-0.45 | 0.50-1.00 | 0.55-0.70 | V 0.05 |
| JIS G 3204:1988 A1:2008 | Grade SFVQ 2 A | --- | --- | 0.27 | 0.50-1.00 | 0.40 | 0.030 | 0.030 | 0.25-0.45 | 0.50-1.00 | 0.55-0.70 | V 0.05 |
| ASME SA-508/SA-508M | Grade 2, Class 2 | K12766 | --- | 0.27 | 0.50-1.00 | 0.40 | 0.025 | 0.025 | 0.25-0.45 | 0.50-1.00 | 0.55-0.75 | V 0.05; Cu 0.20; Cb 0.01; Ca 0.015; B 0.003; Ti 0.015; Al 0.025 |
| ASME SA-541/SA-541M | Grade 2, Class 2 | K12765 | --- | 0.27 | 0.50-0.90 | 0.35 | 0.025 | 0.025 | 0.25-0.45 | 0.50-1.00 | 0.55-0.70 | V 0.05 |
| ASTM A508/A508M-14 | Grade 2, Class 2 | K12766 | --- | 0.27 | 0.50-1.00 | 0.40 | 0.025 | 0.025 | 0.25-0.45 | 0.50-1.00 | 0.55-0.75 | V 0.05; Cu 0.20; Cb 0.01; Ca 0.015; B 0.003; Ti 0.015; Al 0.025 |
| ASTM A541/A541M-05 (2015) | Grade 2, Class 2 | K12765 | --- | 0.27 | 0.50-0.90 | 0.35 | 0.025 | 0.025 | 0.25-0.45 | 0.50-1.00 | 0.55-0.70 | V 0.05 |
| JIS G 3204:1988 A1:2008 | Grade SFVQ 2 B | --- | --- | 0.27 | 0.50-1.00 | 0.40 | 0.030 | 0.030 | 0.25-0.45 | 0.50-1.00 | 0.55-0.70 | V 0.05 |

#### 6.2.2.12B Mechanical Properties of ¾Ni–½Cr–Mo Alloy Steels Forgings for Piping, Pressure Vessel and Components

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | % min. | | |
| ASME SA-508/SA-508M | Grade 2, Class 1 | K12766 | --- | --- | --- | 345 | 50 | 550-725 | 80-105 | 18 | Q | 41 J @ 4.4°C |
| ASME SA-541/SA-541M | Grade 2, Class 1 | K12765 | --- | --- | --- | 345 | 50 | 550-725 | 80-105 | 18 | Q+T | 41 J @ 4.4°C |
| ASTM A508/A508M-14 | Grade 2, Class 1 | K12766 | --- | --- | --- | 345 | 50 | 550-725 | 80-105 | 18 | Q+T | 41 J @ 4.4°C |
| ASTM A541/A541M-05 (2015) | Grade 2, Class 1 | K12765 | --- | --- | --- | 345 | 50 | 550-725 | 80-105 | 18 | Q+T | 41 J @ 4.4°C |
| JIS G 3204:1988 A1:2008 | Grade SFVQ 2 A | --- | --- | --- | --- | 345 | --- | 550-730 | --- | 16 L | Q+T | 40 J @ 0°C |
| ASME SA-508/SA-508M | Grade 2, Class 2 | K12766 | --- | --- | --- | 450 | 65 | 620-795 | 90-115 | 16 | Q | 48 J @ 21°C |
| ASME SA-541/SA-541M | Grade 2, Class 2 | K12765 | --- | --- | --- | 450 | 65 | 620-795 | 90-115 | 16 | Q+T | 47 J @ 21°C |
| ASTM A508/A508M-14 | Grade 2, Class 2 | K12766 | --- | --- | --- | 450 | 65 | 620-795 | 90-115 | 16 | Q+T | 48 J @ 21°C |
| ASTM A541/A541M-05 (2015) | Grade 2, Class 2 | K12765 | --- | --- | --- | 450 | 65 | 620-795 | 90-115 | 16 | Q+T | 47 J @ 21°C |
| JIS G 3204:1988 A1:2008 | Grade SFVQ 2 B | --- | --- | --- | --- | 450 | --- | 620-790 | --- | 14 L | Q+T | 47 J @ 20°C |

### 6.2.2 Alloy Steel Forgings for Piping, Pressure Vessel and Components

#### 6.2.2.13A Chemical Composition of ¾Ni-½Mo Alloy Steel Forgings for Piping, Pressure Vessel and Components (Continued)

| Specification | Designation | UNS No. | Steel No. | Weight, %, max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASME SA-508/SA-508M | Grade 3, Class 1 | K12042 | --- | 0.25 | 1.20-1.50 | 0.40 | 0.025 | 0.025 | 0.25 | 0.40-1.00 | 0.45-0.60 | V 0.05; Cu 0.20; Cb 0.01; Ca 0.015; B 0.003; Ti 0.015; Al 0.025 |
| ASME SA-541/SA-541M | Grade 3, Class 1 | K12045 | --- | 0.25 | 1.20-1.50 | 0.35 | 0.025 | 0.025 | 0.25 | 0.40-1.00 | 0.45-0.60 | V 0.05 |
| ASTM A508/A508M-14 | Grade 3, Class 1 | K12042 | --- | 0.25 | 1.20-1.50 | 0.40 | 0.025 | 0.025 | 0.25 | 0.40-1.00 | 0.45-0.60 | V 0.05; Cu 0.20; Cb 0.01; Ca 0.015; B 0.003; Ti 0.015; Al 0.025 |
| ASTM A541/A541M-05 (2015) | Grade 3, Class 1 | K12045 | --- | 0.25 | 1.20-1.50 | 0.35 | 0.025 | 0.025 | 0.25 | 0.40-1.00 | 0.45-0.60 | V 0.05 |
| JIS G 3204:1988 A1:2008 | Grade SFVQ 1 A | --- | --- | 0.25 | 1.20-1.50 | 0.40 | 0.030 | 0.030 | 0.25 | 0.40-1.00 | 0.45-0.60 | V 0.05 |
| ASME SA-508/SA-508M | Grade 3, Class 2 | K12042 | --- | 0.25 | 1.20-1.50 | 0.40 | 0.025 | 0.025 | 0.25 | 0.40-1.00 | 0.45-0.60 | V 0.05; Cu 0.20; Cb 0.01; Ca 0.015; B 0.003; Ti 0.015; Al 0.025 |
| ASME SA-541/SA-541M | Grade 3, Class 2 | K12045 | --- | 0.25 | 1.20-1.50 | 0.35 | 0.025 | 0.025 | 0.25 | 0.40-1.00 | 0.45-0.60 | V 0.05 |
| ASTM A508/A508M-14 | Grade 3, Class 2 | K12042 | --- | 0.25 | 1.20-1.50 | 0.40 | 0.025 | 0.025 | 0.25 | 0.40-1.00 | 0.45-0.60 | V 0.05; Cu 0.20; Cb 0.01; Ca 0.015; B 0.003; Ti 0.015; Al 0.025 |
| ASTM A541/A541M-05 (2015) | Grade 3, Class 2 | K12045 | --- | 0.25 | 1.20-1.50 | 0.35 | 0.025 | 0.025 | 0.25 | 0.40-1.00 | 0.45-0.60 | V 0.05 |
| JIS G 3204:1988 A1:2008 | Grade SFVQ 1 B | --- | --- | 0.25 | 1.20-1.50 | 0.40 | 0.030 | 0.030 | 0.25 | 0.40-1.00 | 0.45-0.60 | V 0.05 |

#### 6.2.2.13B Mechanical Properties of ¾Ni–½Mo Alloy Steel Forgings for Piping, Pressure Vessel and Components

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | % min. | | |
| ASME SA-508/SA-508M | Grade 3, Class 1 | K12042 | --- | --- | --- | 345 | 50 | 550-725 | 80-105 | 18 | Q | 41 J @ 4.4°C |
| ASME SA-541/SA-541M | Grade 3, Class 1 | K12045 | --- | --- | --- | 345 | 50 | 550-725 | 80-105 | 18 | Q+T | 41 J @ 4°C |
| ASTM A508/A508M-14 | Grade 3, Class 1 | K12042 | --- | --- | --- | 345 | 50 | 550-725 | 80-105 | 18 | Q+T | 41 J @ 4.4°C |
| ASTM A541/A541M-05 (2015) | Grade 3, Class 1 | K12045 | --- | --- | --- | 345 | 50 | 550-725 | 80-105 | 18 | Q+T | 41 J @ 4°C |
| JIS G 3204:1988 A1:2008 | Grade SFVQ 1 A | --- | --- | --- | --- | 345 | --- | 550-730 | --- | 16 L | Q+T | 40 J @ 0°C |
| ASME SA-508/SA-508M | Grade 3, Class 2 | K12042 | --- | --- | --- | 450 | 65 | 620-795 | 90-115 | 16 | Q | 48 J @ 21°C |
| ASME SA-541/SA-541M | Grade 3, Class 2 | K12045 | --- | --- | --- | 450 | 65 | 620-795 | 90-115 | 16 | Q+T | 47 J @ 21°C |
| ASTM A508/A508M-14 | Grade 3, Class 2 | K12042 | --- | --- | --- | 450 | 65 | 620-795 | 90-115 | 16 | Q+T | 48 J @ 21°C |
| ASTM A541/A541M-05 (2015) | Grade 3, Class 2 | K12045 | --- | --- | --- | 450 | 65 | 620-795 | 90-115 | 16 | Q+T | 47 J @ 21°C |
| JIS G 3204:1988 A1:2008 | Grade SFVQ 1 B | --- | --- | --- | --- | 450 | --- | 620-790 | --- | 14 L | Q+T | 47 J @ 20°C |

### 6.2.2 Alloy Steel Forgings for Piping, Pressure Vessel and Components

#### 6.2.2.14A Chemical Composition of 3¼Ni-1¾Cr-½Mo Alloy Steel Forgings for Piping, Pressure Vessel and Components

| Specification | Designation | UNS No. | Steel No. | Weight, %, max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASME SA-508/SA-508M | Grade 4N, Class 3 | K42343 | --- | 0.23 | 0.20-0.40 | 0.40 | 0.020 | 0.020 | 1.50-2.00 | 2.8-3.9 | 0.40-0.60 | V 0.03; Cu 0.25; Cb 0.01; Ca 0.015; B 0.003; Ti 0.015; Al 0.025 |
| ASME SA-541/SA-541M | Grade 4N, Class 3 | K42343 | --- | 0.23 | 0.20-0.40 | 0.30 | 0.025 | 0.025 | 1.25-2.00 | 2.8-3.9 | 0.40-0.60 | V 0.03 |
| ASTM A508/A508M-14 | Grade 4N, Class 3 | K42343 | --- | 0.23 | 0.20-0.40 | 0.40 | 0.020 | 0.020 | 1.50-2.00 | 2.8-3.9 | 0.40-0.60 | V 0.03; Cu 0.25; Cb 0.01; Ca 0.015; B 0.003; Ti 0.015; Al 0.025 |
| ASTM A541/A541M-05 (2015) | Grade 4N, Class 3 | K42343 | --- | 0.23 | 0.20-0.40 | 0.30 | 0.025 | 0.025 | 1.25-2.00 | 2.8-3.9 | 0.40-0.60 | V 0.03 |
| JIS G 3204:1988 A1:2008 | Grade SFVQ 3 | --- | --- | 0.23 | 0.20-0.40 | 0.40 | 0.020 | 0.020 | 1.50-2.00 | 2.75-3.90 | 0.40-0.60 | V 0.03 |

#### 6.2.2.14B Mechanical Properties of 3¼Ni–1¾Cr–½Mo Alloy Steel Forgings for Piping, Pressure Vessel and Components

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | % min. | | |
| ASME SA-508/SA-508M | Grade 4N, Class 3 | K42343 | --- | --- | --- | 485 | 70 | 620-795 | 90-115 | 20 | Q | 48 J @ -29°C |
| ASME SA-541/SA-541M | Grade 4N, Class 3 | K42343 | --- | --- | --- | 485 | 70 | 620-795 | 90-115 | 20 | Q+T | 47 J @ 4°C |
| ASTM A508/A508M-14 | Grade 4N, Class 3 | K42343 | --- | --- | --- | 485 | 70 | 620-795 | 90-115 | 20 | Q+T | 48 J @ -29°C |
| ASTM A541/A541M-05 (2015) | Grade 4N, Class 3 | K42343 | --- | --- | --- | 485 | 70 | 620-795 | 90-115 | 20 | Q+T | 47 J @ 4°C |
| JIS G 3204:1988 A1:2008 | Grade SFVQ 3 | --- | --- | --- | --- | 490 | --- | 620-790 | --- | 18 L | Q+T | 47 J @ -30°C |

## 6.3 Stainless Steel Forgings

### 6.3.1A Chemical Composition of Martensitic Stainless Steel Forgings

| Specification | Designation | UNS No. | Steel No. | Weight, %, max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASME SA-182/SA-182M | Grade F 6a, Class 1 | S41000 | --- | 0.15 | 1.00 | 1.00 | 0.040 | 0.030 | 11.5-13.5 | 0.50 | --- | --- |
| | Grade F 6a, Class 2 | S41000 | --- | 0.15 | 1.00 | 1.00 | 0.040 | 0.030 | 11.5-13.5 | 0.50 | --- | --- |
| | Grade F 6a, Class 3 | S41000 | --- | 0.15 | 1.00 | 1.00 | 0.040 | 0.030 | 11.5-13.5 | 0.50 | --- | --- |
| | Grade F 6a, Class 4 | S41000 | --- | 0.15 | 1.00 | 1.00 | 0.040 | 0.030 | 11.5-13.5 | 0.50 | --- | --- |
| ASTM A1021-05 (2015) | Grade A, Class 1 | S41000 | --- | 0.15 | 1.00 | 1.00 | 0.018 | 0.015 | 11.5-13.5 | 0.75 | 0.50 | --- |
| | Grade A, Class 2 | S41000 | --- | 0.15 | 1.00 | 1.00 | 0.018 | 0.015 | 11.5-13.5 | 0.75 | 0.50 | --- |
| | Grade B, Class 1 | S41005 | --- | 0.10-0.15 | 0.25-0.80 | 0.50 | 0.018 | 0.015 | 11.5-13.0 | 0.75 | 0.50 | Al 0.025; Cu 0.50; Ti 0.05; W 0.10; Cb 0.20; N 0.08; Sn 0.05 |
| ASTM A182/A182M-15 | Grade F 6a, Class 1 | S41000 | --- | 0.15 | 1.00 | 1.00 | 0.040 | 0.030 | 11.5-13.5 | 0.50 | --- | --- |
| | Grade F 6a, Class 2 | S41000 | --- | 0.15 | 1.00 | 1.00 | 0.040 | 0.030 | 11.5-13.5 | 0.50 | --- | --- |
| | Grade F 6a, Class 3 | S41000 | --- | 0.15 | 1.00 | 1.00 | 0.040 | 0.030 | 11.5-13.5 | 0.50 | --- | --- |
| | Grade F 6a, Class 4 | S41000 | --- | 0.15 | 1.00 | 1.00 | 0.040 | 0.030 | 11.5-13.5 | 0.50 | --- | --- |
| ASTM A473-15 | Type 410 | S41000 | --- | 0.15 | 1.00 | 1.00 | 0.040 | 0.030 | 11.5-13.5 | 0.75 | --- | --- |
| EN 10250-4:1999 | X12Cr13 | --- | 1.4006 | 0.08-0.15 | 1.50 | 1.00 | 0.040 | 0.030 | 11.50-13.50 | 0.75 | --- | --- |
| JIS G 3214:1991 A1:2009 | Symbol SUS F 410-A | --- | --- | 0.15 | 1.00 | 1.00 | 0.040 | 0.030 | 11.50-13.50 | 0.50 | --- | --- |
| | Symbol SUS F 410-B | --- | --- | 0.15 | 1.00 | 1.00 | 0.040 | 0.030 | 11.50-13.50 | 0.50 | --- | --- |
| | Symbol SUS F 410-C | --- | --- | 0.15 | 1.00 | 1.00 | 0.040 | 0.030 | 11.50-13.50 | 0.50 | --- | --- |
| | Symbol SUS F 410-D | --- | --- | 0.15 | 1.00 | 1.00 | 0.040 | 0.030 | 11.50-13.50 | 0.50 | --- | --- |
| ASME SA-182/SA-182M | Grade F 6b | S41026 | --- | 0.15 | 1.00 | 1.00 | 0.020 | 0.020 | 11.5-13.5 | 1.00-2.00 | 0.40-0.60 | Cu 0.50 |
| ASTM A182/A182M-15 | Grade F 6b | S41026 | --- | 0.15 | 1.00 | 1.00 | 0.020 | 0.020 | 11.5-13.5 | 1.00-2.00 | 0.40-0.60 | Cu 0.50 |
| JIS G 3214:1991 A1:2009 | Symbol SUS F 6B | --- | --- | 0.15 | 1.00 | 1.00 | 0.020 | 0.020 | 11.50-13.50 | 1.00-2.00 | 0.40-0.60 | Cu 0.50 |
| ASME SA-182/SA-182M | Grade F 6NM | S41500 | --- | 0.05 | 0.50-1.00 | 0.60 | 0.030 | 0.030 | 11.5-14.0 | 3.5-5.5 | 0.50-1.00 | --- |
| ASTM A182/A182M-15 | Grade F 6NM | S41500 | --- | 0.05 | 0.50-1.00 | 0.60 | 0.030 | 0.030 | 11.5-14.0 | 3.5-5.5 | 0.50-1.00 | --- |
| ASTM A473-15 | --- | S41500 | --- | 0.05 | 0.5-1.0 | 0.60 | 0.030 | 0.030 | 11.5-14.0 | 3.5-5.5 | 0.40-0.80 | --- |
| EN 10222-5:1999 | X3 CrNiMo 13-4 | --- | 1.4313 | 0.05 | 1.50 | 0.70 | 0.040 | 0.015 | 12.00-14.00 | 3.50-4.50 | 0.30-0.70 | N 0.020 min. |
| EN 10250-4:1999 | X3CrNiMo13-4 | --- | 1.4313 | 0.05 | 1.50 | 0.70 | 0.040 | 0.015 | 12.00-14.00 | 3.50-4.50 | 0.30-0.70 | N 0.020 min. |
| JIS G 3214:1991 A1:2009 | Symbol SUS F 6NM | --- | --- | 0.05 | 0.50-1.00 | 0.60 | 0.030 | 0.030 | 11.50-14.00 | 3.50-5.50 | 0.50-1.00 | --- |

**6.3 Stainless Steel Forgings**

**6.3.1B Mechanical Properties of Martensitic Stainless Steel Forgings**

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter mm | Section Thickness/Diameter in. | Yield Strength, min. MPa | Yield Strength, min. ksi | Tensile Strength, min. MPa | Tensile Strength, min. ksi | Elongation % min. | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ASME SA-182/SA-182M | Grade F 6a, Class 1 | S41000 | --- | --- | --- | 275 | 40 | 485 | 70 | 18 | A, N+T or T | 143-207 HBW |
| | Grade F 6a, Class 2 | S41000 | --- | --- | --- | 380 | 55 | 585 | 85 | 18 | A, N+T or T | 167-229 HBW |
| | Grade F 6a, Class 3 | S41000 | --- | --- | --- | 585 | 85 | 760 | 110 | 15 | A or N+T | 235-302 HBW |
| | Grade F 6a, Class 4 | S41000 | --- | --- | --- | 760 | 110 | 895 | 130 | 12 | A or N+T | 263-321 HBW |
| ASTM A1021-05 (2015) | Grade A, Class 1 | --- | --- | --- | --- | 485 | 70 | 690 | 100 | 20 | HT+Q+T | 255 max HB; 26 max HRC; 41 J @ RT |
| | Grade A, Class 2 | --- | --- | --- | --- | 550 | 80 | 760 | 110 | 18 | HT+Q+T | 269 max HB; 28 max HRC; 34 J @ RT |
| | Grade B, Class 1 | S41005 | --- | --- | --- | 620 | 90 | 760 | 110 | 18 | HT+Q+T | 269 max HB; 28 max HRC; 41 J @ RT |
| ASTM A182/A182M-15 | Grade F 6a, Class 1 | S41000 | --- | --- | --- | 275 | 40 | 485 | 70 | 18 | A, N+T or T | 143-207 HBW |
| | Grade F 6a, Class 2 | S41000 | --- | --- | --- | 380 | 55 | 585 | 85 | 18 | A, N+T or T | 167-229 HBW |
| | Grade F 6a, Class 3 | S41000 | --- | --- | --- | 585 | 85 | 760 | 110 | 15 | A or N+T | 235-302 HBW |
| | Grade F 6a, Class 4 | S41000 | --- | --- | --- | 760 | 110 | 895 | 130 | 12 | A or N+T | 263-321 HBW |
| ASTM A473-15 | Type 410 | S41000 | --- | --- | --- | 275 | 40 | 485 | 70 | 20 | A | 223 max HB |
| EN 10250-4:1999 | X12Cr13 | --- | 1.4006 | --- | --- | --- | --- | 730 max | --- | --- | A | 220 max HB |
| | | | | t ≤ 160 | --- | 450 | --- | 650-850 | --- | 15 L | Q+T | L: 25 J @ RT |
| JIS G 3214:1991 A1:2009 | Symbol SUS F 410-A | --- | --- | --- | --- | 275 | --- | 480 | --- | 16 L | Q+T | 143-187 HBW |
| | Symbol SUS F 410-B | --- | --- | --- | --- | 380 | --- | 590 | --- | 16 L | Q+T | 167-229 HBW |
| | Symbol SUS F 410-C | --- | --- | --- | --- | 585 | --- | 760 | --- | 14 L | Q+T | 217-302 HBW |
| | Symbol SUS F 410-D | --- | --- | --- | --- | 760 | --- | 900 | --- | 11 L | Q+T | 262-321 HBW |
| ASME SA-182/SA-182M | Grade F 6b | S41026 | --- | --- | --- | 620 | 90 | 760-930 | 110-135 | 16 | N+T or A | 235-285 HBW |
| ASTM A182/A182M-15 | Grade F 6b | S41026 | --- | --- | --- | 620 | 90 | 760-930 | 110-135 | 16 | N+T or A | 235-285 HBW |
| JIS G 3214:1991 A1:2009 | Symbol SUS F 6B | --- | --- | --- | --- | 620 | --- | 760-930 | --- | 15 L | Q+T | 217-285 HBW |
| ASME SA-182/SA-182M | Grade F 6NM | S41500 | --- | --- | --- | 620 | 90 | 790 | 115 | 15 | N+T | 295 max HBW |
| ASTM A182/A182M-15 | Grade F 6NM | S41500 | --- | --- | --- | 620 | 90 | 790 | 115 | 15 | N+T | 295 max HBW |
| ASTM A473-15 | --- | S41500 | --- | --- | --- | 620 | 90 | 795 | 115 | 15 | N+T | 295 max HB |
| EN 10222-5:1999 | X3 CrNiMo13-4 | --- | 1.4313 | t ≤ 250 | --- | 650 | --- | 780-930 | --- | 17 L, 15 T | Q+T | see standard for impact data |
| | | | | t ≤ 350 | --- | 550 | --- | 750-900 | --- | 17 L, 16 T | QT+T | |
| EN 10250-4:1999 | X3CrNiMo13-4 | --- | 1.4313 | --- | --- | --- | --- | 1100 max. | --- | --- | A | 320 max HB |
| | | | | t ≤ 450 | --- | 520 | --- | 650-830 | --- | 15 L, 12 T | Q+T | see standard for impact data |
| | | | | t ≤ 450 | --- | 620 | --- | 780-980 | --- | 15 L, 12 T | Q+T | |
| | | | | t ≤ 450 | --- | 800 | --- | 900-1100 | --- | 12 L, 10 T | Q+T | |
| JIS G 3214:1991 A1:2009 | Symbol SUS F 6NM | --- | --- | --- | --- | 620 | --- | 790 | --- | 14 L | Q+T | 295 max HBW |

**6.3 Stainless Steel Forgings**

**6.3.2A Chemical Composition of Ferritic Stainless Steel Forgings**

| Specification | Designation | UNS No. | Steel No. | Weight, %, max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASME SA-182/SA-182M | Grade F 430 | S43000 | --- | 0.12 | 1.00 | 0.75 | 0.040 | 0.030 | 16.0-18.0 | 0.50 | --- | --- |
| ASTM A182/A182M-15 | Grade F 430 | S43000 | --- | 0.12 | 1.00 | 0.75 | 0.040 | 0.030 | 16.0-18.0 | 0.50 | --- | --- |
| ASTM A473-15 | Type 430 | S43000 | --- | 0.12 | 1.00 | 1.00 | 0.040 | 0.030 | 16.0-18.0 | 0.75 | --- | --- |
| EN 10250-4:1999 | X6Cr17 | --- | 1.4016 | 0.08 | 1.00 | 1.00 | 0.040 | 0.030 | 16.00-18.00 | --- | --- | --- |

**6.3.2B Mechanical Properties of Ferritic Stainless Steel Forgings**

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | % min. | | |
| ASME SA-182/SA-182M | Grade F 430 | S43000 | --- | --- | --- | 240 | 35 | 415 | 60 | 20 | A | 190 max HBW |
| ASTM A182/A182M-15 | Grade F 430 | S43000 | --- | --- | --- | 240 | 35 | 415 | 60 | 20 | A | 190 max HBW |
| ASTM A473-15 | Type 430 | S43000 | --- | --- | --- | 240 | 35 | 485 | 70 | 20 | A | 217 max HB |
| EN 10250-4:1999 | X6Cr17 | --- | 1.4016 | $t \leq 100$ | --- | 240 | --- | 400-630 | --- | --- | A | 200 max HB |

**6.3 Stainless Steel Forgings**

**6.3.3A Chemical Composition of Austenitic Stainless Steel Forgings**

| Specification | Designation | UNS No. | Steel No. | Weight, %, max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASME SA-182/SA-182M | Grade F 304 | S30400 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 18.0-20.0 | 8.0-11.0 | --- | N 0.10 |
| ASME SA-403/SA-403M | Grade WP 304 | S30400 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 18.0-20.0 | 8.0-11.0 | --- | --- |
| | Grade CR 304 | S30400 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 18.0-20.0 | 8.0-11.0 | --- | --- |
| ASTM A182/A182M-15 | Grade F 304 | S30400 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 18.0-20.0 | 8.0-11.0 | --- | N 0.10 |
| ASTM A403/A403M-15 | Grade WP304 | S30400 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 18.0-20.0 | 8.0-11.0 | --- | --- |
| | Grade CR304 | S30400 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 18.0-20.0 | 8.0-11.0 | --- | --- |
| ASTM A473-15 | Type 304 | S30400 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 18.0-20.0 | 8.0-10.5 | --- | N 0.10 |
| ASTM A965/A965M-14 | Grade F304 | S30400 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 18.0-20.0 | 8.0-11.0 | --- | --- |
| EN 10222-5:1999 | X5 CrNi 18-10 | --- | 1.4301 | 0.07 | 2.00 | 1.00 | 0.045 | 0.015 | 17.00-19.50 | 8.00-10.50 | --- | N 0.11 |
| EN 10250-4:1999 | X5CrNi18-10 | --- | 1.4301 | 0.07 | 2.00 | 1.00 | 0.045 | 0.030 | 17.00-19.50 | 8.00-10.50 | --- | N 0.11 |
| ISO 9327-5:1999 | Type X5CrNi18-9 | --- | --- | 0.07 | 2.00 | 1.00 | 0.045 | 0.030 | 17.00-19.00 | 8.00-11.00 | --- | --- |
| JIS G 3214:1991 A1:2009 | Symbol SUS F 304 | --- | --- | 0.08 | 2.00 | 1.00 | 0.040 | 0.030 | 18.00-20.00 | 8.00-11.00 | --- | --- |
| ASME SA-182/SA-182M | Grade F 316N | S31651 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 16.0-18.0 | 11.0-14.0 | 2.00-3.00 | N 0.10-0.16 |
| ASTM A182/A182M-15 | Grade F 316N | S31651 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 16.0-18.0 | 11.0-14.0 | 2.00-3.00 | N 0.10-0.16 |
| ASTM A965/A965M-14 | Grade F316N | S31651 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 16.0-18.0 | 10.0-13.0 | 2.00-3.00 | N 0.10-0.16 |
| JIS G 3214:1991 A1:2009 | Symbol SUS F 316N | --- | --- | 0.08 | 2.00 | 0.75 | 0.040 | 0.030 | 16.00-18.00 | 11.00-14.00 | 2.00-3.00 | N 0.10-0.16 |
| ASME SA-182/SA-182M | Grade F 304L | S30403 | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 18.0-20.0 | 8.0-13.0 | --- | N 0.10 |
| ASME SA-403/SA-403M | Grade WP 304L | S30403 | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 18.0-20.0 | 8.0-12.0 | --- | --- |
| | Grade CR 304L | S30403 | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 18.0-20.0 | 8.0-12.0 | --- | --- |
| ASTM A182/A182M-15 | Grade F 304L | S30403 | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 18.0-20.0 | 8.0-13.0 | --- | N 0.10 |
| ASTM A403/A403M-15 | Grade WP403L | S30403 | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 18.0-20.0 | 8.0-12.0 | --- | --- |
| | Grade CR403L | S30403 | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 18.0-20.0 | 8.0-12.0 | --- | --- |
| ASTM A473-15 | Type 304L | S30403 | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 18.0-20.0 | 8.0-12.0 | --- | N 0.10 |
| ASTM A965/A965M-14 | Grade F304L | S30403 | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 18.0-20.0 | 8.0-12.0 | --- | --- |
| EN 10222-5:1999 | X2 CrNi 18-9 | --- | 1.4307 | 0.030 | 2.00 | 1.00 | 0.045 | 0.015 | 17.50-19.50 | 8.00-10.00 | --- | N 0.11 |
| EN 10250-4:1999 | X2CrNi19-11 | --- | 1.4306 | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 18.00-20.00 | 10.00-12.00 | --- | N 0.11 |
| | X2CrNi18-9 | --- | 1.4307 | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 17.50-19.50 | 8.00-10.00 | --- | N 0.11 |
| ISO 9327-5:1999 | Type X2CrNi18-10 | --- | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 17.00-19.00 | 9.00-12.00 | --- | --- |
| JIS G 3214:1991 A1:2009 | Symbol SUS F 304L | --- | --- | 0.030 | 2.00 | 1.00 | 0.040 | 0.030 | 18.00-20.00 | 9.00-13.00 | --- | --- |
| ASME SA-182/SA-182M | Grade F 304H | S30409 | --- | 0.04-0.10 | 2.00 | 1.00 | 0.045 | 0.030 | 18.0-20.0 | 8.0-11.0 | --- | --- |
| ASTM A182/A182M-15 | Grade F 304H | S30409 | --- | 0.04-0.10 | 2.00 | 1.00 | 0.045 | 0.030 | 18.0-20.0 | 8.0-11.0 | --- | --- |
| ASTM A965/A965M-14 | Grade F304H | S30409 | --- | 0.04-0.10 | 2.00 | 1.00 | 0.045 | 0.030 | 18.0-20.0 | 8.0-11.0 | --- | --- |
| EN 10222-5:1999 | X6 CrNi 18-10 | --- | 1.4948 | 0.04-0.08 | 2.00 | 1.00 | 0.035 | 0.015 | 17.00-19.00 | 8.00-11.00 | --- | N 0.11 |
| ISO 9327-5:1999 | Type X7CrNi18-9 | --- | --- | 0.04-0.10 | 2.00 | 1.00 | 0.045 | 0.030 | 17.00-19.00 | 8.00-11.00 | --- | --- |
| JIS G 3214:1991 A1:2009 | Symbol SUS F 304H | --- | --- | 0.04-0.10 | 2.00 | 1.00 | 0.040 | 0.030 | 18.00-20.00 | 8.00-12.00 | --- | --- |

**6.3 Stainless Steel Forgings**

**6.3.3A Chemical Composition of Austenitic Stainless Steel Forgings (Continued)**

| Specification | Designation | UNS No. | Steel No. | Weight, %, max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASME SA-182/SA-182M | Grade F 304N | S30451 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 18.0-20.0 | 8.0-10.5 | --- | N 0.10-0.16 |
| ASTM A182/A182M-15 | Grade F 304N | S30451 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 18.0-20.0 | 8.0-10.5 | --- | N 0.10-0.16 |
| ASTM A965/A965M-14 | Grade F304N | S30451 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 18.0-20.0 | 8.0-11.0 | --- | N 0.10-0.16 |
| JIS G 3214:1991 A1:2009 | Symbol SUS F 304N | --- | --- | 0.08 | 2.00 | 0.75 | 0.040 | 0.030 | 18.00-20.00 | 8.00-11.00 | --- | N 0.10-0.16 |
| ASME SA-182/SA-182M | Grade F 304LN | S30453 | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 18.0-20.0 | 8.0-10.5 | --- | N 0.10-0.16 |
| ASME SA-403/SA-403M | Grade WP 304LN | S30453 | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 18.0-20.0 | 8.0-11.0 | --- | N 0.10-0.16 |
| | Grade CR 304 LN | S30453 | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 18.0-20.0 | 8.0-11.0 | --- | N 0.10-0.16 |
| ASTM A182/A182M-15 | Grade F 304LN | S30453 | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 18.0-20.0 | 8.0-10.5 | --- | N 0.10-0.16 |
| ASTM A403/A403M-15 | Grade WP304LN | S30453 | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 18.0-20.0 | 8.0-11.0 | --- | N 0.10-0.16 |
| | Grade CR304LN | S30453 | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 18.0-20.0 | 8.0-11.0 | --- | N 0.10-0.16 |
| ASTM A965/A965M-14 | Grade F304LN | S30453 | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 18.0-20.0 | 8.0-11.0 | --- | N 0.10-0.16 |
| EN 10222-5:1999 | X2CrNiN 18-10 | --- | 1.4311 | 0.030 | 2.00 | 1.00 | 0.045 | 0.015 | 17.00-19.50 | 8.50-11.50 | --- | N 0.12-0.22 |
| EN 10250-4:1999 | X2CrNiN18-10 | --- | 1.4311 | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 17.00-19.50 | 8.50-11.50 | --- | N 0.12-0.22 |
| ISO 9327-5:1999 | Type X2CrNiN18-10 | --- | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 17.00-19.00 | 8.50-11.50 | --- | N 0.12-0.22 |
| JIS G 3214:1991 A1:2009 | Symbol SUS F 304LN | --- | --- | 0.030 | 2.00 | 1.00 | 0.040 | 0.030 | 18.00-20.00 | 8.00-11.00 | --- | N 0.10-0.16 |
| ASME SA-182/SA-182M | Grade F 310 | S31000 | --- | 0.25 | 2.00 | 1.00 | 0.045 | 0.030 | 24.0-26.0 | 19.0-22.0 | --- | --- |
| | Grade F 310H | S31009 | --- | 0.04-0.10 | 2.00 | 1.00 | 0.045 | 0.030 | 24.0-26.0 | 19.0-22.0 | --- | --- |
| ASME SA-403/SA-403M | Grade WP 310S | S31008 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 24.0-26.0 | 19.0-22.0 | --- | --- |
| | Grade CR 310S | S31008 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 24.0-26.0 | 19.0-22.0 | --- | --- |
| ASTM A182/A182M-15 | Grade F 310 | S31000 | --- | 0.25 | 2.00 | 1.00 | 0.045 | 0.030 | 24.0-26.0 | 19.0-22.0 | --- | --- |
| | Grade F 310H | S31009 | --- | 0.04-0.10 | 2.00 | 1.00 | 0.045 | 0.030 | 24.0-26.0 | 19.0-22.0 | --- | --- |
| ASTM A403/A403M-15 | Grade WP310S | S31008 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 24.0-26.0 | 19.0-22.0 | --- | --- |
| | Grade CR310S | S31008 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 24.0-26.0 | 19.0-22.0 | --- | --- |
| ASTM A473-15 | Type 310 | S31000 | --- | 0.25 | 2.00 | 1.50 | 0.045 | 0.030 | 24.0-26.0 | 19.0-22.0 | --- | --- |
| ASTM A965/A965M-14 | Grade F310 | S31000 | --- | 0.15 | 2.00 | 1.00 | 0.045 | 0.030 | 24.0-26.00 | 19.0-22.0 | --- | --- |
| | Grade F310H | S31009 | --- | 0.04-0.10 | 2.00 | 1.00 | 0.045 | 0.030 | 24.0-26.00 | 19.0-22.0 | --- | --- |
| ISO 9327-5:1999 | Type X6CrNi25-21 | --- | --- | 0.08 | 2.00 | 1.50 | 0.045 | 0.030 | 24.00-26.00 | 19.00-23.00 | --- | --- |
| JIS G 3214:1991 A1:2009 | Symbol SUS F 310 | --- | --- | 0.15 | 2.00 | 1.00 | 0.040 | 0.030 | 24.00-26.00 | 19.00-22.00 | --- | --- |

**6.3 Stainless Steel Forgings**

**6.3.3A Chemical Composition of Austenitic Stainless Steel Forgings (Continued)**

| Specification | Designation | UNS No. | Steel No. | Weight, %, max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASME SA-182/SA-182M | Grade F 316 | S31600 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 16.0-18.0 | 10.0-14.0 | 2.00-3.00 | N 0.10 |
| ASME SA-403/SA-403M | Grade WP 316 | S31600 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 16.0-18.0 | 10.0-14.0 | 2.00-3.00 | --- |
| | Grade CR 316 | S31600 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 16.0-18.0 | 10.0-14.0 | 2.00-3.00 | --- |
| ASTM A182/A182M-15 | Grade F 316 | S31600 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 16.0-18.0 | 10.0-14.0 | 2.00-3.00 | N 0.10 |
| ASTM A403/A403M-15 | Grade WP316 | S31600 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 16.0-18.0 | 10.0-14.0 | 2.00-3.00 | --- |
| | Grade CR316 | S31600 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 16.0-18.0 | 10.0-14.0 | 2.00-3.00 | --- |
| ASTM A473-15 | Type 316 | S31600 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 16.0-18.0 | 10.0-14.0 | 2.00-3.00 | N 0.10 |
| ASTM A965/A965M-14 | Grade F316 | S31600 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 16.0-18.0 | 10.0-14.0 | 2.00-3.00 | --- |
| EN 10222-5:1999 | X5 CrNiMo 17-12-2 | --- | 1.4401 | 0.07 | 2.00 | 1.00 | 0.045 | 0.015 | 16.50-18.50 | 10.00-13.00 | 2.00-2.50 | N 0.11 |
| | X3 CrNiMo 17-13-3 | --- | 1.4436 | 0.05 | 2.00 | 1.00 | 0.045 | 0.015 | 16.50-18.50 | 10.50-13.00 | 2.50-3.00 | N 0.11 |
| EN 10250-4:1999 | X5CrNiMo17-12-2 | --- | 1.4401 | 0.07 | 2.00 | 1.00 | 0.045 | 0.030 | 16.50-18.50 | 10.00-13.00 | 2.00-2.50 | N 0.11 |
| | X3CrNiMo17-13-3 | --- | 1.4436 | 0.05 | 2.00 | 1.00 | 0.045 | 0.030 | 16.50-18.50 | 10.50-13.00 | 2.50-3.00 | N 0.11 |
| ISO 9327-5:1999 | Type X5CrNiMo17-12 | --- | --- | 0.07 | 2.00 | 1.00 | 0.045 | 0.030 | 16.50-18.50 | 10.50-13.50 | 2.00-2.50 | --- |
| | Type X5CrNiMo17-13 | --- | --- | 0.07 | 2.00 | 1.00 | 0.045 | 0.030 | 16.50-18.50 | 11.00-14.00 | 2.50-3.00 | --- |
| JIS G 3214:1991 A1:2009 | Symbol SUS F 316 | --- | --- | 0.08 | 2.00 | 1.00 | 0.040 | 0.030 | 16.00-18.00 | 10.00-14.00 | 2.00-3.00 | --- |
| ASME SA-182/SA-182M | Grade F 316L | S31603 | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 16.0-18.0 | 10.0-15.0 | 2.00-3.00 | N 0.10 |
| ASME SA-403/SA-403M | Grade WP 316L | S31603 | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 16.0-18.0 | 10.0-14.0 | 2.00-3.00 | --- |
| | Grade CR 316L | S31603 | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 16.0-18.0 | 10.0-14.0 | 2.00-3.00 | --- |
| ASTM A182/A182M-15 | Grade F 316L | S31603 | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 16.0-18.0 | 10.0-15.0 | 2.00-3.00 | N 0.10 |
| ASTM A403/A403M-15 | Grade WP316L | S31603 | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 16.0-18.0 | 10.0-14.0 | 2.00-3.00 | --- |
| | Grade CR316L | S31603 | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 16.0-18.0 | 10.0-14.0 | 2.00-3.00 | --- |
| ASTM A473-15 | Type 316L | S31603 | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 16.0-18.0 | 10.0-14.0 | 2.00-3.00 | N 0.10 |
| ASTM A965/A965M-14 | Grade F316L | S31603 | --- | 0.035 | 2.00 | 1.00 | 0.040 | 0.030 | 16.0-18.0 | 10.0-15.0 | 2.00-3.00 | --- |
| EN 10222-5:1999 | X2 CrNiMo 17-12-2 | --- | 1.4404 | 0.030 | 2.00 | 1.00 | 0.045 | 0.015 | 16.50-18.50 | 10.00-13.00 | 2.00-2.50 | N 0.11 |
| | X2 CrNiMo 17-12-3 | --- | 1.4432 | 0.030 | 2.00 | 1.00 | 0.045 | 0.015 | 16.50-18.50 | 10.50-13.00 | 2.50-3.00 | N 0.11 |
| | X2 CrNiMo 18-14-3 | --- | 1.4435 | 0.030 | 2.00 | 1.00 | 0.045 | 0.015 | 17.00-19.00 | 12.50-15.00 | 2.50-3.00 | N 0.11 |
| EN 10250-4:1999 | X2CrNiMo17-12-2 | --- | 1.4404 | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 16.50-18.50 | 10.00-13.00 | 2.00-2.50 | N 0.11 |
| | X2CrNiMo18-14-3 | --- | 1.4435 | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 17.00-19.00 | 12.50-15.00 | 2.50-3.00 | N 0.11 |
| ISO 9327-5:1999 | Type X2CrNiMo17-12 | --- | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 16.50-18.50 | 11.00-14.00 | 2.00-2.50 | --- |
| | Type X2CrNiMo17-13 | --- | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 16.50-18.50 | 11.50-14.50 | 2.50-3.00 | --- |
| JIS G 3214:1991 A1:2009 | Symbol SUS F 316L | --- | --- | 0.030 | 2.00 | 1.00 | 0.040 | 0.030 | 16.00-18.00 | 12.00-15.00 | 2.00-3.00 | --- |

**6.3 Stainless Steel Forgings**

**6.3.3A Chemical Composition of Austenitic Stainless Steel Forgings (Continued)**

| Specification | Designation | UNS No. | Steel No. | Weight, %, max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASME SA-182/SA-182M | Grade F 316LN | S31653 | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 16.0-18.0 | 11.0-14.0 | 2.00-3.00 | N 0.10-0.16 |
| ASTM A182/A182M-15 | Grade F 316LN | S31653 | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 16.0-18.0 | 11.0-14.0 | 2.00-3.00 | N 0.10-0.16 |
| ASTM A965/A965M-14 | Grade F316LN | S31653 | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 16.0-18.0 | 10.0-13.0 | 2.00-3.00 | N 0.10-0.16 |
| EN 10222-5:1999 | X2 CrNiMoN 17-11-2 | --- | 1.4406 | 0.030 | 2.00 | 1.00 | 0.045 | 0.015 | 16.50-18.50 | 10.00-12.00 | 2.00-2.50 | N 0.12-0.22 |
| | X2 CrNiMoN 17-13-3 | --- | 1.4429 | 0.030 | 2.00 | 1.00 | 0.045 | 0.015 | 16.50-18.50 | 11.00-14.00 | 2.50-3.00 | N 0.12-0.22 |
| EN 10250-4:1999 | X2CrNiMoN17-11-2 | --- | 1.4406 | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 16.50-18.50 | 10.00-12.00 | 2.00-2.50 | N 0.12-0.22 |
| | X2CrNiMoN17-13-3 | --- | 1.4429 | 0.030 | 2.00 | 1.00 | 0.045 | 0.015 | 16.50-18.50 | 11.00-14.00 | 2.50-3.00 | N 0.12-0.22 |
| ISO 9327-5:1999 | Type X2CrNiMoN17-12 | --- | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 16.50-18.50 | 10.50-13.50 | 2.00-2.50 | N 0.12-0.22 |
| | Type X2CrNiMoN17-13 | --- | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 16.50-18.50 | 11.50-14.50 | 2.50-3.00 | N 0.12-0.22 |
| JIS G 3214:1991 A1:2009 | Symbol SUS F 316LN | --- | --- | 0.030 | 2.00 | 1.00 | 0.040 | 0.030 | 16.00-18.00 | 10.00-14.00 | 2.00-3.00 | N 0.10-0.16 |
| ASME SA-182/SA-182M | Grade F 316H | S31609 | --- | 0.04-0.10 | 2.00 | 1.00 | 0.045 | 0.030 | 16.0-18.0 | 10.0-14.0 | 2.00-3.00 | --- |
| ASTM A182/A182M-15 | Grade F 316H | S31609 | --- | 0.04-0.10 | 2.00 | 1.00 | 0.045 | 0.030 | 16.0-18.0 | 10.0-14.0 | 2.00-3.00 | --- |
| ASTM A965/A965M-14 | Grade F316H | S31609 | --- | 0.04-0.10 | 2.00 | 1.00 | 0.045 | 0.030 | 16.0-18.0 | 10.0-14.0 | 2.00-3.00 | --- |
| ISO 9327-5:1999 | Type X7CrNiMo17-12 | --- | --- | 0.40-0.10 | 2.00 | 1.00 | 0.045 | 0.030 | 16.50-18.50 | 10.50-13.50 | 2.00-2.50 | --- |
| JIS G 3214:1991 A1:2009 | Symbol SUS F 316H | --- | --- | 0.04-0.10 | 2.00 | 1.00 | 0.040 | 0.030 | 16.00-18.00 | 10.00-14.00 | 2.00-3.00 | --- |
| ASME SA-182/SA-182M | Grade F 317 | S31700 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 18.0-20.0 | 11.0-15.0 | 3.0-4.0 | --- |
| ASME SA-403/SA-403M | Grade WP 317 | S31700 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 18.0-20.0 | 11.0-15.0 | 3.0-4.0 | --- |
| | Grade CR 317 | S31700 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 18.0-20.0 | 11.0-15.0 | 3.0-4.0 | --- |
| ASTM A182/A182M-15 | Grade F 317 | S31700 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 18.0-20.0 | 11.0-15.0 | 3.0-4.0 | --- |
| ASTM A403/A403M-15 | Grade WP317 | S31700 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 18.0-20.0 | 11.0-15.0 | 3.0-4.0 | --- |
| | Grade CR317 | S31700 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 18.0-20.0 | 11.0-15.0 | 3.0-4.0 | --- |
| ASTM A473-15 | Type 317 | S31700 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 18.0-20.0 | 11.0-15.0 | 3.0-4.0 | N 0.10 |
| EN 10250-4:1999 | X6CrNiMoTi17-12-2 | --- | 1.4571 | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 16.50-18.50 | 10.50-13.50 | 2.00-2.50 | Ti 5xC to 0.70 |
| ISO 9327-5:1999 | Type X6CrNiMoTi17-12 | --- | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 16.50-18.50 | 11.00-14.00 | 2.00-2.50 | Ti 5xC to 0.80 |
| JIS G 3214:1991 A1:2009 | Symbol SUS F 317 | --- | --- | 0.08 | 2.00 | 1.00 | 0.040 | 0.030 | 18.00-20.00 | 11.00-15.00 | 3.00-4.00 | --- |
| ASME SA-182/SA-182M | Grade F 317L | S31703 | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 18.0-20.0 | 11.0-15.0 | 3.0-4.0 | --- |
| ASME SA-403/SA-403M | Grade WP 317L | S31703 | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 18.0-20.0 | 11.0-15.0 | 3.0-4.0 | --- |
| | Grade CR 317L | S31703 | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 18.0-20.0 | 11.0-15.0 | 3.0-4.0 | --- |
| ASTM A182/A182M-15 | Grade F 317L | S31703 | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 18.0-20.0 | 11.0-15.0 | 3.0-4.0 | --- |
| ASTM A403/A403M-15 | Grade WP317L | S31703 | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 18.0-20.0 | 11.0-15.0 | 3.0-4.0 | --- |
| | Grade CR317L | S31703 | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 18.0-20.0 | 11.0-15.0 | 3.0-4.0 | --- |
| ASTM A774/A774M-14 | Grade TP 317L | S31703 | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 18.0-20.0 | 11.0-15.0 | 3.0-4.0 | N 0.10 |
| JIS G 3214:1991 A1:2009 | Symbol SUS F 317L | --- | --- | 0.030 | 2.00 | 1.00 | 0.040 | 0.030 | 18.00-20.00 | 11.00-15.00 | 3.00-4.00 | --- |

**6.3 Stainless Steel Forgings**

**6.3.3A Chemical Composition of Austenitic Stainless Steel Forgings (Continued)**

| Specification | Designation | UNS No. | Steel No. | Weight, %, max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASME SA-182/SA-182M | Grade F 321 | S32100 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 17.0-19.0 | 9.0-12.0 | --- | Ti 5xC to 0.70 |
| ASME SA-403/SA-403M | Grade WP 321 | S32100 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 17.0-19.0 | 9.0-12.0 | --- | Ti 5x(C+N) to 0.70 |
| | Grade CR 321 | S32100 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 17.0-19.0 | 9.0-12.0 | --- | Ti 5x(C+N) to 0.70 |
| ASTM A182/A182M-15 | Grade F 321 | S32100 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 17.0-19.0 | 9.0-12.0 | --- | Ti 5xC to 0.70 |
| ASTM A403/A403M-15 | Grade WP321 | S32100 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 17.0-19.0 | 9.0-12.0 | --- | Ti 5x(C+N) to 0.70 |
| | Grade CR321 | S32100 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 17.0-19.0 | 9.0-12.0 | --- | Ti 5x(C+N) to 0.70 |
| ASTM A473-15 | Type 321 | S32100 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 17.0-19.0 | 9.0-12.0 | --- | Ti 5xC min. |
| ASTM A774/A774M-14 | Grade TP 321 | S32100 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 17.0-19.0 | 9.0-12.0 | --- | Ti 5x(C+N) to 0.70 |
| ASTM A965/A965M-14 | Grade F321 | S32100 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 17.0-19.0 | 9.0-12.0 | --- | N 0.10; Ti 5x(C+N) to 0.70 |
| EN 10222-5:1999 | X6 CrNiTi 18-10 | --- | 1.4541 | 0.08 | 2.00 | 1.00 | 0.045 | 0.015 | 17.00-19.00 | 9.00-12.00 | --- | Ti 5xC to 0.70 |
| EN 10250-4:1999 | X6CrNiTi18-10 | --- | 1.4541 | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 17.00-19.00 | 9.00-12.00 | --- | Ti 5xC to 0.70 |
| ISO 9327-5:1999 | Type X6CrNiTi18-10 | --- | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 17.00-19.00 | 9.00-12.00 | --- | Ti 5xC to 0.80 |
| JIS G 3214:1991 A1:2009 | Symbol SUS F 321 | --- | --- | 0.08 | 2.00 | 1.00 | 0.040 | 0.030 | 17.00 min. | 9.00-12.00 | --- | Ti 5xC to 0.60 |
| ASME SA-182/SA-182M | Grade F 321H | S32109 | --- | 0.04-0.10 | 2.00 | 1.00 | 0.045 | 0.030 | 17.0-19.0 | 9.0-12.0 | --- | Ti 4xC to 0.70 |
| ASTM A182/A182M-15 | Grade F 321H | S32109 | --- | 0.04-0.10 | 2.00 | 1.00 | 0.045 | 0.030 | 17.0-19.0 | 9.0-12.0 | --- | Ti 4xC to 0.70 |
| ASTM A965/A965M-14 | Grade F321H | S32109 | --- | 0.04-0.10 | 2.00 | 1.00 | 0.045 | 0.030 | 17.0-19.0 | 9.0-12.0 | --- | Ti 4x(C+N) to 0.70 |
| ISO 9327-5:1999 | Type X7CrNiTi18-10 | --- | --- | 0.04-0.10 | 2.00 | 1.00 | 0.045 | 0.030 | 17.00-19.00 | 9.00-12.00 | --- | Ti 5xC to 0.80 |
| JIS G 3214:1991 A1:2009 | Symbol SUS F 321H | --- | --- | 0.04-0.10 | 2.00 | 1.00 | 0.040 | 0.030 | 17.00 min. | 9.00-12.00 | --- | Ti 4xC to 0.60 |

**6.3 Stainless Steel Forgings**

**6.3.3A Chemical Composition of Austenitic Stainless Steel Forgings (Continued)**

| Specification | Designation | UNS No. | Steel No. | Weight, %, max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASME SA-182/SA-182M | Grade F 347 | S34700 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 17.0-20.0 | 9.0-13.0 | --- | Cb 10xC to 1.10 |
| | Grade F 348 | S34800 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 17.0-20.0 | 9.0-13.0 | --- | Cb 10xC to 1.10; Co 0.20; Ta 0.10 |
| ASME SA-403/SA-403M | Grade WP 347 | S34700 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 17.0-19.0 | 9.0-12.0 | --- | Cb 10xC to 1.10 |
| | Grade CR 347 | S34700 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 17.0-19.0 | 9.0-12.0 | --- | Cb 10xC to 1.10 |
| ASTM A182/A182M-15 | Grade F 347 | S34700 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 17.0-20.0 | 9.0-13.0 | --- | Cb 10xC to 1.10 |
| | Grade F 348 | S34800 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 17.0-20.0 | 9.0-13.0 | --- | Cb 10xC to 1.10; Co 0.20; Ta 0.10 |
| ASTM A403/A403M-15 | Grade WP347 | S34700 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 17.0-19.0 | 9.0-12.0 | --- | Cb 10xC to 1.10 |
| | Grade CR347 | S34700 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 17.0-19.0 | 9.0-12.0 | --- | Cb 10xC to 1.10 |
| ASTM A473-15 | Type 347 | S34700 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 17.0-19.0 | 9.0-13.0 | --- | (Cb+Ta) 10xC min. |
| ASTM A965/A965M-14 | Grade F347 | S34700 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 17.0-19.0 | 9.0-12.0 | --- | Cb 10xC to 1.10 |
| | Grade F 348 | S34800 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 17.0-19.0 | 9.0-12.0 | --- | (Cb+Ta) 10xC to 1.10; Co 0.020; Ta 0.10 |
| EN 10222-5:1999 | X6 CrNiNb 18-10 | --- | 1.4550 | 0.08 | 2.00 | 1.00 | 0.045 | 0.015 | 17.00-19.00 | 9.00-12.00 | --- | Nb 10xC to 1.00 |
| ISO 9327-5:1999 | Type X6CrNiNb18-10 | --- | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 17.00-19.00 | 9.00-12.00 | --- | Nb 10xC to 1.00 |
| JIS G 3214:1991 A1:2009 | Symbol SUS F 347 | --- | --- | 0.08 | 2.00 | 1.00 | 0.040 | 0.030 | 17.00-20.00 | 9.00-13.00 | --- | Nb 10xC to 1.00 |
| ASME SA-182/SA-182M | Grade F 347H | S34709 | --- | 0.04-0.10 | 2.00 | 1.00 | 0.045 | 0.030 | 17.0-20.0 | 9.0-13.0 | --- | Cb 8xC to 1.10 |
| ASTM A182/A182M-15 | Grade F 347H | S34709 | --- | 0.04-0.10 | 2.00 | 1.00 | 0.045 | 0.030 | 17.0-20.0 | 9.0-13.0 | --- | Cb 8xC to 1.10 |
| EN 10222-5:1999 | X7 CrNiNb 18-10 | --- | 1.4912 | 0.04-0.10 | 2.00 | 1.00 | 0.045 | 0.015 | 17.00-19.00 | 9.00-12.00 | --- | Nb 10xC to 1.20 |
| ISO 9327-5:1999 | Type X7CrNiNb18-10 | --- | --- | 0.04-0.10 | 2.00 | 1.00 | 0.045 | 0.030 | 17.00-19.00 | 9.00-12.00 | --- | Nb 10xC to 1.20 |
| JIS G 3214:1991 A1:2009 | Symbol SUS F 347H | --- | --- | 0.04-0.10 | 2.00 | 1.00 | 0.040 | 0.030 | 17.00-20.00 | 9.00-13.00 | --- | Nb 8xC to 1.00 |
| EN 10250-4:1999 | X1NiCrMoCu25-20-5 | --- | 1.4539 | 0.020 | 2.00 | 0.70 | 0.030 | 0.010 | 19.00-21.00 | 24.00-26.00 | 4.00-5.00 | Cu 1.20-2.00; N 0.15 |
| ISO 9327-5:1999 | Type X2NiCrMoCu25-20-5 | --- | --- | 0.025 | 2.00 | 1.00 | 0.030 | 0.020 | 19.00-22.00 | 24.00-27.00 | 4.00-5.00 | Cu 1.00-2.00; N 0.15 |

**6.3 Stainless Steel Forgings**

**6.3.3B Mechanical Properties of Austenitic Stainless Steel Forgings**

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | % min. | | |
| ASME SA-182/SA-182M | Grade F 304 | S30400 | --- | t ≤ 130 | t ≤ 5 | 205 | 30 | 515 | 75 | 30 | ST+Q | --- |
| | | | | t > 130 | t > 5 | 205 | 30 | 485 | 70 | 30 | ST+Q | --- |
| ASME SA-403/SA-403M | Grade WP 304 | S30400 | --- | --- | --- | 205 | 30 | 515 | 75 | 28 L, 20 T | SA | --- |
| | Grade CR 304 | S30400 | --- | --- | --- | 205 | 30 | 515 | 75 | 28 L, 20 T | SA | --- |
| ASTM A182/A182M-15 | Grade F 304 | S30400 | --- | t ≤ 130 | t ≤ 5 | 205 | 30 | 515 | 75 | 30 | ST+Q | --- |
| | | | | t > 130 | t > 5 | 205 | 30 | 485 | 70 | 30 | ST+Q | --- |
| ASTM A403/A403M-15 | Grade WP304 | S30400 | --- | --- | --- | 205 | 30 | 515 | 75 | 28 L, 20 T | SA+Q or RC | --- |
| | Grade CR304 | S30400 | --- | --- | --- | 205 | 30 | 515 | 75 | 28 L, 20 T | SA+Q or RC | --- |
| ASTM A473-15 | Type 304 | S30400 | --- | t ≤ 127 | t ≤ 5 | 205 | 30 | 515 | 75 | 40 | SHT | --- |
| | | | | t > 127 | t > 5 | 205 | 30 | 485 | 70 | 40 | SHT | --- |
| ASTM A965/A965M-14 | Grade F304 | S30400 | --- | --- | --- | 205 | 30 | 485 | 70 | 40 | SA+Q | --- |
| EN 10222-5:1999 | X5 CrNi 18-10 | --- | 1.4301 | t ≤ 250 | --- | 200 | --- | 500-700 | --- | 45 L, 35 T | ST | see standard for impact data |
| EN 10250-4:1999 | X5CrNi18-10 | --- | 1.4301 | t ≤ 250 | --- | 190 | --- | 500-700 | --- | 35 T | SA | see standard for impact data |
| ISO 9327-5:1999 | Type X5CrNi18-9 | --- | --- | t ≤ 250 | --- | 195 | --- | 500-700 | --- | 30 L, 30 T | Q+T | see standard for impact data |
| JIS G 3214:1991 A1:2009 | Symbol SUS F 304 | --- | --- | t < 130 | --- | 205 | --- | 520 | --- | 43 L | ST | 187 max HB |
| | | | | 130 ≤ t ≤ 200 | --- | 205 | --- | 480 | --- | 29 L | ST | 187 max HB |
| ASME SA-182/SA-182M | Grade F 316N | S31651 | --- | --- | --- | 240 | 35 | 550 | 80 | 30 L, 25 T | ST+Q | --- |
| ASTM A182/A182M-15 | Grade F 316N | S31651 | --- | --- | --- | 240 | 35 | 550 | 80 | 30 L, 25 T | ST+Q | --- |
| ASTM A965/A965M-14 | Grade F316N | S31651 | --- | --- | --- | 240 | 35 | 550 | 80 | 25 | SA+Q | --- |
| JIS G 3214:1991 A1:2009 | Symbol SUS F 316N | --- | --- | t < 130 | --- | 240 | --- | 550 | --- | 29 L | ST | 217 max HB |
| | | | | 130 ≤ t ≤ 200 | --- | 240 | --- | 550 | --- | 24 L | ST | 217 max HB |
| ASME SA-182/SA-182M | Grade F 304L | S30403 | --- | t ≤ 130 | t ≤ 5 | 170 | 25 | 485 | 70 | 30 | ST+Q | --- |
| | | | | t > 130 | t > 5 | 170 | 25 | 450 | 65 | 30 | ST+Q | --- |
| ASME SA-403/SA-403M | Grade WP 304L | S30403 | --- | --- | --- | 170 | 25 | 485 | 70 | 28 L, 20 T | SA | --- |
| | Grade CR 304L | S30403 | --- | --- | --- | 170 | 25 | 485 | 70 | 28 L, 20 T | SA | --- |
| ASTM A182/A182M-15 | Grade F 304L | S30403 | --- | t ≤ 130 | t ≤ 5 | 170 | 25 | 485 | 70 | 30 | ST+Q | --- |
| | | | | t > 130 | t > 5 | 170 | 25 | 450 | 65 | 30 | ST+Q | --- |
| ASTM A403/A403M-15 | Grade WP304L | S30403 | --- | --- | --- | 170 | 25 | 485 | 70 | 28 L, 20 T | SA+Q or RC | --- |
| | Grade CR304L | S30403 | --- | --- | --- | 170 | 25 | 485 | 70 | 28 L, 20 T | SA+Q or RC | --- |
| ASTM A473-15 | Type 304L | S30403 | --- | --- | --- | 170 | 25 | 450 | 65 | 40 | SHT | --- |
| ASTM A965/A965M-14 | Grade F304L | S30403 | --- | --- | --- | 170 | 25 | 450 | 65 | 30 | SA+Q | --- |
| EN 10222-5:1999 | X2 CrNi 18-9 | --- | 1.4307 | t ≤ 250 | --- | 200 | --- | 500-700 | --- | 45 L, 35 T | ST | see standard for impact data |
| EN 10250-4:1999 | X2CrNi19-11 | --- | 1.4306 | t ≤ 250 | --- | 180 | --- | 460-680 | --- | 35 T | SA | see standard for impact data |
| | X2CrNi18-9 | --- | 1.4307 | t ≤ 250 | --- | 175 | --- | 450-680 | --- | 35 T | SA | |
| ISO 9327-5:1999 | Type X2CrNi18-10 | --- | --- | t ≤ 250 | --- | 180 | --- | 480-680 | --- | 30 L, 30 T | Q+T | see standard for impact data |
| JIS G 3214:1991 A1:2009 | Symbol SUS F 304L | --- | --- | t < 130 | --- | 175 | --- | 480 | --- | 29 L | ST | 187 max HB |
| | | | | 130 ≤ t ≤ 200 | --- | 175 | --- | 450 | --- | 29 L | ST | 187 max HB |

**6.3 Stainless Steel Forgings**

**6.3.3B Mechanical Properties of Austenitic Stainless Steel Forgings (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | % min. | | |
| ASME SA-182/SA-182M | Grade F 304H | S30409 | --- | t ≤ 130 | t ≤ 5 | 205 | 30 | 515 | 75 | 30 | ST+Q | --- |
| | | | | t > 130 | t > 5 | 205 | 30 | 485 | 70 | 30 | ST+Q | --- |
| ASTM A182/A182M-15 | Grade F 304H | S30409 | --- | t ≤ 130 | t ≤ 5 | 205 | 30 | 515 | 75 | 30 | ST+Q | --- |
| | | | | t > 130 | t > 5 | 205 | 30 | 485 | 70 | 30 | ST+Q | --- |
| ASTM A965/A965M-14 | Grade F304H | S30409 | --- | --- | --- | 205 | 30 | 485 | 70 | 30 | SA+Q | --- |
| EN 10222-5:1999 | X6 CrNi 18-10 | --- | 1.4948 | t ≤ 250 | --- | 195 | --- | 490-690 | --- | 45 L, 35 T | ST | see standard for impact data |
| ISO 9327-5:1999 | Type X7CrNi18-9 | --- | --- | t ≤ 250 | --- | 195 | --- | 490-690 | --- | 30 L, 30 T | Q+T | see standard for impact data |
| JIS G 3214:1991 A1:2009 | Symbol SUS F 304H | --- | --- | t < 130 | --- | 205 | --- | 520 | --- | 43 L | ST | 187 max HB |
| | | | | 130 ≤ t ≤ 200 | --- | 205 | --- | 480 | --- | 29 L | ST | 187 max HB |
| ASME SA-182/SA-182M | Grade F 304N | S30451 | --- | --- | --- | 240 | 35 | 550 | 80 | 30 L, 25 T | ST+Q | --- |
| ASTM A182/A182M-15 | Grade F 304N | S30451 | --- | --- | --- | 240 | 35 | 550 | 80 | 30 L, 25 T | ST+Q | --- |
| ASTM A965/A965M-14 | Grade F304N | S30451 | --- | --- | --- | 240 | 35 | 550 | 80 | 25 | SA+Q | --- |
| JIS G 3214:1991 A1:2009 | Symbol SUS F 304N | --- | --- | t < 130 | --- | 240 | --- | 550 | --- | 29 L | ST | 217 max HB |
| | | | | 130 ≤ t ≤ 200 | --- | 240 | --- | 550 | --- | 24 L | ST | 217 max HB |
| ASME SA-182/SA-182M | Grade F 304LN | S30453 | --- | t ≤ 130 | t ≤ 5 | 205 | 30 | 515 | 75 | 30 | ST+Q | --- |
| | | | | t > 130 | t > 5 | 205 | 30 | 485 | 70 | 30 | ST+Q | --- |
| ASTM A182/A182M-15 | Grade F 304LN | S30453 | --- | t ≤ 130 | t ≤ 5 | 205 | 30 | 515 | 75 | 30 | ST+Q | --- |
| | | | | t > 130 | t > 5 | 205 | 30 | 485 | 70 | 30 | ST+Q | --- |
| ASTM A965/A965M-14 | Grade F304LN | S30453 | --- | --- | --- | 205 | 30 | 485 | 70 | 30 | SA+Q | --- |
| EN 10222-5:1999 | X2CrNiN 18-10 | --- | 1.4311 | t ≤ 250 | --- | 270 | --- | 550-750 | --- | 45 L, 35 T | ST | see standard for impact data |
| EN 10250-4:1999 | X2CrNiN18-10 | --- | 1.4311 | t ≤ 250 | --- | 270 | --- | 550-760 | --- | 30 T | SA | see standard for impact data |
| ISO 9327-5:1999 | Type X2CrNiN18-10 | --- | --- | t ≤ 250 | --- | 270 | --- | 550-750 | --- | 30 L, 30 T | Q+T | see standard for impact data |
| JIS G 3214:1991 A1:2009 | Symbol SUS F 304LN | --- | --- | t < 130 | --- | 205 | --- | 520 | --- | 29 L | ST | 187 max HB |
| | | | | 130 ≤ t ≤ 200 | --- | 205 | --- | 480 | --- | 29 L | ST | 187 max HB |

**6.3 Stainless Steel Forgings**

**6.3.3B Mechanical Properties of Austenitic Stainless Steel Forgings (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter mm | Section Thickness/Diameter in. | Yield Strength, min. MPa | Yield Strength, min. ksi | Tensile Strength, min. MPa | Tensile Strength, min. ksi | Elongation % min. | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ASME SA-182/SA-182M | Grade F 310 | S31000 | --- | t ≤ 130 | t ≤ 5 | 205 | 30 | 515 | 75 | 30 | ST+Q | --- |
| | | | | t > 130 | t > 5 | 205 | 30 | 485 | 70 | 30 | ST+Q | --- |
| | Grade F 310H | S31009 | --- | t ≤ 130 | t ≤ 5 | 205 | 30 | 515 | 75 | 30 | ST+Q | --- |
| | | | | t > 130 | t > 5 | 205 | 30 | 485 | 70 | 30 | ST+Q | --- |
| ASME SA-403/SA-403M | Grade WP 310S | S31008 | --- | --- | --- | 205 | 30 | 515 | 75 | 28 L, 20 T | SA | --- |
| | Grade CR 310S | S31008 | --- | --- | --- | 205 | 30 | 515 | 75 | 28 L, 20 T | SA | --- |
| ASTM A182/A182M-15 | Grade F 310 | S31000 | --- | t ≤ 130 | t ≤ 5 | 205 | 30 | 515 | 75 | 30 | ST+Q | --- |
| | | | | t > 130 | t > 5 | 205 | 30 | 485 | 70 | 30 | ST+Q | --- |
| | Grade F 310H | S31009 | --- | t ≤ 130 | t ≤ 5 | 205 | 30 | 515 | 75 | 30 | ST+Q | --- |
| | | | | t > 130 | t > 5 | 205 | 30 | 485 | 70 | 30 | ST+Q | --- |
| ASTM A403/A403M-15 | Grade WP310S | S31008 | --- | --- | --- | 205 | 30 | 515 | 75 | 28 L, 20 T | SA+Q or RC | --- |
| | Grade CR310S | S31008 | --- | --- | --- | 205 | 30 | 515 | 75 | 28 L, 20 T | SA+Q or RC | --- |
| ASTM A473-15 | Type 310 | S31000 | --- | --- | --- | 205 | 30 | 515 | 75 | 40 | SHT | --- |
| ASTM A965/A965M-14 | Grade F310 | S31000 | --- | --- | --- | 205 | 30 | 515 | 75 | 30 | SA+Q | --- |
| | Grade F310H | S31009 | --- | --- | --- | 205 | 30 | 485 | 70 | 30 | SA+Q | --- |
| ISO 9327-5:1999 | Type X6CrNi25-21 | --- | --- | t ≤ 160 | --- | 210 | --- | 500-700 | --- | 30 L, 30 T | Q+T | see standard for impact data |
| JIS G 3214:1991 A1:2009 | Symbol SUS F 310 | --- | --- | t < 130 | --- | 205 | --- | 520 | --- | 34 L | ST | 187 max HB |
| | | | | 130 ≤ t ≤ 200 | --- | 205 | --- | 480 | --- | 29 L | ST | 187 max HB |
| ASME SA-182/SA-182M | Grade F 316 | S31600 | --- | t ≤ 130 | t ≤ 5 | 205 | 30 | 515 | 75 | 30 | ST+Q | --- |
| | | | | t > 130 | t > 5 | 205 | 30 | 485 | 70 | 30 | ST+Q | --- |
| ASME SA-403/SA-403M | Grade WP 316 | S31600 | --- | --- | --- | 205 | 30 | 515 | 75 | 28 L, 20 T | SA | --- |
| | Grade CR 316 | S31600 | --- | --- | --- | 205 | 30 | 515 | 75 | 28 L, 20 T | SA | --- |
| ASTM A182/A182M-15 | Grade F 316 | S31600 | --- | t ≤ 130 | t ≤ 5 | 205 | 30 | 515 | 75 | 30 | ST+Q | --- |
| | | | | t > 130 | t > 5 | 205 | 30 | 485 | 70 | 30 | ST+Q | --- |
| ASTM A403/A403M-15 | Grade WP316 | S31600 | --- | --- | --- | 205 | 30 | 515 | 75 | 28 L, 20 T | SA+Q or RC | --- |
| | Grade CR316 | S31600 | --- | --- | --- | 205 | 30 | 515 | 75 | 28 L, 20 T | SA+Q or RC | --- |
| ASTM A473-15 | Type 316 | S31600 | --- | t ≤ 127 | t ≤ 5 | 205 | 30 | 515 | 75 | 40 | SHT | --- |
| | | | | t > 127 | t > 5 | 205 | 30 | 485 | 70 | 40 | SHT | --- |
| ASTM A965/A965M-14 | Grade F316 | S31600 | --- | --- | --- | 205 | 30 | 485 | 70 | 30 | SA+Q | --- |
| EN 10222-5:1999 | X5 CrNiMo 17-12-2 | --- | 1.4401 | t ≤ 250 | --- | 205 | --- | 510-710 | --- | 45 L, 35 T | ST | see standard for impact data |
| | X3 CrNiMo 17-13-3 | --- | 1.4436 | t ≤ 250 | --- | 205 | --- | 510-710 | --- | 45 L, 35 T | ST | |
| EN 10250-4:1999 | X5CrNiMo17-12-2 | --- | 1.4401 | t ≤ 250 | --- | 200 | --- | 500-700 | --- | 30 T | SA | see standard for impact data |
| | X3CrNiMo17-13-3 | --- | 1.4436 | t ≤ 250 | --- | 200 | --- | 500-700 | --- | 30 T | SA | |
| ISO 9327-5:1999 | Type X5CrNiMo17-12 | --- | --- | t ≤ 250 | --- | 205 | --- | 510-710 | --- | 30 L, 30 T | Q+T | see standard for impact data |
| | Type X5CrNiMo17-13 | --- | --- | t ≤ 250 | --- | 205 | --- | 510-710 | --- | 30 L, 30 T | Q+T | see standard for impact data |
| JIS G 3214:1991 A1:2009 | Symbol SUS F 316 | --- | --- | t < 130 | --- | 205 | --- | 520 | --- | 43 L | ST | 187 max HB |
| | | | | 130 ≤ t ≤ 200 | --- | 205 | --- | 480 | --- | 29 L | ST | 187 max HB |

**6.3 Stainless Steel Forgings**

**6.3.3B Mechanical Properties of Austenitic Stainless Steel Forgings (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | % min. | | |
| ASME SA-182/SA-182M | Grade F 316L | S31603 | --- | t ≤ 130 | t ≤ 5 | 170 | 25 | 485 | 70 | 30 | ST+Q | --- |
| | | | | t > 130 | t > 5 | 170 | 25 | 450 | 65 | 30 | ST+Q | --- |
| ASME SA-403/SA-403M | Grade WP 316L | S31603 | --- | --- | --- | 170 | 25 | 485 | 70 | 28 L, 20 T | SA | --- |
| | Grade CR 316L | S31603 | --- | --- | --- | 170 | 25 | 485 | 70 | 28 L, 20 T | SA | --- |
| ASTM A182/A182M-15 | Grade F 316L | S31603 | --- | t ≤ 130 | t ≤ 5 | 170 | 25 | 485 | 70 | 30 | ST+Q | --- |
| | | | | t > 130 | t > 5 | 170 | 25 | 450 | 65 | 30 | ST+Q | --- |
| ASTM A403/A403M-15 | Grade WP316L | S31603 | --- | --- | --- | 170 | 25 | 485 | 70 | 28 L, 20 T | SA+Q or RC | --- |
| | Grade CR316L | S31603 | --- | --- | --- | 170 | 25 | 485 | 70 | 28 L, 20 T | SA+Q or RC | --- |
| ASTM A473-15 | Type 316L | S31603 | --- | --- | --- | 170 | 25 | 450 | 65 | 40 | SHT | --- |
| ASTM A965/A965M-14 | Grade F316L | S31603 | --- | --- | --- | 170 | 25 | 450 | 65 | 30 | SA+Q | --- |
| EN 10222-5:1999 | X2 CrNiMo 17-12-2 | --- | 1.4404 | t ≤ 250 | --- | 190 | --- | 490-690 | --- | 45 L, 35 T | ST | see standard for impact data |
| | X2 CrNiMo 17-12-3 | --- | 1.4432 | t ≤ 250 | --- | 190 | --- | 490-690 | --- | 45 L, 35 T | ST | |
| | X2 CrNiMo 18-14-3 | --- | 1.4435 | t ≤ 75 | --- | 200 | --- | 520-670 | --- | 45 T | ST | |
| EN 10250-4:1999 | X2CrNiMo17-12-2 | --- | 1.4404 | t ≤ 250 | --- | 200 | --- | 500-700 | --- | 30 T | SA | see standard for impact data |
| | X2CrNiMo18-14-3 | --- | 1.4435 | t ≤ 250 | --- | 200 | --- | 500-700 | --- | 30 T | SA | |
| ISO 9327-5:1999 | Type X2CrNiMo17-12 | --- | --- | t ≤ 250 | --- | 190 | --- | 490-690 | --- | 30 L, 30 T | Q+T | see standard for impact data |
| | Type X2CrNiMo17-13 | --- | --- | t ≤ 250 | --- | 190 | --- | 490-690 | --- | 30 L, 30 T | Q+T | see standard for impact data |
| JIS G 3214:1991 A1:2009 | Symbol SUS F 316L | --- | --- | t < 130 | --- | 175 | --- | 480 | --- | 29 L | ST | 187 max HB |
| | | | | 130 ≤ t ≤ 200 | --- | 175 | --- | 450 | --- | 29 L | ST | 187 max HB |
| ASME SA-182/SA-182M | Grade F 316LN | S31653 | --- | t ≤ 130 | t ≤ 5 | 205 | 30 | 515 | 75 | 30 | ST+Q | --- |
| | | | | t > 130 | t > 5 | 205 | 30 | 485 | 70 | 30 | ST+Q | --- |
| ASTM A182/A182M-15 | Grade F 316LN | S31653 | --- | t ≤ 130 | t ≤ 5 | 205 | 30 | 515 | 75 | 30 | ST+Q | --- |
| | | | | t > 130 | t > 5 | 205 | 30 | 485 | 70 | 30 | ST+Q | --- |
| ASTM A965/A965M-14 | Grade F316LN | S31653 | --- | --- | --- | 205 | 30 | 485 | 70 | 30 | SA+Q | --- |
| EN 10222-5:1999 | X2 CrNiMoN 17-11-2 | --- | 1.4406 | t ≤ 160 | --- | 280 | --- | 580-780 | --- | 45 L, 35 T | ST | see standard for impact data |
| | X2 CrNiMoN 17-13-3 | --- | 1.4429 | t ≤ 160 | --- | 280 | --- | 580-780 | --- | 45 L, 35 T | ST | |
| EN 10250-4:1999 | X2CrNiMoN17-11-2 | --- | 1.4406 | t ≤ 250 | --- | 280 | --- | 580-800 | --- | 30 T | SA | see standard for impact data |
| | X2CrNiMoN17-13-3 | --- | 1.4429 | t ≤ 400 | --- | 280 | --- | 580-800 | --- | 30 T | SA | |
| ISO 9327-5:1999 | Type X2CrNiMoN17-12 | --- | --- | t ≤ 160 | --- | 280 | --- | 580-780 | --- | 30 L, 30 T | Q+T | see standard for impact data |
| | Type X2CrNiMoN17-13 | --- | --- | t ≤ 160 | --- | 280 | --- | 580-780 | --- | 30 L, 30 T | Q+T | see standard for impact data |
| JIS G 3214:1991 A1:2009 | Symbol SUS F 316LN | --- | --- | t < 130 | --- | 205 | --- | 520 | --- | 29 L | ST | 187 max HB |
| | | | | 130 ≤ t ≤ 200 | --- | 205 | --- | 480 | --- | 29 L | ST | 187 max HB |

**6.3 Stainless Steel Forgings**

**6.3.3B Mechanical Properties of Austenitic Stainless Steel Forgings (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter mm | Section Thickness/Diameter in. | Yield Strength, min. MPa | Yield Strength, min. ksi | Tensile Strength, min. MPa | Tensile Strength, min. ksi | Elongation % min. | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ASME SA-182/SA-182M | Grade F 316H | S31609 | --- | t ≤ 130 | t ≤ 5 | 205 | 30 | 515 | 75 | 30 | ST+Q | --- |
| | | | | t > 130 | t > 5 | 205 | 30 | 485 | 70 | 30 | ST+Q | --- |
| ASTM A182/A182M-15 | Grade F 316H | S31609 | --- | t ≤ 130 | t ≤ 5 | 205 | 30 | 515 | 75 | 30 | ST+Q | --- |
| | | | | t > 130 | t > 5 | 205 | 30 | 485 | 70 | 30 | ST+Q | --- |
| ASTM A965/A965M-14 | Grade F316H | S31609 | --- | --- | --- | 205 | 30 | 485 | 70 | 30 | SA+Q | --- |
| ISO 9327-5:1999 | Type X7CrNiMo17-12 | --- | --- | t ≤ 250 | --- | 205 | --- | 510-710 | --- | 30 L, 30 T | Q+T | see standard for impact data |
| JIS G 3214:1991 A1:2009 | Symbol SUS F 316H | --- | --- | t < 130 | --- | 205 | --- | 520 | --- | 43 L | ST | 187 max HB |
| | | | | 130 ≤ t ≤ 200 | --- | 205 | --- | 480 | --- | 29 L | ST | 187 max HB |
| ASME SA-182/SA-182M | Grade F 317 | S31700 | --- | t ≤ 130 | t ≤ 5 | 205 | 30 | 515 | 75 | 30 | ST+Q | --- |
| | | | | t > 130 | t > 5 | 205 | 30 | 485 | 70 | 30 | ST+Q | --- |
| ASME SA-403/SA-403M | Grade WP 317 | S31700 | --- | --- | --- | 205 | 30 | 515 | 75 | 28 L, 20 T | SA | --- |
| | Grade CR 317 | S31700 | --- | --- | --- | 205 | 30 | 515 | 75 | 28 L, 20 T | SA | --- |
| ASTM A182/A182M-15 | Grade F 317 | S31700 | --- | t ≤ 130 | t ≤ 5 | 205 | 30 | 515 | 75 | 30 | ST+Q | --- |
| | | | | t > 130 | t > 5 | 205 | 30 | 485 | 70 | 30 | ST+Q | --- |
| ASTM A403/A403M-15 | Grade WP317 | S31700 | --- | --- | --- | 205 | 30 | 515 | 75 | 28 L, 20 T | SA+Q or RC | --- |
| | Grade CR317 | S31700 | --- | --- | --- | 205 | 30 | 515 | 75 | 28 L, 20 T | SA+Q or RC | --- |
| ASTM A473-15 | Type 317 | S31700 | --- | --- | --- | 205 | 30 | 515 | 75 | 40 | SHT | --- |
| EN 10250-4:1999 | X6CrNiMoTi17-12-2 | --- | 1.4571 | t ≤ 450 | --- | 200 | --- | 500-700 | --- | 30 T | SA | see standard for impact data |
| ISO 9327-5:1999 | Type X6CrNiMoTi17-12 | --- | --- | t ≤ 450 | --- | 210 | --- | 510-710 | --- | 30 L, 30 T | Q+T | see standard for impact data |
| JIS G 3214:1991 A1:2009 | Symbol SUS F 317 | --- | --- | t < 130 | --- | 205 | --- | 520 | --- | 29 L | ST | 187 max HB |
| | | | | 130 ≤ t ≤ 200 | --- | 205 | --- | 480 | --- | 29 L | ST | 187 max HB |
| ASME SA-182/SA-182M | Grade F 317L | S31703 | --- | t ≤ 130 | t ≤ 5 | 170 | 25 | 485 | 70 | 30 | ST+Q | --- |
| | | | | t > 130 | t > 5 | 170 | 25 | 450 | 65 | 30 | ST+Q | --- |
| ASME SA-403/SA-403M | Grade WP 317L | S31703 | --- | --- | --- | 205 | 30 | 515 | 75 | 28 L, 20 T | SA | --- |
| | Grade CR 317L | S31703 | --- | --- | --- | 205 | 30 | 515 | 75 | 28 L, 20 T | SA | --- |
| ASTM A182/A182M-15 | Grade F 317L | S31703 | --- | t ≤ 130 | t ≤ 5 | 170 | 25 | 485 | 70 | 30 | ST+Q | --- |
| | | | | t > 130 | t > 5 | 170 | 25 | 450 | 65 | 30 | ST+Q | --- |
| ASTM A403/A403M-15 | Grade WP317L | S31703 | --- | --- | --- | 205 | 30 | 515 | 75 | 28 L, 20 T | SA+Q or RC | --- |
| | Grade CR317L | S31703 | --- | --- | --- | 205 | 30 | 515 | 75 | 28 L, 20 T | SA+Q or RC | --- |
| ASTM A774/A774M-14 | Grade TP 317L | S31703 | --- | 1.6 ≤ t ≤ 12.7 | 0.062 ≤ t ≤ 0.500 | 205 | 30 | 515-690 | 75-100 | 35.0 | --- | 217 max HB; 95 max HRB |
| JIS G 3214:1991 A1:2009 | Symbol SUS F 317L | --- | --- | t < 130 | --- | 175 | --- | 480 | --- | 29 L | ST | 187 max HB |
| | | | | 130 ≤ t ≤ 200 | --- | 175 | --- | 450 | --- | 29 L | ST | 187 max HB |

**6.3 Stainless Steel Forgings**

**6.3.3B Mechanical Properties of Austenitic Stainless Steel Forgings (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | % min. | | |
| ASME SA-182/SA-182M | Grade F 321 | S32100 | --- | t ≤ 130 | t ≤ 5 | 205 | 30 | 515 | 75 | 30 | ST+Q | --- |
| | | | | t > 130 | t > 5 | 205 | 30 | 485 | 70 | 30 | ST+Q | --- |
| ASME SA-403/SA-403M | Grade WP 321 | S32100 | --- | --- | --- | 205 | 30 | 515 | 75 | 28 L, 20 T | SA | --- |
| | Grade CR 321 | S32100 | --- | --- | --- | 205 | 30 | 515 | 75 | 28 L, 20 T | SA | --- |
| ASTM A182/A182M-15 | Grade F 321 | S32100 | --- | t ≤ 130 | t ≤ 5 | 205 | 30 | 515 | 75 | 30 | ST+Q | --- |
| | | | | t > 130 | t > 5 | 205 | 30 | 485 | 70 | 30 | ST+Q | --- |
| ASTM A403/A403M-15 | Grade WP321 | S32100 | --- | --- | --- | 205 | 30 | 515 | 75 | 28 L, 20 T | SA+Q or RC | --- |
| | | | | --- | t ≤ 0.375 | 205 | 30 | 515 | 75 | 28 L, 20 T | SA+Q or RC | --- |
| | | | | --- | t > 0.375 | 170 | 25 | 485 | 70 | 28 L, 20 T | SA+Q or RC | --- |
| | Grade CR321 | S32100 | --- | --- | --- | 205 | 30 | 515 | 75 | 28 L, 20 T | SA+Q or RC | --- |
| | | | | --- | t ≤ 0.375 | 205 | 30 | 515 | 75 | 28 L, 20 T | SA+Q or RC | --- |
| | | | | --- | t > 0.375 | 170 | 25 | 485 | 70 | 28 L, 20 T | SA+Q or RC | --- |
| ASTM A473-15 | Type 321 | S32100 | --- | --- | --- | 205 | 30 | 515 | 75 | 40 | SHT | --- |
| ASTM A774/A774M-14 | Grade TP 321 | S32100 | --- | 1.6 ≤ t ≤ 12.7 | 0.062 ≤ t ≤ 0.500 | 205 | 30 | 515-690 | 75-100 | 40.0 | --- | 217 max HB; 95 max HRB |
| ASTM A965/A965M-14 | Grade F321 | S32100 | --- | --- | --- | 205 | 30 | 485 | 70 | 30 | SA+Q | --- |
| EN 10222-5:1999 | X6 CrNiTi 18-10 | --- | 1.4541 | t ≤ 450 | --- | 200 | --- | 510-710 | --- | 40 L, 30 T | ST | see standard for impact data |
| EN 10250-4:1999 | X6CrNiTi18-10 | --- | 1.4541 | t ≤ 450 | --- | 190 | --- | 500-700 | --- | 30 T | SA | see standard for impact data |
| ISO 9327-5:1999 | Type X6CrNiTi18-10 | --- | --- | t ≤ 450 | --- | 200 | --- | 510-710 | --- | 30 L, 30 T | Q+T | see standard for impact data |
| JIS G 3214:1991 A1:2009 | Symbol SUS F 321 | --- | --- | t < 130 | --- | 205 | --- | 520 | --- | 43 L | ST | 187 max HB |
| | | | | 130 ≤ t ≤ 200 | --- | 205 | --- | 480 | --- | 29 L | ST | 187 max HB |
| ASME SA-182/SA-182M | Grade F 321H | S32109 | --- | t ≤ 130 | t ≤ 5 | 205 | 30 | 515 | 75 | 30 | ST+Q | --- |
| | | | | t > 130 | t > 5 | 205 | 30 | 485 | 70 | 30 | ST+Q | --- |
| ASTM A182/A182M-15 | Grade F 321H | S32109 | --- | t ≤ 130 | t ≤ 5 | 205 | 30 | 515 | 75 | 30 | ST+Q | --- |
| | | | | t > 130 | t > 5 | 205 | 30 | 485 | 70 | 30 | ST+Q | --- |
| ASTM A965/A965M-14 | Grade F321H | S32109 | --- | --- | --- | 205 | 30 | 485 | 70 | 30 | SA+Q | --- |
| ISO 9327-5:1999 | Type X7CrNiTi18-10 | --- | --- | t ≤ 450 | --- | 175 | --- | 490-690 | --- | 30 L, 30 T | Q+T | see standard for impact data |
| JIS G 3214:1991 A1:2009 | Symbol SUS F 321H | --- | --- | t < 130 | --- | 205 | --- | 520 | --- | 43 L | ST | 187 max HB |
| | | | | 130 ≤ t ≤ 200 | --- | 205 | --- | 480 | --- | 29 L | ST | 187 max HB |

### 6.3 Stainless Steel Forgings

#### 6.3.3B Mechanical Properties of Austenitic Stainless Steel Forgings (Continued)

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | % min. | | |
| ASME SA-182/SA-182M | Grade F 347 | S34700 | --- | t ≤ 130 | t ≤ 5 | 205 | 30 | 515 | 75 | 30 | ST+Q | --- |
| | | | | t > 130 | t > 5 | 205 | 30 | 485 | 70 | 30 | ST+Q | --- |
| | Grade F 348 | S34800 | --- | t ≤ 130 | t ≤ 5 | 205 | 30 | 515 | 75 | 30 | ST+Q | --- |
| | | | | t > 130 | t > 5 | 205 | 30 | 485 | 70 | 30 | ST+Q | --- |
| ASME SA-403/SA-403M | Grade WP 347 | S34700 | --- | --- | --- | 205 | 30 | 515 | 75 | 28 L, 20 T | SA | --- |
| | Grade CR 347 | S34700 | --- | --- | --- | 205 | 30 | 515 | 75 | 28 L, 20 T | SA | --- |
| ASTM A182/A182M-15 | Grade F 347 | S34700 | --- | t ≤ 130 | t ≤ 5 | 205 | 30 | 515 | 75 | 30 | ST+Q | --- |
| | | | | t > 130 | t > 5 | 205 | 30 | 485 | 70 | 30 | ST+Q | --- |
| | Grade F 348 | S34800 | --- | t ≤ 130 | t ≤ 5 | 205 | 30 | 515 | 75 | 30 | ST+Q | --- |
| | | | | t > 130 | t > 5 | 205 | 30 | 485 | 70 | 30 | ST+Q | --- |
| ASTM A403/A403M-15 | Grade WP347 | S34700 | --- | --- | --- | 205 | 30 | 515 | 75 | 28 L, 20 T | SA+Q or RC | --- |
| | Grade CR347 | S34700 | --- | --- | --- | 205 | 30 | 515 | 75 | 28 L, 20 T | SA+Q or RC | --- |
| ASTM A473-15 | Type 347 | S34700 | --- | --- | --- | 205 | 30 | 515 | 75 | 40 | SHT | --- |
| ASTM A965/A965M-14 | Grade F347 | S34700 | --- | --- | --- | 205 | 30 | 485 | 70 | 30 | SA+Q | --- |
| | Grade F348 | S34800 | --- | --- | --- | 205 | 30 | 485 | 70 | 30 | SA+Q | --- |
| EN 10222-5:1999 | X6 CrNiNb 18-10 | --- | 1.4550 | t ≤ 450 | --- | 205 | --- | 510-710 | --- | 40 L, 30 T | ST | see standard for impact data |
| ISO 9327-5:1999 | Type X6CrNiNb18-10 | --- | --- | t ≤ 450 | --- | 205 | --- | 510-710 | --- | 30 L, 30 T | Q+T | see standard for impact data |
| JIS G 3214:1991 A1:2009 | Symbol SUS F 347 | --- | --- | t < 130 | --- | 205 | --- | 520 | --- | 43 L | ST | 187 max HB |
| | | | | 130 ≤ t ≤ 200 | --- | 205 | --- | 480 | --- | 29 L | ST | 187 max HB |
| ASME SA-182/SA-182M | Grade F 347H | S34709 | --- | t ≤ 130 | t ≤ 5 | 205 | 30 | 515 | 75 | 30 | ST+Q | --- |
| | | | | t > 130 | t > 5 | 205 | 30 | 485 | 70 | 30 | ST+Q | --- |
| ASTM A182/A182M-15 | Grade F 347H | S34709 | --- | t ≤ 130 | t ≤ 5 | 205 | 30 | 515 | 75 | 30 | ST+Q | --- |
| | | | | t > 130 | t > 5 | 205 | 30 | 485 | 70 | 30 | ST+Q | --- |
| EN 10222-5:1999 | X7 CrNiNb 18-10 | --- | 1.4912 | t ≤ 450 | --- | 205 | --- | 510-710 | --- | 40 L, 30 T | ST | see standard for impact data |
| ISO 9327-5:1999 | Type X7CrNiNb18-10 | --- | --- | t ≤ 450 | --- | 205 | --- | 510-710 | --- | 30 L, 30 T | Q+T | see standard for impact data |
| JIS G 3214:1991 A1:2009 | Symbol SUS F 347H | --- | --- | t < 130 | --- | 205 | --- | 520 | --- | 43 L | ST | 187 max HB |
| | | | | 130 ≤ t ≤ 200 | --- | 205 | --- | 480 | --- | 29 L | ST | 187 max HB |
| EN 10250-4:1999 | X1NiCrMoCu25-20-5 | --- | 1.4539 | t ≤ 250 | --- | 230 | --- | 530-730 | --- | 30 T | SA | see standard for impact data |
| ISO 9327-5:1999 | Type X2NiCrMoCu25-20-5 | --- | --- | t ≤ 160 | --- | 220 | --- | 520-720 | --- | 30 L, 30 T | Q+T | see standard for impact data |

#### 6.3.4A Chemical Composition of Precipitation-Hardening Stainless Steel Forgings

| Specification | Designation | UNS No. | Steel No. | Weight, %, max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASME SA-705/SA-705M | Type 630 | S17400 | --- | 0.07 | 1.00 | 1.00 | 0.040 | 0.030 | 15.00-17.50 | 3.00-5.00 | --- | Cu 3.00-5.00; (Cb+Ta) 0.15-0.45 |
| ASTM A705/A705M-13 | Type 630 | S17400 | --- | 0.07 | 1.00 | 1.00 | 0.040 | 0.030 | 15.00-17.50 | 3.00-5.00 | --- | Cu 3.00-5.00; (Cb+Ta) 0.15-0.45 |
| EN 10250-4:1999 | X5CrNiCuNb16-4 | --- | 1.4542 | 0.07 | 1.50 | 0.70 | 0.040 | 0.030 | 15.00-17.00 | 3.00-5.00 | 0.60 | Cu 3.00-5.00; Nb 5xC to 0.45 |
| JIS G 3214:1991 A1:2009 | Symbol SUS F 630 | --- | --- | 0.07 | 1.00 | 1.00 | 0.040 | 0.030 | 15.00-17.50 | 3.00-5.00 | --- | Cu 3.00-5.00; Nb 0.15-0.45 |

**6.3 Stainless Steel Forgings**

**6.3.4B Mechanical Properties of Precipitation-Hardening Stainless Steel Forgings**

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | % min. | | |
| ASME SA-705/SA-705M | Type 630 | S17400 | --- | --- | --- | --- | --- | --- | --- | --- | ST | 363 max HB; 38 max HRC |
| | | | | t ≤ 75 | t ≤ 3 | 1170 | 170 | 1310 | 190 | 10 L | AH | 388 min HB; 40 min HRC |
| | | | | t ≤ 75 | t ≤ 3 | 1070 | 155 | 1170 | 170 | 10 L | AH | 375 min HB; 38 min HRC; L: 6.8 J @ RT |
| | | | | t ≤ 200 | t ≤ 8 | 1000 | 145 | 1070 | 155 | 12 L | AH | 331 min HB; 35 min HRC; L: 20 J @ RT |
| | | | | t ≤ 200 | t ≤ 8 | 860 | 125 | 1000 | 145 | 13 L | AH | 311 min HB; 32 min HRC; L: 27 J @ RT |
| | | | | t ≤ 200 | t ≤ 8 | 795 | 115 | 965 | 140 | 14 L | AH | 302 min HB; 31 min HRC; L: 34 J @ RT |
| | | | | t ≤ 200 | t ≤ 8 | 725 | 105 | 930 | 135 | 16 L | AH | 277 min HB; 28 min HRC; L: 41 J @ RT |
| | | | | t ≤ 200 | t ≤ 8 | 520 | 75 | 795 | 115 | 18 L | AH | 255 min HB; 24 min HRC; L: 75 J @ RT |
| ASTM A705/A705M-13 | Type 630 | S17400 | --- | --- | --- | --- | --- | --- | --- | --- | ST | 363 max HB; 38 max HRC |
| | | | | t ≤ 75 | t ≤ 3 | 1170 | 170 | 1310 | 190 | 10 L | AH | 388 min HB; 40 min HRC |
| | | | | t ≤ 75 | t ≤ 3 | 1070 | 155 | 1170 | 170 | 10 L | AH | 375 min HB; 38 min HRC; L: 6.8 J @ RT |
| | | | | t ≤ 200 | t ≤ 8 | 1000 | 145 | 1070 | 155 | 12 L | AH | 331 min HB; 35 min HRC; L: 20 J @ RT |
| | | | | t ≤ 200 | t ≤ 8 | 860 | 125 | 1000 | 145 | 13 L | AH | 311 min HB; 32 min HRC; L: 27 J @ RT |
| | | | | t ≤ 200 | t ≤ 8 | 795 | 115 | 965 | 140 | 14 L | AH | 302 min HB; 31 min HRC; L: 34 J @ RT |
| | | | | t ≤ 200 | t ≤ 8 | 725 | 105 | 930 | 135 | 16 L | AH | 277 min HB; 28 min HRC; L: 41 J @ RT |
| | | | | t ≤ 200 | t ≤ 8 | 520 | 75 | 795 | 115 | 18 L | AH | 255 min HB; 24 min HRC; L: 75 J @ RT |
| EN 10250-4:1999 | X5CrNiCuNb16-4 | --- | 1.4542 | --- | --- | --- | --- | 1200 max. | --- | --- | A | 360 max HB |
| | | | | t ≤ 250 | --- | 720 | --- | 930 | --- | 15 L, 12 T | PH | see standard for impact data |
| | | | | t ≤ 250 | --- | 1000 | --- | 1070 | --- | 12 L, 10 T | PH | |
| | | | | t ≤ 250 | --- | 1150 | --- | 1300 | --- | 8 L, 6 T | PH | --- |
| JIS G 3214:1991 A1:2009 | Symbol SUS F 630 | --- | --- | t ≤ 200 | --- | 860 | --- | 1000 | --- | 12 L | HT | 311 min HBW; 27 J @ RT |
| | | | | t ≤ 200 | --- | 795 | --- | 970 | --- | 13 L | HT | 302 min HBW; 34 J @ RT |
| | | | | t ≤ 200 | --- | 725 | --- | 930 | --- | 15 L | HT | 277 min HBW; 41 J @ RT |

**6.3 Stainless Steel Forgings**

**6.3.5A Chemical Composition of Duplex (Ferritic-Austenitic) Stainless Steel Forgings**

| Specification | Designation | UNS No. | Steel No. | Weight, %, max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASME SA-182/SA-182M | Grade F 50 | S31200 | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 24.0-26.0 | 5.5-6.5 | 1.20-2.00 | N 0.14-0.20 |
| ASTM A182/A182M-15 | Grade F 50 | S31200 | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 24.0-26.0 | 5.5-6.5 | 1.20-2.00 | N 0.14-0.20 |
| EN 10250-4:1999 | X3CrNiMoN27-5-2 | --- | 1.4460 | 0.05 | 2.00 | 1.00 | 0.035 | 0.030 | 25.00-28.00 | 4.50-6.50 | 1.30-2.00 | N 0.05-0.20 |
| ASME SA-182/SA-182M | Grade F 51 | S31803 | --- | 0.030 | 2.00 | 1.00 | 0.030 | 0.020 | 21.0-23.0 | 4.5-6.5 | 2.5-3.5 | N 0.08-0.20 |
| | Grade F 60 | S32205 | --- | 0.030 | 2.00 | 1.00 | 0.030 | 0.020 | 22.0-23.0 | 4.5-6.5 | 3.0-3.5 | N 0.14-0.20 |
| ASME SA-815/SA-815M | Grade WPS31803 | S31803 | --- | 0.030 | 2.00 | 1.0 | 0.030 | 0.020 | 21.0-23.0 | 4.5-6.5 | 2.5-3.5 | N 0.08-0.20 |
| | Grade CRS31803 | S31803 | --- | 0.030 | 2.00 | 1.0 | 0.030 | 0.020 | 21.0-23.0 | 4.5-6.5 | 2.5-3.5 | N 0.08-0.20 |
| | Grade WPS32205 | S32205 | --- | 0.030 | 2.00 | 1.00 | 0.030 | 0.020 | 22.0-23.0 | 4.5-6.5 | 3.0-3.5 | N 0.14-0.20 |
| | Grade CRS32205 | S32205 | --- | 0.030 | 2.00 | 1.00 | 0.030 | 0.020 | 22.0-23.0 | 4.5-6.5 | 3.0-3.5 | N 0.14-0.20 |
| ASTM A182/A182M-15 | Grade F 51 | S31803 | --- | 0.030 | 2.00 | 1.00 | 0.030 | 0.020 | 21.0-23.0 | 4.5-6.5 | 2.5-3.5 | N 0.08-0.20 |
| | Grade F 60 | S32205 | --- | 0.030 | 2.00 | 1.00 | 0.030 | 0.020 | 22.0-23.0 | 4.5-6.5 | 3.0-3.5 | N 0.14-0.20 |
| ASTM A815/A815M-14 | Grade WPS31803 | S31803 | --- | 0.030 | 2.00 | 1.0 | 0.030 | 0.020 | 21.0-23.0 | 4.5-6.5 | 2.5-3.5 | N 0.08-0.20 |
| | Grade CRS31803 | S31803 | --- | 0.030 | 2.00 | 1.0 | 0.030 | 0.020 | 21.0-23.0 | 4.5-6.5 | 2.5-3.5 | N 0.08-0.20 |
| | Grade WPS32205 | S32205 | --- | 0.030 | 2.00 | 1.00 | 0.030 | 0.020 | 22.0-23.0 | 4.5-6.5 | 3.0-3.5 | N 0.14-0.20 |
| | Grade CRS32205 | S32205 | --- | 0.030 | 2.00 | 1.00 | 0.030 | 0.020 | 22.0-23.0 | 4.5-6.5 | 3.0-3.5 | N 0.14-0.20 |
| EN 10222-5:1999 | X2 CrNiMoN 22-5-3 | --- | 1.4462 | 0.030 | 2.00 | 1.00 | 0.035 | 0.015 | 21.00-23.00 | 4.50-6.50 | 2.50-3.50 | N 0.10-0.22 |
| EN 10250-4:1999 | X2CrNiMoN22-5-3 | --- | 1.4462 | 0.030 | 2.00 | 1.00 | 0.035 | 0.015 | 21.00-23.00 | 4.50-6.50 | 2.50-3.50 | N 0.10-0.22 |
| ISO 9327-5:1999 | Type X2CrNiMoN22-5-3 | --- | --- | 0.030 | 2.00 | 1.00 | 0.035 | 0.020 | 21.00-23.00 | 4.50-6.50 | 2.50-3.50 | N 0.08-0.20 |
| ASME SA-182/SA-182M | Grade F 53 | S32750 | --- | 0.030 | 1.20 | 0.80 | 0.035 | 0.020 | 24.0-26.0 | 6.0-8.0 | 3.0-5.0 | Cu 0.50; N 0.24-0.32 |
| ASME SA-815/SA-815M | Grade WPS32750 | S32750 | --- | 0.030 | 1.20 | 0.8 | 0.035 | 0.020 | 24.0-26.0 | 6.0-8.0 | 3.0-5.0 | Cu 0.5; N 0.24-0.32 |
| | Grade CRS32750 | S32750 | --- | 0.030 | 1.20 | 0.8 | 0.035 | 0.020 | 24.0-26.0 | 6.0-8.0 | 3.0-5.0 | Cu 0.5; N 0.24-0.32 |
| ASTM A182/A182M-15 | Grade F 53 | S32750 | --- | 0.030 | 1.20 | 0.80 | 0.035 | 0.020 | 24.0-26.0 | 6.0-8.0 | 3.0-5.0 | Cu 0.50; N 0.24-0.32 |
| ASTM A815/A815M-14 | Grade WPS32750 | S32750 | --- | 0.030 | 1.20 | 0.8 | 0.035 | 0.020 | 24.0-26.0 | 6.0-8.0 | 3.0-5.0 | Cu 0.5; N 0.24-0.32 |
| | Grade CRS32750 | S32750 | --- | 0.030 | 1.20 | 0.8 | 0.035 | 0.020 | 24.0-26.0 | 6.0-8.0 | 3.0-5.0 | Cu 0.5; N 0.24-0.32 |
| EN 10222-5:1999 | X2 CrNiMoN 25-7-4 | --- | 1.4410 | 0.030 | 2.00 | 1.00 | 0.035 | 0.015 | 24.00-26.00 | 6.00-8.00 | 3.00-4.50 | N 0.20-0.35 |
| EN 10250-4:1999 | X2CrNiMoN25-7-4 | --- | 1.4410 | 0.030 | 2.00 | 1.00 | 0.035 | 0.015 | 24.00-26.00 | 6.00-8.00 | 3.00-4.50 | N 0.20-0.35 |

**6.3 Stainless Steel Forgings**

**6.3.5A Chemical Composition of Duplex (Ferritic-Austenitic) Stainless Steel Forgings (Continued)**

| Specification | Designation | UNS No. | Steel No. | Weight, %, max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASME SA-182/SA-182M | Grade F 55 | S32760 | --- | 0.030 | 1.00 | 1.00 | 0.030 | 0.010 | 24.0-26.0 | 6.0-8.0 | 3.0-4.0 | Cu 0.50-1.00; W 0.50-1.00; N 0.20-0.30; [Cr+(3.3xMo)+(16xN)] 0.40 min. |
| ASME SA-815/SA-815M | Grade WPS32760 | S32760 | --- | 0.030 | 1.00 | 1.00 | 0.030 | 0.010 | 24.0-26.0 | 6.0-8.0 | 3.0-4.0 | Cu 0.50-1.00; W 0.50-1.00; N 0.20-0.30; [Cr+(3.3xMo)+(16xN)] 0.40 min. |
| | Grade CRS32760 | S32760 | --- | 0.030 | 1.00 | 1.00 | 0.030 | 0.010 | 24.0-26.0 | 6.0-8.0 | 3.0-4.0 | Cu 0.50-1.00; W 0.50-1.00; N 0.20-0.30; [Cr+(3.3xMo)+(16xN)] 0.40 min. |
| ASTM A182/A182M-15 | Grade F 55 | S32760 | --- | 0.030 | 1.00 | 1.00 | 0.030 | 0.010 | 24.0-26.0 | 6.0-8.0 | 3.0-4.0 | Cu 0.50-1.00; W 0.50-1.00; N 0.20-0.30; [Cr+(3.3xMo)+(16xN)] 0.40 min. |
| ASTM A473-15 | --- | S32760 | --- | 0.030 | 1.00 | 1.00 | 0.030 | 0.010 | 24.0-26.0 | 6.0-8.0 | 3.0-4.0 | Cu 0.50-1.00; W 0.50-1.00; N 0.20-0.30; [Cr+(3.3xMo)+(16xN)] 0.40 min. |
| ASTM A815/A815M-14 | Grade WPS32760 | S32760 | --- | 0.030 | 1.00 | 1.00 | 0.030 | 0.010 | 24.0-26.0 | 6.0-8.0 | 3.0-4.0 | Cu 0.50-1.00; W 0.50-1.00; N 0.20-0.30; [Cr+(3.3xMo)+(16xN)] 0.40 min. |
| | Grade CRS32760 | S32760 | --- | 0.030 | 1.00 | 1.00 | 0.030 | 0.010 | 24.0-26.0 | 6.0-8.0 | 3.0-4.0 | Cu 0.50-1.00; W 0.50-1.00; N 0.20-0.30; [Cr+(3.3xMo)+(16xN)] 0.40 min. |
| EN 10250-4:1999 | X2CrNiMoCuWN25-7-4 | --- | 1.4501 | 0.030 | 1.00 | 1.00 | 0.035 | 0.015 | 24.00-26.00 | 6.00-8.00 | 3.00-4.00 | Cu 0.50-1.00; W 0.50-1.00; N 0.20-0.30 |
| ASME SA-182/SA-182M | Grade F 59 | S32520 | --- | 0.030 | 1.50 | 0.80 | 0.035 | 0.020 | 24.0-26.0 | 5.5-8.0 | 3.0-5.0 | Cu 0.50-3.00; N 0.20-0.35 |
| ASTM A182/A182M-15 | Grade F 59 | S32520 | --- | 0.030 | 1.50 | 0.80 | 0.035 | 0.020 | 24.0-26.0 | 5.5-8.0 | 3.0-5.0 | Cu 0.50-3.00; N 0.20-0.35 |
| ASTM A473-15 | --- | S32550 | --- | 0.04 | 1.50 | 1.00 | 0.040 | 0.030 | 24.0-27.0 | 4.5-6.5 | 2.9-3.9 | Cu 1.50-2.50; N 0.10-0.25; [Cr+(3.3xMo)+(16xN)] 0.40 min. |
| EN 10250-4:1999 | X2CrNiMoCuN25-6-3 | --- | 1.4507 | 0.030 | 2.00 | 0.70 | 0.035 | 0.015 | 24.00-26.00 | 5.50-7.50 | 2.70-4.00 | Cu 1.00-2.50; N 0.15-0.30 |
| EN 10250-4:1999 | X2CrNiN23-4 | --- | 1.4362 | 0.030 | 2.00 | 1.00 | 0.035 | 0.015 | 22.00-24.00 | 3.50-5.50 | 0.10-0.60 | Cu 0.10-0.60; N 0.05-0.20 |
| ISO 9327-5:1999 | Type X2CrNiN23-4 | --- | --- | 0.030 | 2.50 | 1.00 | 0.035 | 0.020 | 22.00-24.00 | 3.50-5.00 | 0.60 | Cu 0.60; N 0.05-0.20 |

**6.3 Stainless Steel Forgings**

**6.3.5B Mechanical Properties of Duplex (Ferritic-Austenitic) Stainless Steel Forgings**

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | % min. | | |
| ASME SA-182/SA-182M | Grade F 50 | S31200 | --- | --- | --- | 450 | 65 | 690-900 | 100-130 | 25 | ST+Q | --- |
| ASTM A182/A182M-15 | Grade F 50 | S31200 | --- | --- | --- | 450 | 65 | 690-900 | 100-130 | 25 | ST+Q | --- |
| EN 10250-4:1999 | X3CrNiMoN27-5-2 | --- | 1.4460 | t ≤ 160 | --- | 460 | --- | 620-880 | --- | 20 L, 15 T | SA | see standard for impact data |
| ASME SA-182/SA-182M | Grade F 51 | S31803 | --- | --- | --- | 450 | 65 | 620 | 90 | 25 | ST+Q | --- |
| | Grade F 60 | S32205 | --- | --- | --- | 450 | 65 | 655 | 95 | 25 | ST+Q | --- |
| ASME SA-815/SA-815M | Grade WPS31803 | S31803 | --- | --- | --- | 450 | 65 | 620 | 90 | 20.0 | HT+Q or RC | 290 max HBW |
| | Grade CRS31803 | S31803 | --- | --- | --- | 450 | 65 | 620 | 90 | 20.0 | HT+Q or RC | 290 max HBW |
| | Grade WPS32205 | S32205 | --- | --- | --- | 450 | 65 | 655 | 95 | 20.0 | HT+Q | 290 max HBW |
| | Grade CRS32205 | S32205 | --- | --- | --- | 450 | 65 | 655 | 95 | 20.0 | HT+Q | 290 max HBW |
| ASTM A182/A182M-15 | Grade F 51 | S31803 | --- | --- | --- | 450 | 65 | 620 | 90 | 25 | ST+Q | --- |
| | Grade F 60 | S32205 | --- | --- | --- | 450 | 65 | 655 | 95 | 25 | ST+Q | --- |
| ASTM A815/A815M-14 | Grade WPS31803 | S31803 | --- | --- | --- | 450 | 65 | 620 | 90 | 20.0 | HT+Q or RC | 290 max HBW |
| | Grade CRS31803 | S31803 | --- | --- | --- | 450 | 65 | 620 | 90 | 20.0 | HT+Q or RC | 290 max HBW |
| | Grade WPS32205 | S32205 | --- | --- | --- | 450 | 65 | 655 | 95 | 20.0 | HT+Q | 290 max HBW |
| | Grade CRS32205 | S32205 | --- | --- | --- | 450 | 65 | 655 | 95 | 20.0 | HT+Q | 290 max HBW |
| EN 10222-5:1999 | X2 CrNiMoN 22-5-3 | --- | 1.4462 | t ≤ 350 | --- | 450 | --- | 680-880 | --- | 30 L, 25 T | ST | see standard for impact data |
| EN 10250-4:1999 | X2CrNiMoN22-5-3 | --- | 1.4462 | t ≤ 350 | --- | 450 | --- | 650-880 | --- | 25 L, 20 T | SA | see standard for impact data |
| ISO 9327-5:1999 | Type X2CrNiMoN22-5-3 | --- | --- | t ≤ 250 | --- | 450 | --- | 600-860 | --- | 25 L, 20 T | Q+T | see standard for impact data |
| ASME SA-182/SA-182M | Grade F 53 | S32750 | --- | t ≤ 50 | t ≤ 2 | 550 | 80 | 800 | 116 | 15 | ST+Q | 310 max HBW |
| | | | | t > 50 | t > 2 | 515 | 75 | 730 | 106 | 15 | ST+Q | 310 max HBW |
| ASME SA-815/SA-815M | Grade WPS32750 | S32750 | --- | --- | --- | 550 | 80 | 800-965 | 116-140 | 15.0 | HT+Q or RC | 310 max HBW |
| | Grade CRS32750 | S32750 | --- | --- | --- | 550 | 80 | 800-965 | 116-140 | 15.0 | HT+Q or RC | 310 max HBW |
| ASTM A182/A182M-15 | Grade F 53 | S32750 | --- | t ≤ 50 | t ≤ 2 | 550 | 80 | 800 | 116 | 15 | ST+Q | 310 max HBW |
| | | | | t > 50 | t > 2 | 515 | 75 | 730 | 106 | 15 | ST+Q | 310 max HBW |
| ASTM A815/A815M-14 | Grade WPS32750 | S32750 | --- | --- | --- | 550 | 80 | 800-965 | 116-140 | 15.0 | HT+Q or RC | 310 max HBW |
| | Grade CRS32750 | S32750 | --- | --- | --- | 550 | 80 | 800-965 | 116-140 | 15.0 | HT+Q or RC | 310 max HBW |
| EN 10222-5:1999 | X2 CrNiMoN 25-7-4 | --- | 1.4410 | t ≤ 160 | --- | 500 | --- | 800-1000 | --- | 30 L, 25 T | ST | see standard for impact data |
| EN 10250-4:1999 | X2CrNiMoN25-7-4 | --- | 1.4410 | t ≤ 160 | --- | 530 | --- | 730-930 | --- | 25 L, 20 T | SA | see standard for impact data |

**6.3 Stainless Steel Forgings**

**6.3.5B Mechanical Properties of Duplex (Ferritic-Austenitic) Stainless Steel Forgings (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness/Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | % min. | | |
| ASME SA-182/SA-182M | Grade F 55 | S32760 | --- | --- | --- | 550 | 80 | 750-895 | 109-130 | 25 | ST+Q | --- |
| ASME SA-815/SA-815M | Grade WPS32760 | S32760 | --- | --- | --- | 550 | 80 | 750-895 | 109-130 | 25.0 | HT+Q or RC | 270 max HBW |
| | Grade CRS32760 | S32760 | --- | --- | --- | 550 | 80 | 750-895 | 109-130 | 25.0 | HT+Q or RC | 270 max HBW |
| ASTM A182/A182M-15 | Grade F 55 | S32760 | --- | --- | --- | 550 | 80 | 750-895 | 109-130 | 25 | ST+Q | --- |
| ASTM A473-15 | --- | S32760 | --- | --- | --- | 550 | 80 | 750 | 109 | 25 | A | 290 max HB |
| ASTM A815/A815M-14 | Grade WPS32760 | S32760 | --- | --- | --- | 550 | 80 | 750-895 | 109-130 | 25.0 | HT+Q or RC | 270 max HBW |
| | Grade CRS32760 | S32760 | --- | --- | --- | 550 | 80 | 750-895 | 109-130 | 25.0 | HT+Q or RC | 270 max HBW |
| EN 10250-4:1999 | X2CrNiMoCuWN25-7-4 | --- | 1.4501 | t ≤ 160 | --- | 530 | --- | 730-930 | --- | 25 L, 20 T | SA | see standard for impact data |
| ASME SA-182/SA-182M | Grade F 59 | S32520 | --- | --- | --- | 550 | 80 | 770 | 112 | 25 | ST+Q | --- |
| ASTM A182/A182M-15 | Grade F 59 | S32520 | --- | --- | --- | 550 | 80 | 770 | 112 | 25 | ST+Q | --- |
| ASTM A473-15 | --- | S32550 | --- | --- | --- | 550 | 80 | 750 | 109 | 25.0 | A+Q or RC | 290 max HB |
| EN 10250-4:1999 | X2CrNiMoCuN25-6-3 | --- | 1.4507 | t ≤ 160 | --- | 500 | --- | 700-900 | --- | 25 L, 20 T | SA | see standard for impact data |
| EN 10250-4:1999 | X2CrNiN23-4 | --- | 1.4362 | t ≤ 160 | --- | 400 | --- | 600-830 | --- | 25 L, 20 T | SA | see standard for impact data |
| ISO 9327-5:1999 | Type X2CrNiN23-4 | --- | --- | t ≤ 160 | --- | 400 | --- | 600-820 | --- | 25 L, 20 T | Q+T | see standard for impact data |

# Chapter 7

# *STEEL CASTINGS*

### AFNOR Standards

| | |
|---|---|
| AFNOR NF A 32-058:1984 | Cast Steels and White Cast Iron Resistant to Abrasion |

### ASME Standards

| | |
|---|---|
| ASME SA-216/SA-216M | Steel Castings, Carbon, Suitable for Fusion Welding for High-Temperature Service |
| ASME SA-217/SA-217M | Steel Castings, Martensitic Stainless and Alloy, for Pressure-Containing Parts, Suitable for High-Temperature Service |
| ASME SA-351/SA-351 | Castings, Austenitic, Austenitic-Ferritic (Duplex), for Pressure-Containing Parts |
| ASME SA-352/SA-352M | Steel Castings, Ferritic and Martensitic, for Pressure-Containing Parts, Suitable for Low-Temperature Service |
| ASME SA-487/SA-487M | Steel Castings Suitable for Pressure Service |

### ASTM Standards

| | |
|---|---|
| ASTM A27/A27M-13 | Steel Castings, Carbon, for General Application |
| ASTM A128/A128M-93 (2012) | Steel Castings, Austenitic Manganese |
| ASTM A148/A148 M-14 | Steel Castings, High Strength, for Structural Purposes |
| ASTM A216/A216M-14e1 | Steel Castings, Carbon, Suitable for Fusion Welding, for High-Temperature Service |
| ASTM A217/A217M-14 | Steel Castings, Martensitic Stainless and Alloy, for Pressure- Containing Parts, Suitable for High-Temperature Service |
| ASTM A297/A297M-14 | Steel Castings, Iron-Chromium and Iron-Chromium-Nickel, Heat Resistant, for General Application<br>*Note: Mechanical properties data are supplementary requirements, provided for information only.* |
| ASTM A351/A351M-14 | Castings, Austenitic, for Pressure-Containing Parts |
| ASTM A352/A352M-06 (2012) | Steel Castings, Ferritic and Martensitic, for Pressure-Containing Parts, Suitable for Low-Temperature Service |
| ASTM A389/A389M-13 | Steel Castings, Alloy, Specially Heat-Treated, for Pressure-Containing Parts, Suitable for High-Temperature Service |
| ASTM A447/A447M-11 | Steel Castings, Chromium-Nickel-Iron Alloy (25-12 Class), for High-Temperature Service |
| ASTM A487/A487M-14 | Steel Castings Suitable for Pressure Service |
| ASTM A608/A608M-14 | Centrifugally Cast Iron-Chromium-Nickel High-Alloy Tubing for Pressure Application at High Temperatures<br>*Note: Mechanical properties data are supplementary requirements, provided for information only.* |
| ASTM A743/A743M-13ae1 | Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion Resistant, for General Application<br>*Note: Mechanical properties data are supplementary requirements, provided for information only.* |
| ASTM A744/A744M-13 | Castings, Iron-Chromium-Nickel, Corrosion Resistant, for Severe Service<br>*Note: Mechanical properties data are supplementary requirements, provided for information only.* |
| ASTM A757/A757M-15 | Steel Castings, Ferritic and Martensitic, for Pressure-Containing and Other Applications, for Low-Temperature Service |
| ASTM A958/A958M-14 | Steel Castings, Carbon and Alloy, with Tensile Requirements, Chemical Requirements Similar to Standard Wrought Grades |

### EN Standards

| | |
|---|---|
| EN 10213:2007 C1:2008 | Steel castings for pressure purposes |
| EN 10283:2010 | Corrosion resistant steel castings |
| EN 10293:2015 | Steel castings – Steel castings for general engineering uses |
| EN 10295:2002 | Heat resistant steel castings |

### GB Standards

| | |
|---|---|
| GB/T 5680-1998 | Austenitic Manganese Steel Castings |
| GB 7659-87 | Carbon Steel Castings Suitable for Welded Structure |
| GB 11352-89 | Carbon Steel Castings for General Engineering Purposes |
| GB/T 14408-93 | Low Alloy Steel Castings for General Engineering and Structural Purposes |
| GB/T 16253-1996 | Steel Castings for Pressure Purposes |

### ISO Standards

| | |
|---|---|
| ISO 3755:1991 | Cast Carbon Steels for General Engineering Purposes |
| ISO 4991:1994 | Steel Castings for Pressure Purposes |
| ISO 9477:1992 | High Strength Cast Steels for General Engineering and Structural Purposes |
| ISO 11972:1998 | Corrosion-Resistant Cast Steels for General Applications |
| ISO 11973:1999 | Heat-Resistant Cast Steels and Alloys for General Applications |
| ISO 13521:1999 | Austenitic Manganese Steel Castings |
| ISO 14737:2003 | Cast Non-Alloy and Low Alloy Steels for General Applications |

### JIS Standards

| | |
|---|---|
| JIS G 5101:1991 | Carbon steel castings |
| JIS G 5102:1991 | Steel castings for welded structure |
| JIS G 5111:1991 | High tensile strength carbon steel castings and low alloy steel castings for structural purposes |
| JIS G 5121:2003 | Corrosion-resistant cast steels for general applications |
| JIS G 5122:2003 | Heat-resistant cast steels and alloys for general applications |
| JIS G 5131:2008 | High manganese steel castings |
| JIS G 5151:1991 | Steel castings for high temperature and high pressure service |
| JIS G 5152:1991 | Steel castings for low temperature and high pressure service |

### Heat Treatment Terms Applicable to this Chapter

| Standard | Heat Treatment Terms |
|---|---|
| AFNOR NF A 32-058:1984 | Q: water quenched |
| ASME SA-216/SA-216M | A: annealed; N: normalized; N+T: normalized and tempered |
| ASME SA-217/SA-217M | N+T: normalized and tempered |
| ASME SA-351/SA-351 | Q: quenched; AC: as-cast |
| ASME SA-352/SA-352M | N+T: normalized and tempered; Q+T: quenched and tempered |
| ASME SA-487/SA-487M | N+T: normalized and tempered; Q+T: quenched and tempered |
| ASTM A27/A27M-13 | FA: full annealed; N: normalized; N+T: normalized and tempered; Q+T: quenched and tempered |
| ASTM A128/A128M-93 (2012) | Q: quenched |
| ASTM A148/A148 M-14 | FA: full annealed; N: normalized; N+T: normalized and tempered; Q+T: quenched and tempered |
| ASTM A216/A216M-14e1 | A: annealed; N: normalized; N+T: normalized and tempered |
| ASTM A217/A217M-14 | N+T: normalized and tempered |
| ASTM A297/A297M-14 | AC: as cast; BA: by agreement |
| ASTM A351/A351M-14 | Q: quenched; AC: as-cast |
| ASTM A352/A352M-06 (2012) | N+T: normalized and tempered; Q+T: quenched and tempered |
| ASTM A389/A389M-13 | N+T: normalized and tempered |
| ASTM A447/A447M-11 | --- |
| ASTM A487/A487M-14 | N+T: normalized and tempered; Q+T: quenched and tempered |
| ASTM A608/A608M-14 | --- |
| ASTM A743/A743M-13ae1 | A: annealed; N+T: normalized and tempered; Q: quenched; AC: as-cast |
| ASTM A744/A744M-13 | Q: quenched |
| ASTM A757/A757M-15 | N+T: normalized and tempered; Q+T: quenched and tempered |
| ASTM A958/A958M-14 | N: normalized; N+T: normalized and tempered; HT+Q+T: heat treated and quenched, then tempered |
| EN 10213:2007 C1:2008 | N: normalized; Q+T: quenched and tempered; SA+Q: solution annealed and water quenched |
| EN 10283:2010 | Q+T: quenched and tempered; SA+Q: solution annealed and water quenched |
| EN 10293:2015 | N: normalized; Q+T: quenched and tempered |
| EN 10295:2002 | A: annealed |
| GB/T 5680-1998 | Q: water quenched |
| GB 7659-87 | A: annealed; N: normalized; N+T: normalized and tempered |
| GB 11352-89 | A: annealed; N: normalized; N+T: normalized and tempered; Q+T: quenched and tempered |
| GB/T 14408-93 | A: annealed; N: normalized; N+T: normalized and tempered; Q+T: quenched and tempered |
| GB/T 16253-1996 | A: annealed; N: normalized; N+T: normalized and tempered; Q+T: quenched and tempered; N+C(A)+T: normalized and rapid air cooled and tempered; ST: solution treated |
| ISO 3755:1991 | AM: at discretion of the manufacturer |
| ISO 4991:1994 | A: annealed; N: normalized; N+T: normalized and tempered; Q+T: quenched and tempered; ST: solution treated |
| ISO 9477:1992 | AM: at discretion of the manufacturer |
| ISO 11972:1998 | N+T: normalized and tempered; ST+Q: solution treated and quenched |
| ISO 11973:1999 | A: annealed; AC: as-cast |
| ISO 13521:1999 | ST+Q: solution treated and water quenched |
| JIS G 5101:1991 | A: annealed; N: normalized; N+T: normalized and tempered; Q+T: quenched and tempered |
| JIS G 5102:1991 | A: annealed; N: normalized; N+T: normalized and tempered; Q+T: quenched and tempered |
| JIS G 5111:1991 | N+T: normalized and tempered; Q+T: quenched and tempered |
| JIS G 5121:2003 | Q+T: quenched and tempered; ST: solution treated |
| JIS G 5122:2003 | A: annealed; AC: as cast; BA: by agreement |
| JIS G 5131:2008 | Q: water toughened |
| JIS G 5151:1991 | A: annealed; N: normalized; N+T: normalized and tempered; Q+T: quenched and tempered |
| JIS G 5152:1991 | A: annealed; N: normalized; N+T: normalized and tempered; Q+T: quenched and tempered |

### Impact Testing Notes Applicable to this Chapter

see standard for impact data: impact testing requirements are listed in the standard for multiple test temperatures.

## 7.1 Cast Carbon Steels

### 7.1.1A Mechanical Properties of Cast Carbon Steel for General and Structural Applications

| Specification | Designation | UNS No. | Steel No. | Section Thickness, mm | Yield Strength, min. MPa | Yield Strength, min. ksi | Tensile Strength, min. MPa | Tensile Strength, min. ksi | Elongation % min. | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|
| JIS G 5101:1991 | Class SC 360 | --- | --- | --- | 175 | --- | 360 | --- | 23 | A, N, N+T or Q+T | --- |
| EN 10293:2015 | GE200 | --- | 1.0420 | t ≤ 300 | 200 | --- | 380-530 | --- | 25 | N | 27 J @ RT |
| | GS200 | --- | 1.0449 | t ≤ 100 | 200 | --- | 380-530 | --- | 25 | N | 35 J @ RT |
| GB 11352-89 | Grade ZG 200-400 | --- | --- | t ≤ 100 | 200 | --- | 400 | --- | 25 | A, N, N+T or Q+T | 30 J @ RT |
| GB 7659-87 | Grade ZG200-400H | --- | --- | --- | 200 | --- | 400 | --- | 25 | A, N or N+T | see standard for impact data |
| ISO 3755:1991 | Grade 200-400 | --- | --- | t ≤ 28 | 200 | --- | 400-550 | --- | 25 | AM | 30 J @ 23°C ± 5 |
| | Grade 200-400W | --- | --- | t ≤ 28 | 200 | --- | 400-550 | --- | 25 | AM | 45 J @ 23°C ± 5 |
| JIS G 5101:1991 | Class SC 410 | --- | --- | --- | 205 | --- | 410 | --- | 21 | A, N, N+T or Q+T | --- |
| JIS G 5102:1991 | Class SCW 410 | --- | --- | --- | 235 | --- | 410 | --- | 21 | A, N, N+T or Q+T | 27 J @ 0°C |
| ASTM A27/A27M-13 | Grade 60-30 [415-205] | J03000 | --- | --- | 205 | 30 | 415 | 60 | 24 | FA, N, N+T or Q+T | --- |
| | Grade U-60-30 [415-205] | J02500 | --- | --- | 205 | 30 | 415 | 60 | 22 | --- | --- |
| JIS G 5101:1991 | Class SC 450 | --- | --- | --- | 225 | --- | 450 | --- | 19 | A, N, N+T or Q+T | --- |
| GB 11352-89 | Grade ZG 230-450 | --- | --- | t ≤ 100 | 230 | --- | 450 | --- | 22 | A, N, N+T or Q+T | 25 J @ RT |
| GB 7659-87 | Grade ZG230-450H | --- | --- | --- | 230 | --- | 450 | --- | 22 | A, N or N+T | see standard for impact data |
| ISO 3755:1991 | Grade 230-450 | --- | --- | t ≤ 28 | 230 | --- | 450-600 | --- | 22 | AM | 25 J @ 23°C ± 5 |
| | Grade 230-450W | --- | --- | t ≤ 28 | 230 | --- | 450-600 | --- | 22 | AM | 45 J @ 23°C ± 5 |
| ASTM A27/A27M-13 | Grade 65-35 [450-240] | J03001 | --- | --- | 240 | 35 | 450 | 65 | 24 | FA, N, N+T or Q+T | --- |
| ASTM A958/A958M-14 | Grade SC 1020, Class 65/35 | J02003 | --- | --- | 240 | 35 | 450 | 65 | 24 | N | --- |
| | Grade SC 1025, Class 65/35 | J02508 | --- | --- | 240 | 35 | 450 | 65 | 24 | N | --- |
| | Grade SC 1030, Class 65/35 | J03012 | --- | --- | 240 | 35 | 450 | 65 | 24 | N | --- |
| EN 10293:2015 | GE240 | --- | 1.0446 | t ≤ 300 | 240 | --- | 450-600 | --- | 22 | N | 27 J @ RT |
| | GS240 | --- | 1.0455 | t ≤ 100 | 240 | --- | 450-600 | --- | 22 | N | 31 J @ RT |
| | G17Mn5 | --- | 1.1131 | t ≤ 50 | 240 | --- | 450-600 | --- | 24 | Q+T | see standard for impact data |
| JIS G 5102:1991 | Class SCW 450 | --- | --- | --- | 255 | --- | 450 | --- | 20 | A, N, N+T or Q+T | 27 J @ 0°C |

**7.1 Cast Carbon Steels**

**7.1.1A Mechanical Properties of Cast Carbon Steel for General and Structural Applications (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness, mm | Yield Strength, min. MPa | Yield Strength, min. ksi | Tensile Strength, min. MPa | Tensile Strength, min. ksi | Elongation % min. | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|
| JIS G 5101:1991 | Class SC 480 | --- | --- | --- | 245 | --- | 480 | --- | 17 | A, N, N+T or Q+T | --- |
| GB/T 14408-93 | Grade ZGD270-480 | --- | --- | --- | 270 | --- | 480 | --- | 18 | A, N, N+T or Q+T | --- |
| ISO 3755:1991 | Grade 270-480 | --- | --- | t ≤ 28 | 270 | --- | 480-630 | --- | 18 | AM | 22 J @ 23°C ± 5 |
| | | | | 28 < t ≤ 40 | 260 | --- | 500-650 | --- | --- | AM | --- |
| | Grade 270-480W | --- | --- | t ≤ 28 | 270 | --- | 480-630 | --- | 18 | AM | 22 J @ 23°C ± 5 |
| | | | | 28 < t ≤ 40 | 260 | --- | 500-650 | --- | --- | AM | --- |
| JIS G 5102:1991 | Class SCW 480 | --- | --- | --- | 275 | --- | 480 | --- | 20 | A, N, N+T or Q+T | 27 J @ 0°C |
| EN 10293:2015 | G20Mn5 | --- | 1.6220 | t ≤ 30 | 300 | --- | 480-620 | --- | 20 | N | see standard for impact data |
| | | | | t ≤ 100 | 300 | --- | 500-650 | --- | 22 | Q+T | |
| ASTM A27/A27M-13 | Grade 70-36 [485-250] | J03501 | --- | --- | 250 | 36 | 485 | 70 | 22 | FA, N, N+T or Q+T | --- |
| | Grade 70-40 [485-275] | J02501 | --- | --- | 275 | 40 | 485 | 70 | 22 | FA, N, N+T or Q+T | --- |
| ASTM A958/A958M-14 | Grade SC 1020, Class 70/36 | J02003 | --- | --- | 250 | 36 | 485 | 70 | 22 | N | --- |
| | Grade SC 1025, Class 70/36 | J02508 | --- | --- | 250 | 36 | 485 | 70 | 22 | N | --- |
| | Grade SC 1030, Class 70/36 | J03012 | --- | --- | 250 | 36 | 485 | 70 | 22 | N+T | --- |
| | Grade SC 1040, Class 70/36 | J04003 | --- | --- | 250 | 36 | 485 | 70 | 22 | N+T | --- |
| GB 7659-87 | Grade ZG275-485H | --- | --- | --- | 275 | --- | 485 | --- | 20 | A, N or N+T | see standard for impact data |
| GB 11352-89 | Grade ZG 270-500 | --- | --- | t ≤ 100 | 270 | --- | 500 | --- | 18 | A, N, N+T or Q+T | 22 J @ RT |
| GB/T 14408-93 | Grade ZGD290-510 | --- | --- | --- | 290 | --- | 510 | --- | 16 | A, N, N+T or Q+T | --- |
| | Grade ZGD345-570 | --- | --- | --- | 345 | --- | 570 | --- | 14 | A, N, N+T or Q+T | --- |
| JIS G 5111:1991 | Class SCC 3A | --- | --- | --- | 265 | --- | 520 | --- | 13 | N+T | 143 min. HB |
| | Class SCMn 1A | --- | --- | --- | 275 | --- | 540 | --- | 17 | N+T | 143 min. HB |
| ASTM A148/A148 M-14 | Grade 80-40 [550-275] | D50400 | --- | --- | 275 | 40 | 550 | 80 | 18 | FA, N, N+T or Q+T | --- |
| | Grade 80-50 [550-345] | D50500 | --- | --- | 345 | 50 | 550 | 80 | 22 | FA, N, N+T or Q+T | --- |
| ASTM A958/A958M-14 | Grade SC 1030, Class 80/40 | J03012 | --- | --- | 275 | 40 | 550 | 80 | 18 | HT+Q+T | --- |
| | Grade SC 1030, Class 80/50 | J03012 | --- | --- | 345 | 50 | 550 | 80 | 22 | HT+Q+T | --- |
| | Grade SC 1040, Class 80/40 | J04003 | --- | --- | 275 | 40 | 550 | 80 | 18 | N+T | --- |
| | Grade SC 1040, Class 80/50 | J04003 | --- | --- | 345 | 50 | 550 | 80 | 22 | N+T | --- |
| | Grade SC 1045, Class 80/40 | J04502 | --- | --- | 275 | 40 | 550 | 80 | 18 | N+T | --- |
| | Grade SC 1045, Class 80/50 | J04502 | --- | --- | 345 | 50 | 550 | 80 | 22 | N+T | --- |
| ISO 3755:1991 | Grade 340-550 | --- | --- | t ≤ 28 | 340 | --- | 550-700 | --- | 15 | AM | 20 J @ 23°C ± 5 |
| | | | | 28 < t ≤ 40 | 300 | --- | 570-720 | --- | --- | AM | --- |
| | Grade 340-550W | --- | --- | t ≤ 28 | 340 | --- | 550-700 | --- | 15 | AM | 20 J @ 23°C ± 5 |
| | | | | 28 < t ≤ 40 | 300 | --- | 570-720 | --- | --- | AM | --- |
| JIS G 5102:1991 | Class SCW 550 | --- | --- | --- | 355 | --- | 550 | --- | 18 | A, N, N+T or Q+T | 27 J @ 0°C |

**7.1 Cast Carbon Steels**

**7.1.1A Mechanical Properties of Cast Carbon Steel for General and Structural Applications (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness, mm | Yield Strength, min. MPa | Yield Strength, min. ksi | Tensile Strength, min. MPa | Tensile Strength, min. ksi | Elongation % min. | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|
| GB 11352-89 | Grade ZG 310-570 | --- | --- | t ≤ 100 | 310 | --- | 570 | --- | 15 | A, N, N+T or Q+T | 15 J @ RT |
| JIS G 5111:1991 | Class SCMn 2A | --- | --- | --- | 345 | --- | 590 | --- | 16 | N+T | 163 min. HB |
| | Class SCSiMn 2A | --- | --- | --- | 295 | --- | 590 | --- | 13 | N+T | 163 min. HB |
| | Class SCMn 1B | --- | --- | --- | 390 | --- | 590 | --- | 17 | Q+T | 170 min. HB |
| EN 10293:2015 | GE300 | --- | 1.0558 | t ≤ 30 | 300 | --- | 600-750 | --- | 15 | N | 27 J @ RT |
| | | | | 30 < t ≤ 100 | 300 | --- | 520-670 | --- | 18 | N | 31 J @ RT |
| JIS G 5111:1991 | Class SCC 5A | --- | --- | --- | 295 | --- | 620 | --- | 9 | N+T | 163 min. HB |
| | Class SCMn 3A | --- | --- | --- | 370 | --- | 640 | --- | 13 | N+T | 170 min. HB |
| | Class SCC 3B | --- | --- | --- | 370 | --- | 620 | --- | 13 | Q+T | 183 min. HB |
| | Class SCSiMn 2B | --- | --- | --- | 440 | --- | 640 | --- | 17 | Q+T | 183 min. HB |
| | Class SCMn 2B | --- | --- | --- | 440 | --- | 640 | --- | 16 | Q+T | 183 min. HB |
| GB/T 14408-93 | Grade ZGD410-620 | --- | --- | --- | 410 | --- | 620 | --- | 13 | A, N, N+T or Q+T | --- |
| ISO 9477:1992 | Grade 410-620 | --- | --- | --- | 410 | --- | 620-770 | --- | 16 | AM | 20 J @ 23°C ± 5 |
| ASTM A148/A148 M-14 | Grade 90-60 [620-415] | D50600 | --- | --- | 415 | 60 | 620 | 90 | 20 | FA, N, N+T or Q+T | --- |
| ASTM A958/A958M-14 | Grade SC 1040, Class 90/60 | J04003 | --- | --- | 415 | 60 | 620 | 90 | 18 | N+T | --- |
| | Grade SC 1045, Class 90/60 | J04502 | --- | --- | 415 | 60 | 620 | 90 | 18 | N+T | --- |
| JIS G 5102:1991 | Class SCW 620 | --- | --- | --- | 430 | --- | 620 | --- | 17 | A, N, N+T or Q+T | 27 J @ 0°C |
| GB 11352-89 | Grade ZG 340-640 | --- | --- | t ≤ 100 | 340 | --- | 640 | --- | 10 | A, N, N+T or Q+T | 10 J @ RT |
| JIS G 5111:1991 | Class SCMn 5A | --- | --- | --- | 390 | --- | 690 | --- | 9 | N+T | 183 min. HB |
| | Class SCC 5B | --- | --- | --- | 440 | --- | 690 | --- | 9 | Q+T | 201 min. HB |
| | Class SCMn 3B | --- | --- | --- | 490 | --- | 690 | --- | 13 | Q+T | 197 min. HB |
| EN 10293:2015 | G24Mn6 | --- | 1.1118 | t ≤ 50 | 550 | --- | 700-800 | --- | 12 | Q+T | 27 J @ -20°C |
| | | | | t ≤ 100 | 500 | --- | 650-800 | --- | 15 | Q+T | 27 J @ -30°C |
| | | | | t ≤ 150 | 400 | --- | 600-800 | --- | 18 | Q+T | 27 J @ -30°C |
| | G28Mn6 | --- | 1.1165 | t ≤ 50 | 550 | --- | 700-850 | --- | 10 | Q+T | 31 J @ RT |
| | | | | t ≤ 100 | 450 | --- | 600-750 | --- | 14 | Q+T | 35 J @ RT |
| | | | | t ≤ 250 | 260 | --- | 520-670 | --- | 18 | N | 27 J @ RT |

## 7.1 Cast Carbon Steels

### 7.1.1A Mechanical Properties of Cast Carbon Steel for General and Structural Applications (Continued)

| Specification | Designation | UNS No. | Steel No. | Section Thickness, mm | Yield Strength, min. | | Tensile Strength, min. | | Elongation % min. | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | MPa | ksi | MPa | ksi | | | |
| GB/T 14408-93 | Grade ZGD535-720 | --- | --- | --- | 535 | --- | 720 | --- | 12 | A, N, N+T or Q+T | --- |
| ISO 9477:1992 | Grade 540-720 | --- | --- | --- | 540 | --- | 720-870 | --- | 14 | AM | 20 J @ 23°C ± 5 |
| ASTM A148/A148 M-14 | Grade 105-85 [725-585] | D50850 | --- | --- | 585 | 85 | 725 | 105 | 17 | FA, N, N+T or Q+T | --- |
| ASTM A958/A958M-14 | Grade SC 1045, Class 105/85 | J04502 | --- | --- | 585 | 85 | 725 | 105 | 17 | N+T | --- |
| JIS G 5111:1991 | Class SCMn 5B | --- | --- | --- | 540 | --- | 740 | --- | 9 | Q+T | 212 min. HB |
| ASTM A148/A148 M-14 | Grade 115-95 [795-655] | D50950 | --- | --- | 655 | 95 | 795 | 115 | 14 | FA, N, N+T or Q+T | --- |
| ISO 9477:1992 | Grade 620-820 | --- | --- | --- | 620 | --- | 820-970 | --- | 11 | AM | 18 J @ 23°C ± 5 |
| GB/T 14408-93 | Grade ZGD650-830 | --- | --- | --- | 650 | --- | 830 | --- | 10 | A, N, N+T or Q+T | --- |
| ASTM A148/A148 M-14 | Grade 130-115 [895-795] | D51150 | --- | --- | 795 | 115 | 895 | 130 | 11 | FA, N, N+T or Q+T | --- |
| GB/T 14408-93 | Grade ZGD730-910 | --- | --- | --- | 730 | --- | 910 | --- | 8 | A, N, N+T or Q+T | --- |
| GB/T 14408-93 | Grade ZGD840-1030 | --- | --- | --- | 840 | --- | 1030 | --- | 6 | A, N, N+T or Q+T | --- |
| ISO 9477:1992 | Grade 840-1030 | --- | --- | --- | 840 | --- | 1030-1180 | --- | 7 | AM | 15 J @ 23°C ± 5 |
| ASTM A148/A148 M-14 | Grade 150-135 [1035-930] | D51350 | --- | --- | 930 | 135 | 1035 | 150 | 7 | FA, N, N+T or Q+T | --- |

### 7.1.1B Chemical Composition of Cast Carbon Steel for General and Structural Applications

| Specification | Designation | UNS No. | Steel No. | Weight, %, max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| JIS G 5101:1991 | Class SC 360 | --- | --- | 0.20 | --- | --- | 0.040 | 0.040 | --- | --- | --- | --- |
| EN 10293:2015 | GE200 | --- | 1.0420 | --- | --- | --- | 0.035 | 0.030 | 0.30 | 0.40 | 0.12 | V 0.03; Cu 0.30; (Cr+Mo+Ni+V+Cu) 1.00 |
| | GS200 | --- | 1.0449 | 0.18 | 1.20 | 0.60 | 0.030 | 0.025 | 0.30 | 0.40 | 0.12 | V 0.03; Cu 0.30; (Cr+Mo+Ni+V+Cu) 1.00 |
| GB 11352-89 | Grade ZG 200-400 | --- | --- | 0.20 | 0.80 | 0.50 | 0.04 | 0.04 | 0.35 | 0.30 | 0.20 | V 0.05; Cu 0.30 |
| GB 7659-87 | Grade ZG200-400H | --- | --- | 0.20 | 0.80 | 0.50 | 0.04 | 0.04 | 0.30 | 0.30 | 0.15 | V 0.05; Cu 0.30 |
| ISO 3755:1991 | Grade 200-400 | --- | --- | --- | --- | --- | 0.035 | 0.035 | --- | --- | --- | --- |
| | Grade 200-400W | --- | --- | 0.25 | 1.00 | 0.60 | 0.035 | 0.035 | --- | --- | --- | --- |

**7.1 Cast Carbon Steels**

**7.1.1B Chemical Composition of Cast Carbon Steel for General and Structural Applications (Continued)**

| Specification | Designation | UNS No. | Steel No. | Weight, %, max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| JIS G 5101:1991 | Class SC 410 | --- | --- | 0.30 | --- | --- | 0.040 | 0.040 | --- | --- | --- | --- |
| JIS G 5102:1991 | Class SCW 410 | --- | --- | 0.22 | 1.50 | 0.80 | 0.040 | 0.040 | --- | --- | --- | --- |
| ASTM A27/A27M-13 | Grade 60-30 [415-205] | J03000 | --- | 0.30 | 0.60 | 0.80 | 0.035 | 0.035 | --- | --- | --- | --- |
| | Grade U-60-30 [415-205] | J02500 | --- | 0.25 | 0.75 | 0.80 | 0.035 | 0.035 | --- | --- | --- | --- |
| JIS G 5101:1991 | Class SC 450 | --- | --- | 0.35 | --- | --- | 0.040 | 0.040 | --- | --- | --- | --- |
| GB 11352-89 | Grade ZG 230-450 | --- | --- | 0.30 | 0.90 | 0.50 | 0.04 | 0.04 | 0.35 | 0.30 | 0.20 | V 0.05; Cu 0.30 |
| GB 7659-87 | Grade ZG230-450H | --- | --- | 0.20 | 1.20 | 0.50 | 0.04 | 0.04 | 0.30 | 0.30 | 0.15 | V 0.05; Cu 0.30 |
| ISO 3755:1991 | Grade 230-450 | --- | --- | --- | --- | --- | 0.035 | 0.035 | --- | --- | --- | --- |
| | Grade 230-450W | --- | --- | 0.25 | 1.20 | 0.60 | 0.035 | 0.035 | --- | --- | --- | --- |
| ASTM A27/A27M-13 | Grade 65-35 [450-240] | J03001 | --- | 0.30 | 0.70 | 0.80 | 0.035 | 0.035 | --- | --- | --- | --- |
| ASTM A958/A958M-14 | Grade SC 1020, Class 65/35 | J02003 | --- | 0.18-0.23 | 0.40-0.80 | 0.30-0.60 | 0.040 | 0.040 | --- | --- | --- | --- |
| | Grade SC 1025, Class 65/35 | J02508 | --- | 0.22-0.28 | 0.40-0.80 | 0.30-0.60 | 0.040 | 0.040 | --- | --- | --- | --- |
| | Grade SC 1030, Class 65/35 | J03012 | --- | 0.28-0.34 | 0.50-0.90 | 0.30-0.60 | 0.040 | 0.040 | --- | --- | --- | --- |
| EN 10293:2015 | GE240 | --- | 1.0446 | --- | --- | --- | 0.035 | 0.030 | 0.30 | 0.40 | 0.12 | V 0.03; Cu 0.30; (Cr+Mo+Ni+V+Cu) 1.00 |
| | GS240 | --- | 1.0455 | 0.23 | 1.20 | 0.60 | 0.030 | 0.025 | 0.30 | 0.40 | 0.12 | V 0.03; Cu 0.30; (Cr+Mo+Ni+V+Cu) 1.00 |
| | G17Mn5 | --- | 1.1131 | 0.15-0.20 | 1.00-1.60 | 0.60 | 0.020 | 0.020 | 0.30 | 0.40 | 0.12 | V 0.03; Cu 0.30; (Cr+Mo+Ni+V+Cu) 1.00 |
| JIS G 5102:1991 | Class SCW 450 | --- | --- | 0.22 | 1.50 | 0.80 | 0.040 | 0.040 | --- | --- | --- | --- |
| JIS G 5101:1991 | Class SC 480 | --- | --- | 0.40 | --- | --- | 0.040 | 0.040 | --- | --- | --- | --- |
| GB/T 14408-93 | Grade ZGD270-480 | --- | --- | --- | --- | --- | 0.040 | 0.040 | --- | --- | --- | --- |
| ISO 3755:1991 | Grade 270-480 | --- | --- | --- | --- | --- | 0.035 | 0.035 | --- | --- | --- | --- |
| | Grade 270-480W | --- | --- | 0.25 | 1.20 | 0.60 | 0.035 | 0.035 | --- | --- | --- | --- |
| JIS G 5102:1991 | Class SCW 480 | --- | --- | 0.22 | 1.50 | 0.80 | 0.040 | 0.040 | 0.50 | 0.50 | --- | --- |
| EN 10293:2015 | G20Mn5 | --- | 1.6220 | 0.17-0.23 | 1.00-1.60 | 0.60 | 0.020 | 0.020 | 0.30 | 0.80 | 0.12 | V 0.03; Cu 0.30; (Cr+Mo+Ni+V+Cu) 1.00 |
| ASTM A27/A27M-13 | Grade 70-36 [485-250] | J03501 | --- | 0.35 | 0.70 | 0.80 | 0.035 | 0.035 | --- | --- | --- | --- |
| | Grade 70-40 [485-275] | J02501 | --- | 0.25 | 1.20 | 0.80 | 0.035 | 0.035 | --- | --- | --- | --- |
| ASTM A958/A958M-14 | Grade SC 1020, Class 70/36 | J02003 | --- | 0.18-0.23 | 0.40-0.80 | 0.30-0.60 | 0.040 | 0.040 | --- | --- | --- | --- |
| | Grade SC 1025, Class 70/36 | J02508 | --- | 0.22-0.28 | 0.40-0.80 | 0.30-0.60 | 0.040 | 0.040 | --- | --- | --- | --- |
| | Grade SC 1030, Class 70/36 | J03012 | --- | 0.28-0.34 | 0.50-0.90 | 0.30-0.60 | 0.040 | 0.040 | --- | --- | --- | --- |
| | Grade SC 1040, Class 70/36 | J04003 | --- | 0.37-0.44 | 0.50-0.90 | 0.30-0.60 | 0.040 | 0.040 | --- | --- | --- | --- |
| GB 7659-87 | Grade ZG275-485H | --- | --- | 0.25 | 1.20 | 0.50 | 0.04 | 0.04 | 0.30 | 0.30 | 0.15 | V 0.05; Cu 0.30 |

**7.1 Cast Carbon Steels**

**7.1.1B Chemical Composition of Cast Carbon Steel for General and Structural Applications (Continued)**

| Specification | Designation | UNS No. | Steel No. | Weight, %, max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| GB 11352-89 | Grade ZG 270-500 | --- | --- | 0.40 | 0.90 | 0.50 | 0.04 | 0.04 | 0.35 | 0.30 | 0.20 | V 0.05; Cu 0.30 |
| GB/T 14408-93 | Grade ZGD290-510 | --- | --- | --- | --- | --- | 0.040 | 0.040 | --- | --- | --- | --- |
| | Grade ZGD345-570 | --- | --- | --- | --- | --- | 0.040 | 0.040 | --- | --- | --- | --- |
| JIS G 5111:1991 | Class SCC 3A | --- | --- | 0.30-0.40 | 0.50-0.80 | 0.30-0.60 | 0.040 | 0.040 | --- | --- | --- | --- |
| | Class SCMn 1A | --- | --- | 0.20-0.30 | 1.00-1.60 | 0.30-0.60 | 0.040 | 0.040 | --- | --- | --- | --- |
| ASTM A148/A148 M-14 | Grade 80-40 [550-275] | D50400 | --- | --- | --- | --- | 0.05 | 0.06 | --- | --- | --- | --- |
| | Grade 80-50 [550-345] | D50500 | --- | --- | --- | --- | 0.05 | 0.06 | --- | --- | --- | --- |
| ASTM A958/A958M-14 | Grade SC 1030, Class 80/40 | J03012 | --- | 0.28-0.34 | 0.50-0.90 | 0.30-0.60 | 0.040 | 0.040 | --- | --- | --- | --- |
| | Grade SC 1030, Class 80/50 | J03012 | --- | 0.28-0.34 | 0.50-0.90 | 0.30-0.60 | 0.040 | 0.040 | --- | --- | --- | --- |
| | Grade SC 1040, Class 80/40 | J04003 | --- | 0.37-0.44 | 0.50-0.90 | 0.30-0.60 | 0.040 | 0.040 | --- | --- | --- | --- |
| | Grade SC 1040, Class 80/50 | J04003 | --- | 0.37-0.44 | 0.50-0.90 | 0.30-0.60 | 0.040 | 0.040 | --- | --- | --- | --- |
| | Grade SC 1045, Class 80/40 | J04502 | --- | 0.43-0.50 | 0.50-0.90 | 0.30-0.60 | 0.040 | 0.040 | --- | --- | --- | --- |
| | Grade SC 1045, Class 80/50 | J04502 | --- | 0.43-0.50 | 0.50-0.90 | 0.30-0.60 | 0.040 | 0.040 | --- | --- | --- | --- |
| ISO 3755:1991 | Grade 340-550 | --- | --- | --- | --- | --- | 0.035 | 0.035 | --- | --- | --- | --- |
| | Grade 340-550W | --- | --- | 0.25 | 1.50 | 0.60 | 0.035 | 0.035 | --- | --- | --- | --- |
| JIS G 5102:1991 | Class SCW 550 | --- | --- | 0.22 | 1.50 | 0.80 | 0.040 | 0.040 | 0.50 | 2.50 | 0.30 | V 0.20 |
| GB 11352-89 | Grade ZG 310-570 | --- | --- | 0.50 | 0.90 | 0.60 | 0.04 | 0.04 | 0.35 | 0.30 | 0.20 | V 0.05; Cu 0.30 |
| JIS G 5111:1991 | Class SCMn 2A | --- | --- | 0.25-0.35 | 1.00-1.60 | 0.30-0.60 | 0.040 | 0.040 | --- | --- | --- | --- |
| | Class SCSiMn 2A | --- | --- | 0.25-0.35 | 0.90-1.20 | 0.50-0.80 | 0.040 | 0.040 | --- | --- | --- | --- |
| | Class SCMn 1B | --- | --- | 0.20-0.30 | 1.00-1.60 | 0.30-0.60 | 0.040 | 0.040 | --- | --- | --- | --- |
| EN 10293:2015 | GE300 | --- | 1.0558 | --- | --- | --- | 0.035 | 0.030 | 0.30 | 0.40 | 0.12 | V 0.03; Cu 0.30; (Cr+Mo+Ni+V+Cu) 1.00 |
| JIS G 5111:1991 | Class SCC 5A | --- | --- | 0.40-0.50 | 0.50-0.80 | 0.30-0.60 | 0.040 | 0.040 | --- | --- | --- | --- |
| | Class SCMn 3A | --- | --- | 0.30-0.40 | 1.00-1.60 | 0.30-0.60 | 0.040 | 0.040 | --- | --- | --- | --- |
| | Class SCC 3B | --- | --- | 0.30-0.40 | 0.50-0.80 | 0.30-0.60 | 0.040 | 0.040 | --- | --- | --- | --- |
| | Class SCSiMn 2B | --- | --- | 0.25-0.35 | 0.90-1.20 | 0.50-0.80 | 0.040 | 0.040 | --- | --- | --- | --- |
| | Class SCMn 2B | --- | --- | 0.25-0.35 | 1.00-1.60 | 0.30-0.60 | 0.040 | 0.040 | --- | --- | --- | --- |
| GB/T 14408-93 | Grade ZGD410-620 | --- | --- | --- | --- | --- | 0.040 | 0.040 | --- | --- | --- | --- |
| ISO 9477:1992 | Grade 410-620 | --- | --- | --- | --- | 0.60 | 0.035 | 0.035 | --- | --- | --- | --- |
| ASTM A148/A148 M-14 | Grade 90-60 [620-415] | D50600 | --- | --- | --- | --- | 0.05 | 0.06 | --- | --- | --- | --- |
| ASTM A958/A958M-14 | Grade SC 1040, Class 90/60 | J04003 | --- | 0.37-0.44 | 0.50-0.90 | 0.30-0.60 | 0.040 | 0.040 | --- | --- | --- | --- |
| | Grade SC 1045, Class 90/60 | J04502 | --- | 0.43-0.50 | 0.50-0.90 | 0.30-0.60 | 0.040 | 0.040 | --- | --- | --- | --- |
| JIS G 5102:1991 | Class SCW 620 | --- | --- | 0.22 | 1.50 | 0.80 | 0.040 | 0.040 | 0.50 | 2.50 | 0.30 | V 0.20 |
| GB 11352-89 | Grade ZG 340-640 | --- | --- | 0.60 | 0.90 | 0.60 | 0.04 | 0.04 | 0.35 | 0.30 | 0.20 | V 0.05; Cu 0.30 |

**7.1 Cast Carbon Steels**

**7.1.1B Chemical Composition of Cast Carbon Steel for General and Structural Applications (Continued)**

| Specification | Designation | UNS No. | Steel No. | Weight, %, max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| JIS G 5111:1991 | Class SCMn 5A | --- | --- | 0.40-0.50 | 1.00-1.60 | 0.30-0.60 | 0.040 | 0.040 | --- | --- | --- | --- |
| | Class SCC 5B | --- | --- | 0.40-0.50 | 0.50-0.80 | 0.30-0.60 | 0.040 | 0.040 | --- | --- | --- | --- |
| | Class SCMn 3B | --- | --- | 0.30-0.40 | 1.00-1.60 | 0.30-0.60 | 0.040 | 0.040 | --- | --- | --- | --- |
| EN 10293:2015 | G24Mn6 | --- | 1.1118 | 0.20-0.25 | 1.50-1.80 | 0.60 | 0.020 | 0.015 | 0.30 | 0.40 | 0.12 | V 0.03; Cu 0.30; (Cr+Mo+Ni+V+Cu) 1.00 |
| | G28Mn6 | --- | 1.1165 | 0.25-0.32 | 1.20-1.80 | 0.60 | 0.035 | 0.030 | 0.30 | 0.40 | 0.12 | V 0.03; Cu 0.30; (Cr+Mo+Ni+V+Cu) 1.00 |
| GB/T 14408-93 | Grade ZGD535-720 | --- | --- | --- | --- | --- | 0.040 | 0.040 | --- | --- | --- | --- |
| ISO 9477:1992 | Grade 540-720 | --- | --- | --- | --- | 0.60 | 0.035 | 0.035 | --- | --- | --- | --- |
| ASTM A148/A148 M-14 | Grade 105-85 [725-585] | D50850 | --- | --- | --- | --- | 0.05 | 0.06 | --- | --- | --- | --- |
| ASTM A958/A958M-14 | Grade SC 1045, Class 105/85 | J04502 | --- | 0.43-0.50 | 0.50-0.90 | 0.30-0.60 | 0.040 | 0.040 | --- | --- | --- | --- |
| JIS G 5111:1991 | Class SCMn 5B | --- | --- | 0.40-0.50 | 1.00-1.60 | 0.30-0.60 | 0.040 | 0.040 | --- | --- | --- | --- |
| ASTM A148/A148 M-14 | Grade 115-95 [795-655] | D50950 | --- | --- | --- | --- | 0.05 | 0.06 | --- | --- | --- | --- |
| ISO 9477:1992 | Grade 620-820 | --- | --- | --- | --- | 0.60 | 0.035 | 0.035 | --- | --- | --- | --- |
| GB/T 14408-93 | Grade ZGD650-830 | --- | --- | --- | --- | --- | 0.040 | 0.040 | --- | --- | --- | --- |
| ASTM A148/A148 M-14 | Grade 130-115 [895-795] | D51150 | --- | --- | --- | --- | 0.05 | 0.06 | --- | --- | --- | --- |
| GB/T 14408-93 | Grade ZGD730-910 | --- | --- | --- | --- | --- | 0.035 | 0.035 | --- | --- | --- | --- |
| GB/T 14408-93 | Grade ZGD840-1030 | --- | --- | --- | --- | --- | 0.035 | 0.035 | --- | --- | --- | --- |
| ISO 9477:1992 | Grade 840-1030 | --- | --- | --- | --- | 0.60 | 0.035 | 0.035 | --- | --- | --- | --- |
| ASTM A148/A148 M-14 | Grade 150-135 [1035-930] | D51350 | --- | --- | --- | --- | 0.05 | 0.06 | --- | --- | --- | --- |

**7.1 Cast Carbon Steels**

**7.1.2A Mechanical Properties of Cast Carbon Steel for Pressure Purposes at High Temperatures**

| Specification | Designation | UNS No. | Steel No. | Section Thickness, mm | Yield Strength, min. MPa | Yield Strength, min. ksi | Tensile Strength, min. MPa | Tensile Strength, min. ksi | Elongation % min. | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|
| JIS G 5151:1991 | Class SCPH 1 | --- | --- | --- | 205 | --- | 410 | --- | 21 | A, N, N+T or Q+T | --- |
| ASME SA-216/SA-216M | Grade WCA | J02502 | --- | --- | 205 | 30 | 415-585 | 60-85 | 24 | A, N or N+T | --- |
| ASTM A216/A216M-14e1 | Grade WCA | J02502 | --- | --- | 205 | 30 | 415-585 | 60-85 | 24 | A, N or N+T | --- |
| EN 10213:2007 C1:2008 | GP240GH | --- | 1.0619 | t ≤ 100 | 240 | --- | 420-600 | --- | 22 | N | 27 J @ RT |
| | | | | t ≤ 100 | 240 | --- | 420-600 | --- | 22 | Q+T | 40 J @ RT |
| GB/T 16253-1996 | Grade ZG240-450A | --- | --- | --- | 240 | --- | 450-600 | --- | 22 | A, N, N+T or Q+T | 27 J @ RT |
| | Grade ZG240-450AG | --- | --- | --- | 240 | --- | 450-600 | --- | 22 | N, N+T or Q+T | 27 J @ RT |
| | Grade ZG240-450B | --- | --- | --- | 240 | --- | 450-600 | --- | 22 | A, N, N+T or Q+T | 45 J @ RT |
| | Grade ZG240-450BG | --- | --- | --- | 240 | --- | 450-600 | --- | 22 | N, N+T or Q+T | 45 J @ RT |
| ISO 4991:1994 | Type C23-45A | --- | --- | --- | 240 | --- | 450-600 | --- | 22 | A, N, N+T or Q+T | 27 J @ RT |
| | Type C23-45AH | --- | --- | --- | 240 | --- | 450-600 | --- | 22 | N, N+T or Q+T | 27 J @ RT |
| | Type C23-45B | --- | --- | --- | 240 | --- | 450-600 | --- | 22 | A, N, N+T or Q+T | 45 J @ RT |
| | Type C23-45BH | --- | --- | --- | 240 | --- | 450-600 | --- | 22 | N, N+T or Q+T | 45 J @ RT |
| JIS G 5151:1991 | Class SCPH 2 | --- | --- | --- | 245 | --- | 480 | --- | 19 | A, N, N+T or Q+T | --- |
| EN 10213:2007 C1:2008 | GP280GH | --- | 1.0625 | t ≤ 100 | 280 | --- | 480-640 | --- | 22 | N | 27 J @ RT |
| | | | | t ≤ 100 | 280 | --- | 480-640 | --- | 22 | Q+T | 35 J @ RT |
| ASME SA-216/SA-216M | Grade WCB | J03002 | --- | --- | 250 | 36 | 485-655 | 70-95 | 22 | A, N or N+T | --- |
| | Grade WCC | J02503 | --- | --- | 275 | 40 | 485-655 | 70-95 | 22 | A, N or N+T | --- |
| ASTM A216/A216M-14e1 | Grade WCB | J03002 | --- | --- | 250 | 36 | 485-655 | 70-95 | 22 | A, N or N+T | --- |
| | Grade WCC | J02503 | --- | --- | 275 | 40 | 485-655 | 70-95 | 22 | A, N or N+T | --- |
| GB/T 16253-1996 | Grade ZG280-520 | --- | --- | --- | 280 | --- | 520-670 | --- | 18 | A, N, N+T or Q+T | 35 J @ RT |
| | Grade ZG280-520G | --- | --- | --- | 280 | --- | 520-670 | --- | 18 | N, N+T or Q+T | 35 J @ RT |
| ISO 4991:1994 | Type C26-52 | --- | --- | --- | 280 | --- | 520-670 | --- | 18 | A, N, N+T or Q+T | 35 J @ RT |
| | Type C26-52H | --- | --- | --- | 280 | --- | 520-670 | --- | 18 | N, N+T or Q+T | 35 J @ RT |

**7.1 Cast Carbon Steels**

**7.1.2B Chemical Composition of Cast Carbon Steel for Pressure Purposes at High Temperatures**

| Specification | Designation | UNS No. | Steel No. | Weight, %, max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| JIS G 5151:1991 | Class SCPH 1 | --- | --- | 0.25 | 0.70 | 0.60 | 0.040 | 0.040 | 0.25 | 0.50 | 0.25 | Cu 0.50; (Cu+Ni+Cr+Mo) 1.00 |
| ASME SA-216/SA-216M | Grade WCA | J02502 | --- | 0.25 | 0.70 | 0.60 | 0.04 | 0.045 | 0.50 | 0.50 | 0.20 | V 0.03; Cu 0.30; (Cr+Ni+Mo+V+Cu) 1.00 |
| ASTM A216/A216M-14e1 | Grade WCA | J02502 | --- | 0.25 | 0.70 | 0.60 | 0.035 | 0.035 | 0.50 | 0.50 | 0.20 | V 0.03; Cu 0.30; (Cr+Ni+Mo+V+Cu) 1.00 |
| EN 10213:2007 C1:2008 | GP240GH | --- | 1.0619 | 0.18-0.23 | 0.50-1.20 | 0.60 | 0.030 | 0.020 | 0.30 | 0.40 | 0.12 | V 0.03; Cu 0.30; (Cr+Mo+Ni+V+Cu) 1.00 |
| GB/T 16253-1996 | Grade ZG240-450A | --- | --- | 0.25 | 1.20 | 0.60 | 0.035 | 0.035 | 0.40 | 0.40 | 0.15 | V 0.03; Cu 0.40 |
| | Grade ZG240-450AG | --- | --- | 0.25 | 1.20 | 0.60 | 0.035 | 0.035 | 0.40 | 0.40 | 0.15 | V 0.03; Cu 0.40 |
| | Grade ZG240-450B | --- | --- | 0.20 | 1.00-1.60 | 0.60 | 0.035 | 0.035 | 0.40 | 0.40 | 0.15 | V 0.03; Cu 0.40 |
| | Grade ZG240-450BG | --- | --- | 0.20 | 1.00-1.60 | 0.60 | 0.035 | 0.035 | 0.40 | 0.40 | 0.15 | V 0.03; Cu 0.40 |
| ISO 4991:1994 | Type C23-45A | --- | --- | 0.25 | 1.20 | 0.60 | 0.035 | 0.035 | --- | --- | --- | --- |
| | Type C23-45AH | --- | --- | 0.25 | 1.20 | 0.60 | 0.035 | 0.035 | 0.40 | 0.40 | 0.15 | (Cr+Mo+Ni+V+Cu) 1.00; V 0.03; Cu 0.40 |
| | Type C23-45B | --- | --- | 0.20 | 1.00-1.60 | 0.60 | 0.035 | 0.035 | 0.40 | 0.40 | 0.15 | (Cr+Mo+Ni+V+Cu) 1.00; V 0.03; Cu 0.40 |
| | Type C23-45BH | --- | --- | 0.20 | 1.00-1.60 | 0.60 | 0.035 | 0.035 | 0.40 | 0.40 | 0.15 | (Cr+Mo+Ni+V+Cu) 1.00; V 0.03; Cu 0.40 |
| JIS G 5151:1991 | Class SCPH 2 | --- | --- | 0.30 | 1.00 | 0.60 | 0.040 | 0.040 | 0.25 | 0.50 | 0.25 | Cu 0.50; (Cu+Ni+Cr+Mo) 1.00 |
| EN 10213:2007 C1:2008 | GP280GH | --- | 1.0625 | 0.18-0.25 | 0.80-1.20 | 0.60 | 0.030 | 0.020 | 0.30 | 0.40 | 0.12 | V 0.03; Cu 0.30; (Cr+Mo+Ni+V+Cu) 1.00 |
| ASME SA-216/SA-216M | Grade WCB | J03002 | --- | 0.30 | 1.00 | 0.60 | 0.04 | 0.045 | 0.50 | 0.50 | 0.20 | V 0.03; Cu 0.30; (Cr+Ni+Mo+V+Cu) 1.00 |
| | Grade WCC | J02503 | --- | 0.25 | 1.20 | 0.60 | 0.04 | 0.045 | 0.50 | 0.50 | 0.20 | V 0.03; Cu 0.30; (Cr+Ni+Mo+V+Cu) 1.00 |
| ASTM A216/A216M-14e1 | Grade WCB | J03002 | --- | 0.30 | 1.00 | 0.60 | 0.035 | 0.035 | 0.50 | 0.50 | 0.20 | V 0.03; Cu 0.30; (Cr+Ni+Mo+V+Cu) 1.00 |
| | Grade WCC | J02503 | --- | 0.25 | 1.20 | 0.60 | 0.035 | 0.035 | 0.50 | 0.50 | 0.20 | V 0.03; Cu 0.30; (Cr+Ni+Mo+V+Cu) 1.00 |
| GB/T 16253-1996 | Grade ZG280-520 | --- | --- | 0.25 | 1.20 | 0.60 | 0.035 | 0.035 | 0.40 | 0.40 | 0.15 | V 0.03; Cu 0.40 |
| | Grade ZG280-520G | --- | --- | 0.25 | 1.20 | 0.60 | 0.035 | 0.035 | 0.40 | 0.40 | 0.15 | V 0.03; Cu 0.40 |
| ISO 4991:1994 | Type C26-52 | --- | --- | 0.25 | 1.20 | 0.60 | 0.035 | 0.035 | 0.40 | 0.40 | 0.15 | (Cr+Mo+Ni+V+Cu) 1.00; V 0.03; Cu 0.40 |
| | Type C26-52H | --- | --- | 0.25 | 1.20 | 0.60 | 0.035 | 0.035 | 0.40 | 0.40 | 0.15 | (Cr+Mo+Ni+V+Cu) 1.00; V 0.03; Cu 0.40 |

**7.1 Cast Carbon Steels**

**7.1.3A Mechanical Properties of Cast Carbon Steel for Pressure Purposes at Low Temperatures**

| Specification | Designation | UNS No. | Steel No. | Section Thickness, mm | Yield Strength, min. MPa | Yield Strength, min. ksi | Tensile Strength, min. MPa | Tensile Strength, min. ksi | Elongation % min. | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ASME SA-352/SA-352M | Grade LCA | J02504 | --- | --- | 205 | 30.0 | 415-585 | 60.0-85.0 | 24 | N+T or Q+T | 18 J @ -32°C |
| | Grade LCB | J03003 | --- | --- | 240 | 35.0 | 450-620 | 65.0-90.0 | 24 | N+T or Q+T | 18 J @ -46°C |
| | Grade LCC | J02505 | --- | --- | 275 | 40.0 | 485-655 | 70.0-95.0 | 22 | N+T or Q+T | 20 J @ -46°C |
| ASTM A352/A352M-06 (2012) | Grade LCA | J02504 | --- | --- | 205 | 30.0 | 415-585 | 60.0-85.0 | 24 | N+T or Q+T | 18 J @ -32°C |
| | Grade LCB | J03003 | --- | --- | 240 | 35.0 | 450-620 | 65.0-90.0 | 24 | N+T or Q+T | 18 J @ -46°C |
| | Grade LCC | J02505 | --- | --- | 275 | 40.0 | 485-655 | 70.0-95.0 | 22 | N+T or Q+T | 20 J @ -46°C |
| ASTM A757/A757M-15 | Grade A1Q | J03002 | --- | --- | 240 | 35 | 450 | 65 | 24 | Q+T | L: 17 J @ -46°C |
| | Grade A2Q | J02503 | --- | --- | 275 | 40 | 485 | 70 | 22 | Q+T | L: 20 J @ -46°C |
| EN 10213:2007 C1:2008 | G17Mn5 | --- | 1.1131 | t ≤ 50 | 240 | --- | 450-600 | --- | 24 | Q+T | 27 J @ -40°C |
| | G20Mn5 | --- | 1.6220 | t ≤ 30 | 300 | --- | 480-620 | --- | 20 | N | 27 J @ -30°C |
| | | | | t ≤ 100 | 300 | --- | 500-650 | --- | 22 | Q+T | 27 J @ -40°C |
| GB/T 16253-1996 | Grade ZG240-450BD | --- | --- | --- | 240 | --- | 450-600 | --- | 22 | N, N+T or Q+T | 27 J @ -40°C |
| | Grade ZG280-520D | --- | --- | --- | 280 | --- | 520-670 | --- | 18 | N+T or Q+T | 27 J @ -35°C |
| ISO 4991:1994 | Type C23-45BL | --- | --- | --- | 240 | --- | 450-600 | --- | 22 | N+T or Q+T | 27 J @ -40°C |
| | Type C26-52L | --- | --- | --- | 280 | --- | 520-670 | --- | 18 | N+T or Q+T | 27 J @ -35°C |
| JIS G 5152:1991 | Class SCPL 1 | --- | --- | --- | 245 | --- | 450 | --- | 21 | A, N, N+T or Q+T | see standard for impact data |

**7.1 Cast Carbon Steels**

**7.1.3B Chemical Composition of Cast Carbon Steel for Pressure Purposes at Low Temperatures**

| Specification | Designation | UNS No. | Steel No. | Weight, %, max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASME SA-352/SA-352M | Grade LCA | J02504 | --- | 0.25 | 0.70 | 0.60 | 0.04 | 0.045 | 0.50 | 0.50 | 0.20 | V 0.03; Cu 0.30; (Cr+Ni+V) 1.00 |
| | Grade LCB | J03003 | --- | 0.30 | 1.00 | 0.60 | 0.04 | 0.045 | 0.50 | 0.50 | 0.20 | V 0.03; Cu 0.30; (Cr+Ni+Mo+V+Cu) 1.00 |
| | Grade LCC | J02505 | --- | 0.25 | 1.20 | 0.60 | 0.04 | 0.045 | 0.50 | 0.50 | 0.20 | V 0.03; Cu 0.30; (Cr+Ni+Mo+V+Cu) 1.00 |
| ASTM A352/A352M-06 (2012) | Grade LCA | J02504 | --- | 0.25 | 0.70 | 0.60 | 0.04 | 0.045 | 0.50 | 0.50 | 0.20 | V 0.03; Cu 0.30; (Cr+Ni+V) 1.00 |
| | Grade LCB | J03003 | --- | 0.30 | 1.00 | 0.60 | 0.04 | 0.045 | 0.50 | 0.50 | 0.20 | V 0.03; Cu 0.30; (Cr+Ni+Mo+V+Cu) 1.00 |
| | Grade LCC | J02505 | --- | 0.25 | 1.20 | 0.60 | 0.04 | 0.045 | 0.50 | 0.50 | 0.20 | V 0.03; Cu 0.30; (Cr+Ni+Mo+V+Cu) 1.00 |
| ASTM A757/A757M-15 | Grade A1Q | J03002 | --- | 0.30 | 1.00 | 0.60 | 0.025 | 0.025 | 0.40 | 0.50 | 0.25 | V 0.03; Cu 0.50; (V+Cr+Ni+Mo+Cu+P+S) 1.00 |
| | Grade A2Q | J02503 | --- | 0.25 | 1.20 | 0.60 | 0.025 | 0.025 | 0.40 | 0.50 | 0.25 | V 0.03; Cu 0.50; (V+Cr+Ni+Mo+Cu+P+S) 1.00 |
| EN 10213:2007 C1:2008 | G17Mn5 | --- | 1.1131 | 0.15-0.20 | 1.00-1.60 | 0.60 | 0.020 | 0.020 | 0.30 | 0.40 | 0.12 | V 0.03; Cu 0.30; (Cr+Mo+Ni+V+Cu) 1.00 |
| | G20Mn5 | --- | 1.6220 | 0.17-0.23 | 1.00-1.60 | 0.60 | 0.020 | 0.020 | 0.30 | 0.80 | 0.12 | V 0.03; Cu 0.30 |
| GB/T 16253-1996 | Grade ZG240-450BD | --- | --- | 0.20 | 1.00-1.60 | 0.60 | 0.030 | 0.030 | 0.40 | 0.40 | 0.15 | V 0.03; Cu 0.40 |
| | Grade ZG280-520D | --- | --- | 0.25 | 1.20 | 0.60 | 0.030 | 0.030 | 0.40 | 0.40 | 0.15 | V 0.03; Cu 0.40 |
| ISO 4991:1994 | Type C23-45BL | --- | --- | 0.20 | 1.00-1.60 | 0.60 | 0.030 | 0.030 | 0.40 | 0.40 | 0.15 | (Cr+Mo+Ni+V+Cu) 1.00; V 0.03; Cu 0.40 |
| | Type C26-52L | --- | --- | 0.25 | 1.20 | 0.60 | 0.030 | 0.030 | 0.40 | 0.40 | 0.15 | (Cr+Mo+Ni+V+Cu) 1.00; V 0.03; Cu 0.40 |
| JIS G 5152:1991 | Class SCPL 1 | --- | --- | 0.30 | 1.00 | 0.60 | 0.040 | 0.040 | 0.25 | 0.50 | --- | Cu 0.50; (Cr+Ni+Cu) 1.00 |

### 7.2 Cast Manganese Steels

#### 7.2A Chemical Composition of Cast Manganese Steels

| Specification | Designation | UNS No. | Steel No. | Weight, %, max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| AFNOR NF A 32-058:1984 | Grade Z 100 MD 6 1-M | --- | --- | 0.8-1.2 | 5-7 | 1 | 0.08 | 0.03 | --- | --- | 0.8-1.2 | --- |
| ASTM A128/A128M-93 (2012) | Grade F | J91340 | --- | 1.05-1.35 | 6.0-8.0 | 1.00 | 0.07 | --- | --- | --- | 0.9-1.2 | --- |
| ISO 13521:1999 | Grade GX120MnMo7-1 | --- | --- | 1.05-1.35 | 6.00-8.00 | 0.30-0.90 | 0.060 | 0.045 | --- | --- | 0.90-1.20 | --- |
| AFNOR NF A 32-058:1984 | Grade Z 120 M 12-M | --- | --- | 1.1-1.4 | 11-14 | 1 | 0.08 | 0.03 | --- | --- | --- | [(Mn-2)/10] Cmax.; C (Mn/10)max. |
| ASTM A128/A128M-93 (2012) | Grade A | J91109 | --- | 1.05-1.35 | 11.0 min. | 1.00 | 0.07 | --- | --- | --- | --- | --- |
| | Grade B-1 | J91119 | --- | 0.9-1.05 | 11.5-14.0 | 1.00 | 0.07 | --- | --- | --- | --- | --- |
| | Grade B-2 | J91129 | --- | 1.05-1.2 | 11.5-14.0 | 1.00 | 0.07 | --- | --- | --- | --- | --- |
| | Grade B-3 | J91139 | --- | 1.12-1.28 | 11.5-14.0 | 1.00 | 0.07 | --- | --- | --- | --- | --- |
| | Grade B-4 | J91149 | --- | 1.2-1.35 | 11.5-14.0 | 1.00 | 0.07 | --- | --- | --- | --- | --- |
| GB/T 5680-1998 | Grade ZGMn13-1 | --- | --- | 1.00-1.45 | 11.00-14.00 | 0.30-1.00 | 0.090 | 0.040 | --- | --- | --- | --- |
| | Grade ZGMn13-2 | --- | --- | 0.90-1.35 | 11.00-14.00 | 0.30-1.00 | 0.070 | 0.040 | --- | --- | --- | --- |
| | Grade ZGMn13-3 | --- | --- | 0.95-1.35 | 11.00-14.00 | 0.30-0.80 | 0.070 | 0.035 | --- | --- | --- | --- |
| ISO 13521:1999 | Grade GX100Mn13 | --- | --- | 0.90-1.05 | 11.00-14.00 | 0.30-0.90 | 0.060 | 0.045 | --- | --- | --- | --- |
| | Grade GX120Mn13 | --- | --- | 1.05-1.35 | 11.00-14.00 | 0.30-0.90 | 0.060 | 0.045 | --- | --- | --- | --- |
| JIS G 5131:2008 | Class SCMnH 1 | --- | --- | 0.90-1.30 | 11.00-14.00 | --- | 0.100 | 0.050 | --- | --- | --- | --- |
| | Class SCMnH 2 | --- | --- | 0.90-1.20 | 11.00-14.00 | 0.80 | 0.070 | 0.040 | --- | --- | --- | --- |
| | Class SCMnH 3 | --- | --- | 0.90-1.20 | 11.00-14.00 | 0.30-0.80 | 0.050 | 0.035 | --- | --- | --- | --- |
| AFNOR NF A 32-058:1984 | Grade Z 120 MC 12-M | --- | --- | 1.1-1.4 | 11-14 | 1 | 0.08 | 0.03 | 1-2.5 | --- | --- | --- |
| ASTM A128/A128M-93 (2012) | Grade C | J91309 | --- | 1.05-1.35 | 11.5-14.0 | 1.00 | 0.07 | --- | 1.5-2.5 | --- | --- | --- |
| GB/T 5680-1998 | Grade ZGMn13-4 | --- | --- | 0.90-1.30 | 11.00-14.00 | 0.30-0.80 | 0.070 | 0.040 | 1.50-2.50 | --- | --- | --- |
| ISO 13521:1999 | Grade GX120MnCr13-2 | --- | --- | 1.05-1.35 | 11.00-14.00 | 0.30-0.90 | 0.060 | 0.045 | 1.50-2.50 | --- | --- | --- |
| JIS G 5131:2008 | Class SCMnH 11 | --- | --- | 0.90-1.30 | 11.00-14.00 | 0.80 | 0.070 | 0.040 | 1.50-2.50 | --- | --- | --- |
| AFNOR NF A 32-058:1984 | Grade Z 100 MN 13 4-M | --- | --- | 0.7-1.3 | 12-15 | 1 | 0.08 | 0.03 | --- | 2-5 | --- | --- |
| ASTM A128/A128M-93 (2012) | Grade D | J91459 | --- | 0.7-1.3 | 11.5-14.0 | 1.00 | 0.07 | --- | --- | 3.0-4.0 | --- | --- |
| ISO 13521:1999 | Grade GX120MnNi13-3 | --- | --- | 1.05-1.35 | 11.00-14.00 | 0.30-0.90 | 0.060 | 0.045 | --- | 3.00-4.00 | --- | --- |
| AFNOR NF A 32-058:1984 | Grade Z 110 MD 12 1-M | --- | --- | 0.8-1.3 | 11-14 | 1 | 0.08 | 0.03 | --- | --- | 0.8-1.2 | --- |
| ASTM A128/A128M-93 (2012) | Grade E-1 | J91249 | --- | 0.7-1.3 | 11.5-14.0 | 1.00 | 0.07 | --- | --- | --- | 0.9-1.2 | --- |
| GB/T 5680-1998 | Grade ZGMn13-5 | --- | --- | 0.75-1.30 | 11.00-14.00 | 0.30-1.00 | 0.070 | 0.040 | --- | --- | 0.90-1.20 | --- |
| ISO 13521:1999 | Grade GX110MnMo13-1 | --- | --- | 0.75-1.35 | 11.00-14.00 | 0.30-0.90 | 0.060 | 0.045 | --- | --- | 0.90-1.20 | --- |
| ASTM A128/A128M-93 (2012) | Grade E-2 | J91339 | --- | 1.05-1.45 | 11.5-14.0 | 1.00 | 0.07 | --- | --- | --- | 1.8-2.1 | --- |
| ISO 13521:1999 | Grade GX90MnMo14 | --- | --- | 0.70-1.00 | 13.00-15.00 | 0.30-0.60 | 0.070 | 0.045 | --- | --- | 1.00-1.80 | --- |
| AFNOR NF A 32-058:1984 | Grade Z 120MC 17 2-M | --- | --- | 1.1-1.4 | 16-18 | 1 | 0.08 | 0.03 | 1.8-2.3 | --- | --- | --- |
| ISO 13521:1999 | Grade GX120MnCr17-2 | --- | --- | 1.05-1.35 | 16.00-19.00 | 0.30-0.90 | 0.060 | 0.045 | 1.50-2.50 | --- | --- | --- |

**7.2 Cast Manganese Steels**

**7.2B Mechanical Properties of Cast Manganese Steels**

| Specification | Designation | UNS No. | Steel No. | Section Thickness, mm | Yield Strength, min. MPa | Yield Strength, min. ksi | Tensile Strength, min. MPa | Tensile Strength, min. ksi | Elongation % min. | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|
| AFNOR NF A 32-058:1984 | Grade Z 100 MD 6 1-M | --- | --- | t ≤ 100 | --- | --- | --- | --- | --- | Q | 55 - 58 HRC; 200 - 230 HBW |
| ASTM A128/A128M-93 (2012) | Grade F | J91340 | --- | --- | --- | --- | --- | --- | --- | Q | --- |
| ISO 13521:1999 | Grade GX120MnMo7-1 | --- | --- | --- | --- | --- | --- | --- | --- | ST+Q | --- |
| AFNOR NF A 32-058:1984 | Grade Z 120 M 12-M | --- | --- | t ≤ 200 | --- | --- | --- | --- | --- | Q | 45 - 50 HRC; 180 - 250 HBW |
| ASTM A128/A128M-93 (2012) | Grade A | J91109 | --- | --- | --- | --- | --- | --- | --- | Q | --- |
| | Grade B-1 | J91119 | --- | --- | --- | --- | --- | --- | --- | Q | --- |
| | Grade B-2 | J91129 | --- | --- | --- | --- | --- | --- | --- | Q | --- |
| | Grade B-3 | J91139 | --- | --- | --- | --- | --- | --- | --- | Q | --- |
| | Grade B-4 | J91149 | --- | --- | --- | --- | --- | --- | --- | Q | --- |
| GB/T 5680-1998 | Grade ZGMn13-1 | --- | --- | --- | --- | --- | 635 | --- | 20 | Q | --- |
| | Grade ZGMn13-2 | --- | --- | --- | --- | --- | 685 | --- | 25 | Q | --- |
| | Grade ZGMn13-3 | --- | --- | --- | --- | --- | 735 | --- | 30 | Q | --- |
| ISO 13521:1999 | Grade GX100Mn13 | --- | --- | --- | --- | --- | --- | --- | --- | ST+Q | --- |
| | Grade GX120Mn13 | --- | --- | --- | --- | --- | --- | --- | --- | ST+Q | --- |
| JIS G 5131:2008 | Class SCMnH 1 | --- | --- | --- | --- | --- | --- | --- | --- | Q | --- |
| | Class SCMnH 2 | --- | --- | --- | --- | --- | 740 | --- | 35 | Q | --- |
| | Class SCMnH 3 | --- | --- | --- | --- | --- | 740 | --- | 35 | Q | --- |
| AFNOR NF A 32-058:1984 | Grade Z 120 MC 12-M | --- | --- | t ≤ 100 | --- | --- | --- | --- | --- | Q | 45 - 50 HRC; 180 - 250 HBW |
| ASTM A128/A128M-93 (2012) | Grade C | J91309 | --- | --- | --- | --- | --- | --- | --- | Q | --- |
| GB/T 5680-1998 | Grade ZGMn13-4 | --- | --- | --- | 390 | --- | 735 | --- | 20 | Q | --- |
| ISO 13521:1999 | Grade GX120MnCr13-2 | --- | --- | --- | --- | --- | --- | --- | --- | ST+Q | --- |
| JIS G 5131:2008 | Class SCMnH 11 | --- | --- | --- | 390 | --- | 740 | --- | 20 | Q | --- |
| AFNOR NF A 32-058:1984 | Grade Z 100 MN 13 4-M | --- | --- | t > 100 | --- | --- | --- | --- | --- | Q | 45 - 50 HRC; 180 - 250 HBW |
| ASTM A128/A128M-93 (2012) | Grade D | J91459 | --- | --- | --- | --- | --- | --- | --- | Q | --- |
| ISO 13521:1999 | Grade GX120MnNi13-3 | --- | --- | --- | --- | --- | --- | --- | --- | ST+Q | --- |
| AFNOR NF A 32-058:1984 | Grade Z 110 MD 12 1-M | --- | --- | t ≤ 200 | --- | --- | --- | --- | --- | Q | 45 - 50 HRC; 180 - 250 HBW |
| ASTM A128/A128M-93 (2012) | Grade E-1 | J91249 | --- | --- | --- | --- | --- | --- | --- | Q | --- |
| ISO 13521:1999 | Grade GX110MnMo13-1 | --- | --- | --- | --- | --- | --- | --- | --- | ST+Q | --- |
| ASTM A128/A128M-93 (2012) | Grade E-2 | J91339 | --- | --- | --- | --- | --- | --- | --- | Q | --- |
| ISO 13521:1999 | Grade GX90MnMo14 | --- | --- | --- | --- | --- | --- | --- | --- | ST+Q | --- |
| AFNOR NF A 32-058:1984 | Grade Z 120MC 17 2-M | --- | --- | t ≤ 100 | --- | --- | --- | --- | --- | Q | 45 - 50 HRC; 180 - 250 HBW |
| ISO 13521:1999 | Grade GX120MnCr17-2 | --- | --- | --- | --- | --- | --- | --- | --- | ST+Q | --- |

**7.3 Cast Alloy Steels**

**7.3.1A Chemical Composition of Cast Alloy Steels for General and Structural Purposes**

| Specification | Designation | UNS No. | Steel No. | Weight, %, max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| EN 10293:2015 | G26CrMo4 | --- | 1.7221 | 0.22-0.29 | 0.50-0.80 | 0.60 | 0.025 | 0.020 | 0.80-1.20 | 0.40 | 0.15-0.30 | V 0.05; Cu 0.30 |
| ISO 14737:2003 | Grade G25CrMo4 | --- | --- | 0.20-0.29 | 0.50-0.80 | 0.60 | 0.025 | 0.020 | 0.80-1.20 | 0.40 | 0.15-0.25 | V 0.05; Cu 0.30 |
| JIS G 5111:1991 | Class SCCrM 1A | --- | --- | 0.20-0.30 | 0.50-0.80 | 0.30-0.60 | 0.040 | 0.040 | 0.80-1.20 | --- | 0.15-0.35 | --- |
| ASTM A958/A958M-14 | Grade SC 4130, Class 65/35 | J13502 | --- | 0.28-0.33 | 0.40-0.80 | 0.30-0.60 | 0.035 | 0.040 | 0.80-1.10 | --- | 0.15-0.25 | --- |
| | Grade SC 4130, Class 70/36 | J13502 | --- | 0.28-0.33 | 0.40-0.80 | 0.30-0.60 | 0.035 | 0.040 | 0.80-1.10 | --- | 0.15-0.25 | --- |
| | Grade SC 4130, Class 80/40 | J13502 | --- | 0.28-0.33 | 0.40-0.80 | 0.30-0.60 | 0.035 | 0.040 | 0.80-1.10 | --- | 0.15-0.25 | --- |
| | Grade SC 4130, Class 80/50 | J13502 | --- | 0.28-0.33 | 0.40-0.80 | 0.30-0.60 | 0.035 | 0.040 | 0.80-1.10 | --- | 0.15-0.25 | --- |
| | Grade SC 4130, Class 90/60 | J13502 | --- | 0.28-0.33 | 0.40-0.80 | 0.30-0.60 | 0.035 | 0.040 | 0.80-1.10 | --- | 0.15-0.25 | --- |
| | Grade SC 4130, Class 105/85 | J13502 | --- | 0.28-0.33 | 0.40-0.80 | 0.30-0.60 | 0.035 | 0.040 | 0.80-1.10 | --- | 0.15-0.25 | --- |
| | Grade SC 4130, Class 115/95 | J13502 | --- | 0.28-0.33 | 0.40-0.80 | 0.30-0.60 | 0.035 | 0.040 | 0.80-1.10 | --- | 0.15-0.25 | --- |
| | Grade SC 4130, Class 130/115 | J13502 | --- | 0.28-0.33 | 0.40-0.80 | 0.30-0.60 | 0.035 | 0.040 | 0.80-1.10 | --- | 0.15-0.25 | --- |
| | Grade SC 4130, Class 135/125 | J13502 | --- | 0.28-0.33 | 0.40-0.80 | 0.30-0.60 | 0.035 | 0.040 | 0.80-1.10 | --- | 0.15-0.25 | --- |
| | Grade SC 4130, Class 150/135 | J13502 | --- | 0.28-0.33 | 0.40-0.80 | 0.30-0.60 | 0.035 | 0.040 | 0.80-1.10 | --- | 0.15-0.25 | --- |
| ISO 14737:2003 | Grade G32CrMo4 | --- | --- | 0.28-0.35 | 0.50-0.80 | 0.60 | 0.025 | 0.020 | 0.80-1.20 | 0.40 | 0.15-0.25 | V 0.05; Cu 0.30 |
| JIS G 5111:1991 | Class SCCrM 3A | --- | --- | 0.30-0.40 | 0.50-0.80 | 0.30-0.60 | 0.040 | 0.040 | 0.80-1.20 | --- | 0.15-0.35 | --- |
| ASTM A958/A958M-14 | Grade SC 4140, Class 65/35 | J14045 | --- | 0.38-0.43 | 0.70-1.10 | 0.30-0.60 | 0.035 | 0.040 | 0.80-1.10 | --- | 0.15-0.25 | --- |
| | Grade SC 4140, Class 70/36 | J14045 | --- | 0.38-0.43 | 0.70-1.10 | 0.30-0.60 | 0.035 | 0.040 | 0.80-1.10 | --- | 0.15-0.25 | --- |
| | Grade SC 4140, Class 80/40 | J14045 | --- | 0.38-0.43 | 0.70-1.10 | 0.30-0.60 | 0.035 | 0.040 | 0.80-1.10 | --- | 0.15-0.25 | --- |
| | Grade SC 4140, Class 80/50 | J14045 | --- | 0.38-0.43 | 0.70-1.10 | 0.30-0.60 | 0.035 | 0.040 | 0.80-1.10 | --- | 0.15-0.25 | --- |
| | Grade SC 4140, Class 90/60 | J14045 | --- | 0.38-0.43 | 0.70-1.10 | 0.30-0.60 | 0.035 | 0.040 | 0.80-1.10 | --- | 0.15-0.25 | --- |
| | Grade SC 4140, Class 105/85 | J14045 | --- | 0.38-0.43 | 0.70-1.10 | 0.30-0.60 | 0.035 | 0.040 | 0.80-1.10 | --- | 0.15-0.25 | --- |
| | Grade SC 4140, Class 115/95 | J14045 | --- | 0.38-0.43 | 0.70-1.10 | 0.30-0.60 | 0.035 | 0.040 | 0.80-1.10 | --- | 0.15-0.25 | --- |
| | Grade SC 4140, Class 130/115 | J14045 | --- | 0.38-0.43 | 0.70-1.10 | 0.30-0.60 | 0.035 | 0.040 | 0.80-1.10 | --- | 0.15-0.25 | --- |
| | Grade SC 4140, Class 135/125 | J14045 | --- | 0.38-0.43 | 0.70-1.10 | 0.30-0.60 | 0.035 | 0.040 | 0.80-1.10 | --- | 0.15-0.25 | --- |
| | Grade SC 4140, Class 150/135 | J14045 | --- | 0.38-0.43 | 0.70-1.10 | 0.30-0.60 | 0.035 | 0.040 | 0.80-1.10 | --- | 0.15-0.25 | --- |
| | Grade SC 4140, Class 160/145 | J14045 | --- | 0.38-0.43 | 0.70-1.10 | 0.30-0.60 | 0.035 | 0.040 | 0.80-1.10 | --- | 0.15-0.25 | --- |
| | Grade SC 4140, Class 165/150 | J14045 | --- | 0.38-0.43 | 0.70-1.10 | 0.30-0.60 | 0.035 | 0.040 | 0.80-1.10 | --- | 0.15-0.25 | --- |
| EN 10293:2015 | G42CrMo4 | --- | 1.7231 | 0.38-0.45 | 0.60-1.00 | 0.60 | 0.025 | 0.020 | 0.80-1.20 | 0.40 | 0.15-0.30 | V 0.05; Cu 0.30 |
| ISO 14737:2003 | Grade G42CrMo4 | --- | --- | 0.38-0.45 | 0.60-0.90 | 0.60 | 0.025 | 0.020 | 0.80-1.20 | 0.40 | 0.15-0.25 | V 0.05; Cu 0.30 |

**7.3 Cast Alloy Steels**

**7.3.1A Chemical Composition of Cast Alloy Steels for General and Structural Purposes (Continued)**

| Specification | Designation | UNS No. | Steel No. | Weight, %, max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASTM A958/A958M-14 | Grade SC 4330, Class 65/35 | J23259 | --- | 0.28-0.33 | 0.60-0.90 | 0.30-0.60 | 0.035 | 0.040 | 0.70-0.90 | 1.65-2.00 | 0.20-0.30 | --- |
| | Grade SC 4330, Class 70/36 | J23259 | --- | 0.28-0.33 | 0.60-0.90 | 0.30-0.60 | 0.035 | 0.040 | 0.70-0.90 | 1.65-2.00 | 0.20-0.30 | --- |
| | Grade SC 4330, Class 80/40 | J23259 | --- | 0.28-0.33 | 0.60-0.90 | 0.30-0.60 | 0.035 | 0.040 | 0.70-0.90 | 1.65-2.00 | 0.20-0.30 | --- |
| | Grade SC 4330, Class 80/50 | J23259 | --- | 0.28-0.33 | 0.60-0.90 | 0.30-0.60 | 0.035 | 0.040 | 0.70-0.90 | 1.65-2.00 | 0.20-0.30 | --- |
| | Grade SC 4330, Class 90/60 | J23259 | --- | 0.28-0.33 | 0.60-0.90 | 0.30-0.60 | 0.035 | 0.040 | 0.70-0.90 | 1.65-2.00 | 0.20-0.30 | --- |
| | Grade SC 4330, Class 105/85 | J23259 | --- | 0.28-0.33 | 0.60-0.90 | 0.30-0.60 | 0.035 | 0.040 | 0.70-0.90 | 1.65-2.00 | 0.20-0.30 | --- |
| | Grade SC 4330, Class 115/95 | J23259 | --- | 0.28-0.33 | 0.60-0.90 | 0.30-0.60 | 0.035 | 0.040 | 0.70-0.90 | 1.65-2.00 | 0.20-0.30 | --- |
| | Grade SC 4330, Class 130/115 | J23259 | --- | 0.28-0.33 | 0.60-0.90 | 0.30-0.60 | 0.035 | 0.040 | 0.70-0.90 | 1.65-2.00 | 0.20-0.30 | --- |
| | Grade SC 4330, Class 135/125 | J23259 | --- | 0.28-0.33 | 0.60-0.90 | 0.30-0.60 | 0.035 | 0.040 | 0.70-0.90 | 1.65-2.00 | 0.20-0.30 | --- |
| | Grade SC 4330, Class 150/135 | J23259 | --- | 0.28-0.33 | 0.60-0.90 | 0.30-0.60 | 0.035 | 0.040 | 0.70-0.90 | 1.65-2.00 | 0.20-0.30 | --- |
| | Grade SC 4330, Class 160/145 | J23259 | --- | 0.28-0.33 | 0.60-0.90 | 0.30-0.60 | 0.035 | 0.040 | 0.70-0.90 | 1.65-2.00 | 0.20-0.30 | --- |
| | Grade SC 4330, Class 165/150 | J23259 | --- | 0.28-0.33 | 0.60-0.90 | 0.30-0.60 | 0.035 | 0.040 | 0.70-0.90 | 1.65-2.00 | 0.20-0.30 | --- |
| | Grade SC 4330, Class 210/180 | J23259 | --- | 0.28-0.33 | 0.60-0.90 | 0.30-0.60 | 0.035 | 0.040 | 0.70-0.90 | 1.65-2.00 | 0.20-0.30 | --- |
| JIS G 5111:1991 | Class SCNCrM 2A | --- | --- | 0.25-0.35 | 0.90-1.50 | 0.30-0.60 | 0.040 | 0.040 | 0.30-0.90 | 1.60-2.00 | 0.15-0.35 | --- |
| EN 10293:2015 | G32NiCrMo8-5-4 | --- | 1.6570 | 0.28 - 0.35 | 0.60 - 1.00 | 0.60 | 0.020 | 0.015 | 1.00 - 1.40 | 1.60 - 2.10 | 0.30 - 0.50 | V 0.05; Cu 0.30 |
| ISO 14737:2003 | Grade G32NiCrMo8-5-4 | --- | --- | 0.28 - 0.35 | 0.60 - 1.00 | 0.60 | 0.020 | 0.015 | 1.00 - 1.40 | 1.60 - 2.10 | 0.30 - 0.50 | V 0.05; Cu 0.30 |

**7.3.1B Mechanical Properties of Cast Alloy Steels for General and Structural Purposes**

| Specification | Designation | UNS No. | Steel No. | Section Thickness, mm | Yield Strength, min. | | Tensile Strength, min. | | Elongation % min. | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | MPa | ksi | MPa | ksi | | | |
| EN 10293:2015 | G26CrMo4 | --- | 1.7221 | t ≤ 100 | 550 | --- | 700-850 | --- | 10 | Q+T | 18 J @ RT |
| | | | | t ≤ 100 | 450 | --- | 600-750 | --- | 16 | Q+T | 40 J @ RT |
| | | | | 100 < t ≤ 250 | 300 | --- | 550-700 | --- | 14 | Q+T | 27 J @ RT |
| ISO 14737:2003 | Grade G25CrMo4 | --- | --- | t ≤ 100 | 450 | --- | 600-750 | --- | 16 | Q+T | 40 J @ RT |
| | | | | t ≤ 100 | 550 | --- | 700-850 | --- | 10 | Q+T | 18 J @ RT |
| | | | | 100 < t ≤ 250 | 300 | --- | 550-700 | --- | 14 | Q+T | 27 J @ RT |
| JIS G 5111:1991 | Class SCCrM 1A | --- | --- | --- | 390 | --- | 590 | --- | 13 | N+T | 170 min. HB |

**7.3 Cast Alloy Steels**

**7.3.1B Mechanical Properties of Cast Alloy Steels for General and Structural Purposes (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness, mm | Yield Strength, min. MPa | Yield Strength, min. ksi | Tensile Strength, min. MPa | Tensile Strength, min. ksi | Elongation % min. | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ASTM A958/A958M-14 | Grade SC 4130, Class 65/35 | J13502 | --- | --- | 240 | 35 | 450 | 65 | 24 | N+T | --- |
| | Grade SC 4130, Class 70/36 | J13502 | --- | --- | 250 | 36 | 485 | 70 | 22 | N+T | --- |
| | Grade SC 4130, Class 80/40 | J13502 | --- | --- | 275 | 40 | 550 | 80 | 18 | N+T | --- |
| | Grade SC 4130, Class 80/50 | J13502 | --- | --- | 345 | 50 | 550 | 80 | 22 | N+T | --- |
| | Grade SC 4130, Class 90/60 | J13502 | --- | --- | 415 | 60 | 620 | 90 | 18 | N+T; or HT+Q+T | --- |
| | Grade SC 4130, Class 105/85 | J13502 | --- | --- | 585 | 85 | 725 | 105 | 17 | HT+Q+T | --- |
| | Grade SC 4130, Class 115/95 | J13502 | --- | --- | 655 | 95 | 795 | 115 | 14 | HT+Q+T | --- |
| | Grade SC 4130, Class 130/115 | J13502 | --- | --- | 795 | 115 | 895 | 130 | 11 | HT+Q+T | --- |
| | Grade SC 4130, Class 135/125 | J13502 | --- | --- | 860 | 125 | 930 | 135 | 9 | HT+Q+T | --- |
| | Grade SC 4130, Class 150/135 | J13502 | --- | --- | 930 | 135 | 1035 | 150 | 7 | HT+Q+T | --- |
| ISO 14737:2003 | Grade G32CrMo4 | --- | --- | t ≤ 100 | 270 | --- | 630-780 | --- | 16 | N+T | 10 J @ RT |
| | | | | t ≤ 100 | 540 | --- | 700-850 | --- | 12 | Q+T | 35 J @ RT |
| | | | | t ≤ 100 | 650 | --- | 800-950 | --- | 10 | Q+T | 18 J @ RT |
| | | | | 100 < t ≤ 150 | 480 | --- | 620-770 | --- | 10 | Q+T | 27 J @ RT |
| | | | | 150 < t ≤ 250 | 330 | --- | 620-770 | --- | 10 | Q+T | 16 J @ RT |
| JIS G 5111:1991 | Class SCCrM 3A | --- | --- | --- | 440 | --- | 690 | --- | 9 | N+T | 201 min. HB |
| ASTM A958/A958M-14 | Grade SC 4140, Class 65/35 | J14045 | --- | --- | 240 | 35 | 450 | 65 | 24 | N+T | --- |
| | Grade SC 4140, Class 70/36 | J14045 | --- | --- | 250 | 36 | 485 | 70 | 22 | N+T | --- |
| | Grade SC 4140, Class 80/40 | J14045 | --- | --- | 275 | 40 | 550 | 80 | 18 | N+T | --- |
| | Grade SC 4140, Class 80/50 | J14045 | --- | --- | 345 | 50 | 550 | 80 | 22 | N+T | --- |
| | Grade SC 4140, Class 90/60 | J14045 | --- | --- | 415 | 60 | 620 | 90 | 18 | N+T | --- |
| | Grade SC 4140, Class 105/85 | J14045 | --- | --- | 585 | 85 | 725 | 105 | 17 | N+T; or HT+Q+T | --- |
| | Grade SC 4140, Class 115/95 | J14045 | --- | --- | 655 | 95 | 795 | 115 | 14 | HT+Q+T | --- |
| | Grade SC 4140, Class 130/115 | J14045 | --- | --- | 795 | 115 | 895 | 130 | 11 | HT+Q+T | --- |
| | Grade SC 4140, Class 135/125 | J14045 | --- | --- | 860 | 125 | 930 | 135 | 9 | HT+Q+T | --- |
| | Grade SC 4140, Class 150/135 | J14045 | --- | --- | 930 | 135 | 1035 | 150 | 7 | HT+Q+T | --- |
| | Grade SC 4140, Class 160/145 | J14045 | --- | --- | 1000 | 145 | 1105 | 160 | 6 | HT+Q+T | --- |
| | Grade SC 4140, Class 165/150 | J14045 | --- | --- | 1035 | 150 | 1140 | 165 | 5 | HT+Q+T | --- |
| EN 10293:2015 | G42CrMo4 | --- | 1.7231 | t ≤ 100 | 700 | --- | 850-1000 | --- | 10 | Q+T | 27 J @ RT |
| | | | | t ≤ 100 | 600 | --- | 800-950 | --- | 12 | Q+T | 31 J @ RT |
| | | | | 100 < t ≤ 150 | 550 | --- | 700-850 | --- | 10 | Q+T | 27 J @ RT |
| | | | | 150 < t ≤ 250 | 350 | --- | 650-800 | --- | 10 | Q+T | 16 J @ RT |
| ISO 14737:2003 | Grade G42CrMo4 | --- | --- | t ≤ 100 | 300 | --- | 700-850 | --- | 15 | N+T | 10 J @ RT |
| | | | | t ≤ 100 | 600 | --- | 780-930 | --- | 12 | Q+T | 31 J @ RT |
| | | | | t ≤ 100 | 700 | --- | 850-1000 | --- | 10 | Q+T | 16 J @ RT |
| | | | | 100 < t ≤ 150 | 550 | --- | 700-850 | --- | 10 | Q+T | 27 J @ RT |
| | | | | 150 < t ≤ 250 | 350 | --- | 650-800 | --- | 10 | Q+T | 16 J @ RT |

**7.3 Cast Alloy Steels**

**7.3.1B Mechanical Properties of Cast Alloy Steels for General and Structural Purposes (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness, mm | Yield Strength, min. MPa | Yield Strength, min. ksi | Tensile Strength, min. MPa | Tensile Strength, min. ksi | Elongation % min. | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ASTM A958/A958M-14 | Grade SC 4330, Class 65/35 | J23259 | --- | --- | 240 | 35 | 450 | 65 | 24 | N+T | --- |
| | Grade SC 4330, Class 70/36 | J23259 | --- | --- | 250 | 36 | 485 | 70 | 22 | N+T | --- |
| | Grade SC 4330, Class 80/40 | J23259 | --- | --- | 275 | 40 | 550 | 80 | 18 | N+T | --- |
| | Grade SC 4330, Class 80/50 | J23259 | --- | --- | 345 | 50 | 550 | 80 | 22 | N+T | --- |
| | Grade SC 4330, Class 90/60 | J23259 | --- | --- | 415 | 60 | 620 | 90 | 18 | N+T; or HT+Q+T | --- |
| | Grade SC 4330, Class 105/85 | J23259 | --- | --- | 585 | 85 | 725 | 105 | 17 | HT+Q+T | --- |
| | Grade SC 4330, Class 115/95 | J23259 | --- | --- | 655 | 95 | 795 | 115 | 14 | HT+Q+T | --- |
| | Grade SC 4330, Class 130/115 | J23259 | --- | --- | 795 | 115 | 895 | 130 | 11 | HT+Q+T | --- |
| | Grade SC 4330, Class 135/125 | J23259 | --- | --- | 860 | 125 | 930 | 135 | 9 | HT+Q+T | --- |
| | Grade SC 4330, Class 150/135 | J23259 | --- | --- | 930 | 135 | 1035 | 150 | 7 | HT+Q+T | --- |
| | Grade SC 4330, Class 160/145 | J23259 | --- | --- | 1000 | 145 | 1105 | 160 | 6 | HT+Q+T | --- |
| | Grade SC 4330, Class 165/150 | J23259 | --- | --- | 1035 | 150 | 1140 | 165 | 5 | HT+Q+T | --- |
| | Grade SC 4330, Class 210/180 | J23259 | --- | --- | 1240 | 180 | 1450 | 210 | 4 | HT+Q+T | --- |
| JIS G 5111:1991 | Class SCNCrM 2A | --- | --- | --- | 590 | --- | 780 | --- | 9 | N+T | 223 min. HB |
| EN 10293:2015 | G32NiCrMo8-5-4 | --- | 1.6570 | $t \leq 100$ | 950 | --- | 1050-1200 | --- | 10 | Q+T | 35 J @ RT |
| | | | | $t \leq 100$ | 700 | --- | 850-1000 | --- | 16 | Q+T | 50 J @ RT |
| | | | | $100 < t \leq 250$ | 650 | --- | 820-970 | --- | 14 | Q+T | 35 J @ RT |
| ISO 14737:2003 | Grade G32NiCrMo8-5-4 | --- | 1.6570 | $t \leq 100$ | 950 | --- | 1050-1200 | --- | 10 | Q+T | 35 J @ RT |
| | | | | $t \leq 100$ | 700 | --- | 850-1000 | --- | 16 | Q+T | 50 J @ RT |
| | | | | $100 < t \leq 250$ | 650 | --- | 820-970 | --- | 14 | Q+T | 35 J @ RT |

**7.3 Cast Alloy Steels**

**7.3.2A Chemical Composition of Cast Alloy Steels for Pressure Purposes at High Temperatures**

| Specification | Designation | UNS No. | Steel No. | Weight, %, max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASME SA-217/SA-217M | Grade WC1 | J12524 | --- | 0.25 | 0.50-0.80 | 0.60 | 0.04 | 0.045 | 0.35 | 0.50 | 0.45-0.65 | Cu 0.50; W 0.10; (Cu+Ni+Cr+W) 1.00 |
| ASTM A217/A217M-14 | Grade WC1 | J12524 | --- | 0.25 | 0.50-0.80 | 0.60 | 0.04 | 0.045 | 0.35 | 0.50 | 0.45-0.65 | Cu 0.50; W 0.10; (Cu+Ni+Cr+W) 1.00 |
| EN 10213:2007 C1:2008 | G20Mo5 | --- | 1.5419 | 0.15-0.23 | 0.50-1.00 | 0.60 | 0.025 | 0.020 | 0.30 | 0.40 | 0.40-0.60 | V 0.05; Cu 0.30 |
| GB/T 16253-1996 | Grade ZG19MoG | --- | --- | 0.15-0.23 | 0.50-1.00 | 0.30-0.60 | 0.035 | 0.035 | 0.030 | --- | 0.40-0.60 | --- |
| ISO 4991:1994 | Type C28H | --- | --- | 0.15-0.23 | 0.50-1.00 | 0.30-0.60 | 0.035 | 0.035 | 0.30 | --- | 0.40-0.60 | --- |
| JIS G 5151:1991 | Class SCPH 11 | --- | --- | 0.25 | 0.50-0.80 | 0.60 | 0.040 | 0.040 | 0.35 | 0.50 | 0.45-0.65 | Cu 0.50; W 0.10; (Cu+Ni+Cr+W) 1.00 |
| ASME SA-217/SA-217M | Grade WC6 | J12072 | --- | 0.05-0.20 | 0.50-0.80 | 0.60 | 0.04 | 0.045 | 1.00-1.50 | 0.50 | 0.45-0.65 | Cu 0.50; W 0.10; (Cu+Ni+W) 1.00 |
| ASTM A217/A217M-14 | Grade WC6 | J12072 | --- | 0.05-0.20 | 0.50-0.80 | 0.60 | 0.035 | 0.035 | 1.00-1.50 | 0.50 | 0.45-0.65 | Cu 0.50; W 0.10; (Cu+Ni+W) 1.00 |
| EN 10213:2007 C1:2008 | G17CrMo5-5 | --- | 1.7357 | 0.15-0.20 | 0.50-1.00 | 0.60 | 0.020 | 0.020 | 1.00-1.50 | 0.40 | 0.45-0.65 | V 0.05; Cu 0.30 |
| GB/T 16253-1996 | Grade ZG15Cr1MoG | --- | --- | 0.10-0.20 | 0.50-0.80 | 0.30-0.60 | 0.035 | 0.035 | 1.00-1.50 | --- | 0.45-0.65 | --- |
| ISO 4991:1994 | Type C32H | --- | --- | 0.10-0.20 | 0.50-0.80 | 0.30-0.60 | 0.035 | 0.035 | 1.00-1.50 | --- | 0.45-0.65 | --- |
| JIS G 5151:1991 | Class SCPH 21 | --- | --- | 0.20 | 0.50-0.80 | 0.60 | 0.040 | 0.040 | 1.00-1.50 | 0.50 | 0.45-0.65 | Cu 0.50; W 0.10; (Cu+Ni+W) 1.00 |
| ASTM A389/A389M-13 | Grade C24 | J12092 | --- | 0.20 | 0.30-0.80 | 0.60 | 0.035 | 0.035 | 0.80-1.25 | --- | 0.90-1.20 | V 0.15-0.25 |
| EN 10213:2007 C1:2008 | G17CrMoV5-10 | --- | 1.7706 | 0.15-0.20 | 0.50-0.90 | 0.60 | 0.020 | 0.015 | 1.20-1.50 | 0.40 | 0.90-1.10 | V 0.20-0.30; Cu 0.30; Sn 0.025 |
| GB/T 16253-1996 | Grade ZG17Cr1Mo1VG | --- | --- | 0.13-0.20 | 0.50-0.80 | 0.30-0.60 | 0.035 | 0.035 | 1.20-1.60 | --- | 0.90-1.20 | V 0.15-0.35 |
| ISO 4991:1994 | Type C35BH | --- | --- | 0.13-0.20 | 0.50-0.80 | 0.30-0.60 | 0.035 | 0.035 | 1.20-1.60 | --- | 0.90-1.20 | V 0.15-0.35 |
| JIS G 5151:1991 | Class SCPH 23 | --- | --- | 0.20 | 0.50-0.80 | 0.60 | 0.040 | 0.040 | 1.00-1.50 | 0.50 | 0.90-1.20 | V 0.15-0.25; Cu 0.50; W 0.10; (Cu+Ni+W) 1.00 |
| ASME SA-217/SA-217M | Grade WC9 | J21890 | --- | 0.05-0.18 | 0.40-0.70 | 0.60 | 0.04 | 0.045 | 2.00-2.75 | 0.50 | 0.90-1.20 | Cu 0.50; W 0.10; (Cu+Ni+W) 1.00 |
| ASME SA-487/SA-487M | Grade 8, Class A | J22091 | --- | 0.05-0.20 | 0.50-0.90 | 0.80 | 0.04 | 0.045 | 2.00-2.75 | --- | 0.90-1.10 | Cu 0.50; W 0.10; V 0.03; (Cu+W+V) 0.60 |
| | Grade 8, Class B | J22091 | --- | 0.05-0.20 | 0.50-0.90 | 0.80 | 0.04 | 0.045 | 2.00-2.75 | --- | 0.90-1.10 | Cu 0.50; W 0.10; V 0.03; (Cu+W+V) 0.60 |
| | Grade 8, Class C | J22091 | --- | 0.05-0.20 | 0.50-0.90 | 0.80 | 0.04 | 0.045 | 2.00-2.75 | --- | 0.90-1.10 | Cu 0.50; W 0.10; V 0.03; (Cu+W+V) 0.60 |
| ASTM A217/A217M-14 | Grade WC9 | J21890 | --- | 0.05-0.18 | 0.40-0.70 | 0.60 | 0.035 | 0.035 | 2.00-2.75 | 0.50 | 0.90-1.20 | Cu 0.50; W 0.10; (Cu+Ni+W) 1.00 |
| ASTM A487/A487M-14 | Grade 8, Class A | J22091 | --- | 0.05-0.20 | 0.50-0.90 | 0.80 | 0.035 | 0.035 | 2.00-2.75 | --- | 0.90-1.10 | Cu 0.50; W 0.10; V 0.03; (Cu+W+V) 0.60 |
| | Grade 8, Class B | J22091 | --- | 0.05-0.20 | 0.50-0.90 | 0.80 | 0.035 | 0.035 | 2.00-2.75 | --- | 0.90-1.10 | Cu 0.50; W 0.10; V 0.03; (Cu+W+V) 0.60 |
| | Grade 8, Class C | J22091 | --- | 0.05-0.20 | 0.50-0.90 | 0.80 | 0.035 | 0.035 | 2.00-2.75 | --- | 0.90-1.10 | Cu 0.50; W 0.10; V 0.03; (Cu+W+V) 0.60 |

Note: This section continued on next page.

**7.3 Cast Alloy Steels**

**7.3.2A Chemical Composition of Cast Alloy Steels for Pressure Purposes at High Temperatures (Continued)**

| Specification | Designation | UNS No. | Steel No. | Weight, %, max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| EN 10213:2007 C1:2008 | G17CrMo9-10 | --- | 1.7379 | 0.13-0.20 | 0.50-0.90 | 0.60 | 0.020 | 0.020 | 2.00-2.50 | 0.40 | 0.90-1.20 | V 0.05; Cu 0.30 |
| GB/T 16253-1996 | Grade ZG12Cr2Mo1G | --- | --- | 0.08-0.15 | 0.50-0.80 | 0.30-0.60 | 0.035 | 0.035 | 2.00-2.50 | --- | 0.90-1.20 | --- |
| | Grade ZG16Cr2Mo1G | --- | --- | 0.13-0.20 | 0.50-0.80 | 0.30-0.60 | 0.035 | 0.035 | 2.00-2.50 | --- | 0.90-1.20 | --- |
| ISO 4991:1994 | Type C34AH | --- | --- | 0.08-0.15 | 0.50-0.80 | 0.30-0.60 | 0.035 | 0.035 | 2.00-2.50 | --- | 0.90-1.20 | --- |
| | Type C34BH | --- | --- | 0.13-0.20 | 0.50-0.80 | 0.30-0.60 | 0.035 | 0.035 | 2.00-2.50 | --- | 0.90-1.20 | --- |
| JIS G 5151:1991 | Class SCPH 32 | --- | --- | 0.20 | 0.50-0.80 | 0.60 | 0.040 | 0.040 | 2.00-2.75 | 0.50 | 0.90-1.20 | Cu 0.50; W 0.10; (Cu+Ni+W) 1.00 |
| ASME SA-217/SA-217M | Grade C5 | J42045 | --- | 0.20 | 0.40-0.70 | 0.75 | 0.04 | 0.045 | 4.00-6.50 | 0.50 | 0.45-0.65 | Cu 0.50; W 0.10; (Cu+Ni+W) 1.00 |
| ASTM A217/A217M-14 | Grade C5 | J42045 | --- | 0.20 | 0.40-0.70 | 0.75 | 0.04 | 0.045 | 4.00-6.50 | 0.50 | 0.45-0.65 | Cu 0.50; W 0.10; (Cu+Ni+W) 1.00 |
| EN 10213:2007 C1:2008 | GX15CrMo5 | --- | 1.7365 | 0.12-0.19 | 0.50-0.80 | 0.80 | 0.025 | 0.025 | 4.00-6.00 | --- | 0.45-0.65 | V 0.05; Cu 0.30 |
| GB/T 16253-1996 | Grade ZG16Cr5MoG | --- | --- | 0.12-0.19 | 0.50-0.80 | 0.80 | 0.035 | 0.035 | 4.00-6.00 | --- | 0.45-0.65 | --- |
| ISO 4991:1994 | Type C37H | --- | --- | 0.12-0.19 | 0.50-0.80 | 0.80 | 0.035 | 0.035 | 4.00-6.00 | --- | 0.45-0.65 | --- |
| JIS G 5151:1991 | Class SCPH 61 | --- | --- | 0.20 | 0.50-0.80 | 0.75 | 0.040 | 0.040 | 4.00-6.50 | 0.50 | 0.45-0.65 | Cu 0.50; W 0.10; (Cu+Ni+W) 1.00 |
| EN 10295:2002 | GX30CrSi7 | --- | 1.4710 | 0.20-0.35 | 0.50-1.00 | 1.00-2.50 | 0.035 | 0.030 | 6.00-8.00 | 0.50 | 0.15 | --- |
| ISO 11973:1999 | Grade GX30CrSi7 | --- | --- | 0.20-0.35 | 0.50-1.00 | 1.00-2.5 | 0.040 | 0.040 | 6.0-8.0 | 0.50 | 0.5 | --- |
| ASME SA-217/SA-217M | Grade C12 | J82090 | --- | 0.20 | 0.35-0.65 | 1.00 | 0.04 | 0.045 | 8.00-10.00 | 0.50 | 0.90-1.20 | Cu 0.50; W 0.10; (Cu+Ni+W) 1.00 |
| ASTM A217/A217M-14 | Grade C12 | J82090 | --- | 0.20 | 0.35-0.65 | 1.00 | 0.035 | 0.035 | 8.00-10.00 | 0.50 | 0.90-1.20 | Cu 0.50; W 0.10; Cb 0.03; V 0.06; (Cu+Ni+W) 1.00 |
| GB/T 16253-1996 | Grade ZG14Cr9Mo1G | --- | --- | 0.10-0.17 | 0.50-0.80 | 0.80 | 0.035 | 0.035 | 8.00-10.0 | --- | 1.00-1.30 | --- |
| ISO 4991:1994 | Type C38H | --- | --- | 0.10-0.17 | 0.50-0.80 | 0.80 | 0.035 | 0.035 | 8.00-10.00 | --- | 1.00-1.30 | --- |
| EN 10213:2007 C1:2008 | G12MoCrV5-2 | --- | 1.7720 | 0.10-0.15 | 0.40-0.70 | 0.45 | 0.030 | 0.020 | 0.30-0.50 | 0.40 | 0.40-0.60 | V 0.22-0.30; Cu 0.30; Sn 0.025 |
| GB/T 16253-1996 | Grade ZG14MoVG | --- | --- | 0.10-0.17 | 0.40-0.70 | 0.30-0.60 | 0.035 | 0.035 | 0.30-0.60 | 0.40 | 0.40-0.60 | V 0.22-0.32 |
| ISO 4991:1994 | Type C33H | --- | --- | 0.10-0.17 | 0.40-0.70 | 0.30-0.60 | 0.035 | 0.035 | 0.30-0.60 | 0.40 | 0.40-0.60 | V 0.22-0.32 |

**7.3.2B Mechanical Properties of Cast Alloy Steels for Pressure Purposes at High Temperatures**

| Specification | Designation | UNS No. | Steel No. | Section Thickness, mm | Yield Strength, min. | | Tensile Strength, min. | | Elongation % min. | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | MPa | ksi | MPa | ksi | | | |
| ASME SA-217/SA-217M | Grade WC1 | J12524 | --- | --- | 240 | 35 | 450-620 | 65-90 | 24 | N+T | --- |
| ASTM A217/A217M-14 | Grade WC1 | J12524 | --- | --- | 240 | 35 | 450-620 | 65-90 | 24 | N+T | --- |
| EN 10213:2007 C1:2008 | G20Mo5 | --- | 1.5419 | t ≤ 100 | 245 | --- | 440-590 | --- | 22 | Q+T | 27 J @ RT |
| GB/T 16253-1996 | Grade ZG19MoG | --- | --- | --- | 250 | --- | 450-600 | --- | 21 | N+T or Q+T | 25 J @ RT |
| ISO 4991:1994 | Type C28H | --- | --- | --- | 250 | --- | 450-600 | --- | 21 | N+T or Q+T | 25 J @ RT |
| JIS G 5151:1991 | Class SCPH 11 | --- | --- | --- | 245 | --- | 450 | --- | 22 | A, N, N+T or Q+T | --- |
| ASME SA-217/SA-217M | Grade WC6 | J12072 | --- | --- | 275 | 40 | 485-655 | 70-95 | 20 | N+T | --- |
| ASTM A217/A217M-14 | Grade WC6 | J12072 | --- | --- | 275 | 40 | 485-655 | 70-95 | 20 | N+T | --- |

Note: This section continued on next page.

**7.3 Cast Alloy Steels**

**7.3.2B Mechanical Properties of Cast Alloy Steels for Pressure Purposes at High Temperatures (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness, mm | Yield Strength, min. MPa | Yield Strength, min. ksi | Tensile Strength, min. MPa | Tensile Strength, min. ksi | Elongation % min. | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|
| EN 10213:2007 C1:2008 | G17CrMo5-5 | --- | 1.7357 | t ≤ 100 | 315 | --- | 490-690 | --- | 20 | Q+T | 27 J @ RT |
| GB/T 16253-1996 | Grade ZG15Cr1MoG | --- | --- | --- | 290 | --- | 490-640 | --- | 18 | N+T or Q+T | 27 J @ RT |
| ISO 4991:1994 | Type C32H | --- | --- | --- | 290 | --- | 490-640 | --- | 18 | N+T or Q+T | 27 J @ RT |
| JIS G 5151:1991 | Class SCPH 21 | --- | --- | --- | 275 | --- | 480 | --- | 17 | A, N, N+T or Q+T | --- |
| ASTM A389/A389M-13 | Grade C24 | J12092 | --- | --- | 345 | 50 | 552 | 80 | 15.0 | N+T | --- |
| EN 10213:2007 C1:2008 | G17CrMoV5-10 | --- | 1.7706 | t ≤ 150 | 440 | --- | 590-780 | --- | 15 | Q+T | 27 J @ RT |
| GB/T 16253-1996 | Grade ZG17Cr1Mo1VG | --- | --- | --- | 420 | --- | 590-740 | --- | 15 | N+T or Q+T | 24 J @ RT |
| ISO 4991:1994 | Type C35BH | --- | --- | --- | 420 | --- | 590-740 | --- | 15 | N+T or Q+T | 24 J @ RT |
| JIS G 5151:1991 | Class SCPH 23 | --- | --- | --- | 345 | --- | 550 | --- | 13 | A, N, N+T or Q+T | --- |
| ASME SA-217/SA-217M | Grade WC9 | J21890 | --- | --- | 275 | 40 | 485-655 | 70-95 | 20 | N+T | --- |
| ASME SA-487/SA-487M | Grade 8, Class A | J22091 | --- | --- | 380 | 55 | 585-760 | 85-110 | 20 | N+T | --- |
| | Grade 8, Class B | J22091 | --- | --- | 585 | 85 | 725 | 105 | 17 | Q+T | --- |
| | Grade 8, Class C | J22091 | --- | --- | 515 | 75 | 690 | 100 | 17 | Q+T | 235 max HB; 22 max HRC |
| ASTM A217/A217M-14 | Grade WC9 | J21890 | --- | --- | 275 | 40 | 485-655 | 70-95 | 20 | N+T | --- |
| ASTM A487/A487M-14 | Grade 8, Class A | J22091 | --- | --- | 380 | 55 | 585-760 | 85-110 | 20 | N+T | --- |
| | Grade 8, Class B | J22091 | --- | --- | 585 | 85 | 725 | 105 | 17 | Q+T | --- |
| | Grade 8, Class C | J22091 | --- | --- | 515 | 75 | 690 | 100 | 17 | Q+T | 235 max HB; 22 max HRC |
| EN 10213:2007 C1:2008 | G17CrMo9-10 | --- | 1.7379 | t ≤ 150 | 400 | --- | 590-740 | --- | 18 | Q+T | 40 J @ RT |
| GB/T 16253-1996 | Grade ZG12Cr2Mo1G | --- | --- | --- | 280 | --- | 510-660 | --- | 18 | N+T | 25 J @ RT |
| | Grade ZG16Cr2Mo1G | --- | --- | --- | 390 | --- | 600-750 | --- | 18 | N+T or Q+T | 40 J @ RT |
| ISO 4991:1994 | Type C34AH | --- | --- | --- | 280 | --- | 510-660 | --- | 18 | N+T | 25 J @ RT |
| | Type C34BH | --- | --- | --- | 390 | --- | 600-750 | --- | 18 | N+T or Q+T | 40 J @ RT |
| JIS G 5151:1991 | Class SCPH 32 | --- | --- | --- | 275 | --- | 480 | --- | 17 | A, N, N+T or Q+T | --- |
| ASME SA-217/SA-217M | Grade C5 | J42045 | --- | --- | 415 | 60 | 620-795 | 90-115 | 18 | N+T | --- |
| ASTM A217/A217M-14 | Grade C5 | J42045 | --- | --- | 415 | 60 | 620-795 | 90-115 | 18 | N+T | --- |
| EN 10213:2007 C1:2008 | GX15CrMo5 | --- | 1.7365 | t ≤ 150 | 420 | --- | 630-760 | --- | 16 | Q+T | 27 J @ RT |
| GB/T 16253-1996 | Grade ZG16Cr5MoG | --- | --- | --- | 420 | --- | 630-780 | --- | 16 | N+T | 25 J @ RT |
| ISO 4991:1994 | Type C37H | --- | --- | --- | 420 | --- | 630-780 | --- | 16 | N+T | 25 J @ RT |
| JIS G 5151:1991 | Class SCPH 61 | --- | --- | --- | 410 | --- | 620 | --- | 17 | A, N, N+T or Q+T | --- |
| EN 10295:2002 | GX30CrSi7 | --- | 1.4710 | --- | --- | --- | --- | --- | --- | A | 300 max HB |
| ISO 11973:1999 | Grade GX30CrSi7 | --- | --- | --- | --- | --- | --- | --- | --- | A or AC | --- |
| ASME SA-217/SA-217M | Grade C12 | J82090 | --- | --- | 415 | 60 | 620-795 | 90-115 | 18 | N+T | --- |
| ASTM A217/A217M-14 | Grade C12 | J82090 | --- | --- | 415 | 60 | 620-795 | 90-115 | 18 | N+T | --- |
| GB/T 16253-1996 | Grade ZG14Cr9Mo1G | --- | --- | --- | 420 | --- | 630-780 | --- | 16 | N+T | 20 J @ RT |
| ISO 4991:1994 | Type C38H | --- | --- | --- | 420 | --- | 630-780 | --- | 16 | N+T | 20 J @ RT |
| EN 10213:2007 C1:2008 | G12MoCrV5-2 | --- | 1.7720 | t ≤ 100 | 295 | --- | 510-660 | --- | 17 | Q+T | 27 J @ RT |
| GB/T 16253-1996 | Grade ZG14MoVG | --- | --- | --- | 320 | --- | 500-650 | --- | 17 | N+T | 13 J @ RT |
| ISO 4991:1994 | Type C33H | --- | --- | --- | 320 | --- | 500-650 | --- | 17 | N+T | 13 J @ RT |

**7.3 Cast Alloy Steels**

**7.3.3A Chemical Composition of Cast Alloy Steels for Pressure Purposes at Low Temperatures**

| Specification | Designation | UNS No. | Steel No. | Weight, %, max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASME SA-352/SA-352M | Grade LC1 | J12522 | --- | 0.25 | 0.50-0.80 | 0.60 | 0.04 | 0.045 | --- | --- | 0.45-0.65 | --- |
| ASTM A352/A352M-06 (2012) | Grade LC1 | J12522 | --- | 0.25 | 0.50-0.80 | 0.60 | 0.04 | 0.045 | --- | --- | 0.45-0.65 | --- |
| EN 10213:2007 C1:2008 | G18Mo5 | --- | 1.5422 | 0.15-0.20 | 0.80-1.20 | 0.60 | 0.020 | 0.020 | 0.30 | 0.40 | 0.45-0.65 | V 0.05; Cu 0.30 |
| JIS G 5152:1991 | Class SCPL 11 | --- | --- | 0.25 | 0.50-0.80 | 0.60 | 0.040 | 0.040 | 0.35 | --- | 0.45-0.65 | Cu 0.50 |
| ASME SA-352/SA-352M | Grade LC2 | J22500 | --- | 0.25 | 0.50-0.80 | 0.60 | 0.04 | 0.045 | --- | 2.00-3.00 | --- | --- |
| ASTM A352/A352M-06 (2012) | Grade LC2 | J22500 | --- | 0.25 | 0.50-0.80 | 0.60 | 0.04 | 0.045 | --- | 2.00-3.00 | --- | --- |
| ASTM A757/A757M-15 | Grade B2N | J22501 | --- | 0.25 | 0.50-0.80 | 0.60 | 0.025 | 0.025 | 0.40 | 2.0-3.0 | 0.25 | V 0.03; Cu 0.50; (V+Cu+Cr+Mo+P+S) 1.00 |
| | Grade B2Q | J22501 | --- | 0.25 | 0.50-0.80 | 0.60 | 0.025 | 0.025 | 0.40 | 2.0-3.0 | 0.25 | V 0.03; Cu 0.50; (V+Cu+Cr+Mo+P+S) 1.00 |
| EN 10213:2007 C1:2008 | G9Ni10 | --- | 1.5636 | 0.06-0.12 | 0.50-0.80 | 0.60 | 0.020 | 0.015 | 0.30 | 2.00-3.00 | 0.20 | V 0.05; Cu 0.30 |
| JIS G 5152:1991 | Class SCPL 21 | --- | --- | 0.25 | 0.50-0.80 | 0.60 | 0.040 | 0.040 | 0.35 | 2.00-3.00 | --- | Cu 0.50 |
| ASME SA-352/SA-352M | Grade LC3 | J31550 | --- | 0.15 | 0.50-0.80 | 0.60 | 0.04 | 0.045 | --- | 3.00-4.00 | --- | --- |
| ASTM A352/A352M-06 (2012) | Grade LC3 | J31550 | --- | 0.15 | 0.50-0.80 | 0.60 | 0.04 | 0.045 | --- | 3.00-4.00 | --- | --- |
| ASTM A757/A757M-15 | Grade B3N | J31500 | --- | 0.15 | 0.50-0.80 | 0.60 | 0.025 | 0.025 | 0.40 | 3.0-4.0 | 0.25 | V 0.03; Cu 0.50; (V+Cu+Cr+Mo+P+S) 1.00 |
| | Grade B3Q | J31500 | --- | 0.15 | 0.50-0.80 | 0.60 | 0.025 | 0.025 | 0.40 | 3.0-4.0 | 0.25 | V 0.03; Cu 0.50; (V+Cu+Cr+Mo+P+S) 1.00 |
| EN 10213:2007 C1:2008 | G9Ni14 | --- | 1.5638 | 0.06-0.12 | 0.50-0.80 | 0.60 | 0.020 | 0.015 | 0.30 | 3.00-4.00 | 0.20 | V 0.05; Cu 0.30 |
| GB/T 16253-1996 | Grade ZG14Ni4D | --- | --- | 0.14 | 0.50-0.80 | 0.30-0.60 | 0.030 | 0.030 | --- | 3.00-4.00 | --- | --- |
| ISO 4991:1994 | Type C43L | --- | --- | 0.14 | 0.50-0.80 | 0.30-0.60 | 0.030 | 0.030 | --- | 3.00-4.00 | --- | --- |
| JIS G 5152:1991 | Class SCPL 31 | --- | --- | 0.15 | 0.50-0.80 | 0.60 | 0.040 | 0.040 | 0.35 | 3.00-4.00 | --- | Cu 0.50 |

**7.3 Cast Alloy Steels**

**7.3.3A Chemical Composition of Cast Alloy Steels for Pressure Purposes at Low Temperatures (Continued)**

| Specification | Designation | UNS No. | Steel No. | Weight, %, max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASME SA-352/SA-352M | Grade LC2-1 | J42215 | --- | 0.22 | 0.55-0.75 | 0.50 | 0.04 | 0.045 | 1.35-1.85 | 2.50-3.50 | 0.30-0.60 | --- |
| ASTM A352/A352M-06 (2012) | Grade LC2-1 | J42215 | --- | 0.22 | 0.55-0.75 | 0.50 | 0.04 | 0.045 | 1.35-1.85 | 2.50-3.50 | 0.30-0.60 | --- |
| ASTM A757/A757M-15 | Grade E1Q | J42220 | --- | 0.22 | 0.50-0.80 | 0.60 | 0.025 | 0.025 | 1.35-1.85 | 2.5-3.5 | 0.35-0.60 | V 0.03; Cu 0.50; (V+Cu+P+S) 0.70 |
| | Grade E2N1 | J42065 | --- | 0.20 | 0.40-0.70 | 0.60 | 0.020 | 0.020 | 1.50-2.0 | 2.75-3.90 | 0.40-0.60 | V 0.03; Cu 0.50; W 0.10; (V+Cu+W+P+S) 0.70 |
| | Grade E2N2 | J42065 | --- | 0.20 | 0.40-0.70 | 0.60 | 0.020 | 0.020 | 1.50-2.0 | 2.75-3.90 | 0.40-0.60 | V 0.03; Cu 0.50; W 0.10; (V+Cu+W+P+S) 0.70 |
| | Grade E2N3 | J42065 | --- | 0.20 | 0.40-0.70 | 0.60 | 0.020 | 0.020 | 1.50-2.0 | 2.75-3.90 | 0.40-0.60 | V 0.03; Cu 0.50; W 0.10; (V+Cu+W+P+S) 0.70 |
| | Grade E2Q1 | J42065 | --- | 0.20 | 0.40-0.70 | 0.60 | 0.020 | 0.020 | 1.50-2.0 | 2.75-3.90 | 0.40-0.60 | V 0.03; Cu 0.50; W 0.10; (V+Cu+W+P+S) 0.70 |
| | Grade E2Q2 | J42065 | --- | 0.20 | 0.40-0.70 | 0.60 | 0.020 | 0.020 | 1.50-2.0 | 2.75-3.90 | 0.40-0.60 | V 0.03; Cu 0.50; W 0.10; (V+Cu+W+P+S) 0.70 |
| | Grade E2Q3 | J42065 | --- | 0.20 | 0.40-0.70 | 0.60 | 0.020 | 0.020 | 1.50-2.0 | 2.75-3.90 | 0.40-0.60 | V 0.03; Cu 0.50; W 0.10; (V+Cu+W+P+S) 0.70 |
| EN 10213:2007 C1:2008 | G17NiCrMo13-6 | --- | 1.6781 | 0.15-0.19 | 0.55-0.80 | 0.50 | 0.015 | 0.015 | 1.30-1.80 | 3.00-3.50 | 0.45-0.65 | V 0.05; Cu 0.30 |
| GB/T 16253-1996 | Grade ZG22Ni3Cr2MoAD | --- | --- | 0.22 | 0.40-0.80 | 0.60 | 0.030 | 0.030 | 1.35-2.00 | 2.50-3.50 | 0.35-0.60 | --- |
| | Grade ZG22Ni3Cr2MoBD | --- | --- | 0.22 | 0.40-0.80 | 0.60 | 0.030 | 0.030 | 1.50-2.00 | 2.75-3.90 | 0.35-0.60 | --- |
| ISO 4991:1994 | Type C43E2aL | --- | --- | 0.22 | 0.40-0.80 | 0.60 | 0.030 | 0.030 | 1.35-2.00 | 2.50-3.50 | 0.35-0.60 | --- |
| | Type C43E2bL | --- | --- | 0.22 | 0.40-0.80 | 0.60 | 0.030 | 0.030 | 1.50-2.00 | 2.75-3.90 | 0.35-0.60 | --- |
| GB/T 16253-1996 | Grade ZG29Cr1MoD | --- | --- | 0.29 | 0.50-0.80 | 0.30-0.60 | 0.030 | 0.030 | 0.90-1.20 | --- | 0.15-0.30 | --- |
| ISO 4991:1994 | Type C31L | --- | --- | 0.29 | 0.50-0.80 | 0.30-0.60 | 0.030 | 0.030 | 0.90-1.20 | --- | 0.15-0.30 | --- |
| ASTM A757/A757M-15 | Grade D1N1 | J22092 | --- | 0.20 | 0.40-0.80 | 0.60 | 0.025 | 0.025 | 2.0-2.75 | 0.50 | 0.90-1.20 | V 0.03; Cu 0.50; W 0.10; (V+Ni+Cu+W+P+S) 1.00 |
| | Grade D1N2 | J22092 | --- | 0.20 | 0.40-0.80 | 0.60 | 0.025 | 0.025 | 2.0-2.75 | 0.50 | 0.90-1.20 | V 0.03; Cu 0.50; W 0.10; (V+Ni+Cu+W+P+S) 1.00 |
| | Grade D1N3 | J22092 | --- | 0.20 | 0.40-0.80 | 0.60 | 0.025 | 0.025 | 2.0-2.75 | 0.50 | 0.90-1.20 | V 0.03; Cu 0.50; W 0.10; (V+Ni+Cu+W+P+S) 1.00 |
| | Grade D1Q1 | J22092 | --- | 0.20 | 0.40-0.80 | 0.60 | 0.025 | 0.025 | 2.0-2.75 | 0.50 | 0.90-1.20 | V 0.03; Cu 0.50; W 0.10; (V+Ni+Cu+W+P+S) 1.00 |
| | Grade D1Q2 | J22092 | --- | 0.20 | 0.40-0.80 | 0.60 | 0.025 | 0.025 | 2.0-2.75 | 0.50 | 0.90-1.20 | V 0.03; Cu 0.50; W 0.10; (V+Ni+Cu+W+P+S) 1.00 |
| | Grade D1Q3 | J22092 | --- | 0.20 | 0.40-0.80 | 0.60 | 0.025 | 0.025 | 2.0-2.75 | 0.50 | 0.90-1.20 | V 0.03; Cu 0.50; W 0.10; (V+Ni+Cu+W+P+S) 1.00 |
| GB/T 16253-1996 | Grade ZG20Cr2Mo1D | --- | --- | 0.20 | 0.50-0.80 | 0.30-0.60 | 0.030 | 0.030 | 2.00-2.50 | --- | 0.90-1.20 | --- |
| ISO 4991:1994 | Type C34BL | --- | --- | 0.20 | 0.50-0.80 | 0.30-0.60 | 0.030 | 0.030 | 2.00-2.50 | --- | 0.90-1.20 | --- |
| ASTM A757/A757M-15 | Grade C1Q | J12582 | --- | 0.25 | 1.20 | 0.60 | 0.025 | 0.025 | 0.40 | 1.5-2.0 | 0.15-0.30 | V 0.03; Cu 0.50; (Cr+V+Cu+P+S) 1.00 |
| GB/T 16253-1996 | Grade ZG24Ni2MoD | --- | --- | 0.24 | 0.80-1.20 | 0.30-0.60 | 0.030 | 0.030 | --- | 1.50-2.00 | 0.15-0.30 | --- |
| ISO 4991:1994 | Type C43C1L | --- | --- | 0.24 | 0.80-1.20 | 0.30-0.60 | 0.030 | 0.030 | --- | 1.50-2.00 | 0.15-0.30 | --- |

**7.3 Cast Alloy Steels**

**7.3.3B Mechanical Properties of Cast Alloy Steels for Pressure Purposes at Low Temperatures**

| Specification | Designation | UNS No. | Steel No. | Section Thickness, mm | Yield Strength, min. MPa | Yield Strength, min. ksi | Tensile Strength, min. MPa | Tensile Strength, min. ksi | Elongation % min. | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ASME SA-352/SA-352M | Grade LC1 | J12522 | --- | --- | 240 | 35.0 | 450-620 | 65.0-90.0 | 24 | N+T or Q+T | 18 J @ -59°C |
| ASTM A352/A352M-06 (2012) | Grade LC1 | J12522 | --- | --- | 240 | 35.0 | 450-620 | 65.0-90.0 | 24 | N+T or Q+T | 18 J @ -59°C |
| EN 10213:2007 C1:2008 | G18Mo5 | --- | 1.5422 | t ≤ 100 | 240 | --- | 440-790 | --- | 23 | Q+T | 27 J @ -45°C |
| JIS G 5152:1991 | Class SCPL 11 | --- | --- | --- | 245 | --- | 450 | --- | 21 | A, N, N+T or Q+T | see standard for impact data |
| ASME SA-352/SA-352M | Grade LC2 | J22500 | --- | --- | 275 | 40.0 | 485-655 | 70.0-95.0 | 24 | N+T or Q+T | 20 J @ -73°C |
| ASTM A352/A352M-06 (2012) | Grade LC2 | J22500 | --- | --- | 275 | 40.0 | 485-655 | 70.0-95.0 | 24 | N+T or Q+T | 20 J @ -73°C |
| ASTM A757/A757M-15 | Grade B2N | J22501 | --- | --- | 275 | 40 | 485 | 70 | 24 | N+T or Q+T | L: 20 J @ -73°C |
| | Grade B2Q | J22501 | --- | --- | 275 | 40 | 485 | 70 | 24 | N+T or Q+T | L: 20 J @ -73°C |
| EN 10213:2007 C1:2008 | G9Ni10 | --- | 1.5636 | t ≤ 35 | 280 | --- | 480-630 | --- | 24 | Q+T | 27 J @ -70°C |
| JIS G 5152:1991 | Class SCPL 21 | --- | --- | --- | 275 | --- | 480 | --- | 21 | A, N, N+T or Q+T | see standard for impact data |
| ASME SA-352/SA-352M | Grade LC3 | J31550 | --- | --- | 275 | 40.0 | 485-655 | 70.0-95.0 | 24 | N+T or Q+T | 20 J @ -101°C |
| ASTM A352/A352M-06 (2012) | Grade LC3 | J31550 | --- | --- | 275 | 40.0 | 485-655 | 70.0-95.0 | 24 | N+T or Q+T | 20 J @ -101°C |
| ASTM A757/A757M-15 | Grade B3N | J31500 | --- | --- | 275 | 40 | 485 | 70 | 24 | N+T or Q+T | L: 20 J @ -101°C |
| | Grade B3Q | J31500 | --- | --- | 275 | 40 | 485 | 70 | 24 | N+T or Q+T | L: 20 J @ -101°C |
| EN 10213:2007 C1:2008 | G9Ni14 | --- | 1.5638 | t ≤ 35 | 360 | --- | 500-650 | --- | 20 | Q+T | 27 J @ -90°C |
| GB/T 16253-1996 | Grade ZG14Ni4D | --- | --- | --- | 300 | --- | 460-610 | --- | 20 | Q+T | 27 J @ -70°C |
| ISO 4991:1994 | Type C43L | --- | --- | --- | 300 | --- | 460-610 | --- | 20 | Q+T | 27 J @ -70°C |
| JIS G 5152:1991 | Class SCPL 31 | --- | --- | --- | 275 | --- | 480 | --- | 21 | A, N, N+T or Q+T | see standard for impact data |

**7.3 Cast Alloy Steels**

**7.3.3B Mechanical Properties of Cast Alloy Steels for Pressure Purposes at Low Temperatures (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness, mm | Yield Strength, min. MPa | Yield Strength, min. ksi | Tensile Strength, min. MPa | Tensile Strength, min. ksi | Elongation % min. | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ASME SA-352/SA-352M | Grade LC2-1 | J42215 | --- | --- | 550 | 80.0 | 725-895 | 105.0-130.0 | 18 | N+T or Q+T | 41 J @ -73°C |
| ASTM A352/A352M-06 (2012) | Grade LC2-1 | J42215 | --- | --- | 550 | 80.0 | 725-895 | 105.0-130.0 | 18 | N+T or Q+T | 41 J @ -73°C |
| ASTM A757/A757M-15 | Grade E1Q | J42220 | --- | --- | 450 | 65 | 620 | 90 | 22 | Q+T | L: 41 J @ -73°C |
| | Grade E2N1 | J42065 | --- | --- | 485 | 70 | 620-825 | 90-120 | 18 | N+T or Q+T | L: 41 J @ -73°C |
| | Grade E2N2 | J42065 | --- | --- | 585 | 85 | 725-930 | 105-135 | 15 | N+T or Q+T | L: 27 J @ -73°C |
| | Grade E2N3 | J42065 | --- | --- | 690 | 100 | 795-1000 | 115-145 | 13 | N+T or Q+T | L: 20 J @ -73°C |
| | Grade E2Q1 | J42065 | --- | --- | 485 | 70 | 620-825 | 90-120 | 18 | N+T or Q+T | L: 41 J @ -73°C |
| | Grade E2Q2 | J42065 | --- | --- | 585 | 85 | 725-930 | 105-135 | 15 | N+T or Q+T | L: 27 J @ -73°C |
| | Grade E2Q3 | J42065 | --- | --- | 690 | 100 | 795-1000 | 115-145 | 13 | N+T or Q+T | L: 20 J @ -73°C |
| EN 10213:2007 C1:2008 | G17NiCrMo13-6 | --- | 1.6781 | t ≤ 200 | 600 | --- | 750-900 | --- | 15 | Q+T | 27 J @ -80°C |
| GB/T 16253-1996 | Grade ZG22Ni3Cr2MoAD | --- | --- | --- | 450 | --- | 620-800 | --- | 16 | N+T or Q+T | 27 J @ -80°C |
| | Grade ZG22Ni3Cr2MoBD | --- | --- | --- | 655 | --- | 800-950 | --- | 13 | N+T or Q+T | 27 J @ -60°C |
| ISO 4991:1994 | Type C43E2aL | --- | --- | --- | 450 | --- | 620-800 | --- | 16 | N+T or Q+T | 27 J @ -80°C |
| | Type C43E2bL | --- | --- | --- | 655 | --- | 800-950 | --- | 13 | N+T or Q+T | 27 J @ -60°C |
| GB/T 16253-1996 | Grade ZG29Cr1MoD | --- | --- | --- | 370 | --- | 550-700 | --- | 16 | N+T or Q+T | 27 J @ -45°C |
| ISO 4991:1994 | Type C31L | --- | --- | --- | 370 | --- | 550-700 | --- | 16 | N+T or Q+T | 27 J @ -45°C |
| ASTM A757/A757M-15 | Grade D1N1 | J22092 | --- | --- | 380 | 55 | 585-795 | 85-115 | 20 | N+T or Q+T | L: BA J @ BA°C |
| | Grade D1N2 | J22092 | --- | --- | 515 | 75 | 655-860 | 95-125 | 18 | N+T or Q+T | L: BA J @ BA°C |
| | Grade D1N3 | J22092 | --- | --- | 585 | 85 | 725-930 | 105-135 | 15 | N+T or Q+T | L: BA J @ BA°C |
| | Grade D1Q1 | J22092 | --- | --- | 380 | 55 | 585-795 | 85-115 | 20 | N+T or Q+T | L: BA J @ BA°C |
| | Grade D1Q2 | J22092 | --- | --- | 515 | 75 | 655-860 | 95-125 | 18 | N+T or Q+T | L: BA J @ BA°C |
| | Grade D1Q3 | J22092 | --- | --- | 585 | 85 | 725-930 | 105-135 | 15 | N+T or Q+T | L: BA J @ BA°C |
| GB/T 16253-1996 | Grade ZG20Cr2Mo1D | --- | --- | --- | 390 | --- | 600-750 | --- | 18 | N+T, N+C(A)+T, Q+T | 27 J @ -50°C |
| ISO 4991:1994 | Type C34BL | --- | --- | --- | 390 | --- | 600-750 | --- | 18 | N+T or Q+T | 27 J @ 50°C |
| ASTM A757/A757M-15 | Grade C1Q | J12582 | --- | --- | 380 | 55 | 515 | 75 | 22 | Q+T | L: 20 J @ -46°C |
| GB/T 16253-1996 | Grade ZG24Ni2MoD | --- | --- | --- | 380 | --- | 520-670 | --- | 20 | Q+T | 27 J @ -35°C |
| ISO 4991:1994 | Type C43C1L | --- | --- | --- | 380 | --- | 520-670 | --- | 20 | Q+T | 27 J @ -35°C |

## 7.4 Cast Stainless Steels

### 7.4.1 Cast Stainless Steels for General and Corrosion Resistant Applications

#### 7.4.1.1A Chemical Composition of Martensitic and Ferritic Stainless Steels for General and Corrosion Resistant Applications

| Specification | Designation | UNS No. | Steel No. | Weight, %, max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASTM A743/A743M-13ae1 | Grade CA15 | J91150 | --- | 0.15 | 1.00 | 1.50 | 0.04 | 0.04 | 11.5-14.0 | 1.00 | 0.50 | --- |
| EN 10283:2010 | GX12Cr12 | --- | 1.4011 | 0.15 | 1.00 | 1.00 | 0.035 | 0.025 | 11.50-13.50 | 1.00 | 0.50 | V 0.08; Cu 0.30 |
| ISO 11972:1998 | Grade GX 12 Cr 12 | --- | --- | 0.15 | 0.80 | 0.80 | 0.035 | 0.025 | 11.5-13.5 | 1.00 | 0.50 | --- |
| JIS G 5121:2003 | Class SCS 1 | --- | --- | 0.15 | 1.00 | 1.50 | 0.040 | 0.040 | 11.50-14.00 | 1.00 | 0.50 | --- |
| ASTM A743/A743M-13ae1 | Grade CA15M | J91151 | --- | 0.15 | 1.00 | 0.65 | 0.040 | 0.040 | 11.5-14.0 | 1.0 | 0.15-1.0 | --- |
| EN 10283:2010 | GX7CrNiMo12-1 | --- | 1.4008 | 0.10 | 1.00 | 1.00 | 0.035 | 0.025 | 12.00-13.50 | 1.00-2.00 | 0.20-0.50 | V 0.08; Cu 0.30 |
| ISO 11972:1998 | Grade GX 8 CrNiMo 12 1 | --- | --- | 0.10 | 0.80 | 0.80 | 0.035 | 0.025 | 11.5-13.0 | 0.80-1.80 | 0.20-0.50 | --- |
| JIS G 5121:2003 | Class SCS 3 | --- | --- | 0.15 | 1.00 | 1.00 | 0.040 | 0.040 | 11.50-14.00 | 0.50-1.50 | 0.15-1.00 | --- |
| ASTM A743/A743M-13ae1 | Grade CA40 | J91153 | --- | 0.20-0.40 | 1.00 | 1.50 | 0.04 | 0.04 | 11.5-14.0 | 1.0 | 0.5 | --- |
| JIS G 5121:2003 | Class SCS 2 | --- | --- | 0.16-0.24 | 1.00 | 1.50 | 0.040 | 0.040 | 11.50-14.00 | 1.00 | 0.50 | --- |
| | Class SCS 2A | --- | --- | 0.25-0.40 | 1.00 | 1.50 | 0.040 | 0.040 | 11.50-14.00 | 1.00 | 0.50 | --- |
| EN 10283:2010 | GX4CrNi13-4 | --- | 1.4317 | 0.06 | 1.00 | 1.00 | 0.035 | 0.025 | 12.00-13.50 | 3.50-5.00 | 0.70 | V 0.08; Cu 0.30 |
| ISO 11972:1998 | Grade GX 4 CrNi 12 4 (QT1) | --- | --- | 0.06 | 1.50 | 1.00 | 0.035 | 0.025 | 11.5-13.0 | 3.50-5.00 | 1.00 | --- |
| | Grade GX 4 CrNi 12 4 (QT2) | --- | --- | 0.06 | 1.50 | 1.00 | 0.035 | 0.025 | 11.5-13.0 | 3.5-5.00 | 1.00 | --- |
| JIS G 5121:2003 | Class SCS 5 | --- | --- | 0.06 | 1.00 | 1.00 | 0.040 | 0.040 | 11.50-14.00 | 3.50-4.50 | --- | --- |
| ASTM A743/A743M-13ae1 | Grade CA6NM | J91540 | --- | 0.06 | 1.00 | 1.00 | 0.04 | 0.03 | 11.5-14.0 | 3.5-4.5 | 0.40-1.0 | --- |
| JIS G 5121:2003 | Class SCS 6 | --- | --- | 0.06 | 1.00 | 1.00 | 0.040 | 0.030 | 11.50-14.00 | 3.50-4.50 | 0.40-1.00 | --- |
| EN 10283:2010 | GX4CrNiMo16-5-1 | --- | 1.4405 | 0.06 | 1.00 | 0.80 | 0.035 | 0.025 | 15.00-17.00 | 4.00-6.00 | 0.70-1.50 | V 0.08; Cu 0.30 |
| ISO 11972:1998 | Grade GX 4 CrNiMo 16 5 1 | --- | --- | 0.06 | 0.80 | 0.80 | 0.035 | 0.025 | 15.0-17.0 | 4.00-6.00 | 0.70-1.50 | --- |

## 7.4 Cast Stainless Steels

### 7.4.1 Cast Stainless Steels for General and Corrosion Resistant Applications

#### 7.4.1.1B Mechanical Properties of Martensitic and Ferritic Stainless Steels for General and Corrosion Resistant Applications

| Specification | Designation | UNS No. | Steel No. | Section Thickness, mm | Yield Strength, min. | | Tensile Strength, min. | | Elongation % min. | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | MPa | ksi | MPa | ksi | | | |
| ASTM A743/A743M-13ae1* | Grade CA15 | J91150 | --- | --- | 450 | 65 | 620 | 90 | 18 | N+T or A | --- |
| EN 10283:2010 | GX12Cr12 | --- | 1.4011 | t ≤ 150 | 450 | --- | 620 | --- | 15 | Q+T | 20 J @ RT |
| ISO 11972:1998 | Grade GX 12 Cr 12 | --- | --- | t ≤ 150 | 450 | --- | 620 | --- | 14 | N+T | 20 J @ RT |
| JIS G 5121:2003 | Class SCS 1 | --- | --- | --- | 345 | --- | 540 | --- | 18 | Q+T | 163-229 HB |
| | | | | --- | 450 | --- | 620 | --- | 16 | Q+T | 179-241 HB |
| ASTM A743/A743M-13ae1* | Grade CA15M | J91151 | --- | --- | 450 | 65 | 620 | 90 | 18 | N+T or A | --- |
| EN 10283:2010 | GX7CrNiMo12-1 | --- | 1.4008 | t ≤ 300 | 440 | --- | 590 | --- | 15 | Q+T | 27 J @ RT |
| ISO 11972:1998 | Grade GX 8 CrNiMo 12 1 | --- | --- | t ≤ 300 | 440 | --- | 590 | --- | 15 | N+T | 27 J @ RT |
| JIS G 5121:2003 | Class SCS 3 | --- | --- | --- | 440 | --- | 590 | --- | 16 | Q+T | 170-235 HB |
| ASTM A743/A743M-13ae1* | Grade CA40 | J91153 | --- | --- | 485 | 70 | 690 | 100 | 15 | N+T or A | --- |
| JIS G 5121:2003 | Class SCS 2 | --- | --- | --- | 390 | --- | 590 | --- | 16 | Q+T | 170-235 HB |
| | Class SCS 2A | --- | --- | --- | 485 | --- | 690 | --- | 15 | Q+T | 269 max. HB |
| EN 10283:2010 | GX4CrNi13-4 | --- | 1.4317 | t ≤ 300 | 550 | --- | 760 | --- | 15 | Q+T | 50 J @ RT |
| | | | | t ≤ 300 | 830 | --- | 900 | --- | 12 | Q+T | 35 J @ RT |
| | | | | t ≤ 300 | 500 | --- | 700 | --- | 16 | Q+T | 50 J @ RT |
| ISO 11972:1998 | Grade GX 4 CrNi 12 4 (QT1) | --- | --- | t ≤ 300 | 550 | --- | 750 | --- | 15 | N+T | 45 J @ RT |
| | Grade GX 4 CrNi 12 4 (QT2) | --- | --- | t ≤ 300 | 830 | --- | 900 | --- | 12 | N+T | 35 J @ RT |
| JIS G 5121:2003 | Class SCS 5 | --- | --- | --- | 540 | --- | 740 | --- | 13 | Q+T | 217-277 HB |
| ASTM A743/A743M-13ae1* | Grade CA6NM | J91540 | --- | --- | 550 | 80 | 755 | 110 | 15 | N+T | --- |
| JIS G 5121:2003 | Class SCS 6 | --- | --- | --- | 550 | --- | 750 | --- | 15 | Q+T | 285 max. HB |
| EN 10283:2010 | GX4CrNiMo16-5-1 | --- | 1.4405 | t ≤ 300 | 540 | --- | 760 | --- | 15 | Q+T | 60 J @ RT |
| ISO 11972:1998 | Grade GX 4 CrNiMo 16 5 1 | --- | --- | t ≤ 300 | 540 | --- | 760 | --- | 15 | N+T | 60 J @ RT |

*: See "List of Standards" at the beginning of the chapter.

**7.4 Cast Stainless Steels**

**7.4.1 Cast Stainless Steels for General and Corrosion Resistant Applications**

**7.4.1.2A Chemical Composition of Austenitic Stainless Steels for General and Corrosion Resistant Applications**

| Specification | Designation | UNS No. | Steel No. | Weight, %, max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASTM A743/A743M-13ae1 | Grade CF20 | J92602 | --- | 0.20 | 1.50 | 2.00 | 0.04 | 0.04 | 18.0-21.0 | 8.0-11.0 | --- | --- |
| JIS G 5121:2003 | Class SCS 12 | --- | --- | 0.20 | 2.00 | 2.00 | 0.040 | 0.040 | 18.00-21.00 | 8.00-11.00 | --- | --- |
| ASTM A743/A743M-13ae1 | Grade CF8 | J92600 | --- | 0.08 | 1.50 | 2.00 | 0.04 | 0.04 | 18.0-21.0 | 8.0-11.0 | --- | --- |
| ASTM A744/A744M-13 | Grade CF8 | J92600 | --- | 0.08 | 1.50 | 2.0 | 0.04 | 0.04 | 18.0-21.0 | 8.0-11.0 | --- | --- |
| EN 10283:2010 | GX5CrNi19-10 | --- | 1.4308 | 0.07 | 1.50 | 1.50 | 0.040 | 0.030 | 18.00-20.00 | 8.00-11.00 | --- | Cu 0.50 |
| ISO 11972:1998 | Grade GX 5 CrNi 19 9 | --- | --- | 0.07 | 1.50 | 1.50 | 0.040 | 0.030 | 18.0-21.0 | 8.00-11.00 | --- | --- |
| JIS G 5121:2003 | Class SCS 13 | --- | --- | 0.08 | 2.00 | 2.00 | 0.040 | 0.040 | 18.00-21.00 | 8.00-11.00 | --- | --- |
| | Class SCS 13A | --- | --- | 0.08 | 1.50 | 2.00 | 0.040 | 0.040 | 18.00-21.00 | 8.00-11.00 | --- | --- |
| ASTM A743/A743M-13ae1 | Grade CF3 | J92500 | --- | 0.03 | 1.50 | 2.00 | 0.04 | 0.04 | 17.0-21.0 | 8.0-12.0 | --- | --- |
| ASTM A744/A744M-13 | Grade CF3 | J92500 | --- | 0.03 | 1.50 | 2.0 | 0.04 | 0.04 | 17.0-21.0 | 8.0-12.0 | --- | --- |
| EN 10283:2010 | GX2CrNi19-11 | --- | 1.4309 | 0.030 | 2.00 | 1.50 | 0.035 | 0.025 | 18.00-20.00 | 9.00-12.00 | --- | N 0.20; Cu 0.50 |
| ISO 11972:1998 | Grade GX 2 CrNi 18 10 | --- | --- | 0.03 | 1.50 | 1.50 | 0.040 | 0.030 | 17.0-19.0 | 9.00-12.00 | --- | --- |
| JIS G 5121:2003 | Class SCS 19A | --- | --- | 0.03 | 1.50 | 2.00 | 0.040 | 0.040 | 17.00-21.00 | 8.00-12.00 | --- | --- |
| | Class SCS 19 | --- | --- | 0.03 | 2.00 | 2.00 | 0.040 | 0.040 | 17.00-21.00 | 8.00-12.00 | --- | --- |
| ASTM A743/A743M-13ae1 | Grade CF8C | J92710 | --- | 0.08 | 1.50 | 2.00 | 0.04 | 0.04 | 18.0-21.0 | 9.0-12.0 | --- | Cb 8xC to 1.0 |
| ASTM A744/A744M-13 | Grade CF8C | J92710 | --- | 0.08 | 1.50 | 2.0 | 0.04 | 0.04 | 18.0-21.0 | 9.0-12.0 | --- | Cb 8xC to 1.0 |
| EN 10283:2010 | GX5CrNiNb19-11 | --- | 1.4552 | 0.07 | 1.50 | 1.50 | 0.040 | 0.030 | 18.00-20.00 | 9.00-12.00 | --- | (Nb+Ta) 8xC to 1.00; Cu 0.50 |
| ISO 11972:1998 | Grade GX 6 CrNiNb 19 10 | --- | --- | 0.08 | 1.50 | 1.50 | 0.040 | 0.030 | 18.0-21.0 | 9.00-12.00 | --- | Nb 8xC to 1.00 |
| JIS G 5121:2003 | Class SCS 21 | --- | --- | 0.08 | 2.00 | 2.00 | 0.040 | 0.040 | 18.00-21.00 | 9.00-12.00 | --- | Nb 10xC to 1.35 |
| ASTM A743/A743M-13ae1 | Grade CF8M | J92900 | --- | 0.08 | 1.50 | 2.00 | 0.04 | 0.04 | 18.0-21.0 | 9.0-12.0 | 2.0-3.0 | --- |
| ASTM A744/A744M-13 | Grade CF8M | J92900 | --- | 0.08 | 1.50 | 2.0 | 0.04 | 0.04 | 18.0-21.0 | 9.0-12.0 | 2.0-3.0 | --- |
| EN 10283:2010 | GX5CrNiMo19-11-2 | --- | 1.4408 | 0.07 | 1.50 | 1.50 | 0.040 | 0.030 | 18.00-20.00 | 9.00-12.00 | 2.00-2.50 | Cu 0.50 |
| ISO 11972:1998 | Grade GX 5 CrNiMo 19 11 2 | --- | --- | 0.07 | 1.50 | 1.50 | 0.040 | 0.030 | 17.0-20.0 | 9.00-12.00 | 2.00-2.50 | --- |
| | Grade GX 5 CrNiMo 19 11 3 | --- | --- | 0.07 | 1.50 | 1.50 | 0.040 | 0.030 | 17.0-20.0 | 9.00-12.00 | 3.00-3.50 | --- |
| JIS G 5121:2003 | Class SCS 14 | --- | --- | 0.08 | 2.00 | 2.00 | 0.040 | 0.040 | 17.00-20.00 | 10.00-14.00 | 2.00-3.00 | --- |
| | Class SCS 14A | --- | --- | 0.08 | 1.50 | 1.50 | 0.040 | 0.040 | 18.00-21.00 | 9.00-12.00 | 2.00-3.00 | --- |
| EN 10283:2010 | GX5CrNiMoNb19-11-2 | --- | 1.4581 | 0.07 | 1.50 | 1.50 | 0.040 | 0.030 | 18.00-20.00 | 9.00-12.00 | 2.00-2.50 | (Nb+Ta) 8xC to 1.00; Cu 0.50 |
| ISO 11972:1998 | Grade GX 6 CrNiMoNb 19 11 2 | --- | --- | 0.08 | 1.50 | 1.50 | 0.040 | 0.030 | 17.0-20.0 | 9.00-12.00 | 2.00-2.50 | Nb 8xC to 1.00 |
| JIS G 5121:2003 | Class SCS 22 | --- | --- | 0.08 | 2.00 | 2.00 | 0.040 | 0.040 | 17.00-20.00 | 10.00-14.00 | 2.00-3.00 | Nb 10xC to 1.35 |
| ASTM A743/A743M-13ae1 | Grade CF3M | J92800 | --- | 0.03 | 1.50 | 1.50 | 0.04 | 0.04 | 17.0-21.0 | 9.0-13.0 | 2.0-3.0 | --- |
| ASTM A744/A744M-13 | Grade CF3M | J92800 | --- | 0.03 | 1.50 | 1.50 | 0.04 | 0.04 | 17.0-21.0 | 9.0-13.0 | 2.0-3.0 | --- |
| EN 10283:2010 | GX2CrNiMo19-11-2 | --- | 1.4409 | 0.030 | 2.00 | 1.50 | 0.035 | 0.025 | 18.00-20.00 | 9.00-12.00 | 2.00-2.50 | N 0.20; Cu 0.50 |
| ISO 11972:1998 | Grade GX 2 CrNiMo 19 11 2 | --- | --- | 0.03 | 1.50 | 1.50 | 0.040 | 0.030 | 17.0-20.0 | 9.00-12.00 | 2.00-2.50 | --- |
| JIS G 5121:2003 | Class SCS 16A | --- | --- | 0.03 | 1.50 | 1.50 | 0.040 | 0.040 | 17.00-21.00 | 9.00-13.00 | 2.00-3.00 | --- |

**7.4 Cast Stainless Steels**

**7.4.1 Cast Stainless Steels for General and Corrosion Resistant Applications**

**7.4.1.2A Chemical Composition of Austenitic Stainless Steels for General and Corrosion Resistant Applications (Continued)**

| Specification | Designation | UNS No. | Steel No. | Weight, %, max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASTM A743/A743M-13ae1 | Grade CF3MN | J92804 | --- | 0.03 | 1.50 | 1.50 | 0.040 | 0.040 | 17.0-22.0 | 9.0-13.0 | 2.00-3.00 | N 0.10-0.20 |
| EN 10283:2010 | GX2CrNiMoN17-13-4 | --- | 1.4446 | 0.030 | 1.50 | 1.00 | 0.040 | 0.030 | 16.50-18.50 | 12.50-14.50 | 4.00-4.50 | N 0.12-0.22; Cu 0.50 |
| ISO 11972:1998 | Grade GX 2 CrNiMoN 19 11 2 | --- | --- | 0.03 | 1.50 | 1.50 | 0.040 | 0.030 | 17.0-20.0 | 9.00-12.00 | 2.00-2.50 | N 0.10-0.20 |
| | Grade GX 2 CrNiMoN 19 11 3 | --- | --- | 0.03 | 1.50 | 1.50 | 0.040 | 0.030 | 17.0-20.0 | 9.00-12.00 | 3.00-3.50 | N 0.10-0.20 |
| ASTM A743/A743M-13ae1 | Grade CG8M | J93000 | --- | 0.08 | 1.50 | 1.50 | 0.04 | 0.04 | 18.0-21.0 | 9.0-13.0 | 3.0-4.0 | --- |
| ASTM A744/A744M-13 | Grade CG8M | J93000 | --- | 0.08 | 1.50 | 1.50 | 0.04 | 0.04 | 18.0-21.0 | 9.0-13.0 | 3.0-4.0 | --- |
| EN 10283:2010 | GX5CrNiMo19-11-3 | --- | 1.4412 | 0.07 | 1.50 | 1.50 | 0.040 | 0.030 | 18.00-20.00 | 10.00-13.00 | 3.00-3.50 | --- |
| ASTM A743/A743M-13ae1 | Grade CG3M | J92999 | --- | 0.03 | 1.50 | 1.50 | 0.04 | 0.04 | 18.0-21.0 | 9.0-13.0 | 3.0-4.0 | --- |
| ASTM A744/A744M-13 | Grade CG3M | J92999 | --- | 0.03 | 1.50 | 1.50 | 0.04 | 0.04 | 18.0-21.0 | 9.0-13.0 | 3.0-4.0 | --- |
| ISO 11972:1998 | Grade GX 2 CrNiMo 19 11 3 | --- | --- | 0.03 | 1.50 | 1.50 | 0.040 | 0.030 | 17.0-20.0 | 9.00-12.00 | 3.00-3.50 | --- |
| ASTM A743/A743M-13ae1 | Grade CH20 | J93402 | --- | 0.20 | 1.50 | 2.00 | 0.04 | 0.04 | 22.0-26.0 | 12.0-15.0 | --- | --- |
| JIS G 5121:2003 | Class SCS 17 | --- | --- | 0.20 | 2.00 | 2.00 | 0.040 | 0.040 | 22.00-26.00 | 12.00-15.00 | --- | --- |
| ASTM A743/A743M-13ae1 | Grade CN7M | N08007 | --- | 0.07 | 1.50 | 1.50 | 0.04 | 0.04 | 19.0-22.0 | 27.5-30.5 | 2.0-3.0 | Cu 3.0-4.0 |
| ASTM A744/A744M-13 | Grade CN7M | N08007 | --- | 0.07 | 1.50 | 1.50 | 0.04 | 0.04 | 19.0-22.0 | 27.5-30.5 | 2.0-3.0 | Cu 3.0-4.0 |
| EN 10283:2010 | GX2NiCrMo28-20-2 | --- | 1.4458 | 0.030 | 2.00 | 1.00 | 0.035 | 0.025 | 19.00-22.00 | 26.00-30.00 | 2.00-2.50 | Cu 2.00; N 0.20 |
| | GX4NiCrCuMo30-20-4 | --- | 1.4527 | 0.06 | 1.50 | 1.50 | 0.040 | 0.030 | 19.00-22.00 | 27.50-30.50 | 2.00-3.00 | Cu 3.00-4.00 |
| JIS G 5121:2003 | Class SCS 23 | --- | --- | 0.07 | 2.00 | 2.00 | 0.040 | 0.040 | 19.00-22.00 | 27.50-30.00 | 2.00-3.00 | Cu 3.00-4.00 |
| ASTM A743/A743M-13ae1 | Grade CN3M | J94652 | --- | 0.03 | 2.0 | 1.0 | 0.03 | 0.03 | 20.0-22.0 | 23.0-27.0 | 4.50-5.50 | --- |
| EN 10283:2010 | GX2NiCrMoN25-20-5 | --- | 1.4416 | 0.030 | 1.00 | 1.00 | 0.035 | 0.020 | 19.00-21.00 | 24.00-26.00 | 4.50-5.50 | N 0.12-0.20; Cu 0.50 |
| ASTM A743/A743M-13ae1 | Grade CN3MN | J94651 | --- | 0.03 | 2.00 | 1.00 | 0.040 | 0.010 | 20.0-22.0 | 23.5-25.5 | 6.0-7.0 | Cu 0.75; N 0.18-0.26 |
| ASTM A744/A744M-13 | Grade CN3MN | J94651 | --- | 0.03 | 2.00 | 1.00 | 0.040 | 0.010 | 20.0-22.0 | 23.5-25.5 | 6.00-7.00 | Cu 0.75; N 0.18-0.26 |
| EN 10283:2010 | GX2NiCrMoCuN25-20-6 | --- | 1.4588 | 0.025 | 2.00 | 1.00 | 0.035 | 0.020 | 19.00-21.00 | 24.00-26.00 | 6.00-7.00 | Cu 0.50-1.50; N 0.10-0.25 |
| ASTM A743/A743M-13ae1 | Grade CK3MCuN | J93254 | --- | 0.025 | 1.20 | 1.00 | 0.045 | 0.010 | 19.5-20.5 | 17.5-19.5 | 6.0-7.0 | Cu 0.50-1.00; N 0.180-0.240 |
| ASTM A744/A744M-13 | Grade CK3MCuN | J93254 | --- | 0.025 | 1.20 | 1.00 | 0.045 | 0.010 | 19.5-20.5 | 17.5-19.5 | 6.0-7.0 | Cu 0.50-1.00; N 0.180-0.240 |
| EN 10283:2010 | GX2CrNiMoCuN20-18-6 | --- | 1.4557 | 0.025 | 1.20 | 1.00 | 0.030 | 0.010 | 19.50-20.50 | 17.50-19.50 | 6.00-7.00 | Cu 0.50-1.00; N 0.18-0.24 |
| EN 10283:2010 | GX2CrNiMoCuN25-6-3-3 | --- | 1.4517 | 0.030 | 1.50 | 1.00 | 0.035 | 0.025 | 24.50-26.50 | 5.00-7.00 | 2.50-3.50 | Cu 2.75-3.50; N 0.12-0.22 |
| GB/T 2100-2002 | Grade ZG03Cr26Ni5Cu3Mo3N | --- | --- | 0.03 | 1.5 | 1.0 | 0.035 | 0.025 | 25.0-27.0 | 4.5-6.5 | 2.5-3.5 | Cu 2.4-3.5; N 0.12-0.25 |
| ISO 11972:1998 | Grade GX 2 CrNiCuMoN 26 5 3 3 | --- | --- | 0.03 | 1.50 | 1.00 | 0.035 | 0.025 | 25.0-27.0 | 4.50-6.50 | 2.50-3.50 | Cu 2.50-3.50; N 0.12-0.25 |
| JIS G 5121:2003 | Class SCS 32 | --- | --- | 0.03 | 1.50 | 1.00 | 0.035 | 0.025 | 25.00-27.00 | 4.50-6.50 | 2.50-3.50 | Cu 2.50-3.50; N 0.12-0.25 |
| EN 10283:2010 | GX2CrNiMoN25-6-3 | --- | 1.4468 | 0.030 | 2.00 | 1.00 | 0.035 | 0.025 | 24.50-26.50 | 5.50-7.00 | 2.50-3.50 | N 0.12-0.25; Cu 0.50 |
| GB/T 2100-2002 | Grade ZG03Cr26Ni5Mo3N | --- | --- | 0.03 | 1.5 | 1.0 | 0.035 | 0.025 | 25.0-27.0 | 4.5-6.5 | 2.5-3.5 | N 0.12-0.25 |
| ISO 11972:1998 | Grade GX 2 CrNiMoN 26 5 3 | --- | --- | 0.03 | 1.50 | 1.00 | 0.035 | 0.025 | 25.0-27.0 | 4.50-6.50 | 2.50-3.50 | N 0.12-0.25 |
| JIS G 5121:2003 | Class SCS 10 | --- | --- | 0.03 | 1.50 | 1.50 | 0.040 | 0.030 | 21.00-26.00 | 4.50-8.50 | 2.50-4.00 | N 0.08-0.30 |
| | Class SCS 33 | --- | --- | 0.03 | 1.50 | 1.00 | 0.035 | 0.025 | 25.00-27.00 | 4.50-6.50 | 2.50-3.50 | N 0.12-0.25 |

### 7.4 Cast Stainless Steels

#### 7.4.1 Cast Stainless Steels for General and Corrosion Resistant Applications

#### 7.4.1.2B Mechanical Properties of Austenitic Stainless Steels for General and Corrosion Resistant Applications

| Specification | Designation | UNS No. | Steel No. | Section Thickness, mm | Yield Strength, min. | | Tensile Strength, min. | | Elongation % min. | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | MPa | ksi | MPa | ksi | | | |
| ASTM A743/A743M-13ae1* | Grade CF20 | J92602 | --- | --- | 205 | 30 | 485 | 70 | 30 | Q | --- |
| JIS G 5121:2003 | Class SCS 12 | --- | --- | --- | 205 | --- | 480 | --- | 28 | ST | 183 max HB |
| ASTM A743/A743M-13ae1* | Grade CF8 | J92600 | --- | --- | 205 | 30 | 485 | 70 | 35 | Q | --- |
| ASTM A744/A744M-13* | Grade CF8 | J92600 | --- | --- | 205 | 30 | 485 | 70 | 35 | Q | --- |
| EN 10283:2010 | GX5CrNi19-10 | --- | 1.4308 | t ≤ 150 | 175 | --- | 440 | --- | 30 | SA+Q | 60 J @ RT |
| ISO 11972:1998 | Grade GX 5 CrNi 19 9 | --- | --- | t ≤ 150 | 180 | --- | 440 | --- | 30 | ST+Q | 60 J @ RT |
| JIS G 5121:2003 | Class SCS 13 | --- | --- | --- | 185 | --- | 440 | --- | 30 | ST | 183 max HB |
| | Class SCS 13A | --- | --- | --- | 205 | --- | 480 | --- | 33 | ST | 183 max HB |
| ASTM A743/A743M-13ae1* | Grade CF3 | J92500 | --- | --- | 205 | 30 | 485 | 70 | 35 | AC or Q | --- |
| ASTM A744/A744M-13* | Grade CF3 | J92500 | --- | --- | 205 | 30 | 485 | 70 | 35 | Q | --- |
| EN 10283:2010 | GX2CrNi19-11 | --- | 1.4309 | t ≤ 150 | 185 | --- | 440 | --- | 30 | SA+Q | 80 J @ RT |
| ISO 11972:1998 | Grade GX 2 CrNi 18 10 | --- | --- | t ≤ 150 | 180 | --- | 440 | --- | 30 | ST+Q | 80 J @ RT |
| JIS G 5121:2003 | Class SCS 19A | --- | --- | --- | 205 | --- | 480 | --- | 33 | ST | 183 max HB |
| | Class SCS 19 | --- | --- | --- | 185 | --- | 390 | --- | 33 | ST | 183 max HB |
| ASTM A743/A743M-13ae1* | Grade CF8C | J92710 | --- | --- | 205 | 30 | 485 | 70 | 30 | Q | --- |
| ASTM A744/A744M-13* | Grade CF8C | J92710 | --- | --- | 205 | 30 | 485 | 70 | 30 | Q | --- |
| EN 10283:2010 | GX5CrNiNb19-11 | --- | 1.4552 | t ≤ 150 | 175 | --- | 440 | --- | 25 | SA+Q | 40 J @ RT |
| ISO 11972:1998 | Grade GX 6 CrNiNb 19 10 | --- | --- | t ≤ 150 | 180 | --- | 440 | --- | 25 | ST+Q | 40 J @ RT |
| JIS G 5121:2003 | Class SCS 21 | --- | --- | --- | 205 | --- | 480 | --- | 28 | ST | 183 max HB |
| ASTM A743/A743M-13ae1* | Grade CF8M | J92900 | --- | --- | 205 | 30 | 485 | 70 | 30 | Q | --- |
| ASTM A744/A744M-13* | Grade CF8M | J92900 | --- | --- | 205 | 30 | 485 | 70 | 30 | Q | --- |
| EN 10283:2010 | GX5CrNiMo19-11-2 | --- | 1.4408 | t ≤ 150 | 185 | --- | 440 | --- | 30 | SA+Q | 60 J @ RT |
| ISO 11972:1998 | Grade GX 5 CrNiMo 19 11 2 | --- | --- | t ≤ 150 | 180 | --- | 440 | --- | 30 | ST+Q | 60 J @ RT |
| | Grade GX 5 CrNiMo 19 11 3 | --- | --- | t ≤ 150 | 180 | --- | 440 | --- | 30 | ST+Q | 60 J @ RT |
| JIS G 5121:2003 | Class SCS 14 | --- | --- | --- | 185 | --- | 440 | --- | 28 | ST | 183 max HB |
| | Class SCS 14A | --- | --- | --- | 205 | --- | 480 | --- | 33 | ST | 183 max HB |
| EN 10283:2010 | GX5CrNiMoNb19-11-2 | --- | 1.4581 | t ≤ 150 | 185 | --- | 440 | --- | 25 | SA+Q | 40 J @ RT |
| ISO 11972:1998 | Grade GX 6 CrNiMoNb 19 11 2 | --- | --- | t ≤ 150 | 180 | --- | 440 | --- | 25 | ST+Q | 40 J @ RT |
| JIS G 5121:2003 | Class SCS 22 | --- | --- | --- | 205 | --- | 440 | --- | 28 | ST | 183 max HB |
| ASTM A743/A743M-13ae1* | Grade CF3M | J92800 | --- | --- | 205 | 30 | 485 | 70 | 30 | AC or Q | --- |
| ASTM A744/A744M-13* | Grade CF3M | J92800 | --- | --- | 205 | 30 | 485 | 70 | 30 | Q | --- |
| EN 10283:2010 | GX2CrNiMo19-11-2 | --- | 1.4409 | t ≤ 150 | 195 | --- | 440 | --- | 30 | SA+Q | 80 J @ RT |
| ISO 11972:1998 | Grade GX 2 CrNiMo 19 11 2 | --- | --- | t ≤ 150 | 180 | --- | 440 | --- | 30 | ST+Q | 80 J @ RT |
| JIS G 5121:2003 | Class SCS 16A | --- | --- | --- | 205 | --- | 480 | --- | 33 | ST | 183 max HB |

*: See "List of Standards" at the beginning of the chapter.

**7.4 Cast Stainless Steels**

**7.4.1 Cast Stainless Steels for General and Corrosion Resistant Applications**

**7.4.1.2B Mechanical Properties of Austenitic Stainless Steels for General and Corrosion Resistant Applications (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness, mm | Yield Strength, min. | | Tensile Strength, min. | | Elongation % min. | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | MPa | ksi | MPa | ksi | | | |
| ASTM A743/A743M-13ae1* | Grade CF3MN | J92804 | --- | --- | 255 | 37 | 515 | 75 | 35 | AC or Q | --- |
| EN 10283:2010 | GX2CrNiMoN17-13-4 | --- | 1.4446 | t ≤ 150 | 210 | --- | 440 | --- | 20 | SA+Q | 50 J @ RT |
| ISO 11972:1998 | Grade GX 2 CrNiMoN 19 11 2 | --- | --- | t ≤ 150 | 230 | --- | 510 | --- | 30 | ST+Q | 80 J @ RT |
| | Grade GX 2 CrNiMoN 19 11 3 | --- | --- | t ≤ 150 | 230 | --- | 510 | --- | 30 | ST+Q | 80 J @ RT |
| ASTM A743/A743M-13ae1* | Grade CG8M | J93000 | --- | --- | 240 | 35 | 520 | 75 | 25 | Q | --- |
| ASTM A744/A744M-13* | Grade CG8M | J93000 | --- | --- | 240 | 35 | 520 | 75 | 25 | Q | --- |
| EN 10283:2010 | GX5CrNiMo19-11-3 | --- | 1.4412 | t ≤ 150 | 205 | --- | 440 | --- | 30 | SA+Q | 60 J @ RT |
| ASTM A743/A743M-13ae1* | Grade CG3M | J92999 | --- | --- | 240 | 35 | 515 | 75 | 25 | Q | --- |
| ASTM A744/A744M-13* | Grade CG3M | J92999 | --- | --- | 240 | 35 | 515 | 75 | 25 | Q | --- |
| ISO 11972:1998 | Grade GX 2 CrNiMo 19 11 3 | --- | --- | t ≤ 150 | 180 | --- | 440 | --- | 30 | ST+Q | 80 J @ RT |
| ASTM A743/A743M-13ae1* | Grade CH20 | J93402 | --- | --- | 205 | 30 | 485 | 70 | 30 | Q | --- |
| JIS G 5121:2003 | Class SCS 17 | --- | --- | --- | 205 | --- | 480 | --- | 28 | ST | 183 max. HB |
| ASTM A743/A743M-13ae1* | Grade CN7M | N08007 | --- | --- | 170 | 25 | 425 | 62 | 35 | Q | --- |
| ASTM A744/A744M-13* | Grade CN7M | N08007 | --- | --- | 170 | 25 | 425 | 62 | 35 | Q | --- |
| EN 10283:2010 | GX2NiCrMo28-20-2 | --- | 1.4458 | t ≤ 150 | 165 | --- | 430 | --- | 30 | SA+Q | 60 J @ RT |
| | GX4NiCrCuMo30-20-4 | --- | 1.4527 | t ≤ 150 | 170 | --- | 430 | --- | 35 | SA+Q | 60 J @ RT |
| JIS G 5121:2003 | Class SCS 23 | --- | --- | --- | 165 | --- | 390 | --- | 30 | ST | 183 max. HB |
| ASTM A743/A743M-13ae1* | Grade CN3M | J94652 | --- | --- | 170 | 25 | 435 | 63 | 30 | Q | --- |
| EN 10283:2010 | GX2NiCrMoN25-20-5 | --- | 1.4416 | t ≤ 150 | 185 | --- | 450 | --- | 30 | SA+Q | 60 J @ RT |
| ASTM A743/A743M-13ae1* | Grade CN3MN | J94651 | --- | --- | 260 | 38 | 550 | 80 | 35 | Q | --- |
| ASTM A744/A744M-13* | Grade CN3MN | J94651 | --- | --- | 260 | 38 | 550 | 80 | 35 | Q | --- |
| EN 10283:2010 | GX2NiCrMoCuN25-20-6 | --- | 1.4588 | t ≤ 50 | 210 | --- | 480 | --- | 30 | SA+Q | 60 J @ RT |
| ASTM A743/A743M-13ae1* | Grade CK3MCuN | J93254 | --- | --- | 260 | 38 | 550 | 80 | 35 | Q | --- |
| ASTM A744/A744M-13* | Grade CK3MCuN | J93254 | --- | --- | 260 | 38 | 550 | 80 | 35 | Q | --- |
| EN 10283:2010 | GX2CrNiMoCuN20-18-6 | --- | 1.4557 | t ≤ 50 | 260 | --- | 500 | --- | 35 | SA+Q | 50 J @ RT |
| EN 10283:2010 | GX2CrNiMoCuN25-6-3-3 | --- | 1.4517 | t ≤ 150 | 480 | --- | 650 | --- | 22 | SA+Q | 50 J @ RT |
| GB/T 2100-2002 | Grade ZG03Cr26Ni5Cu3Mo3N | --- | --- | t ≤ 150 | 450 | --- | 650 | --- | 18 | SA+Q | 50 J |
| ISO 11972:1998 | Grade GX 2 CrNiCuMoN 26 5 3 3 | --- | --- | t ≤ 150 | 450 | --- | 650 | --- | 18 | SA+Q | 50 J @ RT |
| JIS G 5121:2003 | Class SCS 32 | --- | --- | --- | 450 | --- | 650 | --- | 18 | ST | 50 J @ 20°C |
| EN 10283:2010 | GX2CrNiMoN25-6-3 | --- | 1.4468 | t ≤ 150 | 480 | --- | 650 | --- | 22 | SA+Q | 50 J @ RT |
| GB/T 2100-2002 | Grade ZG03Cr26Ni5Mo3N | --- | --- | t ≤ 150 | 450 | --- | 650 | --- | 18 | ST+Q | 50 J |
| ISO 11972:1998 | Grade GX 2 CrNiMoN 26 5 3 | --- | --- | t ≤ 150 | 450 | --- | 650 | --- | 18 | SA+Q | 50 J @ RT |
| JIS G 5121:2003 | Class SCS 10 | --- | --- | --- | 390 | --- | 620 | --- | 15 | ST | 302 max. HB |
| | Class SCS 33 | --- | --- | --- | 450 | --- | 650 | --- | 18 | ST | 50 J @ 20°C |

*: See "List of Standards" at the beginning of the chapter.

**7.4 Cast Stainless Steels**

**7.4.2 Cast Stainless Steels for Pressure Purposes**

**7.4.2.1A Chemical Composition of Martensitic and Ferritic Stainless Steels for Pressure Purposes**

| Specification | Designation | UNS No. | Steel No. | Weight, %, max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASME SA-217/SA-217M | Grade CA15 | J91150 | --- | 0.15 | 1.00 | 1.50 | 0.040 | 0.040 | 11.5-14.0 | 1.00 | 0.50 | --- |
| ASME SA-487/SA-487M | Grade CA15, Class A | J91150 | --- | 0.15 | 1.00 | 1.50 | 0.040 | 0.040 | 11.5-14.0 | 1.00 | 0.50 | Cu 0.50; W 0.10; V 0.05; (Cu+W+V) 0.50 |
| | Grade CA15, Class B | J91150 | --- | 0.15 | 1.00 | 1.50 | 0.040 | 0.040 | 11.5-14.0 | 1.00 | 0.50 | Cu 0.50; W 0.10; V 0.05; (Cu+W+V) 0.50 |
| | Grade CA15, Class C | J91150 | --- | 0.15 | 1.00 | 1.50 | 0.040 | 0.040 | 11.5-14.0 | 1.00 | 0.50 | Cu 0.50; W 0.10; V 0.05; (Cu+W+V) 0.50 |
| | Grade CA15, Class D | J91150 | --- | 0.15 | 1.00 | 1.50 | 0.040 | 0.040 | 11.5-14.0 | 1.00 | 0.50 | Cu 0.50; W 0.10; V 0.05; (Cu+W+V) 0.50 |
| ASTM A217/A217M-14 | Grade CA15 | J91150 | --- | 0.15 | 1.00 | 1.50 | 0.040 | 0.025 | 11.5-14.0 | 1.00 | 0.50 | --- |
| ASTM A487/A487M-14 | Grade CA15, Class A | J91150 | --- | 0.15 | 1.00 | 1.50 | 0.035 | 0.035 | 11.5-14.0 | 1.00 | 0.50 | Cu 0.50; W 0.10; V 0.05; (Cu+W+V) 0.50 |
| | Grade CA15, Class B | J91150 | --- | 0.15 | 1.00 | 1.50 | 0.035 | 0.035 | 11.5-14.0 | 1.00 | 0.50 | Cu 0.50; W 0.10; V 0.05; (Cu+W+V) 0.50 |
| | Grade CA15, Class C | J91150 | --- | 0.15 | 1.00 | 1.50 | 0.035 | 0.035 | 11.5-14.0 | 1.00 | 0.50 | Cu 0.50; W 0.10; V 0.05; (Cu+W+V) 0.50 |
| | Grade CA15, Class D | J91150 | --- | 0.15 | 1.00 | 1.50 | 0.035 | 0.035 | 11.5-14.0 | 1.00 | 0.50 | Cu 0.50; W 0.10; V 0.05; (Cu+W+V) 0.50 |
| GB/T 16253-1996 | Grade ZG14Cr12Ni1MoG | --- | --- | 0.10-0.17 | 1.00 | 0.80 | 0.035 | 0.035 | 11.5-13.5 | 1.00 | 0.50 | --- |
| ISO 4991:1994 | Type C39CH | --- | --- | 0.10-0.17 | 1.00 | 0.80 | 0.035 | 0.035 | 11.50-13.50 | 1.00 | 0.50 | --- |
| EN 10213:2007 C1:2008 | GX4CrNi13-4 | --- | 1.4317 | 0.06 | 1.00 | 1.00 | 0.035 | 0.025 | 12.00-13.50 | 3.50-5.00 | 0.70 | V 0.08; Cu 0.30 |
| | GX3CrNi13-4 | --- | 1.6982 | 0.05 | 1.00 | 1.00 | 0.035 | 0.015 | 12.00-13.50 | 3.50-5.00 | 0.70 | V 0.08; Cu 0.30 |
| GB/T 16253-1996 | Grade ZG08Cr12Ni4Mo1D | --- | --- | 0.08 | 1.50 | 1.00 | 0.030 | 0.030 | 11.5-13.5 | 3.50-5.00 | 1.00 | --- |
| | Grade ZG08Cr12Ni4Mo1G | --- | --- | 0.08 | 1.50 | 1.00 | 0.035 | 0.035 | 11.5-13.5 | 3.50-5.00 | 1.00 | --- |
| ISO 4991:1994 | Type C39NiH | --- | --- | 0.08 | 1.50 | 1.00 | 0.035 | 0.035 | 11.50-13.50 | 3.50-5.00 | 1.00 | --- |
| | Type C39NiL | --- | --- | 0.08 | 1.50 | 1.00 | 0.030 | 0.030 | 11.50-13.50 | 3.50-5.00 | 1.00 | --- |
| ASME SA-352/SA-352M | Grade CA6NM | J91540 | --- | 0.06 | 1.00 | 1.00 | 0.04 | 0.03 | 11.5-14.0 | 3.5-4.5 | 0.4-1.0 | --- |
| ASME SA-487/SA-487M | Grade CA6NM, Class A | J91540 | --- | 0.06 | 1.00 | 1.00 | 0.04 | 0.03 | 11.5-14.0 | 3.5-4.5 | 0.4-1.0 | Cu 0.50; W 0.10; V 0.05; (Cu+W+V) 0.50 |
| | Grade CA6NM, Class B | J91540 | --- | 0.06 | 1.00 | 1.00 | 0.04 | 0.03 | 11.5-14.0 | 3.5-4.5 | 0.4-1.0 | Cu 0.50; W 0.10; V 0.05; (Cu+W+V) 0.50 |
| ASTM A352/A352M-06 (2012) | Grade CA6NM | J91540 | --- | 0.06 | 1.00 | 1.00 | 0.04 | 0.03 | 11.5-14.0 | 3.5-4.5 | 0.4-1.0 | --- |
| ASTM A487/A487M-14 | Grade CA6NM, Class A | J91540 | --- | 0.06 | 1.00 | 1.00 | 0.035 | 0.03 | 11.5-14.0 | 3.5-4.5 | 0.4-1.0 | Cu 0.50; W 0.10; V 0.05; (Cu+W+V) 0.50 |
| | Grade CA6NM, Class B | J91540 | --- | 0.06 | 1.00 | 1.00 | 0.035 | 0.03 | 11.5-14.0 | 3.5-4.5 | 0.4-1.0 | Cu 0.50; W 0.10; V 0.05; (Cu+W+V) 0.50 |
| ASTM A757/A757M-15 | Grade E3N | J91550 | --- | 0.06 | 1.00 | 1.00 | 0.030 | 0.030 | 11.5-14.0 | 3.5-4.5 | 0.40-1.0 | Cu 0.50; W 0.10; (Cu+W+P+S) 0.50 |

**7.4 Cast Stainless Steels**

**7.4.2 Cast Stainless Steels for Pressure Purposes**

**7.4.2.1A Chemical Composition of Martensitic and Ferritic Stainless Steels for Pressure Purposes (Continued)**

| Specification | Designation | UNS No. | Steel No. | Weight, %, max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| EN 10213:2007 C1:2008 | GX23CrMoV12-1 | --- | 1.4931 | 0.20-0.26 | 0.50-0.80 | 0.40 | 0.030 | 0.020 | 11.30-12.20 | 1.00 | 1.00-1.20 | V 0.25-0.35; Cu 0.30; W 0.50 |
| GB/T 16253-1996 | Grade ZG23Cr12Mo1NiVG | --- | --- | 0.20-0.26 | 0.50-0.70 | 0.20-0.40 | 0.035 | 0.035 | 11.3-12.3 | 0.70-1.00 | 1.00-1.20 | V 0.25-0.35 |
| ISO 4991:1994 | Type C40H | --- | --- | 0.20-0.26 | 0.50-0.70 | 0.20-0.40 | 0.035 | 0.035 | 11.30-12.30 | 0.70-1.00 | 1.00-1.20 | V 0.25-0.35 |
| EN 10213:2007 C1:2008 | GX8CrNi12 | --- | 1.4107 | 0.10 | 0.50-0.80 | 0.40 | 0.030 | 0.020 | 11.50-12.50 | 0.80-1.50 | 0.50 | V 0.08; Cu 0.30 |
| GB/T 16253-1996 | Grade ZG08Cr12Ni1MoG | --- | --- | 0.05-0.10 | 0.40-0.80 | 0.80 | 0.035 | 0.035 | 11.5-13.0 | 0.80-1.80 | 0.20-0.50 | --- |
| ISO 4991:1994 | Type C39CNiH | --- | --- | 0.05-0.10 | 0.40-0.80 | 0.80 | 0.035 | 0.035 | 11.50-13.00 | 0.80-1.80 | 0.20-0.50 | --- |

**7.4 Cast Stainless Steels**

**7.4.2 Cast Stainless Steels for Pressure Purposes**

**7.4.2.1B Mechanical Properties of Martensitic and Ferritic Stainless Steels for Pressure Purposes**

| Specification | Designation | UNS No. | Steel No. | Section Thickness, mm | Yield Strength, min. | | Tensile Strength, min. | | Elongation % min. | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | MPa | ksi | MPa | ksi | | | |
| ASME SA-217/SA-217M | Grade CA15 | J91150 | --- | --- | 450 | 65 | 620-795 | 90-115 | 18 | N+T | --- |
| ASME SA-487/SA-487M | Grade CA15, Class A | J91150 | --- | --- | 760-895 | 110-130 | 965-1170 | 140-170 | 10 | N+T or Q+T | --- |
| | Grade CA15, Class B | J91150 | --- | --- | 450 | 65 | 620-795 | 90-115 | 18 | N+T or Q+T | --- |
| | Grade CA15, Class C | J91150 | --- | --- | 415 | 60 | 620 | 90 | 18 | N+T or Q+T | 235 max HB; 22 max HRC |
| | Grade CA15, Class D | J91150 | --- | --- | 515 | 75 | 690 | 100 | 17 | N+T or Q+T | 235 max HB; 22 max HRC |
| ASTM A217/A217M-14 | Grade CA15 | J91150 | --- | --- | 450 | 65 | 620-795 | 90-115 | 18 | N+T | --- |
| ASTM A487/A487M-14 | Grade CA15, Class A | J91150 | --- | --- | 760-895 | 110-130 | 965-1170 | 140-170 | 10 | N+T or Q+T | --- |
| | Grade CA15, Class B | J91150 | --- | --- | 450 | 65 | 620-795 | 90-115 | 18 | N+T or Q+T | --- |
| | Grade CA15, Class C | J91150 | --- | --- | 415 | 60 | 620 | 90 | 18 | N+T or Q+T | 235 max HB; 22 max HRC |
| | Grade CA15, Class D | J91150 | --- | --- | 515 | 75 | 690 | 100 | 17 | N+T or Q+T | 235 max HB; 22 max HRC |
| GB/T 16253-1996 | Grade ZG14Cr12Ni1MoG | --- | --- | --- | 450 | --- | 620-770 | --- | 14 | N+T | 20 J @ RT |
| ISO 4991:1994 | Type C39CH | --- | --- | --- | 450 | --- | 620-770 | --- | 14 | N+T | 20 J @ RT |
| EN 10213:2007 C1:2008 | GX4CrNi13-4 | --- | 1.4317 | t ≤ 300 | 550 | --- | 760-960 | --- | 15 | Q+T | 50 J @ RT |
| | GX3CrNi13-4 | --- | 1.6982 | t ≤ 300 | 500 | --- | 700-900 | --- | 15 | Q+T | 27 J @ -120°C |
| GB/T 16253-1996 | Grade ZG08Cr12Ni4Mo1D | --- | --- | --- | 550 | --- | 750-900 | --- | 15 | N+T | 27 J @ -80°C |
| | Grade ZG08Cr12Ni4Mo1G | --- | --- | --- | 550 | --- | 750-900 | --- | 15 | N+T | 45 J @ RT |
| ISO 4991:1994 | Type C39NiH | --- | --- | --- | 550 | --- | 750-900 | --- | 15 | N+T | 45 J @ RT |
| | Type C39NiL | --- | --- | --- | 550 | --- | 750-900 | --- | 15 | N+T | 27 J @ -80°C |
| ASME SA-352/SA-352M | Grade CA6NM | J91540 | --- | --- | 550 | 80.0 | 760-930 | 110.0-135.0 | 15 | N+T | 27 J @ -73°C |
| ASME SA-487/SA-487M | Grade CA6NM, Class A | J91540 | --- | --- | 550 | 80 | 760-930 | 110-135 | 15 | N+T or Q+T | --- |
| | Grade CA6NM, Class B | J91540 | --- | --- | 515 | 75 | 690 | 100 | 17 | N+T or Q+T | 255 max HB; 23 max HRC |
| ASTM A352/A352M-06 (2012) | Grade CA6NM | J91540 | --- | --- | 550 | 80.0 | 760-930 | 110.0-135.0 | 15 | N+T | 27 J @ -73°C |
| ASTM A487/A487M-14 | Grade CA6NM, Class A | J91540 | --- | --- | 550 | 80 | 760-930 | 110-135 | 15 | N+T or Q+T | --- |
| | Grade CA6NM, Class B | J91540 | --- | --- | 515 | 75 | 690 | 100 | 17 | N+T or Q+T | 255 max HB; 23 max HRC |
| ASTM A757/A757M-15 | Grade E3N | J91550 | --- | --- | 550 | 80 | 760 | 110 | 15 | N+T | L: 27 J @ -73°C |
| EN 10213:2007 C1:2008 | GX23CrMoV12-1 | --- | 1.4931 | t ≤ 150 | 540 | --- | 740-880 | --- | 15 | Q+T | 27 J @ RT |
| GB/T 16253-1996 | Grade ZG23Cr12Mo1NiVG | --- | --- | --- | 540 | --- | 740-880 | --- | 15 | N+T | 21 J @ RT |
| ISO 4991:1994 | Type C40H | --- | --- | --- | 540 | --- | 740-880 | --- | 15 | N+T | 21 J @ RT |
| EN 10213:2007 C1:2008 | GX8CrNi12 | --- | 1.4107 | t ≤ 300 | 355 | --- | 540-690 | --- | 18 | Q+T | 45 J @ RT |
| | | | | t ≤ 300 | 500 | --- | 600-800 | --- | 16 | Q+T | 40 J @ RT |
| GB/T 16253-1996 | Grade ZG08Cr12Ni1MoG | --- | --- | --- | 360 | --- | 540-690 | --- | 18 | N+T | 35 J @ RT |
| ISO 4991:1994 | Type C39CNiH | --- | --- | --- | 360 | --- | 540-690 | --- | 18 | N+T | 35 J @ RT |

**7.4 Cast Stainless Steels**

**7.4.2 Cast Stainless Steels for Pressure Purposes**

**7.4.2.2A Chemical Composition of Austenitic Stainless Steels for Pressure Purposes**

| Specification | Designation | UNS No. | Steel No. | Weight, %, max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASME SA-351/SA-351M | Grade CF8 | J92600 | --- | 0.08 | 1.50 | 2.00 | 0.040 | 0.040 | 18.0-21.0 | 8.0-11.0 | 0.50 | --- |
| | Grade CF8A | J92600 | --- | 0.08 | 1.50 | 2.00 | 0.040 | 0.040 | 18.0-21.0 | 8.0-11.0 | 0.50 | --- |
| ASTM A351/A351M-14 | Grade CF8 | J92600 | --- | 0.08 | 1.50 | 2.00 | 0.040 | 0.040 | 18.0-21.0 | 8.0-11.0 | 0.50 | --- |
| | Grade CF8A | J92600 | --- | 0.08 | 1.50 | 2.00 | 0.040 | 0.040 | 18.0-21.0 | 8.0-11.0 | 0.50 | --- |
| EN 10213:2007 C1:2008 | GX5CrNi19-10 | --- | 1.4308 | 0.07 | 1.50 | 1.50 | 0.040 | 0.030 | 18.00-20.00 | 8.00-11.00 | --- | Cu 0.50 |
| GB/T 16253-1996 | Grade ZG07Cr20Ni10 | --- | --- | 0.07 | 2.00 | 2.00 | 0.045 | 0.035 | 18.0-21.0 | 8.0-11.0 | --- | --- |
| ISO 4991:1994 | Type C47 | --- | --- | 0.07 | 2.00 | 2.00 | 0.045 | 0.035 | 18.00-21.00 | 8.00-11.00 | --- | --- |
| ASME SA-351/SA-351M | Grade CF3 | J92700 | --- | 0.03 | 1.50 | 2.00 | 0.040 | 0.040 | 17.0-21.0 | 8.0-12.0 | 0.50 | --- |
| | Grade CF3A | J92700 | --- | 0.03 | 1.50 | 2.00 | 0.040 | 0.040 | 17.0-21.0 | 8.0-12.0 | 0.50 | --- |
| ASTM A351/A351M-14 | Grade CF3 | J92700 | --- | 0.03 | 1.50 | 2.00 | 0.040 | 0.040 | 17.0-21.0 | 8.0-12.0 | 0.50 | --- |
| | Grade CF3A | J92700 | --- | 0.03 | 1.50 | 2.00 | 0.040 | 0.040 | 17.0-21.0 | 8.0-12.0 | 0.50 | --- |
| EN 10213:2007 C1:2008 | GX2CrNi19-11 | --- | 1.4309 | 0.030 | 2.00 | 1.50 | 0.035 | 0.025 | 18.00-20.00 | 9.00-12.00 | --- | N 0.20; Cu 0.50 |
| GB/T 16253-1996 | Grade ZG03Cr18Ni10 | --- | --- | 0.03 | 2.00 | 2.00 | 0.045 | 0.035 | 17.0-19.0 | 9.0-12.0 | --- | --- |
| ISO 4991:1994 | Type C46 | --- | --- | 0.03 | 2.00 | 2.00 | 0.045 | 0.035 | 17.00-19.00 | 9.00-12.00 | --- | --- |
| ASME SA-351/SA-351M | Grade CF8C | J92710 | --- | 0.08 | 1.50 | 2.00 | 0.040 | 0.040 | 18.0-21.0 | 9.0-12.0 | 0.50 | Cb 8xC to 1.00 |
| ASTM A351/A351M-14 | Grade CF8C | J92710 | --- | 0.08 | 1.50 | 2.00 | 0.040 | 0.040 | 18.0-21.0 | 9.0-12.0 | 0.50 | Cb 8xC to 1.00 |
| EN 10213:2007 C1:2008 | GX5CrNiNb19-11 | --- | 1.4552 | 0.07 | 1.50 | 1.50 | 0.040 | 0.030 | 18.00-20.00 | 9.00-12.00 | --- | Nb 8xC to 1.00; Cu 0.50 |
| GB/T 16253-1996 | Grade ZG08Cr20Ni10Nb | --- | --- | 0.08 | 2.00 | 2.00 | 0.045 | 0.035 | 18.0-21.0 | 9.0-12.0 | --- | Nb 8xC to 1.0 |
| ISO 4991:1994 | Type C50 | --- | --- | 0.08 | 2.00 | 2.00 | 0.045 | 0.035 | 18.00-21.00 | 9.00-12.00 | --- | Nb 8xC to 1.0 |
| ASME SA-351/SA-351M | Grade CF8M | J92900 | --- | 0.08 | 1.50 | 1.50 | 0.040 | 0.040 | 18.0-21.0 | 9.0-12.0 | 2.0-3.0 | --- |
| ASTM A351/A351M-14 | Grade CF8M | J92900 | --- | 0.08 | 1.50 | 1.50 | 0.040 | 0.040 | 18.0-21.0 | 9.0-12.0 | 2.0-3.0 | --- |
| EN 10213:2007 C1:2008 | GX5CrNiMo19-11-2 | --- | 1.4408 | 0.07 | 1.50 | 1.50 | 0.040 | 0.030 | 18.00-20.00 | 9.00-12.00 | 2.00-2.50 | Cu 0.50 |
| GB/T 16253-1996 | Grade ZG07Cr19Ni11Mo2 | --- | --- | 0.07 | 2.00 | 2.00 | 0.045 | 0.035 | 17.0-21.0 | 9.0-13.0 | 2.0-2.5 | --- |
| | Grade ZG07Cr19Ni11Mo3 | --- | --- | 0.07 | 2.00 | 2.00 | 0.045 | 0.035 | 17.0-21.0 | 9.0-13.0 | 2.5-3.0 | --- |
| ISO 4991:1994 | Type C60 | --- | --- | 0.07 | 2.00 | 2.00 | 0.045 | 0.035 | 17.00-21.00 | 9.00-13.00 | 2.00-2.50 | --- |
| | Type C61 | --- | --- | 0.07 | 2.00 | 2.00 | 0.045 | 0.035 | 17.00-21.00 | 9.00-13.00 | 2.50-3.00 | --- |
| EN 10213:2007 C1:2008 | GX5CrNiMoNb19-11-2 | --- | 1.4581 | 0.07 | 1.50 | 1.50 | 0.040 | 0.030 | 18.00-12.00 | 9.00-12.00 | 2.00-2.50 | Nb 8xC to 1.00; Cu 0.50 |
| GB/T 16253-1996 | Grade ZG08Cr19Ni11Mo2Nb | --- | --- | 0.08 | 2.00 | 2.00 | 0.045 | 0.035 | 17.0-21.0 | 9.0-13.0 | 2.0-2.5 | Nb 8xC to 1.0 |
| ISO 4991:1994 | Type C60Nb | --- | --- | 0.08 | 2.00 | 2.00 | 0.045 | 0.035 | 17.00-21.00 | 9.00-13.00 | 2.00-2.50 | Nb 8xC to 1.0 |

**7.4 Cast Stainless Steels**

**7.4.2 Cast Stainless Steels for Pressure Purposes**

**7.4.2.2A Chemical Composition of Austenitic Stainless Steels for Pressure Purposes (Continued)**

| Specification | Designation | UNS No. | Steel No. | Weight, %, max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASME SA-351/SA-351M | Grade CF3M | J92800 | --- | 0.03 | 1.50 | 1.50 | 0.040 | 0.040 | 17.0-21.0 | 9.0-13.0 | 2.0-3.0 | --- |
| | Grade CF3MA | J92800 | --- | 0.03 | 1.50 | 1.50 | 0.040 | 0.040 | 17.0-21.0 | 9.0-13.0 | 2.0-3.0 | --- |
| ASTM A351/A351M-14 | Grade CF3M | J92800 | --- | 0.03 | 1.50 | 1.50 | 0.040 | 0.040 | 17.0-21.0 | 9.0-13.0 | 2.0-3.0 | --- |
| | Grade CF3MA | J92800 | --- | 0.03 | 1.50 | 1.50 | 0.040 | 0.040 | 17.0-21.0 | 9.0-13.0 | 2.0-3.0 | --- |
| EN 10213:2007 C1:2008 | GX2CrNiMo19-11-2 | --- | 1.4409 | 0.030 | 2.00 | 1.50 | 0.035 | 0.025 | 18.00-20.00 | 9.00-12.00 | 2.00-2.50 | N 0.20; Cu 0.50 |
| GB/T 16253-1996 | Grade ZG03Cr19Ni11Mo2 | --- | --- | 0.03 | 2.00 | 2.00 | 0.045 | 0.035 | 17.0-21.0 | 9.0-13.0 | 2.0-2.5 | --- |
| | Grade ZG03Cr19Ni11Mo3 | --- | --- | 0.03 | 2.00 | 2.00 | 0.045 | 0.035 | 17.0-21.0 | 9.0-13.0 | 2.5-3.0 | --- |
| ISO 4991:1994 | Type C57 | --- | --- | 0.03 | 2.00 | 2.00 | 0.045 | 0.035 | 17.00-21.00 | 9.00-13.00 | 2.00-2.50 | --- |
| | Type C61LC | --- | --- | 0.03 | 2.00 | 2.00 | 0.045 | 0.035 | 17.00-21.00 | 9.00-13.00 | 2.50-3.00 | --- |
| ASME SA-351/SA-351M | Grade CN7M | N08007 | --- | 0.07 | 1.50 | 1.50 | 0.040 | 0.040 | 19.0-22.0 | 27.5-30.5 | 2.0-3.0 | Cu 3.0-4.0 |
| ASTM A351/A351M-14 | Grade CN7M | N08007 | --- | 0.07 | 1.50 | 1.50 | 0.040 | 0.040 | 19.0-22.0 | 27.5-30.5 | 2.0-3.0 | Cu 3.0-4.0 |
| EN 10213:2007 C1:2008 | GX2NiCrMo28-20-2 | --- | 1.4458 | 0.030 | 2.00 | 1.00 | 0.035 | 0.025 | 19.00-22.00 | 26.00-30.00 | 2.00-2.50 | N 0.20; Cu 2.00 |
| GB/T 16253-1996 | Grade ZG07Cr20Ni10G | --- | --- | 0.04-0.10 | 2.00 | 2.00 | 0.045 | 0.035 | 18.0-21.0 | 8.0-12.0 | --- | --- |
| ISO 4991:1994 | Type C47H | --- | --- | 0.04-0.10 | 2.00 | 2.00 | 0.045 | 0.035 | 18.00-21.00 | 8.00-12.00 | --- | --- |
| ASME SA-351/SA-351M | Grade CF10M | J92901 | --- | 0.04-0.10 | 1.50 | 1.50 | 0.040 | 0.040 | 18.0-21.0 | 9.0-12.0 | 2.0-3.0 | --- |
| ASTM A351/A351M-14 | Grade CF10M | J92901 | --- | 0.04-0.10 | 1.50 | 1.50 | 0.040 | 0.040 | 18.0-21.0 | 9.0-12.0 | 2.0-3.0 | --- |
| GB/T 16253-1996 | Grade ZG07Cr19Ni11Mo2G | --- | --- | 0.04-0.10 | 2.00 | 2.00 | 0.045 | 0.035 | 17.0-21.0 | 9.0-13.0 | 2.0-2.5 | --- |
| ISO 4991:1994 | Type C60H | --- | --- | 0.04-0.10 | 2.00 | 2.00 | 0.045 | 0.035 | 17.00-21.00 | 9.00-13.00 | 2.00-2.50 | --- |
| GB/T 16253-1996 | Grade ZG07Cr18Ni10D | --- | --- | 0.07 | 2.00 | 2.00 | 0.045 | 0.035 | 17.0-20.0 | 9.0-12.0 | --- | --- |
| ISO 4991:1994 | Type C47L | --- | --- | 0.07 | 2.00 | 2.00 | 0.045 | 0.035 | 17.00-20.00 | 9.00-12.00 | --- | --- |

**7.4 Cast Stainless Steels**

**7.4.2 Cast Stainless Steels for Pressure Purposes**

**7.4.2.2B Mechanical Properties of Austenitic Stainless Steels for Pressure Purposes**

| Specification | Designation | UNS No. | Steel No. | Section Thickness, mm | Yield Strength, min. | | Tensile Strength, min. | | Elongation % min. | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | MPa | ksi | MPa | ksi | | | |
| ASME SA-351/SA-351M | Grade CF8 | J92600 | --- | --- | 205 | 30 | 485 | 70 | 35.0 | Q | --- |
| | Grade CF8A | J92600 | --- | --- | 240 | 35 | 530 | 77 | 35.0 | Q | --- |
| ASTM A351/A351M-14 | Grade CF8 | J92600 | --- | --- | 205 | 30 | 485 | 70 | 35.0 | Q | --- |
| | Grade CF8A | J92600 | --- | --- | 240 | 35 | 530 | 77 | 35.0 | Q | --- |
| EN 10213:2007 C1:2008 | GX5CrNi19-10 | --- | 1.4308 | t ≤ 150 | 200 | --- | 440-640 | --- | 30 | SA+Q | 60 J @ -196°C |
| GB/T 16253-1996 | Grade ZG07Cr20Ni10 | --- | --- | --- | 210 | --- | 440-640 | --- | 30 | ST | --- |
| ISO 4991:1994 | Type C47 | --- | --- | --- | 210 | --- | 440-640 | --- | 30 | ST | --- |
| ASME SA-351/SA-351M | Grade CF3 | J92700 | --- | --- | 205 | 30 | 485 | 70 | 35.0 | Q | --- |
| | Grade CF3A | J92700 | --- | --- | 240 | 35 | 530 | 77 | 35.0 | Q | --- |
| ASTM A351/A351M-14 | Grade CF3 | J92700 | --- | --- | 205 | 30 | 485 | 70 | 35.0 | Q | --- |
| | Grade CF3A | J92700 | --- | --- | 240 | 35 | 530 | 77 | 35.0 | Q | --- |
| EN 10213:2007 C1:2008 | GX2CrNi19-11 | --- | 1.4309 | t ≤ 150 | 210 | --- | 440-640 | --- | 30 | SA+Q | 70 J @ -196°C |
| GB/T 16253-1996 | Grade ZG03Cr18Ni10 | --- | --- | --- | 210 | --- | 440-640 | --- | 30 | ST | --- |
| ISO 4991:1994 | Type C46 | --- | --- | --- | 210 | --- | 440-640 | --- | 30 | ST | --- |
| ASME SA-351/SA-351M | Grade CF8C | J92710 | --- | --- | 205 | 30 | 485 | 70 | 30.0 | Q | --- |
| ASTM A351/A351M-14 | Grade CF8C | J92710 | --- | --- | 205 | 30 | 485 | 70 | 30.0 | Q | --- |
| EN 10213:2007 C1:2008 | GX5CrNiNb19-11 | --- | 1.4552 | t ≤ 150 | 200 | --- | 440-640 | --- | 25 | SA+Q | 40 J @ RT |
| GB/T 16253-1996 | Grade ZG08Cr20Ni10Nb | --- | --- | --- | 210 | --- | 440-640 | --- | 25 | ST | --- |
| ISO 4991:1994 | Type C50 | --- | --- | --- | 210 | --- | 440-640 | --- | 25 | ST | --- |
| ASME SA-351/SA-351M | Grade CF8M | J92900 | --- | --- | 205 | 30 | 485 | 70 | 30.0 | Q | --- |
| ASTM A351/A351M-14 | Grade CF8M | J92900 | --- | --- | 205 | 30 | 485 | 70 | 30.0 | Q | --- |
| EN 10213:2007 C1:2008 | GX5CrNiMo19-11-2 | --- | 1.4408 | t ≤ 150 | 210 | --- | 440-640 | --- | 30 | SA+Q | 60 J @ -196°C |
| GB/T 16253-1996 | Grade ZG07Cr19Ni11Mo2 | --- | --- | --- | 210 | --- | 440-640 | --- | 30 | ST | --- |
| | Grade ZG07Cr19Ni11Mo3 | --- | --- | --- | 210 | --- | 440-640 | --- | 30 | ST | --- |
| ISO 4991:1994 | Type C60 | --- | --- | --- | 210 | --- | 440-640 | --- | 30 | ST | --- |
| | Type C61 | --- | --- | --- | 210 | --- | 440-640 | --- | 30 | ST | --- |
| EN 10213:2007 C1:2008 | GX5CrNiMoNb19-11-2 | --- | 1.4581 | t ≤ 150 | 210 | --- | 440-640 | --- | 25 | SA+Q | 40 J @ RT |
| GB/T 16253-1996 | Grade ZG08Cr19Ni11Mo2Nb | --- | --- | --- | 210 | --- | 440-640 | --- | 25 | ST | --- |
| ISO 4991:1994 | Type C60Nb | --- | --- | --- | 210 | --- | 440-640 | --- | 25 | ST | --- |

**7.4 Cast Stainless Steels**

**7.4.2 Cast Stainless Steels for Pressure Purposes**

**7.4.2.2B Mechanical Properties of Austenitic Stainless Steels for Pressure Purposes (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness, mm | Yield Strength, min. | | Tensile Strength, min. | | Elongation % min. | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | MPa | ksi | MPa | ksi | | | |
| ASME SA-351/SA-351M | Grade CF3M | J92800 | --- | --- | 205 | 30 | 485 | 70 | 30.0 | Q | --- |
| | Grade CF3MA | J92800 | --- | --- | 255 | 37 | 550 | 80 | 30.0 | Q | --- |
| ASTM A351/A351M-14 | Grade CF3M | J92800 | --- | --- | 205 | 30 | 485 | 70 | 30.0 | Q | --- |
| | Grade CF3MA | J92800 | --- | --- | 255 | 37 | 550 | 80 | 30.0 | Q | --- |
| EN 10213:2007 C1:2008 | GX2CrNiMo19-11-2 | --- | 1.4409 | t ≤ 150 | 220 | --- | 440-640 | --- | 30 | SA+Q | 70 J @ -196°C |
| GB/T 16253-1996 | Grade ZG03Cr19Ni11Mo2 | --- | --- | --- | 210 | --- | 440-620 | --- | 30 | ST | --- |
| | Grade ZG03Cr19Ni11Mo3 | --- | --- | --- | 210 | --- | 440-640 | --- | 30 | ST | --- |
| ISO 4991:1994 | Type C57 | --- | --- | --- | 210 | --- | 440-620 | --- | 30 | ST | --- |
| | Type C61LC | --- | --- | --- | 210 | --- | 440-640 | --- | 30 | ST | --- |
| ASME SA-351/SA-351M | Grade CN7M | N08007 | --- | --- | 170 | 25 | 425 | 62 | 35.0 | Q | --- |
| ASTM A351/A351M-14 | Grade CN7M | N08007 | --- | --- | 170 | 25 | 425 | 62 | 35.0 | Q | --- |
| EN 10213:2007 C1:2008 | GX2NiCrMo28-20-2 | --- | 1.4458 | t ≤ 150 | 190 | --- | 430-630 | --- | 30 | SA+Q | 60 J @ -196°C |
| GB/T 16253-1996 | Grade ZG07Cr20Ni10G | --- | --- | --- | 230 | --- | 470-670 | --- | 30 | ST | --- |
| ISO 4991:1994 | Type C47H | --- | --- | --- | 230 | --- | 470-670 | --- | 30 | ST | --- |
| ASME SA-351/SA-351M | Grade CF10M | J92901 | --- | --- | 205 | 30 | 485 | 70 | 30.0 | Q | --- |
| ASTM A351/A351M-14 | Grade CF10M | J92901 | --- | --- | 205 | 30 | 485 | 70 | 30.0 | Q | --- |
| GB/T 16253-1996 | Grade ZG07Cr19Ni11Mo2G | --- | --- | --- | 230 | --- | 470-670 | --- | 30 | ST | --- |
| ISO 4991:1994 | Type C60H | --- | --- | --- | 230 | --- | 470-670 | --- | 30 | ST | --- |
| GB/T 16253-1996 | Grade ZG07Cr18Ni10D | --- | --- | --- | 210 | --- | 440-640 | --- | 30 | ST | 45 J @ -195°C |
| ISO 4991:1994 | Type C47L | --- | --- | --- | 210 | --- | 440-640 | --- | 30 | ST | 45 J @ -195°C |

## 7.5 Cast Heat Resistant Steels

### 7.5A Chemical Composition of Cast Heat Resistant Steels

| Specification | Designation | UNS No. | Steel No. | Weight, %, max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| EN 10295:2002 | GX40CrSi13 | --- | 1.4729 | 0.30-0.50 | 1.00 | 1.00-2.50 | 0.040 | 0.030 | 12.00-14.00 | 1.00 | 0.50 | --- |
| ISO 11973:1999 | Grade GX40CrSi13 | --- | --- | 0.30-0.50 | 0.50-1.00 | 1.00-2.5 | 0.040 | 0.030 | 12.0-14.0 | 1.00 | 0.5 | --- |
| JIS G 5122:2003 | Class SCH 3 | --- | --- | 0.40 | 1.00 | 2.00 | 0.040 | 0.040 | 12.00-15.00 | 1.00 | 0.50 | --- |
| | Class SCH 1 | --- | --- | 0.20-0.40 | 1.00 | 1.50-3.00 | 0.040 | 0.040 | 12.00-15.00 | 1.00 | 0.50 | --- |
| EN 10295:2002 | GX40CrSi17 | --- | 1.4740 | 0.30-0.50 | 1.00 | 1.00-2.50 | 0.040 | 0.030 | 16.00-19.00 | 1.00 | 0.50 | --- |
| ISO 11973:1999 | Grade GX40CrSi17 | --- | --- | 0.30-0.50 | 0.50-1.00 | 1.00-2.5 | 0.040 | 0.030 | 16.0-19.0 | 1.00 | 0.5 | --- |
| EN 10295:2002 | GX40CrSi24 | --- | 1.4745 | 0.30-0.50 | 1.00 | 1.00-2.50 | 0.040 | 0.030 | 23.00-26.00 | 1.00 | 0.50 | --- |
| ISO 11973:1999 | Grade GX40CrSi24 | --- | --- | 0.30-0.50 | 0.50-1.00 | 1.00-2.5 | 0.040 | 0.030 | 23.0-26.0 | 1.00 | 0.5 | --- |
| EN 10295:2002 | GX40CrSi28 | --- | 1.4776 | 0.30-0.50 | 1.00 | 1.00-2.50 | 0.040 | 0.030 | 27.00-30.00 | 1.00 | 0.50 | --- |
| ISO 11973:1999 | Grade GX40CrSi28 | --- | --- | 0.30-0.50 | 0.50-1.00 | 1.00-2.5 | 0.040 | 0.030 | 27.0-30.0 | 1.00 | 0.5 | --- |
| EN 10295:2002 | GX130CrSi29 | --- | 1.4777 | 1.20-1.40 | 0.50-1.00 | 1.00-2.50 | 0.035 | 0.030 | 27.00-30.00 | 1.00 | 0.50 | --- |
| ISO 11973:1999 | Grade GX130CrSi29 | --- | --- | 1.20-1.40 | 0.50-1.00 | 1.00-2.5 | 0.040 | 0.030 | 27.0-30.0 | 1.00 | 0.5 | --- |
| ASTM A297/A297M-14 | Grade HC | J92605 | --- | 0.50 | 1.00 | 2.00 | 0.04 | 0.04 | 26.0-30.0 | 4.00 | 0.50 | --- |
| ASTM A608/A608M-14 | Grade HC30 | J92613 | --- | 0.25-0.35 | 0.5-1.0 | 0.50-2.00 | 0.04 | 0.04 | 26-30 | 4.0 | 0.50 | --- |
| JIS G 5122:2003 | Class SCH 2 | --- | --- | 0.40 | 1.00 | 2.00 | 0.040 | 0.040 | 25.00-28.00 | 1.00 | 0.50 | --- |
| ASTM A297/A297M-14 | Grade HD | J93005 | --- | 0.50 | 1.50 | 2.00 | 0.04 | 0.04 | 26.0-30.0 | 4.0-7.0 | 0.50 | --- |
| ASTM A608/A608M-14 | Grade HD50 | J93015 | --- | 0.45-0.55 | 1.50 | 0.50-2.00 | 0.04 | 0.04 | 26-30 | 4-7 | 0.50 | --- |
| EN 10295:2002 | GX40CrNiSi27-4 | --- | 1.4823 | 0.30-0.50 | 1.50 | 1.00-2.50 | 0.040 | 0.030 | 25.00-28.00 | 3.00-6.00 | 0.50 | --- |
| ISO 11973:1999 | Grade GX40CrNiSi27-4 | --- | --- | 0.30-0.50 | 1.50 | 1.00-2.5 | 0.040 | 0.030 | 25.0-28.0 | 3.00-6.00 | 0.5 | --- |
| JIS G 5122:2003 | Class SCH 11 | --- | --- | 0.40 | 1.00 | 2.00 | 0.040 | 0.040 | 24.00-28.00 | 4.00-6.00 | 0.50 | --- |
| ASTM A297/A297M-14 | Grade HE | J93403 | --- | 0.20-0.50 | 2.00 | 2.00 | 0.04 | 0.04 | 26.0-30.0 | 8.0-11.0 | 0.50 | --- |
| ASTM A608/A608M-14 | Grade HE35 | J93413 | --- | 0.30-0.40 | 1.50 | 0.50-2.00 | 0.04 | 0.04 | 26-30 | 8-11 | 0.50 | --- |
| JIS G 5122:2003 | Class SCH 17 | --- | --- | 0.20-0.50 | 2.00 | 2.00 | 0.040 | 0.040 | 26.00-30.00 | 8.00-11.00 | 0.50 | --- |
| ASTM A297/A297M-14 | Grade HF | J92603 | --- | 0.20-0.40 | 2.00 | 2.00 | 0.04 | 0.04 | 18.0-23.0 | 8.0-12.0 | 0.50 | --- |
| ASTM A608/A608M-14 | Grade HF30 | J92803 | --- | 0.25-0.35 | 1.50 | 0.50-2.00 | 0.04 | 0.04 | 19-23 | 9-12 | 0.50 | --- |
| EN 10295:2002 | GX25CrNiSi18-9 | --- | 1.4825 | 0.15-0.35 | 2.00 | 0.50-2.50 | 0.040 | 0.030 | 17.00-19.00 | 8.00-10.00 | 0.50 | --- |
| | GX40CrNiSi22-10 | --- | 1.4826 | 0.30-0.50 | 2.00 | 1.00-2.50 | 0.040 | 0.030 | 21.00-23.00 | 9.00-11.00 | 0.50 | --- |
| ISO 11973:1999 | Grade GX25CrNiSi18-9 | --- | --- | 0.15-0.35 | 2.00 | 1.00-2.5 | 0.040 | 0.030 | 17.0-19.0 | 8.00-10.00 | 0.5 | --- |
| | Grade GX40CrNiSi22-10 | --- | --- | 0.30-0.50 | 2.00 | 1.00-2.5 | 0.040 | 0.030 | 21.0-23.0 | 9.00-11.00 | 0.5 | --- |
| JIS G 5122:2003 | Class SCH 12 | --- | --- | 0.20-0.40 | 2.00 | 2.00 | 0.040 | 0.040 | 18.00-23.00 | 8.00-12.00 | 0.50 | --- |
| EN 10295:2002 | GX25CrNiSi20-14 | --- | 1.4832 | 0.15-0.35 | 2.00 | 0.50-2.50 | 0.040 | 0.030 | 19.00-21.00 | 13.00-15.00 | 0.50 | --- |
| ISO 11973:1999 | Grade GX25 CrNiSi 20-14 | --- | --- | 0.15-0.35 | 2.00 | 1.00-2.5 | 0.040 | 0.030 | 19.0-21.0 | 13.00-15.00 | 0.5 | --- |

**7.5 Cast Heat Resistant Steels**

**7.5A Chemical Composition of Cast Heat Resistant Steels (Continued)**

| Specification | Designation | UNS No. | Steel No. | Weight, %, max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASTM A297/A297M-14 | Grade HH | J93503 | --- | 0.20-0.50 | 2.00 | 2.00 | 0.04 | 0.04 | 24.0-28.0 | 11.0-14.0 | 0.50 | --- |
| ASTM A447/A447M-11 | Type I | J93303 | --- | 0.20-0.45 | 2.50 | 1.75 | 0.030 | 0.030 | 23.00-28.00 | 10.00-14.00 | --- | N 0.20 |
| | Type II | J93303 | --- | 0.20-0.45 | 2.50 | 1.75 | 0.030 | 0.030 | 23.00-28.00 | 10.00-14.00 | --- | N 0.20 |
| ASTM A608/A608M-14 | Grade HH30 | J93513 | --- | 0.25-0.35 | 1.50 | 0.50-2.00 | 0.04 | 0.04 | 24-28 | 11-14 | 0.50 | --- |
| | Grade HH33 | J93633 | --- | 0.28-0.38 | 1.50 | 0.50-2.00 | 0.04 | 0.04 | 24-26 | 12-14 | 0.50 | --- |
| EN 10295:2002 | GX40CrNiSi25-12 | --- | 1.4837 | 0.30-0.50 | 2.00 | 1.00-2.50 | 0.040 | 0.030 | 24.00-27.00 | 11.00-14.00 | 0.50 | --- |
| ISO 11973:1999 | Grade GX40CrNiSi25-12 | --- | --- | 0.30-0.50 | 2.00 | 1.00-2.5 | 0.040 | 0.030 | 24.0-27.0 | 11.00-14.00 | 0.5 | --- |
| JIS G 5122:2003 | Class SCH 13 | --- | --- | 0.20-0.50 | 2.00 | 2.00 | 0.040 | 0.040 | 24.00-28.00 | 11.00-14.00 | 0.50 | --- |
| | Class SCH 13A | --- | --- | 0.25-0.50 | 2.50 | 1.75 | 0.040 | 0.040 | 23.00-26.00 | 12.00-14.00 | 0.50 | --- |
| ASTM A297/A297M-14 | Grade HI | J94003 | --- | 0.20-0.50 | 2.00 | 2.00 | 0.04 | 0.04 | 26.0-30.0 | 14.0-18.0 | 0.50 | --- |
| ASTM A608/A608M-14 | Grade HI35 | J94013 | --- | 0.30-0.40 | 1.50 | 0.50-2.00 | 0.04 | 0.04 | 26-30 | 14-18 | 0.50 | --- |
| JIS G 5122:2003 | Class SCH 18 | --- | --- | 0.20-0.50 | 2.00 | 2.00 | 0.040 | 0.040 | 26.00-30.00 | 14.00-18.00 | 0.50 | --- |
| ASME SA-351/SA-351M | Grade HK30 | J94203 | --- | 0.25-0.35 | 1.50 | 1.75 | 0.040 | 0.040 | 23.0-27.0 | 19.0-22.0 | 0.50 | --- |
| ASTM A297/A297M-14 | Grade HK | J94224 | --- | 0.20-0.60 | 2.00 | 2.00 | 0.04 | 0.04 | 24.0-28.0 | 18.0-22.0 | 0.50 | --- |
| ASTM A351/A351M-14 | Grade HK30 | J94203 | --- | 0.25-0.35 | 1.50 | 1.75 | 0.040 | 0.040 | 23.0-27.0 | 19.0-22.0 | 0.50 | --- |
| ASTM A608/A608M-14 | Grade HK30 | J94203 | --- | 0.25-0.35 | 1.50 | 0.50-2.00 | 0.04 | 0.04 | 23-27 | 19-22 | 0.50 | --- |
| JIS G 5122:2003 | Class SCH 21 | --- | --- | 0.25-0.35 | 1.50 | 1.75 | 0.040 | 0.040 | 23.00-27.00 | 19.00-22.00 | 0.50 | --- |
| ASME SA-351/SA-351M | Grade HK40 | J94204 | --- | 0.35-0.45 | 1.50 | 1.75 | 0.040 | 0.040 | 23.0-27.0 | 19.0-22.0 | 0.50 | --- |
| ASTM A351/A351M-14 | Grade HK40 | J94204 | --- | 0.35-0.45 | 1.50 | 1.75 | 0.040 | 0.040 | 23.0-27.0 | 19.0-22.0 | 0.50 | --- |
| ASTM A608/A608M-14 | Grade HK40 | J94204 | --- | 0.35-0.45 | 1.50 | 0.50-2.00 | 0.04 | 0.04 | 23-27 | 19-22 | 0.50 | --- |
| EN 10295:2002 | GX40CrNiSi25-20 | --- | 1.4848 | 0.30-0.50 | 2.00 | 1.00-2.50 | 0.040 | 0.030 | 24.00-27.00 | 19.00-22.00 | 0.50 | --- |
| ISO 11973:1999 | Grade GX40CrNiSi25-20 | --- | --- | 0.30-0.50 | 2.00 | 1.00-2.5 | 0.040 | 0.030 | 24.0-27.0 | 19.00-22.00 | 0.5 | --- |
| JIS G 5122:2003 | Class SCH 22 | --- | --- | 0.35-0.45 | 1.50 | 1.75 | 0.040 | 0.040 | 23.00-27.00 | 19.00-22.00 | 0.50 | --- |
| ASTM A297/A297M-14 | Grade HL | N08604 | --- | 0.20-0.60 | 2.00 | 2.00 | 0.04 | 0.04 | 28.0-32.0 | 18.0-22.0 | 0.50 | --- |
| ASTM A608/A608M-14 | Grade HL30 | N08613 | --- | 0.25-0.35 | 1.50 | 0.50-2.00 | 0.04 | 0.04 | 28-32 | 18-22 | 0.50 | --- |
| | Grade HL40 | N08614 | --- | 0.35-0.45 | 1.50 | 0.50-2.00 | 0.04 | 0.04 | 28-32 | 18-22 | 0.50 | --- |
| JIS G 5122:2003 | Class SCH 23 | --- | --- | 0.20-0.60 | 2.00 | 2.00 | 0.040 | 0.040 | 28.00-32.00 | 18.00-22.00 | 0.50 | --- |

**7.5 Cast Heat Resistant Steels**

**7.5A Chemical Composition of Cast Heat Resistant Steels (Continued)**

| Specification | Designation | UNS No. | Steel No. | Weight, %, max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASTM A297/A297M-14 | Grade HN | J94213 | --- | 0.20-0.50 | 2.00 | 2.00 | 0.04 | 0.04 | 19.0-23.0 | 23.0-27.0 | 0.50 | --- |
| ASTM A608/A608M-14 | Grade HN40 | J94214 | --- | 0.35-0.45 | 1.50 | 0.50-2.00 | 0.04 | 0.04 | 19-23 | 23-27 | 0.50 | --- |
| EN 10295:2002 | GX35NiCrSi25-21 | --- | 1.4805 | 0.20-0.50 | 2.00 | 1.00-2.00 | 0.040 | 0.030 | 19.00-23.00 | 23.00-27.00 | 0.50 | --- |
| JIS G 5122:2003 | Class SCH 19 | --- | --- | 0.20-0.50 | 2.00 | 2.00 | 0.040 | 0.040 | 19.00-23.00 | 23.00-27.00 | 0.50 | --- |
| EN 10295:2002 | GX40CrNiSiNb24-24 | --- | 1.4855 | 0.30-0.50 | 2.00 | 1.00-2.50 | 0.040 | 0.030 | 23.00-25.00 | 23.00-25.00 | 0.50 | Nb 0.80-1.80 |
| ISO 11973:1999 | Grade GX40CrNiSiNb24-24 | --- | --- | 0.25-0.50 | 2.00 | 1.00-2.5 | 0.040 | 0.030 | 23.0-25.0 | 23.00-25.00 | 0.5 | Nb 1.20-1.80 |
| ASTM A297/A297M-14 | Grade HP | N08705 | --- | 0.35-0.75 | 2.00 | 2.50 | 0.04 | 0.04 | 24-28 | 33-37 | 0.50 | --- |
| EN 10295:2002 | GX40NiCrSiNb35-26 | --- | 1.4852 | 0.30-0.50 | 2.00 | 1.00-2.50 | 0.040 | 0.030 | 24.00-27.00 | 33.00-36.00 | 0.50 | Nb 0.80-1.80 |
| | GX40NiCrSi35-26 | --- | 1.4857 | 0.30-0.50 | 2.00 | 1.00-2.50 | 0.040 | 0.030 | 24.00-27.00 | 33.00-36.00 | 0.50 | --- |
| ISO 11973:1999 | Grade GX40NiCrSi35-26 | --- | --- | 0.30-0.50 | 2.00 | 1.00-2.50 | 0.040 | 0.030 | 24.0-27.0 | 33.00-36.00 | 0.50 | --- |
| | Grade GX40NiCrSiNb35-26 | --- | --- | 0.30-0.50 | 2.00 | 1.00-2.50 | 0.040 | 0.030 | 24.0-27.0 | 33.00-36.00 | 0.50 | Nb 0.80-1.80 |
| JIS G 5122:2003 | Class SCH 24 | --- | --- | 0.35-0.75 | 2.00 | 2.00 | 0.040 | 0.040 | 24.00-28.00 | 33.00-37.00 | 0.50 | --- |
| ASTM A297/A297M-14 | Grade HT | N08605 | --- | 0.35-0.75 | 2.00 | 2.50 | 0.04 | 0.04 | 15.0-19.0 | 33.0-37.0 | 0.50 | --- |
| ASTM A608/A608M-14 | Grade HT50 | N08050 | --- | 0.40-0.60 | 1.50 | 0.50-2.00 | 0.04 | 0.04 | 15-19 | 33-37 | 0.50 | --- |
| EN 10295:2002 | GX40NiCrSi35-17 | --- | 1.4806 | 0.30-0.50 | 2.00 | 1.00-2.50 | 0.040 | 0.030 | 16.00-18.00 | 34.00-36.00 | 0.50 | --- |
| ISO 11973:1999 | Grade GX40NiCrSi35-17 | --- | --- | 0.30-0.50 | 2.00 | 1.00-2.50 | 0.040 | 0.030 | 16.0-18.0 | 34.00-36.00 | 0.50 | --- |
| JIS G 5122:2003 | Class SCH 15 | --- | --- | 0.35-0.70 | 2.00 | 2.50 | 0.040 | 0.040 | 15.00-19.00 | 33.00-37.00 | 0.50 | --- |
| ASME SA-351/SA-351M | Grade HT30 | N08030 | --- | 0.25-0.35 | 2.00 | 2.50 | 0.040 | 0.040 | 13.0-17.0 | 33.0-37.0 | 0.50 | --- |
| ASTM A351/A351M-14 | Grade HT30 | N08030 | --- | 0.25-0.35 | 2.00 | 2.50 | 0.040 | 0.040 | 13.0-17.0 | 33.0-37.0 | 0.50 | --- |
| JIS G 5122:2003 | Class SCH 16 | --- | --- | 0.20-0.35 | 2.00 | 2.50 | 0.040 | 0.040 | 13.00-17.00 | 33.00-37.00 | 0.50 | --- |
| ASTM A297/A297M-14 | Grade HU | N08004 | --- | 0.35-0.75 | 2.00 | 2.50 | 0.04 | 0.04 | 17.0-21.0 | 37.0-41.0 | 0.50 | --- |
| ASTM A608/A608M-14 | Grade HU50 | N08005 | --- | 0.40-0.60 | 1.50 | 0.50-2.00 | 0.04 | 0.04 | 17-21 | 37-41 | 0.50 | --- |
| EN 10295:2002 | GX40NiCrSiNb35-18 | --- | 1.4807 | 0.30-0.50 | 2.00 | 1.00-2.50 | 0.040 | 0.030 | 17.00-20.00 | 34.00-36.00 | 0.50 | Nb 1.00-1.80 |
| | GX40NiCrSiNb38-19 | --- | 1.4849 | 0.30-0.50 | 2.00 | 1.00-2.50 | 0.040 | 0.030 | 18.00-21.00 | 36.00-39.00 | 0.50 | Nb 1.20-1.80 |
| | GX40NiCrSi38-19 | --- | 1.4865 | 0.30-0.50 | 2.00 | 1.00-2.50 | 0.040 | 0.030 | 18.00-21.00 | 36.00-39.00 | 0.50 | --- |
| ISO 11973:1999 | Grade GX40NiCrSi38-19 | --- | --- | 0.30-0.50 | 2.00 | 1.00-2.50 | 0.040 | 0.030 | 18.0-21.0 | 36.00 | 0.50 | --- |
| | Grade GX40NiCrSiNb38-19 | --- | --- | 0.3-0.50 | 2.00 | 1.00-2.50 | 0.040 | 0.030 | 18.0-21.0 | 36.00-39.00 | 0.50 | Nb 1.20-1.80 |
| JIS G 5122:2003 | Class SCH 20 | --- | --- | 0.35-0.75 | 2.00 | 2.50 | 0.040 | 0.040 | 17.00-21.00 | 37.00-41.00 | 0.50 | --- |
| EN 10295:2002 | G-NiCr50Nb | --- | 2.4680 | 0.10 | 0.50 | 1.00 | 0.020 | 0.020 | 48.00-52.00 | --- | 0.50 | Nb 1.00-1.80; N 0.16; Fe 1.00 |
| ISO 11973:1999 | Grade GX10NiCrNb50-50 | --- | --- | 0.10 | 0.50 | 0.50 | 0.020 | 0.020 | 47.0-52.0 | --- | 0.50 | Nb 1.40-1.70; N 0.16 |

**7.5 Cast Heat Resistant Steels**

**7.5A Chemical Composition of Cast Heat Resistant Steels (Continued)**

| Specification | Designation | UNS No. | Steel No. | Weight, %, max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASTM A297/A297M-14 | Grade HW | N08001 | --- | 0.35-0.75 | 2.00 | 2.50 | 0.04 | 0.04 | 10.0-14.0 | 58.0-62.0 | 0.50 | --- |
| | Grade HX | N06006 | --- | 0.35-0.75 | 2.00 | 2.50 | 0.04 | 0.04 | 15.0-19.0 | 64.0-68.0 | 0.50 | --- |
| ASTM A608/A608M-14 | Grade HW50 | N08006 | --- | 0.40-0.60 | 1.50 | 0.50-2.00 | 0.04 | 0.04 | 10-14 | 58-62 | 0.50 | --- |
| | Grade HX50 | N06050 | --- | 0.40-0.60 | 1.50 | 0.50-2.00 | 0.04 | 0.04 | 15-19 | 64-68 | 0.50 | --- |
| EN 10295:2002 | G-NiCr15 | --- | 2.4815 | 0.35-0.65 | 2.00 | 1.00-2.50 | 0.040 | 0.030 | 12.00-18.00 | 58.00-66.00 | 1.00 | --- |
| ISO 11973:1999 | Grade GX50NiCr65-15 | --- | --- | 0.35-0.65 | 1.30 | 2.00 | 0.040 | 0.030 | 13.0-19.0 | 64.00-69.00 | --- | --- |
| EN 10295:2002 | G-CoCr28 | --- | 2.4778 | 0.05-0.25 | 1.50 | 0.50-1.50 | 0.040 | 0.030 | 27.00-30.00 | 4.00 | 0.50 | Co 48.0-52.0; Nb 0.50 |
| ISO 11973:1999 | Grade GX30CoCr50-28 | --- | --- | 0.50 | 1.00 | 1.00 | 0.040 | 0.030 | 25.0-30.0 | 1.00 | 0.50 | Co 48.00-52.00; Fe 20.0 |
| EN 10295:2002 | G-NiCr28W | --- | 2.4879 | 0.35-0.55 | 1.50 | 1.00-2.00 | 0.040 | 0.030 | 27.00-30.00 | 47.00-50.00 | 0.50 | W 4.00-6.00 |
| ISO 11973:1999 | Grade GX45NiCrWSi48-28-5 | --- | --- | 0.35-0.55 | 1.50 | 1.00-2.50 | 0.040 | 0.030 | 27.0-30.0 | 47.00-50.00 | --- | W 4.00-6.00 |
| EN 10295:2002 | GX50NiCrCo20-20-20 | --- | 1.4874 | 0.35-0.65 | 2.00 | 1.00 | 0.040 | 0.030 | 19.00-22.00 | 18.00-22.00 | 2.50-3.00 | W 2.00-3.00; Co 18,50-22.00; Nb 0.75-1.25 |
| ISO 11973:1999 | Grade GX40NiCrCo20-20-20 | --- | --- | 0.35-0.60 | 2.00 | 1.0 | 0.040 | 0.030 | 19.0-22.0 | 18.00-22.00 | 2.50-3.00 | W 2.00-3.00; Co 18.00-22.00 |

**7.5 Cast Heat Resistant Steels**

**7.5B Mechanical Properties of Cast Heat Resistant Steels**

| Specification | Designation | UNS No. | Steel No. | Section Thickness, mm | Yield Strength, min. MPa | Yield Strength, min. ksi | Tensile Strength, min. MPa | Tensile Strength, min. ksi | Elongation % min. | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|
| EN 10295:2002 | GX40CrSi13 | --- | 1.4729 | --- | --- | --- | --- | --- | --- | A | 300 max HB |
| ISO 11973:1999 | Grade GX40CrSi13 | --- | --- | --- | --- | --- | --- | --- | --- | A | 300 max HB |
| JIS G 5122:2003 | Class SCH 3 | --- | --- | --- | --- | --- | 490 | --- | --- | A | --- |
| | Class SCH 1 | --- | --- | --- | --- | --- | 490 | --- | --- | A | --- |
| EN 10295:2002 | GX40CrSi17 | --- | 1.4740 | --- | --- | --- | --- | --- | --- | A | 300 max HB |
| ISO 11973:1999 | Grade GX40CrSi17 | --- | --- | --- | --- | --- | --- | --- | --- | A | 300 max HB |
| EN 10295:2002 | GX40CrSi24 | --- | 1.4745 | --- | --- | --- | --- | --- | --- | --- | --- |
| ISO 11973:1999 | Grade GX40CrSi24 | --- | --- | --- | --- | --- | --- | --- | --- | A | 300 max HB |
| EN 10295:2002 | GX40CrSi28 | --- | 1.4776 | --- | --- | --- | --- | --- | --- | --- | --- |
| ISO 11973:1999 | Grade GX40CrSi28 | --- | --- | --- | --- | --- | --- | --- | --- | A | 320 max HB |
| EN 10295:2002 | GX130CrSi29 | --- | 1.4777 | --- | --- | --- | --- | --- | --- | --- | --- |
| ISO 11973:1999 | Grade GX130CrSi29 | --- | --- | --- | --- | --- | --- | --- | --- | A | 400 max HB |
| ASTM A297/A297M-14* | Grade HC | J92605 | --- | --- | --- | --- | 380 | 55 | --- | AC or BA | --- |
| ASTM A608/A608M-14* | Grade HC30 | J92613 | --- | --- | --- | --- | 11 | 1.6 | 40 | --- | --- |
| | | | | --- | --- | --- | 20.4 | 2.96 | 50 | --- | --- |
| | | | | --- | --- | --- | 36 | 5.3 | 40 | --- | --- |
| JIS G 5122:2003 | Class SCH 2 | --- | --- | --- | --- | --- | 340 | --- | --- | A | --- |
| ASTM A297/A297M-14* | Grade HD | J93005 | --- | --- | 240 | 35 | 515 | 75 | 8 | AC or BA | --- |
| ASTM A608/A608M-14* | Grade HD50 | J93015 | --- | --- | --- | --- | 6.2 | 0.91 | --- | --- | --- |
| | | | | --- | --- | --- | 17.8 | 2.58 | --- | --- | --- |
| | | | | --- | --- | --- | 51.4 | 7.45 | --- | --- | --- |
| EN 10295:2002 | GX40CrNiSi27-4 | --- | 1.4823 | --- | 250 | --- | 550 | --- | 3 | --- | --- |
| ISO 11973:1999 | Grade GX40CrNiSi27-4 | --- | --- | --- | 250 | --- | 400 | --- | 3 | --- | 400 max HB |
| JIS G 5122:2003 | Class SCH 11 | --- | --- | --- | --- | --- | 590 | --- | --- | AC or BA | --- |
| ASTM A297/A297M-14* | Grade HE | J93403 | --- | --- | 275 | 40 | 585 | 85 | 9 | AC or BA | --- |
| JIS G 5122:2003 | Class SCH 17 | --- | --- | --- | 275 | --- | 540 | --- | 5 | AC or BA | --- |
| ASTM A297/A297M-14* | Grade HF | J92603 | --- | --- | 240 | 35 | 485 | 70 | 25 | AC or BA | --- |
| ASTM A608/A608M-14* | Grade HF30 | J92803 | --- | --- | --- | --- | 100 | 14.5 | 9.0 | --- | --- |
| | | | | --- | --- | --- | 180 | 26 | 7.0 | --- | --- |
| EN 10295:2002 | GX25CrNiSi18-9 | --- | 1.4825 | --- | 230 | --- | 450 | --- | 15 | --- | --- |
| | GX40CrNiSi22-10 | --- | 1.4826 | --- | 230 | --- | 450 | --- | 8 | --- | --- |
| ISO 11973:1999 | Grade GX25CrNiSi18-9 | --- | --- | --- | 230 | --- | 450 | --- | 15 | --- | --- |
| | Grade GX40CrNiSi22-10 | --- | --- | --- | 230 | --- | 450 | --- | 8 | --- | --- |
| JIS G 5122:2003 | Class SCH 12 | --- | --- | --- | 235 | --- | 490 | --- | 23 | AC or BA | --- |
| EN 10295:2002 | GX25CrNiSi20-14 | --- | 1.4832 | --- | 230 | --- | 450 | --- | 10 | --- | --- |
| ISO 11973:1999 | Grade GX25 CrNiSi 20-14 | --- | --- | --- | 230 | --- | 450 | --- | 10 | --- | --- |

*: See "List of Standards" at the beginning of the chapter.

**7.5 Cast Heat Resistant Steels**

**7.5B Mechanical Properties of Cast Heat Resistant Steels (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness, mm | Yield Strength, min. MPa | Yield Strength, min. ksi | Tensile Strength, min. MPa | Tensile Strength, min. ksi | Elongation % min. | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ASTM A297/A297M-14* | Grade HH | J93503 | --- | --- | 240 | 35 | 515 | 75 | 10 | AC or BA | --- |
| ASTM A447/A447M-11 | Type I | J93303 | --- | --- | --- | --- | 550 | 80 | 9 | --- | --- |
| | Type II | J93303 | --- | --- | --- | --- | 550 | 80 | 4 | --- | --- |
| ASTM A608/A608M-14* | Grade HH30 | J93513 | --- | --- | --- | --- | 24.2 | 3.51 | 16.0 | --- | --- |
| | | | | --- | --- | --- | 52.7 | 7.65 | 12.0 | --- | --- |
| | Grade HH33 | J93633 | --- | --- | --- | --- | 28 | 4 | 20.0 | --- | --- |
| | | | | --- | --- | --- | 56 | 8.2 | 12.0 | --- | --- |
| | | | | --- | --- | --- | 138 | 20 | 8.0 | --- | --- |
| EN 10295:2002 | GX40CrNiSi25-12 | --- | 1.4837 | --- | 220 | --- | 450 | --- | 6 | --- | --- |
| ISO 11973:1999 | Grade GX40CrNiSi25-12 | --- | --- | --- | 220 | --- | 450 | --- | 6 | --- | --- |
| JIS G 5122:2003 | Class SCH 13 | --- | --- | --- | 235 | --- | 490 | --- | 8 | AC or BA | --- |
| | Class SCH 13A | --- | --- | --- | 235 | --- | 490 | --- | 8 | AC or BA | --- |
| ASTM A297/A297M-14* | Grade HI | J94003 | --- | --- | 240 | 35 | 485 | 70 | 10 | AC or BA | --- |
| ASTM A608/A608M-14* | Grade HI35 | J94013 | --- | --- | --- | --- | 56 | 8.2 | 12.0 | --- | --- |
| | | | | --- | --- | --- | 138 | 20 | 8.0 | --- | --- |
| JIS G 5122:2003 | Class SCH 18 | --- | --- | --- | 235 | --- | 490 | --- | 8 | AC or BA | --- |
| ASME SA-351/SA-351M | Grade HK30 | J94203 | --- | --- | 240 | 35 | 450 | 65 | 10.0 | AC | --- |
| ASTM A297/A297M-14* | Grade HK | J94224 | --- | --- | 240 | 35 | 450 | 65 | 10 | AC or BA | --- |
| ASTM A351/A351M-14 | Grade HK30 | J94203 | --- | --- | 240 | 35 | 450 | 65 | 10.0 | AC | --- |
| ASTM A608/A608M-14* | Grade HK30 | J94203 | --- | --- | --- | --- | 25 | 3.6 | 24.0 | --- | --- |
| | | | | --- | --- | --- | 52 | 7.5 | 18.0 | --- | --- |
| | | | | --- | --- | --- | 97 | 14 | 9.0 | --- | --- |
| | | | | --- | --- | --- | 180 | 26 | --- | --- | --- |
| JIS G 5122:2003 | Class SCH 21 | --- | --- | --- | 235 | --- | 440 | --- | 8 | AC or BA | --- |
| ASME SA-351/SA-351M | Grade HK40 | J94204 | --- | --- | 240 | 35 | 425 | 62 | 10.0 | AC | --- |
| ASTM A351/A351M-14 | Grade HK40 | J94204 | --- | --- | 240 | 35 | 425 | 62 | 10.0 | AC | --- |
| ASTM A608/A608M-14* | Grade HK40 | J94204 | --- | --- | --- | --- | 29 | 4.2 | 22.0 | --- | --- |
| | | | | --- | --- | --- | 61 | 8.8 | 15.0 | --- | --- |
| | | | | --- | --- | --- | 114 | 16.5 | 6.0 | --- | --- |
| | | | | --- | --- | --- | 200 | 29 | 7.0 | --- | --- |
| EN 10295:2002 | GX40CrNiSi25-20 | --- | 1.4848 | --- | 220 | --- | 450 | --- | 8 | --- | --- |
| ISO 11973:1999 | Grade GX40CrNiSi25-20 | --- | --- | --- | 220 | --- | 450 | --- | 6 | --- | --- |
| JIS G 5122:2003 | Class SCH 22 | --- | --- | --- | 235 | --- | 440 | --- | 8 | AC or BA | --- |
| ASTM A297/A297M-14* | Grade HL | N08604 | --- | --- | 240 | 35 | 450 | 65 | 10 | AC or BA | --- |
| JIS G 5122:2003 | Class SCH 23 | --- | --- | --- | 245 | --- | 450 | --- | 8 | AC or BA | --- |

*: See "List of Standards" at the beginning of the chapter.

**7.5 Cast Heat Resistant Steels**

**7.5B Mechanical Properties of Cast Heat Resistant Steels (Continued)**

| Specification | Designation | UNS No. | Steel No. | Section Thickness, mm | Yield Strength, min. MPa | Yield Strength, min. ksi | Tensile Strength, min. MPa | Tensile Strength, min. ksi | Elongation % min. | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ASTM A297/A297M-14* | Grade HN | J94213 | --- | --- | --- | --- | 435 | 63 | 8 | AC or BA | --- |
| EN 10295:2002 | GX35NiCrSi25-21 | --- | 1.4805 | --- | 220 | --- | 430 | --- | 8 | --- | --- |
| JIS G 5122:2003 | Class SCH 19 | --- | --- | --- | --- | --- | 390 | --- | 5 | AC or BA | --- |
| EN 10295:2002 | GX40CrNiSiNb24-24 | --- | 1.4855 | --- | 220 | --- | 450 | --- | 4 | --- | --- |
| ISO 11973:1999 | Grade GX40CrNiSiNb24-24 | --- | --- | --- | 220 | --- | 400 | --- | 4 | --- | --- |
| ASTM A297/A297M-14* | Grade HP | N08705 | --- | --- | 235 | 34 | 430 | 62.5 | 4.5 | AC or BA | --- |
| EN 10295:2002 | GX40NiCrSiNb35-26 | --- | 1.4852 | --- | 220 | --- | 440 | --- | 4 | --- | --- |
| | GX40NiCrSi35-26 | --- | 1.4857 | --- | 220 | --- | 440 | --- | 6 | --- | --- |
| ISO 11973:1999 | Grade GX40NiCrSi35-26 | --- | --- | --- | 220 | --- | 440 | --- | 6 | --- | --- |
| | Grade GX40NiCrSiNb35-26 | --- | --- | --- | 220 | --- | 440 | --- | 4 | --- | --- |
| JIS G 5122:2003 | Class SCH 24 | --- | --- | --- | 235 | --- | 440 | --- | 5 | AC or BA | --- |
| ASTM A297/A297M-14* | Grade HT | N08605 | --- | --- | --- | --- | 450 | 65 | 4 | AC or BA | --- |
| EN 10295:2002 | GX40NiCrSi35-17 | --- | 1.4806 | --- | 220 | --- | 420 | --- | 6 | --- | --- |
| ISO 11973:1999 | Grade GX40NiCrSi35-17 | --- | --- | --- | 220 | --- | 420 | --- | 6 | --- | --- |
| JIS G 5122:2003 | Class SCH 15 | --- | --- | --- | --- | --- | 440 | --- | 4 | AC or BA | --- |
| ASME SA-351/SA-351M | Grade HT30 | N08030 | --- | --- | 195 | 28 | 450 | 65 | 15.0 | AC | --- |
| ASTM A351/A351M-14 | Grade HT30 | N08030 | --- | --- | 195 | 28 | 450 | 65 | 15.0 | AC | --- |
| JIS G 5122:2003 | Class SCH 16 | --- | --- | --- | 195 | --- | 440 | --- | 13 | AC or BA | --- |
| ASTM A297/A297M-14* | Grade HU | N08004 | --- | --- | --- | --- | 450 | 65 | 4 | AC or BA | --- |
| EN 10295:2002 | GX40NiCrSiNb35-18 | --- | 1.4807 | --- | 220 | --- | 420 | --- | 4 | --- | --- |
| | GX40NiCrSiNb38-19 | --- | 1.4849 | --- | 220 | --- | 420 | --- | 4 | --- | --- |
| | GX40NiCrSi38-19 | --- | 1.4865 | --- | 220 | --- | 420 | --- | 6 | --- | --- |
| ISO 11973:1999 | Grade GX40NiCrSi38-19 | --- | --- | --- | 220 | --- | 420 | --- | 6 | --- | --- |
| | Grade GX40NiCrSiNb38-19 | --- | --- | --- | 220 | --- | 420 | --- | 4 | --- | --- |
| JIS G 5122:2003 | Class SCH 20 | --- | --- | --- | --- | --- | 390 | --- | 4 | AC or BA | --- |
| EN 10295:2002 | G-NiCr50Nb | --- | 2.4680 | --- | 230 | --- | 540 | --- | 8 | --- | --- |
| ISO 11973:1999 | Grade GX10NiCrNb50-50 | --- | --- | --- | 230 | --- | 540 | --- | 8 | --- | --- |
| ASTM A297/A297M-14* | Grade HW | N08001 | --- | --- | --- | --- | 415 | 60 | --- | AC or BA | --- |
| | Grade HX | N06006 | --- | --- | --- | --- | 415 | 60 | --- | AC or BA | --- |
| EN 10295:2002 | G-NiCr15 | --- | 2.4815 | --- | 200 | --- | 400 | --- | 3 | --- | --- |
| ISO 11973:1999 | Grade GX50NiCr65-15 | --- | --- | --- | 200 | --- | 400 | --- | 3 | --- | --- |
| EN 10295:2002 | G-CoCr28 | --- | 2.4778 | --- | 235 | --- | 490 | --- | 6 | --- | --- |
| ISO 11973:1999 | Grade GX30CoCr50-28 | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| EN 10295:2002 | G-NiCr28W | --- | 2.4879 | --- | 240 | --- | 440 | --- | 3 | --- | --- |
| ISO 11973:1999 | Grade GX45NiCrWSi48-28-5 | --- | --- | --- | 220 | --- | 400 | --- | 3 | --- | --- |
| EN 10295:2002 | GX50NiCrCo20-20-20 | --- | 1.4874 | --- | 320 | --- | 420 | --- | 6 | --- | --- |
| ISO 11973:1999 | Grade GX40NiCrCo20-20-20 | --- | --- | --- | 320 | --- | 400 | --- | 6 | --- | --- |

*: See "List of Standards" at the beginning of the chapter.

# Chapter 8

# *WROUGHT STAINLESS STEELS*

## Plate, Sheet, Strip

### ASME Standards

| | |
|---|---|
| ASME SA-240/SA-240M | Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications |
| ASME SA-666 | Annealed or Cold-Worked Austenitic Stainless Steel, Sheet, Strip, Plate, and Flat Bar |
| ASME SA-693 | Precipitation-Hardening Stainless and Heat-Resisting Steel Plate, Sheet, and Strip |

### ASTM Standards

| | |
|---|---|
| ASTM A240/A240M-15a | Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications |
| ASTM A666-15 | Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar |
| ASTM A693–13 | Precipitation-Hardening Stainless and Heat-Resisting Steel Plate, Sheet, and Strip |
| ASTM B688-96 (2014) | Chromium-Nickel-Molybdenum-Iron (UNS N08366 and UNS N08367) Plate, Sheet, and Strip |

### DIN Standard

| | |
|---|---|
| DIN 5512-3:2004 | Materials for rail vehicles – Steels – Part 3: Stainless steel flat products; Selected standard |

### EN Standards

| | |
|---|---|
| EN 10028-7:2007 | Flat products made of steels for pressure purposes – Part 7: Stainless steels |
| EN 10088-2:2014 | Stainless steels – Part 2: Technical delivery conditions for sheet/plate and strip of corrosion resisting steels for general purposes |
| EN 10095:1999 | Heat resisting steels and nickel alloys |
| EN 10151:2002 | Stainless steel strip for springs – Technical delivery conditions |
| EN 10302:2008 | Creep resisting steels, nickel and cobalt alloys |

### GB Standards

| | |
|---|---|
| GB 3280-92 | Cold Rolled Stainless Steel Sheets and Plates |
| GB 4237-92 | Hot Rolled Stainless Steel Sheets and Plates |
| GB 4238-92 | Heat-Resisting Steel Sheets and Plates |
| GB 4239-91 | Cold Rolled Stainless Steel and Heat Resisting Steel Strips |

### ISO Standards

| | |
|---|---|
| ISO 4955:2005 | Heat-Resistant Steels |
| ISO 9328-7:2004 | Steel Flat Products for Pressure Purposes – Technical Delivery Conditions – Part 7: Stainless Steels |
| ISO 16143-1:2004 | Stainless Steels for General Purposes – Part 1: Flat Products |

### JIS Standards

| | |
|---|---|
| JIS G 4304:2012 | Hot-rolled stainless steel plate, sheet and strip |
| JIS G 4305:2012 | Cold-rolled stainless steel plate, sheet and strip |
| JIS G 4312:2011 | Heat-resisting steel plate, sheet and strip |

### SAE Standard

| | |
|---|---|
| SAE J405 JUN98 | Chemical Compositions of SAE Wrought Stainless Steels |

## Bars

### ASME Standards

| | |
|---|---|
| ASME SA-276 | Stainless Steel Bars and Shapes |
| ASME SA-453/SA-453M | High-Temperature Bolting Materials with Expansion Coefficients Comparable to Austenitic Stainless Steels |
| ASME SA-479/SA-479M | Stainless Steel Bars and Shapes for Use in Boilers and Other Pressure Vessels |
| ASME SA-564/SA-564M | Hot-Rolled and Cold-Finished Age-Hardening Stainless Steel Bars and Shapes |

### ASTM Standards

| | |
|---|---|
| ASTM A276/A276M-15 | Stainless Steel Bars and Shapes |
| ASTM A314-13a | Stainless Steel Billets and Bars for Forging |
| ASTM A453/A453M-12 | High-Temperature Bolting, with Expansion Coefficients Comparable to Austenitic Stainless Steels |
| ASTM A479/A479M-14 | Stainless Steel Bars and Shapes for Use in Boilers and Other Pressure Vessels |
| ASTM A564/A564M-13 | Hot-Rolled and Cold-Finished Age-Hardening Stainless Steel Bars and Shapes |
| ASTM A565/A565M-10 | Martensitic Stainless Steel Bars for High-Temperature Service |
| ASTM A582/A582M-12e1 | Free-Machining Stainless Steel Bars |
| ASTM A955/A955M-15 | Deformed and Plain Stainless-Steel Bars for Concrete Reinforcement |
| ASTM A1028-03 (2015) | Stainless Steel Bars for Compressor and Turbine Airfoils |
| ASTM B691-02 (2013) | Iron-Nickel-Chromium-Molybdenum Alloys (UNS N08366 and UNS N08367) Rod, Bar, and Wire |

### EN Standards

| | |
|---|---|
| EN 10088-3:2014 | Stainless steels – Part 3: Technical delivery conditions for semi-finished products, bars, rods, wire, sections and bright products of corrosion resisting steels for general purposes |
| EN 10090:1998 | Valve steels and alloys for internal combustion engines |
| EN 10095:1999 | Heat resisting steels and nickel alloys |
| EN 10263-5:2001 | Steel rod, bars and wire for cold heading and cold extrusion – Part 5: Technical delivery conditions for stainless steels |
| EN 10269:2013 | Steels and nickel alloys for fasteners with specified elevated and/or low temperature properties |
| EN 10272:2007 | Stainless steel bars for pressure purposes |
| EN 10294-2:2012 | Hollow bars for machining – Technical delivery conditions – Part 2: Stainless steels with specified machinability properties |
| EN 10302:2008 | Creep resisting steels, nickel and cobalt alloys |

### GB Standards

| | |
|---|---|
| GB 1220-92 | Stainless Steel Bars |
| GB 1221-92 | Heat Resisting Steel Bars |
| GB 4226-84 | Cold Finished Stainless Steel Bars |

### ISO Standards

| | |
|---|---|
| ISO 683-15:1992 | Heat-Treatable Steels, Alloy Steels and Free-Cutting Steels – Part 15: Valve Steels for Internal Combustion Engines |
| ISO 4954:1993 | Steels for Cold Heading and Cold Extruding |
| ISO 4955:1994 | Heat-Resisting Steels and Alloys |
| ISO 16143-2:2004 | Stainless Steels for General Purposes – Part 2: Semi-Finished Products, Bars, Rods and Sections |

### JIS Standards

| | |
|---|---|
| JIS G 4303:2012 | Stainless steel bars |
| JIS G 4311:2011 | Heat-resisting steel bars and wire rods |
| JIS G 4318:1998 A1:2007 | Cold finished stainless steel bars |

## Heat Treatment Terms Applicable to this Chapter

| Standard | Heat Treatment Terms |
|---|---|
| ASME SA-240/SA-240M | See standard; SA: solution annealed; Q+SA: quenched in water and solution annealed |
| ASME SA-276 | A: annealed; HF: hot finished; CF: cold finished; CW: cold worked; H+T: hardened and tempered; H+CW+CF: strain hardened, lightly cold worked and cold finished |
| ASME SA-453/SA-453M | S+H: solution treated, then hardened |
| ASME SA-479/SA-479M | A: annealed; N+T: normalized and tempered; T: tempered; Q+T: quenched and tempered; H: strain-hardened |
| ASME SA-564/SA-564M | SA: solution annealed; PH: precipitation hardened |
| ASME SA-666 | A: annealed |
| ASME SA-693 | PH: precipitation hardened; ST: solution treated; CR: cold rolled; CR+PH: cold rolled and precipitation hardened |
| ASTM A240/A240M-15a | SA: solution annealed |
| ASTM A276/A276M-15 | A+HF: annealed and hot finished; A+CF: annealed and cold finished; H+T: hardened and tempered; HF: hot finished; CF: cold finished; CW+CF: cold worked and cold finished; H+CF: strain hardened and cold finished |
| ASTM A314-13a | --- |
| ASTM A453/A453M-12 | S+H: solution treated, then hardened |
| ASTM A479/A479M-14 | A: annealed; N+T: normalized and tempered; Q+T: liquid quenched and tempered; SA: solution annealed; H: strain hardened; T: tempered |
| ASTM A564/A564M-13 | SA: solution annealed; PH: precipitation hardened |
| ASTM A565/A565M-10 | A: annealed; HT: heat treated |
| ASTM A582/A582M-12e1 | A: annealed; T: intermediate temper; H: hard temper |
| ASTM A666-15 | A: annealed |
| ASTM A693-13 | PH: precipitation hardened; ST: solution treated; CR: cold rolled; CR+PH: cold rolled and precipitation hardened |
| ASTM A955/A955M-15 | A: annealed; HR: hot rolled; SH: strain hardened |
| ASTM A1028-03 (2015) | A+Q+G: austenitized, then quenched followed by being aged |
| ASTM B688-96 (2014) | --- |
| ASTM B691-02 (2013) | CFA: cold-finished-annealed; HFA: hot-finished-annealed |
| DIN 5512-3:2004 | HR: hot rolled; CR: cold rolled |
| EN 10028-7:2007 | A: annealed; SA: solution annealed; Q+T: quenched and tempered; |
| EN 10088-2:2014 | See standard; A: annealed; Q+T: quenched and tempered; SA: solution annealed; PH: precipitation hardened (with specified temperature) |
| EN 10088-3:2014 | A: annealed; A+PH: annealed and precipitation hardened; Q+T: quenched and tempered; SA: solution annealed; CW: cold work hardened; PH: precipitation hardened |
| EN 10090:1998 | Q: quenched; CTC: control cooled |
| EN 10095:1999 | A: annealed; SA: solution annealed |
| EN 10151:2002 | CW: cold worked |
| EN 10263-5:2001 | CD+A: cold drawn and soft annealed; A: soft annealed; CD+SA: cold drawn and solution annealed; SA: solution annealed |
| EN 10269:2013 | Q+T: quenched and tempered; A: soft annealed; CW: cold work hardened; SA: solution annealed |
| EN 10272:2007 | SA: solution annealed |
| EN 10294-2:2012 | SA: solution annealed |
| EN 10302:2008 | Q+T: quenched and tempered; SA: solution annealed; PH: precipitation hardened; A: annealed |
| GB 1220-92 | A: annealed; ST: solution treated; Q+T: quenched and tempered |
| GB 1221-92 | A: annealed; ST: solution treated; Q+T: quenched and tempered |
| GB 3280-92 | A: annealed; ST: solution treated; Q+T: quenched and tempered; WH: work hardened |
| GB 4226-84 | --- |
| GB 4237-92 | A: annealed; ST: solution treated |
| GB 4238-92 | See standard; A: annealed; ST: solution treated |
| GB 4239-91 | A: annealed; ST: solution treated; Q+T: quenched and tempered; WH: work hardened |

**Heat Treatment Terms Applicable to this Chapter (continued)**

| Standard | Heat Treatment Terms |
|---|---|
| ISO 683-15:1992 | CTC: controlled cooled; Q: quenched |
| ISO 4954:1993 | See standard; CW: cold worked; A: annealed; Q: quenched; CD: cold drawn |
| ISO 4955:2005 | A: annealed; SA: solution annealed |
| ISO 9328-7:2004 | A: annealed; Q+T: quenched and tempered; SA: solution annealed |
| ISO 16143-1:2004 | A: annealed; Q+T: quenched and tempered; SA: solution annealed; PH: precipitation-hardened |
| JIS G 4303:2012 | ST: solution treated; A: annealed; Q+T: quenched and tempered;<br>PH: precipitation hardened at specified temperature |
| JIS G 4304:2012 | ST: solution treated; A: annealed; Q+T: quenched and tempered;<br>PH: precipitation hardening treatment at specified temperature |
| JIS G 4305:2012 | ST: solution treated; A: annealed; Q+T: quenched and tempered T: temper rolled for hardening;<br>PH: precipitation hardening treatment at specified temperature |
| JIS G 4311:2011 | See standard; A: annealed; Q+T: quenched and tempered; ST: solution treated |
| JIS G 4312:2011 | See standard; A: annealed; ST: solution treated |
| JIS G 4318:1998 A1:2007 | --- |
| SAE J405 JUN98 | --- |

**8.1 Stainless Steels: Plates, Sheet and Strip**

**8.1.1A Chemical Composition of Martensitic Stainless Steels**

| Specification | Designation | UNS No | Steel No | Weight, %, max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASTM A240/A240M-15a | Type 403 | S40300 | --- | 0.15 | 1.00 | 0.50 | 0.040 | 0.030 | 11.5-13.0 | 0.60 | --- | --- |
| GB 3280-92 | Grade 1Cr12 | --- | --- | 0.15 | 1.00 | 0.50 | 0.035 | 0.030 | 11.50-13.00 | 0.60 | --- | --- |
| GB 4237-92 | Grade 1Cr12 | --- | --- | 0.15 | 1.00 | 0.50 | 0.035 | 0.030 | 11.50-13.00 | 0.60 | --- | --- |
| GB 4238-92 | Grade 1Cr12 | --- | --- | 0.15 | 1.00 | 0.50 | 0.035 | 0.030 | 11.50-13.00 | 0.60 | --- | Cu 0.30 |
| GB 4239-91 | Grade 1Cr12 | --- | --- | 0.15 | 1.00 | 0.50 | 0.035 | 0.030 | 11.50-13.00 | 0.60 | --- | --- |
| JIS G 4304:2012 | Symbol SUS403 | --- | --- | 0.15 | 1.00 | 0.50 | 0.040 | 0.030 | 11.50-13.00 | 0.60 | --- | --- |
| JIS G 4305:2012 | Symbol SUS403 | --- | --- | 0.15 | 1.00 | 0.50 | 0.040 | 0.030 | 11.50-13.00 | 0.60 | --- | --- |
| EN 10088-2:2014 | X12Cr13 | --- | 1.4006 | 0.08-0.15 | 1.50 | 1.00 | 0.040 | 0.015 | 11.5-13.5 | 0.75 | --- | --- |
| GB 3280-92 | Grade 1Cr13 | --- | --- | 0.15 | 1.00 | 1.00 | 0.035 | 0.030 | 11.50-13.50 | 0.60 | --- | --- |
| GB 4237-92 | Grade 1Cr13 | --- | --- | 0.15 | 1.00 | 1.00 | 0.035 | 0.030 | 11.50-13.50 | 0.60 | --- | --- |
| GB 4238-92 | Grade 1Cr13 | --- | --- | 0.15 | 1.00 | 1.00 | 0.035 | 0.030 | 11.50-13.50 | 0.60 | --- | Cu 0.30 |
| GB 4239-91 | Grade 1Cr13 | --- | --- | 0.15 | 1.00 | 1.00 | 0.035 | 0.030 | 11.50-13.50 | 0.60 | --- | --- |
| ISO 16143-1:2004 | X12Cr13 | --- | --- | 0.08-0.15 | 1.50 | 1.00 | 0.040 | 0.030 | 11.5-13.5 | 0.75 | --- | --- |
| JIS G 4304:2012 | Symbol SUS410 | --- | --- | 0.15 | 1.00 | 1.00 | 0.040 | 0.030 | 11.50-13.50 | 0.60 | --- | --- |
| JIS G 4305:2012 | Symbol SUS410 | --- | --- | 0.15 | 1.00 | 1.00 | 0.040 | 0.030 | 11.50-13.50 | 0.60 | --- | --- |
| SAE J405 JUN98 | Type 410 | S41000 | --- | 0.15 | 1.00 | 1.00 | 0.040 | 0.030 | 11.50-13.50 | 0.75 | --- | --- |
| GB 3280-92 | Grade 00Cr12 | --- | --- | 0.030 | 1.00 | 1.00 | 0.035 | 0.030 | 11.00-13.50 | 0.60 | --- | --- |
| GB 4237-92 | Grade 00Cr12 | --- | --- | 0.030 | 1.00 | 0.75 | 0.035 | 0.030 | 11.00-13.50 | 0.60 | --- | --- |
| GB 4238-92 | Grade 00Cr12 | --- | --- | 0.03 | 1.00 | 1.00 | 0.035 | 0.030 | 11.00-13.00 | 0.60 | --- | --- |
| GB 4239-91 | Grade 00Cr12 | --- | --- | 0.030 | 1.00 | 1.00 | 0.035 | 0.030 | 11.00-13.50 | 0.60 | --- | --- |
| JIS G 4304:2012 | Symbol SUS410L | --- | --- | 0.030 | 1.00 | 1.00 | 0.040 | 0.030 | 11.00-13.50 | 0.60 | --- | --- |
| JIS G 4305:2012 | Symbol SUS410L | --- | --- | 0.030 | 1.00 | 1.00 | 0.040 | 0.030 | 11.00-13.50 | 0.60 | --- | --- |
| ASME SA-240/SA-240M | Type 410S | S41008 | --- | 0.08 | 1.00 | 1.00 | 0.040 | 0.030 | 11.5-13.5 | 0.60 | --- | --- |
| ASTM A240/A240M-15a | Type 410S | S41008 | --- | 0.08 | 1.00 | 1.00 | 0.040 | 0.030 | 11.5-13.5 | 0.60 | --- | --- |
| EN 10088-2:2014 | X6Cr13 | --- | 1.4000 | 0.08 | 1.00 | 1.00 | 0.040 | 0.015 | 12.0-14.0 | --- | --- | --- |
| GB 3280-92 | Grade 0Cr13 | --- | --- | 0.08 | 1.00 | 1.00 | 0.035 | 0.030 | 11.50-13.50 | 0.60 | --- | --- |
| GB 4237-92 | Grade 0Cr13 | --- | --- | 0.08 | 1.00 | 1.00 | 0.035 | 0.030 | 11.50-13.50 | 0.60 | --- | --- |
| GB 4239-91 | Grade 0Cr13 | --- | --- | 0.08 | 1.00 | 1.00 | 0.035 | 0.030 | 11.50-13.50 | 0.60 | --- | --- |
| JIS G 4304:2012 | Symbol SUS410S | --- | --- | 0.08 | 1.00 | 1.00 | 0.040 | 0.030 | 11.50-13.50 | 0.60 | --- | --- |
| JIS G 4305:2012 | Symbol SUS410S | --- | --- | 0.08 | 1.00 | 1.00 | 0.040 | 0.030 | 11.50-13.50 | 0.60 | --- | --- |
| SAE J405 JUN98 | Type 410S | S41008 | --- | 0.08 | 1.00 | 1.00 | 0.040 | 0.030 | 11.50-13.50 | 0.60 | --- | --- |
| ISO 4955:2005 | X6Cr13 | --- | --- | 0.08 | 1.00 | 1.00 | 0.040 | 0.030 | 12.0-14.0 | 1.00 | --- | --- |

**8.1 Stainless Steels: Plates, Sheet and Strip**

**8.1.1A Chemical Composition of Martensitic Stainless Steels (Continued)**

| Specification | Designation | UNS No | Steel No | Weight, %, max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASTM A240/A240M-15a | Type 420 | S42000 | --- | 0.15 min. | 1.00 | 1.00 | 0.040 | 0.030 | 12.0-14.0 | 0.75 | 0.50 | --- |
| EN 10088-2:2014 | X20Cr13 | --- | 1.4021 | 0.16-0.25 | 1.50 | 1.00 | 0.040 | 0.015 | 12.0-14.0 | --- | --- | --- |
| GB 3280-92 | Grade 2Cr13 | --- | --- | 0.16-0.25 | 1.00 | 1.00 | 0.035 | 0.030 | 12.00-14.00 | 0.60 | --- | --- |
| GB 4237-92 | Grade 2Cr13 | --- | --- | 0.16-0.25 | 1.00 | 1.00 | 0.035 | 0.030 | 12.00-14.00 | 0.60 | --- | --- |
| GB 4239-91 | Grade 2Cr13 | --- | --- | 0.16-0.25 | 1.00 | 1.00 | 0.035 | 0.030 | 12.00-14.00 | 0.60 | --- | --- |
| ISO 16143-1:2004 | X20Cr13 | --- | --- | 0.16-0.25 | 1.50 | 1.00 | 0.040 | 0.030 | 12.0-14.0 | --- | --- | --- |
| JIS G 4304:2012 | Symbol SUS420J1 | --- | --- | 0.16-0.25 | 1.00 | 1.00 | 0.040 | 0.030 | 12.00-14.00 | 0.60 | --- | --- |
| JIS G 4305:2012 | Symbol SUS420J1 | --- | --- | 0.16-0.25 | 1.00 | 1.00 | 0.040 | 0.030 | 12.00-14.00 | 0.60 | --- | --- |
| EN 10088-2:2014 | X30Cr13 | --- | 1.4028 | 0.26-0.35 | 1.50 | 1.00 | 0.040 | 0.015 | 12.0-14.0 | --- | --- | --- |
| GB 3280-92 | Grade 3Cr13 | --- | --- | 0.26-0.35 | 1.00 | 1.00 | 0.035 | 0.030 | 12.00-14.00 | 0.60 | --- | --- |
| GB 4237-92 | Grade 3Cr13 | --- | --- | 0.26-0.35 | 1.00 | 1.00 | 0.035 | 0.030 | 12.00-14.00 | 0.60 | --- | --- |
| GB 4239-91 | Grade 3Cr13 | --- | --- | 0.26-0.40 | 1.00 | 1.00 | 0.035 | 0.030 | 12.00-14.00 | 0.60 | --- | --- |
| ISO 16143-1:2004 | X30Cr13 | --- | --- | 0.26-0.35 | 1.50 | 1.00 | 0.040 | 0.030 | 12.0-14.0 | --- | --- | --- |
| JIS G 4304:2012 | Symbol SUS420J2 | --- | --- | 0.26-0.40 | 1.00 | 1.00 | 0.040 | 0.030 | 12.00-14.00 | 0.60 | --- | --- |
| JIS G 4305:2012 | Symbol SUS420J2 | --- | --- | 0.26-0.40 | 1.00 | 1.00 | 0.040 | 0.030 | 12.00-14.00 | 0.60 | --- | --- |
| ASME SA-240/SA-240M | --- | S41500 | --- | 0.05 | 0.50-1.00 | 0.60 | 0.030 | 0.030 | 11.5-14.0 | 3.5-5.5 | 0.50-1.00 | --- |
| ASTM A240/A240M-15a | --- | S41500 | --- | 0.05 | 0.50-1.00 | 0.60 | 0.030 | 0.030 | 11.5-14.0 | 3.5-5.5 | 0.50-1.00 | --- |
| EN 10028-7:2007 | X3CrNiMo13-4 | --- | 1.4313 | 0.05 | 1.50 | 0.70 | 0.040 | 0.015 | 12.0-14.0 | 3.5-4.5 | 0.30-0.70 | N 0.020 min. |
| ISO 9328-7:2004 | Grade X3CrNiMo13-4 | --- | --- | 0.05 | 0.50-1.00 | 0.70 | 0.040 | 0.015 | 12.0-14.0 | 3.5-4.5 | 0.30-1.00 | --- |
| SAE J405 JUN98 | --- | S41500 | --- | 0.05 | 0.5-1.0 | 0.60 | 0.030 | 0.030 | 11.5-14.0 | 3.5-5.5 | 0.5-1.0 | --- |
| EN 10088-2:2014 | X39Cr13 | --- | 1.4031 | 0.36-0.42 | 1.00 | 1.00 | 0.040 | 0.015 | 12.5-14.5 | --- | --- | --- |
| GB 3280-92 | Grade 4Cr13 | --- | --- | 0.36-0.45 | 0.80 | 0.80 | 0.035 | 0.030 | 12.00-14.00 | 0.60 | --- | --- |
| GB 4237-92 | Grade 4Cr13 | --- | --- | 0.36-0.45 | 0.80 | 0.80 | 0.035 | 0.030 | 12.00-14.00 | 0.60 | --- | --- |
| ISO 16143-1:2004 | X39Cr13 | --- | --- | 0.36-0.42 | 1.00 | 1.00 | 0.040 | 0.030 | 12.5-14.5 | --- | --- | --- |
| EN 10028-7:2007 | X4CrNiMo16-5-1 | --- | 1.4418 | 0.06 | 1.50 | 0.70 | 0.040 | 0.015 | 15.0-17.0 | 4.0-6.0 | 0.80-1.50 | N 0.020 min. |
| EN 10088-2:2014 | X4CrNiMo16-5-1 | --- | 1.4418 | 0.06 | 1.50 | 0.70 | 0.040 | 0.015 | 15.0-17.0 | 4.0-6.0 | 0.80-1.50 | N 0.020 min. |
| ISO 9328-7:2004 | Grade X4CrNiMo16-5-1 | --- | --- | 0.06 | 1.50 | 0.70 | 0.040 | 0.015 | 15.0-17.0 | 4.0-6.0 | 0.80-1.50 | N 0.020 min. |
| GB 3280-92 | Grade 7Cr17 | --- | --- | 0.60-0.75 | 1.00 | 1.00 | 0.035 | 0.030 | 16.00-18.00 | 0.60 | 0.75 | --- |
| GB 4237-92 | Grade 7Cr17 | --- | --- | 0.60-0.75 | 1.00 | 1.00 | 0.035 | 0.030 | 16.00-18.00 | 0.60 | 0.75 | --- |
| GB 4239-91 | Grade 7Cr17 | --- | --- | 0.60-0.75 | 1.00 | 1.00 | 0.035 | 0.030 | 16.00-18.00 | 0.60 | 0.75 | --- |
| JIS G 4304:2012 | Symbol SUS440A | --- | --- | 0.60-0.75 | 1.00 | 1.00 | 0.040 | 0.030 | 16.00-18.00 | 0.60 | 0.75 | --- |
| JIS G 4305:2012 | Symbol SUS440A | --- | --- | 0.60-0.75 | 1.00 | 1.00 | 0.040 | 0.030 | 16.00-18.00 | 0.60 | 0.75 | --- |

**8.1 Stainless Steels: Plate, Sheet and Strip**

**8.1.1B Mechanical Properties of Martensitic Stainless Steels**

| Specification | Designation | UNS No | Steel No | Section Thickness/Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation % min | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | | | |
| ASTM A240/A240M-15a | Type 403 | S40300 | --- | t ≤ 1.27 | t ≤ 0.050 | 205 | 30 | 485 | 70 | 20 | --- | 217 max. HBW; 96 max. HRBW |
| | | | | t > 1.27 | t > 0.050 | 205 | 30 | 485 | 70 | 25 | --- | 217 max. HBW; 96 max. HRBW |
| GB 3280-92 | Grade 1Cr12 | --- | --- | --- | --- | 205 | --- | 440 | --- | 20 | A | 200 max. HB; 93 max. HRB |
| GB 4237-92 | Grade 1Cr12 | --- | --- | --- | --- | 205 | --- | 440 | --- | 20 | A | 200 max. HB; 93 max. HRB |
| GB 4238-92 | Grade 1Cr12 | --- | --- | --- | --- | 205 | --- | 440 | --- | 20 | A | 200 max. HB; 93 max. HRB |
| GB 4239-91 | Grade 1Cr12 | --- | --- | --- | --- | 205 | --- | 440 | --- | 20 | A | 93 max. HRB |
| JIS G 4304:2012 | Symbol SUS403 | --- | --- | --- | --- | 205 | --- | 440 | --- | 20 | A | 201 max. HBW; 93 max. HRBW; 210 max. HV |
| JIS G 4305:2012 | Symbol SUS403 | --- | --- | --- | --- | 205 | --- | 440 | --- | 20 | A | 201 max. HBW; 93 max. HRBW; 210 max. HV |
| EN 10088-2:2014 | X12Cr13 | --- | 1.4006 | t ≤ 8 | --- | --- | --- | 600 max. | --- | 20 L, 20 T | A | 200 max. HBW; 90 max. HRB |
| | | | | t ≤ 13.5 | --- | --- | --- | 600 max. | --- | 20 L, 20 T | A | 200 max. HBW; 90 max. HRB |
| | | | | t ≤ 75 | --- | 450 | --- | 650-850 | --- | 12 L, 12 T | Q+T | BA J @ RT |
| | | | | t ≤ 75 | --- | 400 | --- | 550-750 | --- | 15 L, 15 T | Q+T | BA J @ RT |
| GB 3280-92 | Grade 1Cr13 | --- | --- | --- | --- | 205 | --- | 440 | --- | 20 | A | 183 max. HB; 88 max. HRB |
| GB 4237-92 | Grade 1Cr13 | --- | --- | --- | --- | 225 | --- | 440 | --- | 20 | A | 200 max. HB; 93 max. HRB |
| GB 4238-92 | Grade 1Cr13 | --- | --- | --- | --- | 205 | --- | 440 | --- | 20 | A | 200 max. HB; 93 max. HRB |
| GB 4239-91 | Grade 1Cr13 | --- | --- | --- | --- | 205 | --- | 440 | --- | 20 | A | 93 max. HRB |
| ISO 16143-1:2004 | X12Cr13 | --- | --- | t ≤ 8 | --- | --- | --- | 440-600 | --- | 20 | A | --- |
| | | | | t ≤ 13.5 | --- | --- | --- | 440-600 | --- | 20 | A | --- |
| | | | | t ≤ 75 | --- | 400 | --- | 550-750 | --- | 15 | Q+T | --- |
| | | | | t ≤ 75 | --- | 450 | --- | 650-850 | --- | 12 | Q+T | --- |
| JIS G 4304:2012 | Symbol SUS410 | --- | --- | --- | --- | 205 | --- | 440 | --- | 20 | A | 201 max. HBW; 93 max. HRBW; 210 max. HV |
| JIS G 4305:2012 | Symbol SUS410 | --- | --- | --- | --- | 205 | --- | 440 | --- | 20 | A | 201 max. HBW; 93 max. HRBW; 210 max. HV |

**8.1 Stainless Steels: Plate, Sheet and Strip**

**8.1.1B Mechanical Properties of Martensitic Stainless Steels (Continued)**

| Specification | Designation | UNS No | Steel No | Section Thickness/Diameter mm | Section Thickness/Diameter in. | Yield Strength, min. MPa | Yield Strength, min. ksi | Tensile Strength, min. MPa | Tensile Strength, min. ksi | Elongation % min | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GB 3280-92 | Grade 00Cr12 | --- | --- | --- | --- | 190 | --- | 365 | --- | 22 | A | 183 max. HB; 88 max. HRB |
| GB 4237-92 | Grade 00Cr12 | --- | --- | --- | --- | 196 | --- | 370 | --- | 22 | A | 183 max. HB; 88 max. HRB |
| GB 4238-92 | Grade 00Cr12 | --- | --- | --- | --- | 195 | --- | 365 | --- | 22 | A | 183 max. HB; 88 max. HRB |
| GB 4239-91 | Grade 00Cr12 | --- | --- | --- | --- | 195 | --- | 365 | --- | 22 | A | 88 max. HRB |
| JIS G 4304:2012 | Symbol SUS410L | --- | --- | --- | --- | 195 | --- | 360 | --- | 22 | A | 183 max. HBW; 88 max. HRBW; 200 max. HV |
| JIS G 4305:2012 | Symbol SUS410L | --- | --- | --- | --- | 195 | --- | 360 | --- | 22 | A | 183 max. HBW; 88 max. HRBW; 200 max. HV |
| ASME SA-240/SA-240M | Type 410S | S41008 | --- | t ≤ 1.27 | t ≤ 0.050 | 205 | 30 | 415 | 60 | 20 | see standard | 183 max. HB; 89 max. HRB |
| | | | | t > 1.27 | t > 0.050 | 205 | 30 | 415 | 60 | 22 | see standard | 183 max. HB; 89 max. HRB |
| ASTM A240/A240M-15a | Type 410S | S41008 | --- | t ≤ 1.27 | t ≤ 0.050 | 205 | 30 | 415 | 60 | 20 | --- | 183 max. HBW; 89 max. HRBW |
| | | | | t > 1.27 | t > 0.050 | 205 | 30 | 415 | 60 | 22 | --- | 183 max. HBW; 89 max. HRBW |
| EN 10088-2:2014 | X6Cr13 | --- | 1.4000 | t ≤ 8 | --- | 240 | --- | 400-600 | --- | 19 L, 19 T | A | --- |
| | | | | t ≤ 13.5 | --- | 220 | --- | 400-600 | --- | 19 L, 19 T | A | --- |
| | | | | t ≤ 25 | --- | 220 | --- | 400-600 | --- | 19 L, 19 T | A | --- |
| GB 3280-92 | Grade 0Cr13 | --- | --- | --- | --- | 205 | --- | 440 | --- | 20 | A | 200 max. HB; 93 max. HRB |
| GB 4237-92 | Grade 0Cr13 | --- | --- | --- | --- | 205 | --- | 410 | --- | 20 | A | 183 max. HB; 88 max. HRB |
| GB 4239-91 | Grade 0Cr13 | --- | --- | --- | --- | 205 | --- | 410 | --- | 20 | A | 88 max. HRB |
| JIS G 4304:2012 | Symbol SUS410S | --- | --- | --- | --- | 205 | --- | 410 | --- | 20 | A | 183 max. HBW; 88 max. HRBW; 200 max. HV |
| JIS G 4305:2012 | Symbol SUS410S | --- | --- | --- | --- | 205 | --- | 410 | --- | 20 | A | 183 max. HBW; 88 max. HRBW; 200 max. HV |
| ISO 4955:2005 | X6Cr13 | --- | --- | 0.5 ≤ t < 3 | --- | 230 | --- | 400-630 | --- | 18 L, 18 T | A | 197 max. HB |
| | | | | 3 ≤ t ≤ 12 | --- | 230 | --- | 400-630 | --- | 20 L, 18 T | A | 197 max. HB |
| | | | | 5 ≤ t ≤ 15 | --- | 230 | --- | 400-630 | --- | 20 | A | 197 max. HB |
| | | | | 5 ≤ t ≤ 25 | --- | 230 | --- | 400-630 | --- | 20 | A | 197 max. HB |
| | | | | 1.5 ≤ t ≤ 25 | --- | 230 | --- | 400-630 | --- | 20 | A | 197 max. HB |

**8.1 Stainless Steels: Plate, Sheet and Strip**

**8.1.1B Mechanical Properties of Martensitic Stainless Steels (Continued)**

| Specification | Designation | UNS No | Steel No | Section Thickness/Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation % min | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | | | |
| ASTM A240/A240M-15a | Type 420 | S42000 | --- | --- | --- | --- | --- | 690 max. | 100 max. | 15 | --- | 217 max. HBW; 96 max. HRBW |
| EN 10088-2:2014 | X20Cr13 | --- | 1.4021 | t ≤ 3 | --- | --- | --- | --- | --- | --- | Q+T | 44-50 HRC; 440-530 HV |
| | | | | t ≤ 8 | --- | --- | --- | 700 max. | --- | 15 L, 15 T | A | 225 max. HBW; 95 max. HRB |
| | | | | t ≤ 13.5 | --- | --- | --- | 700 max. | --- | 15 L, 15 T | A | 225 max. HBW; 95 max. HRB |
| | | | | t ≤ 75 | --- | 550 | --- | 750-950 | --- | 10 L, 10 T | Q+T | BA J @ RT |
| | | | | t ≤ 75 | --- | 450 | --- | 650-850 | --- | 12 L, 12 T | Q+T | BA J @ RT |
| GB 3280-92 | Grade 2Cr13 | --- | --- | --- | --- | 225 | --- | 520 | --- | 18 | A | 223 max. HB; 97 max. HRB |
| GB 4237-92 | Grade 2Cr13 | --- | --- | --- | --- | 225 | --- | 520 | --- | 18 | A | 223 max. HB; 97 max. HRB |
| GB 4239-91 | Grade 2Cr13 | --- | --- | --- | --- | 225 | --- | 520 | --- | 18 | A | 97 max. HRB |
| ISO 16143-1:2004 | X20Cr13 | --- | --- | t ≤ 3 | --- | --- | --- | --- | --- | --- | Q+T | --- |
| | | | | t ≤ 8 | --- | --- | --- | 520-700 | --- | 15 | A | --- |
| | | | | t ≤ 13.5 | --- | --- | --- | 520-700 | --- | 15 | A | --- |
| | | | | t ≤ 75 | --- | 450 | --- | 650-850 | --- | 12 | Q+T | --- |
| | | | | t ≤ 75 | --- | 550 | --- | 750-950 | --- | 10 | Q+T | --- |
| JIS G 4304:2012 | Symbol SUS420J1 | --- | --- | --- | --- | 225 | --- | 520 | --- | 18 | A | 223 max. HBW; 97 max. HRBW; 234 max. HV |
| JIS G 4305:2012 | Symbol SUS420J1 | --- | --- | --- | --- | 225 | --- | 520 | --- | 18 | A | 223 max. HBW; 97 max. HRBW; 234 max. HV |

**8.1 Stainless Steels: Plate, Sheet and Strip**

**8.1.1B Mechanical Properties of Martensitic Stainless Steels (Continued)**

| Specification | Designation | UNS No | Steel No | Section Thickness/Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation % min | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | | | |
| EN 10088-2:2014 | X30Cr13 | --- | 1.4028 | t ≤ 3 | --- | --- | --- | --- | --- | --- | Q+T | 45-51 HRC; 450-550 HV |
| | | | | t ≤ 8 | --- | --- | --- | 740 max. | --- | 15 L, 15 T | A | 235 max. HBW; 97 max. HRB |
| | | | | t ≤ 13.5 | --- | --- | --- | 740 max. | --- | 15 L, 15 T | A | 235 max. HBW; 97 max. HRB |
| | | | | t ≤ 75 | --- | 600 | --- | 800-1000 | --- | 10 L, 10 T | Q+T | --- |
| GB 3280-92 | Grade 3Cr13 | --- | --- | --- | --- | 225 | --- | 540 | --- | 18 | A | 235 max. HB; 99 max. HRB |
| | | | | --- | --- | --- | --- | --- | --- | --- | Q+T | --- |
| GB 4237-92 | Grade 3Cr13 | --- | --- | --- | --- | 225 | --- | 540 | --- | 18 | A | 235 max. HB; 99 max. HRB |
| GB 4239-91 | Grade 3Cr13 | --- | --- | --- | --- | 225 | --- | 540 | --- | 18 | A | 99 max. HRB |
| | | | | --- | --- | --- | --- | --- | --- | --- | Q+T | --- |
| ISO 16143-1:2004 | X30Cr13 | --- | --- | t ≤ 3 | --- | --- | --- | --- | --- | --- | Q+T | --- |
| | | | | t ≤ 8 | --- | --- | --- | 540-740 | --- | 15 | A | --- |
| | | | | t ≤ 13.5 | --- | --- | --- | 540-740 | --- | 15 | A | --- |
| | | | | t ≤ 75 | --- | 600 | --- | 800-1000 | --- | 10 | Q+T | --- |
| JIS G 4304:2012 | Symbol SUS420J2 | --- | --- | --- | --- | --- | --- | --- | --- | --- | Q+T | 40 min. HRC |
| | | | | --- | --- | 225 | --- | 540 | --- | 18 | A | 235 max. HBW; 99 max. HRBW; 247 max. HV |
| JIS G 4305:2012 | Symbol SUS420J2 | --- | --- | --- | --- | 225 | --- | 540 | --- | 18 | A | 235 max. HBW; 99 max. HRBW; 247 max. HV |
| | | | | --- | --- | --- | --- | --- | --- | --- | Q+T | 40 min. HRC |
| ASME SA-240/SA-240M | --- | S41500 | --- | --- | --- | 620 | 90 | 795 | 115 | 15 | see standard | 302 max. HB; 32 max. HRC |
| ASTM A240/A240M-15a | --- | S41500 | --- | --- | --- | 620 | 90 | 795 | 115 | 15 | --- | 302 max. HBW; 32 max. HRC |
| EN 10028-7:2007 | X3CrNiMo13-4 | --- | 1.4313 | t ≤ 75 | --- | 650 | --- | 780-980 | --- | 14 L, 14 T | Q+T | see standard for impact data |
| ISO 9328-7:2004 | Grade X3CrNiMo13-4 | --- | --- | t ≤ 75 | --- | 650 | --- | 780-980 | --- | 14 L, 14 T | Q+T | see standard for impact data |

**8.1 Stainless Steels: Plate, Sheet and Strip**

**8.1.1B Mechanical Properties of Martensitic Stainless Steels (Continued)**

| Specification | Designation | UNS No | Steel No | Section Thickness/Diameter mm | Section Thickness/Diameter in. | Yield Strength, min. MPa | Yield Strength, min. ksi | Tensile Strength, min. MPa | Tensile Strength, min. ksi | Elongation % min | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| EN 10088-2:2014 | X39Cr13 | --- | 1.4031 | t ≤ 3 | --- | --- | --- | --- | --- | --- | Q+T | 47-53 HRC; 480-580 HV |
| | | | | t ≤ 8 | --- | --- | --- | 760 max. | --- | 12 L, 12 T | A | 240 max. HBW; 98 max. HRB |
| | | | | t ≤ 13.5 | --- | --- | --- | 760 max. | --- | 12 L, 12 T | A | 240 max. HBW; 98 max. HRB |
| GB 3280-92 | Grade 4Cr13 | --- | --- | --- | --- | 225 | --- | 590 | --- | 15 | A | --- |
| | | | | --- | --- | --- | --- | --- | --- | --- | Q+T | --- |
| GB 4237-92 | Grade 4Cr13 | --- | --- | --- | --- | --- | --- | 590 | --- | 15 max. | A | --- |
| ISO 16143-1:2004 | X39Cr13 | --- | --- | t ≤ 3 | --- | --- | --- | --- | --- | --- | Q+T | --- |
| | | | | t ≤ 8 | --- | --- | --- | 760 max. | --- | 12 | A | --- |
| | | | | t ≤ 13.5 | --- | --- | --- | 760 max. | --- | 12 | A | --- |
| EN 10028-7:2007 | X4CrNiMo16-5-1 | --- | 1.4418 | t ≤ 75 | --- | 680 | --- | 840-980 | --- | 14 L, 14 T | Q+T | see standard for impact data |
| EN 10088-2:2014 | X4CrNiMo16-5-1 | --- | 1.4418 | t ≤ 75 | --- | 660 | --- | 840-1100 | --- | 14 L, 14 T | Q+T | 55 J @ RT |
| ISO 9328-7:2004 | Grade X4CrNiMo16-5-1 | --- | --- | t ≤ 75 | --- | 680 | --- | 840-980 | --- | 14 L, 14 T | Q+T | see standard for impact data |
| GB 3280-92 | Grade 7Cr17 | --- | --- | --- | --- | 245 | --- | 590 | --- | 15 | A | 255 max. HB |
| | | | | --- | --- | --- | --- | --- | --- | --- | Q+T | --- |
| GB 4237-92 | Grade 7Cr17 | --- | --- | --- | --- | 245 | --- | 590 | --- | 15 | A | 255 max. HB |
| GB 4239-91 | Grade 7Cr17 | --- | --- | --- | --- | 245 | --- | 590 | --- | 15 | A | --- |
| | | | | --- | --- | --- | --- | --- | --- | --- | Q+T | --- |
| JIS G 4304:2012 | Symbol SUS440A | --- | --- | --- | --- | --- | --- | --- | --- | --- | Q+T | 40 min. HRC |
| | | | | --- | --- | 245 | --- | 590 | --- | 15 | A | 255 max. HBW; 25 max. HRC; 269 max. HV |
| JIS G 4305:2012 | Symbol SUS440A | --- | --- | --- | --- | 245 | --- | 590 | --- | 15 | A | 255 max. HBW; 25 max. HRC; 269 max. HV |
| | | | | --- | --- | --- | --- | --- | --- | --- | Q+T | 40 min. HRC |

**8.1 Stainless Steels: Plates, Sheet and Strip**

**8.1.2A Chemical Composition of Ferritic Stainless Steels**

| Specification | Designation | UNS No | Steel No | Weight, %, max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASME SA-240/SA-240M | Type 405 | S40500 | --- | 0.08 | 1.00 | 1.00 | 0.040 | 0.030 | 11.5-14.5 | 0.60 | --- | Al 0.10-0.30 |
| ASTM A240/A240M-15a | Type 405 | S40500 | --- | 0.08 | 1.00 | 1.00 | 0.040 | 0.030 | 11.5-14.5 | 0.60 | --- | Al 0.10-0.30 |
| EN 10088-2:2014 | X6CrAl13 | --- | 1.4002 | 0.08 | 1.00 | 1.00 | 0.040 | 0.015 | 12.0-14.0 | --- | --- | Al 0.10-0.30 |
| GB 3280-92 | Grade 0Cr13Al | --- | --- | 0.08 | 1.00 | 1.00 | 0.035 | 0.030 | 11.50-14.50 | 0.60 | --- | Al 0.10-0.30 |
| GB 4237-92 | Grade 0Cr13Al | --- | --- | 0.08 | 1.00 | 1.00 | 0.035 | 0.030 | 11.50-14.50 | 0.60 | --- | Al 0.10-0.30 |
| GB 4238-92 | Grade 0Cr13Al | --- | --- | 0.08 | 1.00 | 1.00 | 0.035 | 0.030 | 11.50-14.50 | 0.60 | --- | Al 0.10-0.30 |
| GB 4239-91 | Grade 0Cr13Al | --- | --- | 0.08 | 1.00 | 1.00 | 0.035 | 0.030 | 11.50-14.50 | 0.60 | --- | Al 0.10-0.30 |
| JIS G 4304:2012 | Symbol SUS405 | --- | --- | 0.08 | 1.00 | 1.00 | 0.040 | 0.030 | 11.50-14.50 | 0.60 | --- | Al 0.10-0.30 |
| JIS G 4305:2012 | Symbol SUS405 | --- | --- | 0.08 | 1.00 | 1.00 | 0.040 | 0.030 | 11.50-14.50 | 0.60 | --- | Al 0.10-0.30 |
| SAE J405 JUN98 | Type 405 | S40500 | --- | 0.08 | 1.00 | 1.00 | 0.040 | 0.030 | 11.50-14.50 | 0.60 | --- | Al 0.10-0.30 |
| ASME SA-240/SA-240M | --- | S40977 | --- | 0.030 | 1.50 | 1.00 | 0.040 | 0.015 | 10.5-12.5 | 0.30-1.00 | --- | N 0.030 |
| | --- | S41050 | --- | 0.04 | 1.00 | 1.00 | 0.045 | 0.030 | 10.5-12.5 | 0.60-1.10 | --- | N 0.10 |
| ASTM A240/A240M-15a | --- | S40977 | --- | 0.030 | 1.50 | 1.00 | 0.040 | 0.015 | 10.5-12.5 | 0.30-1.00 | --- | N 0.030 |
| | --- | S41050 | --- | 0.04 | 1.00 | 1.00 | 0.045 | 0.030 | 10.5-12.5 | 0.60-1.10 | --- | N 0.10 |
| EN 10028-7:2007 | X2CrNi12 | --- | 1.4003 | 0.030 | 1.50 | 1.00 | 0.040 | 0.015 | 10.5-12.5 | 0.30-1.00 | --- | N 0.030 |
| EN 10088-2:2014 | X2CrNi12 | --- | 1.4003 | 0.030 | 1.50 | 1.00 | 0.040 | 0.015 | 10.5-12.5 | 0.30-1.00 | --- | N 0.030 |
| JIS G 4312:2011 | Symbol SUH409L | --- | --- | 0.030 | 1.00 | 1.00 | 0.040 | 0.030 | 10.50-11.75 | 0.60 | --- | Ti 6xC to 0.75 |
| ISO 16143-1:2004 | X2CrNi12 | --- | --- | 0.030 | 1.50 | 1.00 | 0.040 | 0.015 | 10.5-12.5 | 0.30-1.10 | --- | N 0.030 |
| ISO 9328-7:2004 | Grade X2CrNi12 | --- | --- | 0.030 | 1.50 | 1.00 | 0.040 | 0.015 | 10.5-12.5 | 0.30-1.10 | --- | N 0.030 |
| SAE J405 JUN98 | --- | S41050 | --- | 0.040 | 1.00 | 1.00 | 0.045 | 0.030 | 10.50-12.50 | 0.60-1.10 | --- | N 0.10 |
| ASME SA-240/SA-240M | --- | S40945 | --- | 0.030 | 1.00 | 1.00 | 0.040 | 0.030 | 10.5-11.7 | 0.50 | --- | Ti 0.05-0.20; Cb 0.18-0.40; N 0.030 |
| | | S40975 | --- | 0.030 | 1.00 | 1.00 | 0.040 | 0.030 | 10.5-11.7 | 0.50-1.00 | --- | N 0.030; Ti 6x(C+N) to 0.75 |
| ASTM A240/A240M-15a | --- | S40945 | --- | 0.030 | 1.00 | 1.00 | 0.040 | 0.030 | 10.5-11.7 | 0.50 | --- | Ti 0.05-0.20; Cb 0.18-0.40; N 0.030 |
| | | S40975 | --- | 0.030 | 1.00 | 1.00 | 0.040 | 0.030 | 10.5-11.7 | 0.50-1.00 | --- | N 0.030; Ti 6x(C+N) to 0.75 |
| EN 10088-2:2014 | X2CrTi12 | --- | 1.4512 | 0.030 | 1.00 | 1.00 | 0.040 | 0.015 | 10.5-12.5 | --- | --- | Ti 6x(C+N) to 0.65 |
| ISO 16143-1:2004 | X2CrTi12 | --- | --- | 0.030 | 1.00 | 1.00 | 0.040 | 0.030 | 10.5-12.5 | 0.50 | --- | Ti 6x(C+N) to 0.65 |
| ISO 4955:2005 | X2CrTi12 | --- | --- | 0.03 | 1.00 | 1.00 | 0.040 | 0.015 | 10.5-12.5 | --- | --- | Ti 6x(C+N) to 0.65 |
| SAE J405 JUN98 | --- | S40945 | --- | 0.030 | 1.00 | 1.00 | 0.040 | 0.030 | 10.50-11.75 | 0.50 | --- | Ti 0.05-0.20; Cb 0.18-0.40; N 0.030 |
| EN 10028-7:2007 | X6CrNiTi12 | --- | 1.4516 | 0.08 | 1.50 | 0.70 | 0.040 | 0.015 | 10.5-12.5 | 0.50-1.50 | --- | Ti 0.05-0.35 |
| EN 10088-2:2014 | X6CrNiTi12 | --- | 1.4516 | 0.08 | 1.50 | 0.70 | 0.040 | 0.015 | 10.5-12.5 | 0.50-1.50 | --- | Ti 0.05-0.35 |
| ISO 9328-7:2004 | Grade X6CrNiTi12 | --- | --- | 0.08 | 1.00 | 1.00 | 0.040 | 0.015 | 10.5-12.5 | 0.50-1.50 | --- | Ti 0.05-0.35 |
| JIS G 4312:2011 | Symbol SUH409 | --- | --- | 0.08 | 1.00 | 1.00 | 0.040 | 0.030 | 10.50-11.75 | 0.60 | --- | Ti 6xC to 0.75 |
| ASME SA-240/SA-240M | --- | S42035 | --- | 0.08 | 1.00 | 1.00 | 0.045 | 0.030 | 13.5-15.5 | 1.0-2.5 | 0.2-1.2 | Ti 0.30-0.50 |
| ASTM A240/A240M-15a | --- | S42035 | --- | 0.08 | 1.00 | 1.00 | 0.045 | 0.030 | 13.5-15.5 | 1.0-2.5 | 0.2-1.2 | Ti 0.30-0.50 |
| DIN 5512-3:2004 | X5CrNiMoTi15-2 | --- | 1.4589 | 0.08 | 1.0 | 1.0 | 0.045 | 0.03 | 13.5-15.5 | 1.0-2.5 | 0.2-1.2 | Ti 0.3-0.5 |
| EN 10088-2:2014 | X5CrNiMoTi15-2 | --- | 1.4589 | 0.08 | 1.00 | 1.00 | 0.040 | 0.015 | 13.5-15.5 | 1.00-2.50 | 0.20-1.20 | Ti 0.30-0.50 |

**8.1 Stainless Steels: Plates, Sheet and Strip**

**8.1.2A Chemical Composition of Ferritic Stainless Steels (Continued)**

| Specification | Designation | UNS No | Steel No | Weight, %, max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASME SA-240/SA-240M | Type 429 | S42900 | --- | 0.12 | 1.00 | 1.00 | 0.040 | 0.030 | 14.0-16.0 | --- | --- | --- |
| ASTM A240/A240M-15a | Type 429 | S42900 | --- | 0.12 | 1.00 | 1.00 | 0.040 | 0.030 | 14.0-16.0 | --- | --- | --- |
| GB 3280-92 | Grade 1Cr15 | --- | --- | 0.12 | 1.00 | 1.00 | 0.035 | 0.030 | 14.00-16.00 | 0.60 | --- | --- |
| GB 4237-92 | Grade 1Cr15 | --- | --- | 0.12 | 1.00 | 1.00 | 0.035 | 0.030 | 14.00-16.00 | 0.60 | --- | --- |
| GB 4239-91 | Grade 1Cr15 | --- | --- | 0.12 | 1.00 | 1.00 | 0.035 | 0.030 | 14.00-16.00 | 0.60 | --- | --- |
| JIS G 4304:2012 | Symbol SUS429 | --- | --- | 0.12 | 1.00 | 1.00 | 0.040 | 0.030 | 14.00-16.00 | 0.60 | --- | --- |
| JIS G 4305:2012 | Symbol SUS429 | --- | --- | 0.12 | 1.00 | 1.00 | 0.040 | 0.030 | 14.00-16.00 | 0.60 | --- | --- |
| SAE J405 JUN98 | Type 429 | S42900 | --- | 0.12 | 1.00 | 1.00 | 0.040 | 0.030 | 14.00-16.00 | --- | --- | --- |
| ASME SA-240/SA-240M | Type 430 | S43000 | --- | 0.12 | 1.00 | 1.00 | 0.040 | 0.030 | 16.0-18.0 | 0.75 | --- | --- |
| ASTM A240/A240M-15a | Type 430 | S43000 | --- | 0.12 | 1.00 | 1.00 | 0.040 | 0.030 | 16.0-18.0 | 0.75 | --- | --- |
| EN 10088-2:2014 | X6Cr17 | --- | 1.4016 | 0.08 | 1.00 | 1.00 | 0.040 | 0.015 | 16.0-18.0 | --- | --- | --- |
| GB 3280-92 | Grade 1Cr17 | --- | --- | 0.12 | 1.00 | 0.75 | 0.035 | 0.030 | 16.00-18.00 | 0.60 | --- | --- |
| GB 4237-92 | Grade 1Cr17 | --- | --- | 0.12 | 1.00 | 0.75 | 0.035 | 0.030 | 16.00-18.00 | 0.60 | --- | --- |
| GB 4238-92 | Grade 1Cr17 | --- | --- | 0.12 | 1.00 | 0.75 | 0.035 | 0.030 | 16.00-18.00 | 0.60 | --- | --- |
| GB 4239-91 | Grade 1Cr17 | --- | --- | 0.12 | 1.00 | 0.75 | 0.035 | 0.030 | 16.00-18.00 | 0.60 | --- | --- |
| ISO 16143-1:2004 | X6Cr17 | --- | --- | 0.08 | 1.00 | 1.00 | 0.040 | 0.030 | 16.0-18.0 | --- | --- | --- |
| JIS G 4304:2012 | Symbol SUS430 | --- | --- | 0.12 | 1.00 | 0.75 | 0.040 | 0.030 | 16.00-18.00 | 0.60 | --- | --- |
| JIS G 4305:2012 | Symbol SUS430 | --- | --- | 0.12 | 1.00 | 0.75 | 0.040 | 0.030 | 16.00-18.00 | 0.60 | --- | --- |
| SAE J405 JUN98 | Type 430 | S43000 | --- | 0.12 | 1.00 | 1.00 | 0.040 | 0.030 | 16.00-18.00 | 0.75 | --- | --- |
| EN 10028-7:2007 | X3CrTi17 | --- | 1.4510 | 0.05 | 1.00 | 1.00 | 0.040 | 0.015 | 16.0-18.0 | --- | --- | Ti [4x(C+N)+0.15] to 0.80 |
| | X2CrTi17 | --- | 1.4520 | 0.025 | 0.50 | 0.50 | 0.040 | 0.015 | 16.0-18.0 | --- | --- | Ti 0.30-0.60; N 0.015 |
| EN 10088-2:2014 | X3CrTi17 | --- | 1.4510 | 0.05 | 1.00 | 1.00 | 0.040 | 0.015 | 16.0-18.0 | --- | --- | Ti [4x(C+N)+0.15] to 0.80 |
| | X3CrNb17 | --- | 1.4511 | 0.05 | 1.00 | 1.00 | 0.040 | 0.015 | 16.0-18.0 | --- | --- | Nb 12xC to 1.00 |
| | X2CrTi17 | --- | 1.4520 | 0.025 | 0.50 | 0.50 | 0.040 | 0.015 | 16.0-18.0 | --- | --- | Ti [4x(C+N)+0.15] to 0.80; N 0.015 |
| GB 3280-92 | Grade 00Cr17 | --- | --- | 0.030 | 1.00 | 0.75 | 0.035 | 0.030 | 16.00-19.00 | 0.60 | --- | Ti 0.10-1.00; Nb 0.10-1.00 |
| GB 4239-91 | Grade 00Cr17 | --- | --- | 0.030 | 1.00 | 0.75 | 0.035 | 0.030 | 16.00-19.00 | 0.60 | --- | Ti 0.10-1.00; Nb 0.10-1.00 |
| ISO 16143-1:2004 | X3CrTi17 | --- | --- | 0.05 | 1.00 | 1.00 | 0.040 | 0.030 | 16.0-19.0 | --- | --- | Ti [4x(C+N)+0.20] to 0.75 |
| | X3CrNb17 | --- | --- | 0.05 | 1.00 | 1.00 | 0.040 | 0.015 | 16.0-18.0 | --- | --- | Nb 12xC to 1.00 |
| ISO 4955:2005 | X3CrTi17 | --- | --- | 0.05 | 1.00 | 1.00 | 0.040 | 0.015 | 16.0-18.0 | --- | --- | Ti [4x(C+N)+0.15] to 0.80 |
| ISO 9328-7:2004 | Grade X2CrTi17 | --- | --- | 0.025 | 0.50 | 0.50 | 0.040 | 0.015 | 16.0-18.0 | --- | --- | Ti 0.30-0.60; N 0.015 |
| | Grade X3CrTi17 | --- | --- | 0.05 | 1.00 | 1.00 | 0.040 | 0.015 | 16.0-19.0 | --- | --- | Ti [4x(C+N)+0.15] to 0.75 |
| JIS G 4304:2012 | Symbol SUS430LX | --- | --- | 0.030 | 1.00 | 0.75 | 0.040 | 0.030 | 16.00-19.00 | 0.60 | --- | Ti 0.10-1.00; Nb 0.10-1.00 |
| JIS G 4305:2012 | Symbol SUS430LX | --- | --- | 0.030 | 1.00 | 0.75 | 0.040 | 0.030 | 16.00-19.00 | 0.60 | --- | Ti 0.10-1.00; Nb 0.10-1.00 |

**8.1 Stainless Steels: Plates, Sheet and Strip**

**8.1.2A Chemical Composition of Ferritic Stainless Steels (Continued)**

| Specification | Designation | UNS No | Steel No | Weight, %, max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASME SA-240/SA-240M | Type 434 | S43400 | --- | 0.12 | 1.00 | 1.00 | 0.040 | 0.030 | 16.0-18.0 | --- | 0.75-1.25 | --- |
| ASTM A240/A240M-15a | Type 434 | S43400 | --- | 0.12 | 1.00 | 1.00 | 0.040 | 0.030 | 16.0-18.0 | --- | 0.75-1.25 | --- |
| EN 10088-2:2014 | X6CrMo17-1 | --- | 1.4113 | 0.08 | 1.00 | 1.00 | 0.040 | 0.015 | 16.0-18.0 | --- | 0.90-1.40 | --- |
| GB 3280-92 | Grade 1Cr17Mo | --- | --- | 0.12 | 1.00 | 1.00 | 0.035 | 0.030 | 16.00-18.00 | 0.60 | 0.75-1.25 | --- |
| GB 4237-92 | Grade 1Cr17Mo | --- | --- | 0.12 | 1.00 | 1.00 | 0.035 | 0.030 | 16.00-18.00 | 0.60 | 0.75-1.25 | --- |
| GB 4239-91 | Grade 1Cr17Mo | --- | --- | 0.12 | 1.00 | 1.00 | 0.035 | 0.030 | 16.00-18.00 | 0.60 | 0.75-1.25 | --- |
| JIS G 4304:2012 | Symbol SUS434 | --- | --- | 0.12 | 1.00 | 1.00 | 0.040 | 0.030 | 16.00-18.00 | 0.60 | 0.75-1.25 | --- |
| JIS G 4305:2012 | Symbol SUS434 | --- | --- | 0.12 | 1.00 | 1.00 | 0.040 | 0.030 | 16.00-18.00 | 0.60 | 0.75-1.25 | --- |
| SAE J405 JUN98 | --- | S43400 | --- | 0.12 | 1.00 | 1.00 | 0.040 | 0.030 | 16.00-18.00 | --- | 0.75-1.25 | --- |
| ASME SA-240/SA-240M | Type 436 | S43600 | --- | 0.12 | 1.00 | 1.00 | 0.040 | 0.030 | 16.0-18.0 | --- | 0.75-1.25 | Cb 5xC to 0.80 |
| ASTM A240/A240M-15a | Type 436 | S43600 | --- | 0.12 | 1.00 | 1.00 | 0.040 | 0.030 | 16.0-18.0 | --- | 0.75-1.25 | Cb 5xC to 0.80 |
| EN 10088-2:2014 | X6CrMoNb17-1 | --- | 1.4526 | 0.08 | 1.00 | 1.00 | 0.040 | 0.015 | 16.0-18.0 | --- | 0.80-1.40 | Nb [7x(C+N)+0.10] to 1.00; N 0.040 |
| SAE J405 JUN98 | --- | S43600 | --- | 0.12 | 1.00 | 1.00 | 0.040 | 0.030 | 16.00-18.00 | --- | 0.75-1.25 | Cb 5xC to 0.80 |
| ASME SA-240/SA-240M | Type 439 | S43035 | --- | 0.030 | 1.00 | 1.00 | 0.040 | 0.030 | 17.0-19.0 | 0.50 | --- | Ti [0.20+4(C+N)] to 1.10; Al 0.15; N 0.030 |
| | --- | S43932 | --- | 0.030 | 1.00 | 1.00 | 0.040 | 0.030 | 17.0-19.0 | 0.50 | --- | (Ti+Cb) [0.20+4(C+N)] to 0.75; Al 0.15; N 0.030 |
| ASTM A240/A240M-15a | Type 439 | S43035 | --- | 0.030 | 1.00 | 1.00 | 0.040 | 0.030 | 17.0-19.0 | 0.50 | --- | Ti [0.20+4(C+N)] to 1.10; Al 0.15; N 0.030 |
| | --- | S43932 | --- | 0.030 | 1.00 | 1.00 | 0.040 | 0.030 | 17.0-19.0 | 0.50 | --- | (Ti+Cb) [0.20+4(C+N)] to 0.75; Al 0.15; N 0.030 |
| SAE J405 JUN98 | --- | S43932 | --- | 0.030 | 1.00 | 1.00 | 0.040 | 0.030 | 17.0-19.0 | 0.50 | --- | (Ti+Cb) [0.20 +4x(C+N)] to 0.75; Al 0.15; N 0.030 |
| ASME SA-240/SA-240M | --- | S43940 | --- | 0.030 | 1.00 | 1.00 | 0.040 | 0.015 | 17.5-18.5 | --- | --- | Cb [0.30+(3xC)] min.; Ti 0.10-0.60 |
| ASTM A240/A240M-15a | --- | S43940 | --- | 0.030 | 1.00 | 1.00 | 0.040 | 0.015 | 17.5-18.5 | --- | --- | Cb [0.30+(3xC)] min.; Ti 0.10-0.60 |
| EN 10028-7:2007 | X2CrTiNb18 | --- | 1.4509 | 0.030 | 1.00 | 1.00 | 0.040 | 0.015 | 17.5-18.5 | --- | --- | Nb [3xC+0.30] to 1.00; Ti 0.10-0.60 |
| EN 10088-2:2014 | X2CrTiNb18 | --- | 1.4509 | 0.030 | 1.00 | 1.00 | 0.040 | 0.015 | 17.5-18.5 | --- | --- | Nb [3xC+0.30] to 1.00; Ti 0.10-0.60 |
| ISO 9328-7:2004 | Grade X2CrTiNb18 | --- | --- | 0.030 | 1.00 | 1.00 | 0.040 | 0.015 | 17.5-18.5 | --- | --- | Nb [3xC+0.30] to 1.00; Ti 0.10-0.60 |
| ISO 4955:2005 | X2CrTiNb18 | --- | --- | 0.03 | 1.00 | 1.00 | 0.040 | 0.015 | 17.5-18.5 | --- | --- | Nb [3xC+0.30] to 1.00; Ti 0.10-0.60 |

**8.1 Stainless Steels: Plates, Sheet and Strip**

**8.1.2A Chemical Composition of Ferritic Stainless Steels (Continued)**

| Specification | Designation | UNS No | Steel No | Weight, %, max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASME SA-240/SA-240M | Type 444 | S44400 | --- | 0.025 | 1.00 | 1.00 | 0.040 | 0.030 | 17.5-19.5 | 1.00 | 1.75-2.50 | (Ti+Cb) [0.20+4x(C+N)] to 0.80; N 0.035 |
| ASTM A240/A240M-15a | Type 444 | S44400 | --- | 0.025 | 1.00 | 1.00 | 0.040 | 0.030 | 17.5-19.5 | 1.00 | 1.75-2.50 | (Ti+Cb) [0.20+4x(C+N)] to 0.80; N 0.035 |
| EN 10028-7:2007 | X2CrMoTi18-2 | --- | 1.4521 | 0.025 | 1.00 | 1.00 | 0.040 | 0.015 | 17.0-20.0 | --- | 1.80-2.50 | Ti [4x(C+N)+0.15] to 0.80; N 0.030 |
| EN 10088-2:2014 | X2CrMoTi18-2 | --- | 1.4521 | 0.025 | 1.00 | 1.00 | 0.040 | 0.015 | 17.0-20.0 | --- | 1.80-2.50 | Ti [4x(C+N)+0.15] to 0.80; N 0.030 |
| GB 3280-92 | Grade 00Cr18Mo2 | --- | --- | 0.025 | 1.00 | 1.00 | 0.035 | 0.030 | 17.00-20.00 | 0.60 | 1.75-2.50 | Ti 8x(C+N) to 0.80; Nb 8x(C+N) to 0.80; Zr 8x(C+N) to 0.80; (Ti+Nb+Zr) 8x(C+N) to 0.80; N 0.025 |
| GB 4237-92 | Grade 00Cr18Mo2 | --- | --- | 0.025 | 1.00 | 1.00 | 0.035 | 0.030 | 17.00-20.00 | 0.60 | 1.75-2.50 | Ti 8x(C+N) to 0.80; Nb 8x(C+N) to 0.80; Zr 8x(C+N) to 0.80; (Ti+Nb+Zr) 8x(C+N) to 0.80; N 0.025 |
| GB 4239-91 | Grade 00Cr18Mo2 | --- | --- | 0.025 | 1.00 | 1.00 | 0.035 | 0.030 | 17.00-20.00 | 0.60 | 1.75-2.50 | Ti 8x(C+N) to 0.80; Nb 8x(C+N) to 0.80; Zr 8x(C+N) to 0.80; (Ti+Nb+Zr) 8x(C+N) to 0.80; N 0.025 |
| ISO 9328-7:2004 | Grade X2CrMoTi18-2 | --- | --- | 0.025 | 1.00 | 1.00 | 0.040 | 0.015 | 17.0-20.0 | --- | 1.80-2.50 | Ti [4x(C+N)+0.15] to 0.80; N 0.030 |
| JIS G 4304:2012 | Symbol SUS444 | --- | --- | 0.025 | 1.00 | 1.00 | 0.040 | 0.030 | 17.00-20.00 | 0.60 | 1.75-2.50 | Ti, Nb, Zr or their combination 8x(C + N) to 0.80; N 0.025 |
| JIS G 4305:2012 | Symbol SUS444 | --- | --- | 0.025 | 1.00 | 1.00 | 0.040 | 0.030 | 17.00-20.00 | 0.60 | 1.75-2.50 | Ti, Nb, Zr or their combination 8x(C + N) to 0.80; N 0.025 |
| SAE J405 JUN98 | Type 444 | S44400 | --- | 0.025 | 1.00 | 1.00 | 0.040 | 0.030 | 17.5-19.5 | 1.00 | 1.75-2.50 | (Ti+Cb) [0.20 +4x(C+N)] to 0.80; N 0.035 |
| GB 4238-92 | Grade 1Cr19Al3 | --- | --- | 0.10 | 1.00 | 1.50 | 0.035 | 0.030 | 17.00-21.00 | 0.60 | --- | Al 2.00-4.00 |
| JIS G 4312:2011 | Symbol SUH21 | --- | --- | 0.10 | 1.00 | 1.50 | 0.040 | 0.030 | 17.00-21.00 | 0.60 | --- | Al 2.00-4.00 |
| ASTM A240/A240M-15a | Type 446 | S44600 | --- | 0.20 | 1.50 | 1.00 | 0.040 | 0.030 | 23.0-27.0 | 0.75 | --- | N 0.25 |
| GB 4238-92 | Grade 2Cr25N | --- | --- | 0.20 | 1.50 | 1.00 | 0.035 | 0.030 | 23.00-27.00 | 0.60 | --- | Cu 0.30; N 0.25 |
| ISO 4955:2005 | X15CrN26 | --- | --- | 0.20 | 1.00 | 1.00 | 0.040 | 0.030 | 24.0-28.0 | 1.00 | --- | N 0.15-0.25 |
| JIS G 4312:2011 | Symbol SUH446 | --- | --- | 0.20 | 1.50 | 1.00 | 0.040 | 0.030 | 23.00-27.00 | 0.60 | --- | N 0.25 |
| ASME SA-240/SA-240M | Type XM-27 | S44627 | --- | 0.010 | 0.40 | 0.40 | 0.020 | 0.020 | 25.0-27.5 | 0.50 | 0.75-1.50 | (Ni+Cu) 0.50; Cu 0.20; Cb 0.05-0.20; N 0.015 |
| ASTM A240/A240M-15a | Type XM-27 | S44627 | --- | 0.010 | 0.40 | 0.40 | 0.020 | 0.020 | 25.0-27.5 | 0.50 | 0.75-1.50 | (Ni+Cu) 0.50; Cu 0.20; Cb 0.05-0.20; N 0.015 |
| GB 3280-92 | Grade 00Cr27Mo | --- | --- | 0.010 | 0.40 | 0.40 | 0.030 | 0.020 | 25.00-27.50 | 0.50 | 0.75-1.50 | (Ni+Cu) 0.50 max.; Cu 0.20; N 0.015 |
| GB 4237-92 | Grade 00Cr27Mo | --- | --- | 0.010 | 0.40 | 0.40 | 0.030 | 0.020 | 25.00-27.00 | 0.50 | 0.75-1.50 | (Ni+Cu) 0.50 max.; Cu 0.20; N 0.015 |
| GB 4239-91 | Grade 00Cr27Mo | --- | --- | 0.010 | 0.40 | 0.40 | 0.030 | 0.020 | 25.00-27.50 | 0.50 | 0.75-1.50 | (Ni+Cu) 0.50 max.; Cu 0.20; N 0.015 |
| JIS G 4304:2012 | Symbol SUSXM27 | --- | --- | 0.010 | 0.40 | 0.40 | 0.030 | 0.020 | 25.00-27.50 | 0.50 | 0.75-1.50 | (Ni+Cu) 0.50 max.; Cu 0.20; N 0.015 |
| JIS G 4305:2012 | Symbol SUSXM27 | --- | --- | 0.010 | 0.40 | 0.40 | 0.030 | 0.020 | 25.00-27.50 | 0.50 | 0.75-1.50 | (Ni+Cu) 0.50 max.; Cu 0.20; N 0.015 |
| SAE J405 JUN98 | Type SM-27 | S44627 | --- | 0.010 | 0.40 | 0.40 | 0.020 | 0.020 | 25.00-27.50 | 0.50 | 0.75-1.50 | (Ni+Cu) 0.50; Cu 0.20; Cb 0.05-0.20; N 0.015 |

**8.1 Stainless Steels: Plates, Sheet and Strip**

**8.1.2A Chemical Composition of Ferritic Stainless Steels (Continued)**

| Specification | Designation | UNS No | Steel No | Weight, %, max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| GB 3280-92 | Grade 00Cr30Mo2 | --- | --- | 0.010 | 0.40 | 0.40 | 0.030 | 0.020 | 28.50-32.00 | 0.50 | 1.50-2.50 | (Ni+Cu) 0.50 max.; Cu 0.20; N 0.015 |
| GB 4237-92 | Grade 00Cr30Mo2 | --- | --- | 0.010 | 0.40 | 0.40 | 0.030 | 0.020 | 28.00-32.00 | 0.50 | 1.50-2.50 | (Ni+Cu) 0.50 max.; Cu 0.20; N 0.015 |
| GB 4239-91 | Grade 00Cr30Mo2 | --- | --- | 0.010 | 0.40 | 0.40 | 0.030 | 0.020 | 28.50-32.00 | 0.50 | 1.50-2.50 | (Ni+Cu) 0.50 max.; Cu 0.20; N 0.015 |
| JIS G 4304:2012 | Symbol SUS447J1 | --- | --- | 0.010 | 0.40 | 0.40 | 0.030 | 0.020 | 28.50-32.00 | 0.50 | 1.50-2.50 | (Ni+Cu) 0.50 max.; Cu 0.20; N 0.015 |
| JIS G 4305:2012 | Symbol SUS447J1 | --- | --- | 0.010 | 0.40 | 0.40 | 0.030 | 0.020 | 28.50-32.00 | 0.50 | 1.50-2.50 | (Ni+Cu) 0.50 max.; Cu 0.20; N 0.015 |
| ASME SA-240/SA-240M | --- | S44735 | --- | 0.030 | 1.00 | 1.00 | 0.040 | 0.030 | 28.0-30.0 | 1.00 | 3.6-4.2 | (Ti+Cb) 6x(C+N) min.; (Ti+Cb) 0.20 to 1.00; N 0.045 |
| ASTM A240/A240M-15a | --- | S44735 | --- | 0.030 | 1.00 | 1.00 | 0.040 | 0.030 | 28.0-30.0 | 1.00 | 3.6-4.2 | (Ti+Cb) 6x(C+N) min.; (Ti+Cb) 0.20 to 1.00; N 0.045 |
| EN 10088-2:2014 | X2CrMoTi29-4 | --- | 1.4592 | 0.025 | 1.00 | 1.00 | 0.030 | 0.010 | 28.0-30.0 | --- | 3.5-4.5 | Ti [4x(C+N)+0.15] to 0.80; N 0.045 |
| SAE J405 JUN98 | --- | S44735 | --- | 0.030 | 1.00 | 1.00 | 0.040 | 0.030 | 28.00-30.00 | 1.00 | 3.60-4.20 | (Ti+Cb) 0.20 to 1.00; (Ti+Cb) [6x(C+N)] min.; N 0.045 |

**8.1 Stainless Steels: Plate, Sheet and Strip**

**8.1.2B Mechanical Properties of Ferritic Stainless Steels**

| Specification | Designation | UNS No | Steel No | Section Thickness/Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation % min | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | | | |
| ASME SA-240/SA-240M | Type 405 | S40500 | --- | --- | --- | 170 | 25 | 415 | 60 | 20 | see standard | 179 max. HB; 88 max. HRB |
| ASTM A240/A240M-15a | Type 405 | S40500 | --- | --- | --- | 170 | 25 | 415 | 60 | 20 | --- | 179 max. HBW; 88 max. HRBW |
| EN 10088-2:2014 | X6CrAl13 | --- | 1.4002 | t ≤ 8 | --- | 230 | --- | 400-600 | --- | 17 L, 17 T | A | --- |
| | | | | t ≤ 13.5 | --- | 210 | --- | 400-600 | --- | 17 L, 17 T | A | --- |
| | | | | t ≤ 25 | --- | 210 | --- | 400-600 | --- | 17 L, 17 T | A | --- |
| GB 3280-92 | Grade 0Cr13Al | --- | --- | --- | --- | 175 | --- | 410 | --- | 20 | A | 183 max. HB; 88 max. HRB |
| GB 4237-92 | Grade 0Cr13Al | --- | --- | --- | --- | 177 | --- | 410 | --- | 20 | A | 183 max. HB; 88 max. HRB |
| GB 4238-92 | Grade 0Cr13Al | --- | --- | --- | --- | 175 | --- | 410 | --- | 20 | A | 183 max. HB; 88 max. HRB |
| GB 4239-91 | Grade 0Cr13Al | --- | --- | --- | --- | 175 | --- | 410 | --- | 20 | A | 88 max. HRB |
| JIS G 4304:2012 | Symbol SUS405 | --- | --- | --- | --- | 175 | --- | 410 | --- | 20 | A | 183 max. HBW; 88 max. HRBW; 200 max. HV |
| JIS G 4305:2012 | Symbol SUS405 | --- | --- | --- | --- | 175 | --- | 410 | --- | 20 | A | 183 max. HBW; 88 max. HRBW; 200 max. HV |

**8.1 Stainless Steels: Plate, Sheet and Strip**

**8.1.2B Mechanical Properties of Ferritic Stainless Steels (Continued)**

| Specification | Designation | UNS No | Steel No | Section Thickness/Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation % min | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | | | |
| ASME SA-240/SA-240M | --- | S40977 | --- | --- | --- | 280 | 41 | 450 | 65 | 18 | see standard | 180 max. HB; 88 max. HRB |
| | | S41050 | --- | --- | --- | 205 | 30 | 415 | 60 | 22 | see standard | 183 max. HB; 89 max. HRB |
| ASTM A240/A240M-15a | --- | S40977 | --- | --- | --- | 280 | 41 | 450 | 65 | 18 | --- | 180 max. HBW; 88 max. HRBW |
| | | S41050 | --- | --- | --- | 205 | 30 | 415 | 60 | 22 | --- | 183 max. HBW; 89 max. HRBW |
| EN 10028-7:2007 | X2CrNi12 | --- | 1.4003 | t ≤ 8 | --- | 280 | --- | 450-650 | --- | 20 L, 20 T | A | T: 50 J @ RT |
| | | | | t ≤ 13.5 | --- | 280 | --- | 450-650 | --- | 20 L, 20 T | A | T: 50 J @ RT |
| | | | | t ≤ 25 | --- | 250 | --- | 450-650 | --- | 18 L, 18 T | A | T: 50 J @ RT |
| EN 10088-2:2014 | X2CrNi12 | --- | 1.4003 | t ≤ 8 | --- | 280 | --- | 450-650 | --- | 20 L, 20 T | A | --- |
| | | | | t ≤ 13.5 | --- | 280 | --- | 450-650 | --- | 20 L, 20 T | A | --- |
| | | | | t ≤ 25 | --- | 250 | --- | 450-650 | --- | 18 L, 18 T | A | --- |
| JIS G 4312:2011 | Symbol SUH409L | --- | --- | --- | --- | 175 | --- | 360 | --- | 25 | A | 162 max. HBW; 80 max. HRBW; 175 max. HV |
| ISO 16143-1:2004 | X2CrNi12 | --- | --- | t ≤ 6 | --- | 320 | --- | 450 | --- | 20 L, 20 T | A | --- |
| | | | | t ≤ 12 | --- | 300 | --- | 450 | --- | 20 L, 20 T | A | --- |
| | | | | t ≤ 25 | --- | 280 | --- | 430 | --- | 20 L, 20 T | A | --- |
| ISO 9328-7:2004 | Grade X2CrNi12 | --- | --- | t ≤ 6 | --- | 280 | --- | 450-650 | --- | 20 L, 20 T | A | T: 50 J @ 20°C |
| | | | | t ≤ 12 | --- | 280 | --- | 450-650 | --- | 20 L, 20 T | A | T: 50 J @ 20°C |
| | | | | t ≤ 25 | --- | 250 | --- | 450-650 | --- | 18 L, 18 T | A | T: 50 J @ 20°C |
| ASME SA-240/SA-240M | --- | S40945 | --- | --- | --- | 205 | 30 | 380 | 55 | 22 | see standard | 80 max. HRB |
| | | S40975 | --- | --- | --- | 275 | 40 | 415 | 60 | 20 | see standard | 197 max. HB; 92 max. HRB |
| ASTM A240/A240M-15a | --- | S40945 | --- | --- | --- | 205 | 30 | 380 | 55 | 22 | --- | 80 max. HRBW |
| | | S40975 | --- | --- | --- | 275 | 40 | 415 | 60 | 20 | --- | 197 max. HBW; 92 max. HRBW |
| EN 10088-2:2014 | X2CrTi12 | --- | 1.4512 | t ≤ 8 | --- | 210 | --- | 380-560 | --- | 25 L, 25 T | A | --- |
| | | | | t ≤ 13.5 | --- | 210 | --- | 380-560 | --- | 25 L, 25 T | A | --- |
| ISO 16143-1:2004 | X2CrTi12 | --- | --- | t ≤ 6 | --- | 220 | --- | 380 | --- | 25 L, 25 T | A | --- |
| | | | | t ≤ 6 | --- | 175 | --- | 360 | --- | 25 L, 25 T | A | --- |
| | | | | t ≤ 12 | --- | 200 | --- | 380 | --- | 25 L, 25 T | A | --- |
| | | | | t ≤ 12 | --- | 175 | --- | 360 | --- | 25 L, 25 T | A | --- |
| ISO 4955:2005 | X2CrTi12 | --- | --- | 0.5 ≤ t < 3 | --- | 210 | --- | 390-590 | --- | 25 L, 25 T | A | --- |
| | | | | 3 ≤ t ≤ 12 | --- | 210 | --- | 390-590 | --- | 25 L, 25 T | A | --- |
| | | | | 5 ≤ t ≤ 15 | --- | 210 | --- | 390-590 | --- | --- | A | --- |
| | | | | 5 ≤ t ≤ 25 | --- | 210 | --- | 390-590 | --- | --- | A | --- |
| | | | | 1.5 ≤ t ≤ 25 | --- | 210 | --- | 390-590 | --- | --- | A | --- |

**8.1 Stainless Steels: Plate, Sheet and Strip**

**8.1.2B Mechanical Properties of Ferritic Stainless Steels (Continued)**

| Specification | Designation | UNS No | Steel No | Section Thickness/Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation % min | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | | | |
| EN 10028-7:2007 | X6CrNiTi12 | --- | 1.4516 | t ≤ 8 | --- | 280 | --- | 450-650 | --- | 23 L, 23 T | A | T: 50 J @ RT |
| | | | | t ≤ 13.5 | --- | 280 | --- | 450-650 | --- | 23 L, 23 T | A | T: 50 J @ RT |
| | | | | t ≤ 25 | --- | 250 | --- | 450-650 | --- | 20 L, 20 T | A | T: 50 J @ RT |
| EN 10088-2:2014 | X6CrNiTi12 | --- | 1.4516 | t ≤ 8 | --- | 280 | --- | 450-650 | --- | 23 L, 23 T | A | --- |
| | | | | t ≤ 13.5 | --- | 280 | --- | 450-650 | --- | 23 L, 23 T | A | --- |
| | | | | t ≤ 25 | --- | 250 | --- | 450-650 | --- | 20 L, 20 T | A | --- |
| ISO 9328-7:2004 | Grade X6CrNiTi12 | --- | --- | t ≤ 6 | --- | 280 | --- | 450-650 | --- | 23 L, 23 T | A | T: 50 J @ 20°C |
| | | | | t ≤ 12 | --- | 280 | --- | 450-650 | --- | 23 L, 23 T | A | T: 50 J @ 20°C |
| | | | | t ≤ 25 | --- | 250 | --- | 450-650 | --- | 20 L, 20 T | A | T: 50 J @ 20°C |
| JIS G 4312:2011 | Symbol SUH409 | --- | --- | --- | --- | 175 | --- | 360 | --- | 22 | A | 162 max. HBW; 80 max. HRBW; 175 max. HV |
| ASME SA-240/SA-240M | --- | S42035 | --- | --- | --- | 380 | 55 | 550 | 80 | 16 | see standard | 180 max. HB; 88 max. HRB |
| ASTM A240/A240M-15a | --- | S42035 | --- | --- | --- | 380 | 55 | 550 | 80 | 16 | --- | 180 max. HBW; 88 max. HRBW |
| DIN 5512-3:2004 | X5CrNiMoTi15-2 | | 1.4589 | --- | --- | 380 | --- | 550-750 | --- | 16 T | HR | --- |
| | | | | t < 3 | --- | 420 | --- | 550-750 | --- | 14 T | CR | --- |
| | | | | t ≥ 3 | --- | 420 | --- | 550-750 | --- | 16 T | CR | --- |
| EN 10088-2:2014 | X5CrNiMoTi15-2 | --- | 1.4589 | t ≤ 8 | --- | 400 | --- | 550-750 | --- | 16 L, 16 T | A | --- |
| | | | | t ≤ 13.5 | --- | 360 | --- | 550-750 | --- | 14 L, 14 T | A | --- |
| ASME SA-240/SA-240M | Type 429 | S42900 | --- | t ≤ 1.27 | t ≤ 0.050 | 205 | 30 | 450 | 65 | 20 | see standard | 183 max. HB; 89 max. HRB |
| | | | | t > 1.27 | t > 0.050 | 205 | 30 | 450 | 65 | 22 | see standard | 183 max. HB; 89 max. HRB |
| ASTM A240/A240M-15a | Type 429 | S42900 | --- | t ≤ 1.27 | t ≤ 0.050 | 205 | 30 | 450 | 65 | 20 | --- | 183 max. HBW; 89 max. HRBW |
| | | | | t > 1.27 | t > 0.050 | 205 | 30 | 450 | 65 | 22 | --- | 183 max. HBW; 89 max. HRBW |
| GB 3280-92 | Grade 1Cr15 | --- | --- | --- | --- | 205 | --- | 450 | --- | 22 | A | 183 max. HB; 88 max. HRB |
| GB 4237-92 | Grade 1Cr15 | --- | --- | --- | --- | 205 | --- | 450 | --- | 22 | A | 183 max. HB; 88 max. HRB |
| GB 4239-91 | Grade 1Cr15 | --- | --- | --- | --- | 205 | --- | 450 | --- | 22 | A | 88 max. HRB |
| JIS G 4304:2012 | Symbol SUS429 | --- | --- | --- | --- | 205 | --- | 450 | --- | 22 | A | 183 max. HBW; 88 max. HRBW; 200 max. HV |
| JIS G 4305:2012 | Symbol SUS429 | --- | --- | --- | --- | 205 | --- | 450 | --- | 22 | A | 183 max. HBW; 88 max. HRBW; 200 max. HV |

**8.1 Stainless Steels: Plate, Sheet and Strip**

**8.1.2B Mechanical Properties of Ferritic Stainless Steels (Continued)**

| Specification | Designation | UNS No | Steel No | Section Thickness/Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation % min | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | | | |
| ASME SA-240/SA-240M | Type 430 | S43000 | --- | t ≤ 1.27 | t ≤ 0.050 | 205 | 30 | 450 | 65 | 20 | see standard | 183 max. HB; 89 max. HRB |
| | | | | t > 1.27 | t > 0.050 | 205 | 30 | 450 | 65 | 22 | see standard | 183 max. HB; 89 max. HRB |
| ASTM A240/A240M-15a | Type 430 | S43000 | --- | t ≤ 1.27 | t ≤ 0.050 | 205 | 30 | 450 | 65 | 20 | --- | 183 max. HBW; 89 max. HRBW |
| | | | | t > 1.27 | t > 0.050 | 205 | 30 | 450 | 65 | 22 | --- | 183 max. HBW; 89 max. HRBW |
| EN 10088-2:2014 | X6Cr17 | --- | 1.4016 | t ≤ 8 | --- | 260 | --- | 430-600 | --- | 20 L, 20 T | A | --- |
| | | | | t ≤ 13.5 | --- | 240 | --- | 430-600 | --- | 18 L, 18 T | A | --- |
| | | | | t ≤ 25 | --- | 240 | --- | 430-630 | --- | 20 L, 20 T | A | --- |
| GB 3280-92 | Grade 1Cr17 | --- | --- | --- | --- | 205 | --- | 450 | --- | 22 | A | 183 max. HB; 88 max. HRB |
| GB 4237-92 | Grade 1Cr17 | --- | --- | --- | --- | 205 | --- | 450 | --- | 22 | A | 183 max. HB; 88 max. HRB |
| GB 4238-92 | Grade 1Cr17 | --- | --- | --- | --- | 205 | --- | 450 | --- | 22 | A | 183 max. HB; 88 max. HRB |
| GB 4239-91 | Grade 1Cr17 | --- | --- | --- | --- | 205 | --- | 450 | --- | 22 | A | 88 max. HRB |
| ISO 16143-1:2004 | X6Cr17 | --- | --- | t ≤ 6 | --- | 250 | --- | 450 | --- | 20 L, 20 T | A | --- |
| | | | | t ≤ 6 | --- | 205 | --- | 450 | --- | 20 L, 20 T | A | --- |
| | | | | t ≤ 12 | --- | 230 | --- | 450 | --- | 20 L, 20 T | A | --- |
| | | | | t ≤ 12 | --- | 205 | --- | 450 | --- | 20 L, 20 T | A | --- |
| | | | | t ≤ 25 | --- | 230 | --- | 430 | --- | 20 L, 20 T | A | --- |
| JIS G 4304:2012 | Symbol SUS430 | --- | --- | --- | --- | 205 | --- | 420 | --- | 22 | A | 183 max. HBW; 88 max. HRBW; 200 max. HV |
| JIS G 4305:2012 | Symbol SUS430 | --- | --- | --- | --- | 205 | --- | 420 | --- | 22 | A | 183 max. HBW; 88 max. HRBW; 200 max. HV |

**8.1 Stainless Steels: Plate, Sheet and Strip**

**8.1.2B Mechanical Properties of Ferritic Stainless Steels (Continued)**

| Specification | Designation | UNS No | Steel No | Section Thickness/Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | % min | | |
| EN 10028-7:2007 | X3CrTi17 | --- | 1.4510 | t ≤ 4 | --- | 230 | --- | 420-600 | --- | 23 L, 23 T | A | --- |
| | X2CrTi17 | --- | 1.4520 | t ≤ 4 | --- | 180 | --- | 380-530 | --- | 24 L, 24 T | A | --- |
| EN 10088-2:2014 | X3CrTi17 | --- | 1.4510 | t ≤ 8 | --- | 230 | --- | 420-600 | --- | 23 L, 23 T | A | --- |
| | | | | t ≤ 13.5 | --- | 230 | --- | 420-600 | --- | 23 L, 23 T | A | --- |
| | X3CrNb17 | --- | 1.4511 | t ≤ 8 | --- | 230 | --- | 420-600 | --- | 23 L, 23 T | A | --- |
| | X2CrTi17 | --- | 1.4520 | t ≤ 8 | --- | 180 | --- | 380-530 | --- | 24 L, 24 T | A | --- |
| GB 3280-92 | Grade 00Cr17 | --- | --- | --- | --- | 175 | --- | 365 | --- | 22 | A | 183 max. HB; 88 max. HRB |
| GB 4239-91 | Grade 00Cr17 | --- | --- | --- | --- | 175 | --- | 365 | --- | 22 | A | 88 max. HRB |
| ISO 16143-1:2004 | X3CrTi17 | --- | --- | t ≤ 6 | --- | 240 | --- | 420 | --- | 23 L, 23 T | A | --- |
| | | | | t ≤ 6 | --- | 175 | --- | 360 | --- | 23 L, 23 T | A | --- |
| | | | | t ≤ 12 | --- | 220 | --- | 420 | --- | 23 L, 23 T | A | --- |
| | | | | t ≤ 12 | --- | 175 | --- | 360 | --- | 23 L, 23 T | A | --- |
| | X3CrNb17 | --- | --- | t ≤ 6 | --- | 230 | --- | 420 | --- | 23 L, 23 T | A | --- |
| ISO 4955:2005 | X3CrTi17 | --- | --- | 0.5 ≤ t ≤ 12 | --- | 230 | --- | --- | --- | 23 L, 23 T | A | --- |
| | | | | 5 ≤ t ≤ 15 | --- | 230 | --- | --- | --- | --- | A | --- |
| | | | | 1.5 ≤ t ≤ 25 | --- | 230 | --- | --- | --- | --- | A | --- |
| | | | | 5 ≤ t ≤ 25 | --- | 230 | --- | --- | --- | --- | A | --- |
| ISO 9328-7:2004 | Grade X2CrTi17 | --- | --- | t ≤ 2.5 | --- | 180 | --- | 380-530 | --- | 24 L, 24 T | A | --- |
| | Grade X3CrTi17 | --- | --- | t ≤ 3 | --- | 230 | --- | 420-600 | --- | 23 L, 23 T | A | --- |
| JIS G 4304:2012 | Symbol SUS430LX | --- | --- | --- | --- | 175 | --- | 360 | --- | 22 | A | 183 max. HBW; 88 max. HRBW; 200 max. HV |
| JIS G 4305:2012 | Symbol SUS430LX | --- | --- | --- | --- | 175 | --- | 360 | --- | 22 | A | 183 max. HBW; 88 max. HRBW; 200 max. HV |
| ASME SA-240/SA-240M | Type 434 | S43400 | --- | --- | --- | 240 | 35 | 450 | 65 | 22 | see standard | 89 max. HRB |
| ASTM A240/A240M-15a | Type 434 | S43400 | --- | --- | --- | 240 | 35 | 450 | 65 | 22 | --- | 89 max. HRBW |
| EN 10088-2:2014 | X6CrMo17-1 | --- | 1.4113 | t ≤ 8 | --- | 260 | --- | 450-630 | --- | 18 L, 18 T | A | --- |
| | | | | t ≤ 13.5 | --- | 260 | --- | 450-630 | --- | 18 L, 18 T | A | --- |
| GB 3280-92 | Grade 1Cr17Mo | --- | --- | --- | --- | 205 | --- | 450 | --- | 22 | A | 183 max. HB; 88 max. HRB |
| GB 4237-92 | Grade 1Cr17Mo | --- | --- | --- | --- | 205 | --- | 450 | --- | 22 | A | 183 max. HB; 88 max. HRB |
| GB 4239-91 | Grade 1Cr17Mo | --- | --- | --- | --- | 205 | --- | 450 | --- | 22 | A | 88 max. HRB |
| JIS G 4304:2012 | Symbol SUS434 | --- | --- | --- | --- | 205 | --- | 450 | --- | 22 | A | 183 max. HBW; 88 max. HRBW; 200 max. HV |
| JIS G 4305:2012 | Symbol SUS434 | --- | --- | --- | --- | 205 | --- | 450 | --- | 22 | A | 183 max. HBW; 88 max. HRBW; 200 max. HV |

**8.1 Stainless Steels: Plate, Sheet and Strip**

**8.1.2B Mechanical Properties of Ferritic Stainless Steels (Continued)**

| Specification | Designation | UNS No | Steel No | Section Thickness/Diameter mm | Section Thickness/Diameter in. | Yield Strength, min. MPa | Yield Strength, min. ksi | Tensile Strength, min. MPa | Tensile Strength, min. ksi | Elongation % min | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ASME SA-240/SA-240M | Type 436 | S43600 | --- | --- | --- | 240 | 35 | 450 | 65 | 22 | see standard | 89 max. HRB |
| ASTM A240/A240M-15a | Type 436 | S43600 | --- | --- | --- | 240 | 35 | 450 | 65 | 22 | --- | 89 max. HRBW |
| EN 10088-2:2014 | X6CrMoNb17-1 | --- | 1.4526 | t ≤ 8 | --- | 280 | --- | 480-560 | --- | 25 L, 25 T | A | --- |
| ASME SA-240/SA-240M | Type 439 | S43035 | --- | --- | --- | 205 | 30 | 415 | 60 | 22 | see standard | 183 max. HB; 89 max. HRB |
| | --- | S43932 | --- | --- | --- | 205 | 30 | 415 | 60 | 22 | see standard | 183 max. HB; 89 max. HRB |
| ASTM A240/A240M-15a | Type 439 | S43035 | --- | --- | --- | 205 | 30 | 415 | 60 | 22 | --- | 183 max. HBW; 89 max. HRBW |
| | --- | S43932 | --- | --- | --- | 205 | 30 | 415 | 60 | 22 | --- | 183 max. HBW; 89 max. HRBW |
| ASME SA-240/SA-240M | --- | S43940 | --- | --- | --- | 250 | 36 | 430 | 62 | 18 | see standard | 180 max. HB; 88 max. HRB |
| ASTM A240/A240M-15a | --- | S43940 | --- | --- | --- | 250 | 36 | 430 | 62 | 18 | --- | 180 max. HBW; 88 max. HRBW |
| EN 10028-7:2007 | X2CrTiNb18 | --- | 1.4509 | t ≤ 4 | --- | 230 | --- | 430-630 | --- | 18 L, 18 T | A | --- |
| EN 10088-2:2014 | X2CrTiNb18 | --- | 1.4509 | t ≤ 8 | --- | 230 | --- | 430-630 | --- | 18 L, 18 T | A | --- |
| ISO 9328-7:2004 | Grade X2CrTiNb18 | --- | --- | t ≤ 2.5 | --- | 230 | --- | 430-630 | --- | 18 L, 18 T | A | --- |
| ISO 4955:2005 | X2CrTiNb18 | --- | --- | 0.5 ≤ t ≤ 12 | --- | 230 | --- | --- | --- | 18 L, 18 T | A | --- |
| | | | | 5 ≤ t ≤ 15 | --- | 230 | --- | --- | --- | 18 | A | --- |
| | | | | 1.5 ≤ t ≤ 25 | --- | 230 | --- | --- | --- | 18 | A | --- |
| | | | | 5 ≤ t ≤ 25 | --- | 230 | --- | --- | --- | 18 | A | --- |

**8.1 Stainless Steels: Plate, Sheet and Strip**

**8.1.2B Mechanical Properties of Ferritic Stainless Steels (Continued)**

| Specification | Designation | UNS No | Steel No | Section Thickness/Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation % min | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | | | |
| ASME SA-240/SA-240M | Type 444 | S44400 | --- | --- | --- | 275 | 40 | 415 | 60 | 20 | see standard | 217 max. HB; 96 max. HRB |
| ASTM A240/A240M-15a | Type 444 | S44400 | --- | --- | --- | 275 | 40 | 415 | 60 | 20 | --- | 217 max. HBW; 96 max. HRBW |
| EN 10028-7:2007 | X2CrMoTi18-2 | --- | 1.4521 | t ≤ 4 | --- | 300 | --- | 420-640 | --- | 20 L, 20 T | A | --- |
| EN 10088-2:2014 | X2CrMoTi18-2 | --- | 1.4521 | t ≤ 8 | --- | 300 | --- | 420-640 | --- | 20 L, 20 T | A | --- |
| | | | | t ≤ 12 | --- | 280 | --- | 420-620 | --- | 20 L, 20 T | A | --- |
| | | | | t ≤ 13.5 | --- | 280 | --- | 400-600 | --- | 20 L, 20 T | A | --- |
| GB 3280-92 | Grade 00Cr18Mo2 | --- | --- | --- | --- | 245 | --- | 410 | --- | 20 | A | 217 max. HB; 96 max. HRB |
| GB 4237-92 | Grade 00Cr18Mo2 | --- | --- | --- | --- | 245 | --- | 410 | --- | 20 | A | 217 max. HB; 96 max. HRB |
| GB 4239-91 | Grade 00Cr18Mo2 | --- | --- | --- | --- | 245 | --- | 410 | --- | 20 | A | 96 max. HRB |
| ISO 9328-7:2004 | Grade X2CrMoTi18-2 | --- | --- | t ≤ 2.5 | --- | 300 | --- | 420-640 | --- | 20 L, 20 T | A | --- |
| JIS G 4304:2012 | Symbol SUS444 | --- | --- | --- | --- | 245 | --- | 410 | --- | 20 | A | 217 max. HBW; 96 max. HRBW; 230 max. HV |
| JIS G 4305:2012 | Symbol SUS444 | --- | --- | --- | --- | 245 | --- | 410 | --- | 20 | A | 217 max. HBW; 96 max. HRBW; 230 max. HV |
| GB 4238-92 | Grade 1Cr19Al3 | --- | --- | --- | --- | 245 | --- | 440 | --- | 15 | A | 210 max. HB; 95 max. HRB |
| JIS G 4312:2011 | Symbol SUH21 | --- | --- | --- | --- | 245 | --- | 440 | --- | 15 | A | 210 max. HBW; 95 max. HRBW; 220 max. HV |
| ASTM A240/A240M-15a | Type 446 | S44600 | --- | --- | --- | 275 | 40 | 515 | 65 | 20 | --- | 217 max. HBW; 96 max. HRBW |
| GB 4238-92 | Grade 2Cr25N | --- | --- | --- | --- | 275 | --- | 510 | --- | 20 | A | 201 max. HB; 95 max. HRB |
| ISO 4955:2005 | X15CrN26 | --- | --- | 0.5 ≤ t < 3 | --- | 280 | --- | 500-700 | --- | 13 L, 13 T | A | 212 max. HB |
| | | | | 3 ≤ t ≤ 12 | --- | 280 | --- | 500-700 | --- | 15 L, 15 T | A | 212 max. HB |
| | | | | 5 ≤ t ≤ 15 | --- | 280 | --- | 500-700 | --- | 15 | A | 212 max. HB |
| | | | | 5 ≤ t ≤ 25 | --- | 280 | --- | 500-700 | --- | 15 | A | 212 max. HB |
| | | | | 1.5 ≤ t ≤ 25 | --- | 280 | --- | 500-700 | --- | 15 | A | 212 max. HB |
| JIS G 4312:2011 | Symbol SUH446 | --- | --- | --- | --- | 275 | --- | 510 | --- | 20 | A | 201 max. HBW; 95 max. HRBW; 210 max. HV |

**8.1 Stainless Steels: Plate, Sheet and Strip**

**8.1.2B Mechanical Properties of Ferritic Stainless Steels (Continued)**

| Specification | Designation | UNS No | Steel No | Section Thickness/Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation % min | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | | | |
| ASME SA-240/SA-240M | Type XM-27 | S44627 | --- | --- | --- | 275 | 40 | 450 | 65 | 22 | see standard | 187 max. HB; 90 max. HRB |
| ASTM A240/A240M-15a | Type XM-27 | S44627 | --- | --- | --- | 275 | 40 | 450 | 65 | 22 | --- | 187 max. HBW; 90 max. HRBW |
| GB 3280-92 | Grade 00Cr27Mo | --- | --- | --- | --- | 245 | --- | 410 | --- | 22 | A | 190 max. HB; 90 max. HRB |
| GB 4237-92 | Grade 00Cr27Mo | --- | --- | --- | --- | 245 | --- | 410 | --- | 22 | A | 190 max. HB; 90 max. HRB |
| GB 4239-91 | Grade 00Cr27Mo | --- | --- | --- | --- | 245 | --- | 410 | --- | 22 | A | 90 max. HRB |
| JIS G 4304:2012 | Symbol SUSXM27 | --- | --- | --- | --- | 245 | --- | 410 | --- | 22 | A | 192 max. HBW; 90 max. HRBW; 200 max. HV |
| JIS G 4305:2012 | Symbol SUSXM27 | --- | --- | --- | --- | 245 | --- | 410 | --- | 22 | A | 192 max. HBW; 90 max. HRBW; 200 max. HV |
| GB 3280-92 | Grade 00Cr30Mo2 | --- | --- | --- | --- | 295 | --- | 450 | --- | 22 | A | 209 max. HB; 95 max. HRB |
| GB 4237-92 | Grade 00Cr30Mo2 | --- | --- | --- | --- | 295 | --- | 450 | --- | 22 | A | 209 max. HB; 95 max. HRB |
| GB 4239-91 | Grade 00Cr30Mo2 | --- | --- | --- | --- | 295 | --- | 450 | --- | 22 | A | 95 max. HRB |
| JIS G 4304:2012 | Symbol SUS447J1 | --- | --- | --- | --- | 295 | --- | 450 | --- | 22 | A | 207 max. HBW; 95 max. HRBW; 220 max. HV |
| JIS G 4305:2012 | Symbol SUS447J1 | --- | --- | --- | --- | 295 | --- | 450 | --- | 22 | A | 207 max. HBW; 95 max. HRBW; 220 max. HV |
| ASME SA-240/SA-240M | --- | S44735 | --- | --- | --- | 415 | 60 | 550 | 80 | 18 | see standard | 255 max. HB; 25 max. HRC |
| ASTM A240/A240M-15a | --- | S44735 | --- | --- | --- | 415 | 60 | 550 | 80 | 18 | --- | 255 max. HBW; 25 max. HRC |
| EN 10088-2:2014 | X2CrMoTi29-4 | --- | 1.4592 | t ≤ 8 | --- | 430 | --- | 550-700 | --- | 20 L, 20 T | A | --- |

**8.1 Stainless Steels: Plates, Sheet and Strip**

**8.1.3A Chemical Composition of Austenitic Stainless Steels**

| Specification | Designation | UNS No | Steel No | Weight, %, max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASME SA-240/SA-240M | Type 201-1 | S20100 | --- | 0.15 | 5.50-7.50 | 1.00 | 0.060 | 0.030 | 16.0-18.0 | 3.5-5.5 | --- | N 0.25 |
| | Type 201-2 | S20100 | --- | 0.15 | 5.50-7.50 | 1.00 | 0.060 | 0.030 | 16.0-18.0 | 3.5-5.5 | --- | N 0.25 |
| ASME SA-666 | Type 201-1 | S20100 | --- | 0.15 | 5.5-7.5 | 0.75 | 0.060 | 0.030 | 16.0-18.0 | 3.5-5.5 | --- | N 0.25 |
| | Type 201-2 | S20100 | --- | 0.15 | 5.5-7.5 | 0.75 | 0.060 | 0.030 | 16.0-18.0 | 3.5-5.5 | --- | N 0.25 |
| ASTM A240/A240M-15a | Type 201-1 | S20100 | --- | 0.15 | 5.50-7.50 | 1.00 | 0.060 | 0.030 | 16.0-18.0 | 3.5-5.5 | --- | N 0.25 |
| | Type 201-2 | S20100 | --- | 0.15 | 5.50-7.50 | 1.00 | 0.060 | 0.030 | 16.0-18.0 | 3.5-5.5 | --- | N 0.25 |
| ASTM A666-15 | Type 201-1 | S20100 | --- | 0.15 | 5.5-7.5 | 0.75 | 0.060 | 0.030 | 16.0-18.0 | 3.5-5.5 | --- | N 0.25 |
| | Type 201-2 | S20100 | --- | 0.15 | 5.5-7.5 | 0.75 | 0.060 | 0.030 | 16.0-18.0 | 3.5-5.5 | --- | N 0.25 |
| EN 10088-2:2014 | X12CrMnNiN17-7-5 | --- | 1.4372 | 0.15 | 5.5-7.5 | 1.00 | 0.045 | 0.015 | 16.0-18.0 | 3.5-5.5 | --- | N 0.05-0.25 |
| GB 3280-92 | Grade 1Cr17Mn6Ni5N | --- | --- | 0.15 | 5.50-7.50 | 1.00 | 0.060 | 0.030 | 16.00-18.00 | 3.50-5.50 | --- | N 0.25 |
| GB 4237-92 | Grade 1Cr17Mn6Ni5N | --- | --- | 0.15 | 5.50-7.50 | 1.00 | 0.060 | 0.030 | 16.00-18.00 | 3.50-5.50 | --- | N 0.25 |
| GB 4239-91 | Grade 1Cr17Mn6Ni5N | --- | --- | 0.15 | 5.50-7.50 | 1.00 | 0.060 | 0.030 | 16.00-18.00 | 3.50-5.50 | --- | N 0.25 |
| ISO 16143-1:2004 | X12CrMnNiN17-7-5 | --- | --- | 0.15 | 5.5-7.5 | 1.00 | 0.045 | 0.030 | 16.0-18.0 | 3.5-5.5 | --- | N 0.05-0.25 |
| SAE J405 JUN98 | Type 201 | S20100 | --- | 0.15 | 5.50-7.50 | 1.00 | 0.060 | 0.030 | 16.00-18.00 | 3.50-5.50 | --- | N 0.25 |
| ASME SA-240/SA-240M | Type 201L | S20103 | --- | 0.03 | 5.50-7.50 | 0.75 | 0.045 | 0.030 | 16.0-18.0 | 3.5-5.5 | --- | N 0.25 |
| ASME SA-666 | Type 201L | S20103 | --- | 0.03 | 5.5-7.5 | 0.75 | 0.045 | 0.030 | 16.0-18.0 | 3.5-5.5 | --- | N 0.25 |
| ASTM A240/A240M-15a | Type 201L | S20103 | --- | 0.03 | 5.50-7.50 | 0.75 | 0.045 | 0.030 | 16.0-18.0 | 3.5-5.5 | --- | N 0.25 |
| ASTM A666-15 | Type 201L | S20103 | --- | 0.03 | 5.5-7.5 | 0.75 | 0.045 | 0.030 | 16.0-18.0 | 3.5-5.5 | --- | N 0.25 |
| EN 10088-2:2014 | X2CrMnNiN17-7-5 | --- | 1.4371 | 0.030 | 6.0-8.0 | 1.00 | 0.045 | 0.015 | 16.0-17.5 | 3.5-5.5 | --- | N 0.15-0.25; Cu 1.00 |
| SAE J405 JUN98 | --- | S20103 | --- | 0.03 | 5.50-7.50 | 0.75 | 0.045 | 0.030 | 16.00-18.00 | 3.50-5.50 | --- | N 0.25 |
| ASME SA-240/SA-240M | Type 201LN | S20153 | --- | 0.03 | 6.40-7.50 | 0.75 | 0.045 | 0.015 | 16.0-17.5 | 4.0-5.0 | --- | Cu 1.00; N 0.10-0.25 |
| ASME SA-666 | Type 201LN | S20153 | --- | 0.03 | 6.4-7.5 | 0.75 | 0.045 | 0.015 | 16.0-17.5 | 4.0-5.0 | --- | Cu 1.00; N 0.10-0.25 |
| ASTM A240/A240M-15a | Type 201LN | S20153 | --- | 0.03 | 6.40-7.50 | 0.75 | 0.045 | 0.015 | 16.0-17.5 | 4.0-5.0 | --- | Cu 1.00; N 0.10-0.25 |
| ASTM A666-15 | Type 201LN | S20153 | --- | 0.03 | 6.4-7.5 | 0.75 | 0.045 | 0.015 | 16.0-17.5 | 4.0-5.0 | --- | Cu 1.00; N 0.10-0.25 |
| SAE J405 JUN98 | --- | S20153 | --- | 0.03 | 6.40-7.50 | 0.75 | 0.045 | 0.015 | 16.00-17.50 | 4.00-5.00 | --- | Cu 1.00; N 0.10-0.25 |
| ASME SA-240/SA-240M | Type 202 | S20200 | --- | 0.15 | 7.50-10.00 | 1.00 | 0.060 | 0.030 | 17.0-19.0 | 4.0-6.0 | --- | N 0.25 |
| ASME SA-666 | Type 202 | S20200 | --- | 0.15 | 7.5-10.0 | 0.75 | 0.060 | 0.030 | 17.0-19.0 | 4.0-6.0 | --- | N 0.25 |
| ASTM A240/A240M-15a | Type 202 | S20200 | --- | 0.15 | 7.50-10.00 | 1.00 | 0.060 | 0.030 | 17.0-19.0 | 4.0-6.0 | --- | N 0.25 |
| ASTM A666-15 | Type 202 | S20200 | --- | 0.15 | 7.5-10.0 | 0.75 | 0.060 | 0.030 | 17.0-19.0 | 4.0-6.0 | --- | N 0.25 |
| EN 10088-2:2014 | X12CrMnNiN18-9-5 | --- | 1.4373 | 0.15 | 7.5-10.5 | 1.00 | 0.045 | 0.015 | 17.0-19.0 | 4.0-6.0 | --- | N 0.05-0.25 |
| GB 3280-92 | Grade 1Cr18Mn8Ni5N | --- | --- | 0.15 | 7.50-10.00 | 1.00 | 0.060 | 0.030 | 17.00-19.00 | 4.00-6.00 | --- | N 0.25 |
| GB 4237-92 | Grade 1Cr18Mn8Ni5N | --- | --- | 0.15 | 7.50-10.00 | 1.00 | 0.060 | 0.030 | 17.00-19.00 | 4.00-6.00 | --- | N 0.25 |
| GB 4239-91 | Grade 1Cr18Mn8Ni5N | --- | --- | 0.15 | 7.50-10.00 | 1.00 | 0.060 | 0.030 | 17.00-19.00 | 4.00-6.00 | --- | N 0.25 |
| SAE J405 JUN98 | Type 202 | S20200 | --- | 0.15 | 7.50-10.0 | 1.00 | 0.060 | 0.030 | 17.00-19.00 | 4.00-6.00 | --- | N 0.25 |

**8.1 Stainless Steels: Plates, Sheet and Strip**

**8.1.3A Chemical Composition of Austenitic Stainless Steels (continued)**

| Specification | Designation | UNS No | Steel No | Weight, %, max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASME SA-240/SA-240M | Type 301 | S30100 | --- | 0.15 | 2.00 | 1.00 | 0.045 | 0.030 | 16.0-18.0 | 6.0-8.0 | --- | N 0.10 |
| ASME SA-666 | Type 301 | S30100 | --- | 0.15 | 2.00 | 1.00 | 0.045 | 0.030 | 16.0-18.0 | 6.0-8.0 | --- | N 0.10 |
| ASTM A240/A240M-15a | Type 301 | S30100 | --- | 0.15 | 2.00 | 1.00 | 0.045 | 0.030 | 16.0-18.0 | 6.0-8.0 | --- | N 0.10 |
| ASTM A666-15 | Type 301 | S30100 | --- | 0.15 | 2.00 | 1.00 | 0.045 | 0.030 | 16.0-18.0 | 6.0-8.0 | --- | N 0.10 |
| EN 10088-2:2014 | X10CrNi18-8 | --- | 1.4310 | 0.05-0.15 | 2.00 | 2.00 | 0.045 | 0.015 | 16.0-19.0 | 6.0-9.5 | 0.80 | N 0.10 |
| | X5CrNi17-7 | --- | 1.4319 | 0.07 | 2.00 | 1.00 | 0.045 | 0.030 | 16.0-18.0 | 6.0-8.0 | --- | N 0.10 |
| GB 3280-92 | Grade 1Cr17Ni7 | --- | --- | 0.15-0.25 | 2.00 | 1.00 | 0.035 | 0.030 | 16.00-18.00 | 6.00-8.00 | --- | --- |
| | Grade 1Cr17Ni8 | --- | --- | 0.03-0.12 | 2.00 | 1.00 | 0.035 | 0.030 | 16.00-18.00 | 7.00-9.00 | --- | --- |
| GB 4239-91 | Grade 1Cr17Ni7 | --- | --- | 0.15 | 2.00 | 1.00 | 0.035 | 0.030 | 16.00-18.00 | 6.00-8.00 | --- | --- |
| | Grade 1Cr17Ni8 | --- | --- | 0.08-0.12 | 2.00 | 1.00 | 0.035 | 0.030 | 16.00-18.00 | 7.00-9.00 | --- | --- |
| ISO 16143-1:2004 | X10CrNi18-8 | --- | --- | 0.05-0.15 | 2.00 | 2.00 | 0.045 | 0.030 | 16.0-19.0 | 6.0-9.5 | 0.80 | N 0.11 |
| JIS G 4304:2012 | Symbol SUS301 | --- | --- | 0.15 | 2.00 | 1.00 | 0.045 | 0.030 | 16.00-18.00 | 6.00-8.00 | --- | --- |
| | Symbol SUS301J1 | --- | --- | 0.08-0.12 | 2.00 | 1.00 | 0.045 | 0.030 | 16.00-18.00 | 7.00-9.00 | --- | --- |
| JIS G 4305:2012 | Symbol SUS301 | --- | --- | 0.15 | 2.00 | 1.00 | 0.045 | 0.030 | 16.00-18.00 | 6.00-8.00 | --- | --- |
| | Symbol SUS301J1 | --- | --- | 0.08-0.12 | 2.00 | 1.00 | 0.045 | 0.030 | 16.00-18.00 | 7.00-9.00 | --- | --- |
| SAE J405 JUN98 | Type 301 | S30100 | --- | 0.15 | 2.00 | 1.00 | 0.045 | 0.030 | 16.00-18.00 | 6.00-8.00 | --- | N 0.10 |
| ASME SA-240/SA-240M | Type 301L | S30103 | --- | 0.03 | 2.00 | 1.00 | 0.045 | 0.030 | 16.0-18.0 | 6.0-8.0 | --- | N 0.20 |
| ASME SA-666 | Type 301L | S30103 | --- | 0.03 | 2.00 | 1.00 | 0.045 | 0.030 | 16.0-18.0 | 6.0-8.0 | --- | N 0.20 |
| ASTM A240/A240M-15a | Type 301L | S30103 | --- | 0.03 | 2.00 | 1.00 | 0.045 | 0.030 | 16.0-18.0 | 6.0-8.0 | --- | N 0.20 |
| ASTM A666-15 | Type 301L | S30103 | --- | 0.03 | 2.00 | 1.00 | 0.045 | 0.030 | 16.0-18.0 | 6.0-8.0 | --- | N 0.20 |
| JIS G 4304:2012 | Symbol SUS301L | --- | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 16.00-18.00 | 6.00-8.00 | --- | N 0.20 |
| JIS G 4305:2012 | Symbol SUS301L | --- | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 16.00-18.00 | 6.00-8.00 | --- | N 0.20 |
| ASME SA-240/SA-240M | Type 301LN | S30153 | --- | 0.03 | 2.00 | 1.00 | 0.045 | 0.030 | 16.0-18.0 | 6.0-8.0 | --- | N 0.07-0.20 |
| ASME SA-666 | Type 301LN | S30153 | --- | 0.03 | 2.00 | 1.00 | 0.045 | 0.030 | 16.0-18.0 | 6.0-8.0 | --- | N 0.07-0.20 |
| ASTM A240/A240M-15a | Type 301LN | S30153 | --- | 0.03 | 2.00 | 1.00 | 0.045 | 0.030 | 16.0-18.0 | 6.0-8.0 | --- | N 0.07-0.20 |
| ASTM A666-15 | Type 301LN | S30153 | --- | 0.03 | 2.00 | 1.00 | 0.045 | 0.030 | 16.0-18.0 | 6.0-8.0 | --- | N 0.07-0.20 |
| EN 10028-7:2007 | X2CrNiN18-7 | --- | 1.4318 | 0.030 | 2.00 | 1.00 | 0.045 | 0.015 | 16.5-18.5 | 6.0-8.0 | --- | N 0.10-0.20 |
| EN 10088-2:2014 | X2CrNiN18-7 | --- | 1.4318 | 0.030 | 2.00 | 1.00 | 0.045 | 0.015 | 16.5-18.5 | 6.0-8.0 | --- | N 0.10-0.20 |
| ISO 9328-7:2004 | Grade X2CrNiN18-7 | --- | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.015 | 16.5-18.5 | 6.0-8.0 | --- | N 0.10-0.20 |
| ASME SA-240/SA-240M | Type 302 | S30200 | --- | 0.15 | 2.00 | 0.75 | 0.045 | 0.030 | 17.0-19.0 | 8.0-10.0 | --- | N 0.10 |
| ASME SA-666 | Type 302 | S30200 | --- | 0.15 | 2.00 | 0.75 | 0.045 | 0.030 | 17.0-19.0 | 8.0-10.0 | --- | --- |
| ASTM A240/A240M-15a | Type 302 | S30200 | --- | 0.15 | 2.00 | 0.75 | 0.045 | 0.030 | 17.0-19.0 | 8.0-10.0 | --- | N 0.10 |
| ASTM A666-15 | Type 302 | S30200 | --- | 0.15 | 2.00 | 0.75 | 0.045 | 0.030 | 17.0-19.0 | 8.0-10.0 | --- | --- |
| JIS G 4304:2012 | Symbol SUS303 | --- | --- | 0.15 | 2.00 | 1.00 | 0.20 | 0.15 | 17.00-19.00 | 8.00-10.00 | 0.60 | --- |
| SAE J405 JUN98 | Type 302 | S30200 | --- | 0.15 | 2.00 | 0.75 | 0.045 | 0.030 | 17.00-19.00 | 8.00-10.00 | --- | N 0.10 |

**8.1 Stainless Steels: Plates, Sheet and Strip**

**8.1.3A Chemical Composition of Austenitic Stainless Steels (continued)**

| Specification | Designation | UNS No | Steel No | Weight, %, max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| GB 3280-92 | Grade 1Cr18Ni9Si3 | --- | --- | 0.15 | 2.00 | 2.00-3.00 | 0.035 | 0.030 | 17.00-19.00 | 8.00-10.00 | --- | --- |
| GB 4237-92 | Grade 1Cr18Ni9Si3 | --- | --- | 0.15 | 2.00 | 2.00-3.00 | 0.035 | 0.030 | 17.00-19.00 | 8.00-10.00 | --- | --- |
| GB 4238-92 | Grade 1Cr18Ni9Si3 | --- | --- | 0.15 | 2.00 | 2.00-3.00 | 0.035 | 0.030 | 17.00-19.00 | 8.00-10.00 | --- | --- |
| GB 4239-91 | Grade 1Cr18Ni9Si3 | --- | --- | 0.15 | 2.00 | 2.00-3.00 | 0.035 | 0.030 | 17.00-19.00 | 8.00-10.00 | --- | --- |
| JIS G 4304:2012 | Symbol SUS302B | --- | --- | 0.15 | 2.00 | 2.00-3.00 | 0.045 | 0.030 | 17.00-19.00 | 8.00-10.00 | --- | --- |
| JIS G 4305:2012 | Symbol SUS302B | --- | --- | 0.15 | 2.00 | 2.00-3.00 | 0.045 | 0.030 | 17.00-19.00 | 8.00-10.00 | --- | --- |
| ASME SA-240/SA-240M | Type 304 | S30400 | --- | 0.07 | 2.00 | 0.75 | 0.045 | 0.030 | 17.5-19.5 | 8.0-10.5 | --- | N 0.10 |
| ASME SA-666 | Type 304 | S30400 | --- | 0.08 | 2.00 | 0.75 | 0.045 | 0.030 | 18.0-20.0 | 8.0-10.5 | --- | N 0.10 |
| ASTM A240/A240M-15a | Type 304 | S30400 | --- | 0.07 | 2.00 | 0.75 | 0.045 | 0.030 | 17.5-19.5 | 8.0-10.5 | --- | N 0.10 |
| ASTM A666-15 | Type 304 | S30400 | --- | 0.08 | 2.00 | 0.75 | 0.045 | 0.030 | 18.0-20.0 | 8.0-10.5 | --- | N 0.10 |
| EN 10028-7:2007 | X5CrNi18-10 | --- | 1.4301 | 0.07 | 2.00 | 1.00 | 0.045 | 0.015 | 17.5-19.5 | 8.0-10.5 | --- | N 0.10 |
| EN 10088-2:2014 | X5CrNi18-10 | --- | 1.4301 | 0.07 | 2.00 | 1.00 | 0.045 | 0.015 | 17.5-19.5 | 8.0-10.5 | --- | N 0.10 |
| GB 3280-92 | Grade 0Cr18Ni9 | --- | --- | 0.07 | 2.00 | 1.00 | 0.035 | 0.030 | 17.00-19.00 | 8.00-11.00 | --- | --- |
| GB 4237-92 | Grade 0Cr18Ni9 | --- | --- | 0.07 | 2.00 | 1.00 | 0.035 | 0.030 | 17.00-19.00 | 8.00-11.00 | --- | --- |
| GB 4238-92 | Grade 0Cr18Ni9 | --- | --- | 0.07 | 2.00 | 1.00 | 0.035 | 0.030 | 17.00-19.00 | 8.00-11.00 | --- | --- |
| GB 4239-91 | Grade 0Cr18Ni9 | --- | --- | 0.07 | 2.00 | 1.00 | 0.035 | 0.030 | 17.00-19.00 | 8.00-11.00 | --- | --- |
| ISO 16143-1:2004 | X5CrNi18-9 | --- | --- | 0.07 | 2.00 | 1.00 | 0.045 | 0.030 | 17.5-19.5 | 8.0-10.5 | --- | N 0.11 |
| ISO 9328-7:2004 | Grade X5CrNi18-9 | --- | --- | 0.07 | 2.00 | 1.00 | 0.045 | 0.015 | 17.5-19.5 | 8.0-10.5 | --- | N 0.11 |
| JIS G 4304:2012 | Symbol SUS304 | --- | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 18.00-20.00 | 8.00-10.50 | --- | --- |
| JIS G 4305:2012 | Symbol SUS304 | --- | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 18.00-20.00 | 8.00-10.50 | --- | --- |
| SAE J405 JUN98 | Type 304 | S30400 | --- | 0.08 | 2.00 | 0.75 | 0.045 | 0.030 | 18.00-20.00 | 8.00-10.50 | --- | N 0.10 |
| ISO 16143-1:2004 | X6CrNiCu17-8-2 | --- | --- | 0.08 | 3.00 | 1.70 | 0.045 | 0.030 | 15.0-18.0 | 6.0-9.0 | --- | Cu 1.00-3.00 |
| JIS G 4304:2012 | Symbol SUS304J1 | --- | --- | 0.08 | 3.00 | 1.70 | 0.045 | 0.030 | 15.00-18.00 | 6.00-9.00 | --- | Cu 1.00-3.00 |
| JIS G 4305:2012 | Symbol SUS304J1 | --- | --- | 0.08 | 3.00 | 1.70 | 0.045 | 0.030 | 15.00-18.00 | 6.00-9.00 | --- | Cu 1.00-3.00 |

**8.1 Stainless Steels: Plates, Sheet and Strip**

**8.1.3A Chemical Composition of Austenitic Stainless Steels (Continued)**

| Specification | Designation | UNS No | Steel No | Weight, %, max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASME SA-240/SA-240M | Type 304L | S30403 | --- | 0.030 | 2.00 | 0.75 | 0.045 | 0.030 | 17.5-19.5 | 8.0-12.0 | --- | N 0.10 |
| ASME SA-666 | Type 304L | S30403 | --- | 0.030 | 2.00 | 0.75 | 0.045 | 0.030 | 18.0-20.0 | 8.0-12.0 | --- | N 0.10 |
| ASTM A240/A240M-15a | Type 304L | S30403 | --- | 0.030 | 2.00 | 0.75 | 0.045 | 0.030 | 17.5-19.5 | 8.0-12.0 | --- | N 0.10 |
| ASTM A666-15 | Type 304L | S30403 | --- | 0.030 | 2.00 | 0.75 | 0.045 | 0.030 | 18.0-20.0 | 8.0-12.0 | --- | N 0.10 |
| EN 10028-7:2007 | X2CrNi19-11 | --- | 1.4306 | 0.030 | 2.00 | 1.00 | 0.045 | 0.015 | 18.0-20.0 | 10.0-12.0 | --- | N 0.10 |
| | X2CrNi18-9 | --- | 1.4307 | 0.030 | 2.00 | 1.00 | 0.045 | 0.015 | 17.5-19.5 | 8.0-10.5 | --- | N 0.10 |
| EN 10088-2:2014 | X2CrNi19-11 | --- | 1.4306 | 0.030 | 2.00 | 1.00 | 0.045 | 0.015 | 18.0-20.0 | 10.0-12.0 | --- | N 0.10 |
| | X2CrNi18-9 | --- | 1.4307 | 0.030 | 2.00 | 1.00 | 0.045 | 0.015 | 17.5-19.5 | 8.0-10.5 | --- | N 0.10 |
| GB 3280-92 | Grade 00Cr19Ni10 | --- | --- | 0.030 | 2.00 | 1.00 | 0.035 | 0.030 | 18.00-20.00 | 8.00-12.00 | --- | --- |
| | Grade 00Cr19Ni13Mo3 | --- | --- | 0.030 | 2.50 | 1.00 | 0.035 | 0.030 | 18.00-20.00 | 11.00-15.00 | --- | --- |
| GB 4237-92 | Grade 00Cr19Ni10 | --- | --- | 0.030 | 2.00 | 1.00 | 0.035 | 0.030 | 18.00-20.00 | 8.00-12.00 | --- | --- |
| GB 4239-91 | Grade 00Cr19Ni10 | --- | --- | 0.030 | 2.00 | 1.00 | 0.035 | 0.030 | 18.00-20.00 | 8.00-12.00 | --- | --- |
| ISO 16143-1:2004 | X2CrNi18-9 | --- | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 17.5-19.5 | 8.0-10.0 | --- | N 0.11 |
| | X2CrNi19-11 | --- | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 18.0-20.0 | 10.0-12.0 | --- | N 0.11 |
| ISO 9328-7:2004 | Grade X2CrNi18-9 | --- | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.015 | 17.5-19.5 | 8.0-10.0 | --- | N 0.11 |
| | Grade X2CrNi19-11 | --- | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.015 | 18.0-20.0 | 10.0-12.0 | --- | N 0.11 |
| JIS G 4304:2012 | Symbol SUS304L | --- | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 18.00-20.00 | 9.00-13.00 | --- | --- |
| JIS G 4305:2012 | Symbol SUS304L | --- | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 18.00-20.00 | 9.00-13.00 | --- | --- |
| SAE J405 JUN98 | Type 304L | S30403 | --- | 0.030 | 2.00 | 0.75 | 0.045 | 0.030 | 18.00-20.00 | 8.00-12.00 | --- | N 0.10 |
| ASME SA-240/SA-240M | Type 304H | S30409 | --- | 0.04-0.10 | 2.00 | 0.75 | 0.045 | 0.030 | 18.0-20.0 | 8.0-10.5 | --- | --- |
| ASTM A240/A240M-15a | Type 304H | S30409 | --- | 0.04-0.10 | 2.00 | 0.75 | 0.045 | 0.030 | 18.0-20.0 | 8.0-10.5 | --- | --- |
| EN 10028-7:2007 | X6CrNi18-10 | --- | 1.4948 | 0.04-0.08 | 2.00 | 1.00 | 0.035 | 0.015 | 17.0-19.0 | 8.0-11.0 | --- | N 0.10 |
| ISO 9328-7:2004 | Grade X6CrNi18-10 | --- | --- | 0.04-0.08 | 2.00 | 1.00 | 0.035 | 0.015 | 17.0-19.0 | 8.0-11.0 | --- | N 0.11 |
| ISO 4955:2005 | X7CrNi18-9 | --- | --- | 0.04-0.10 | 2.00 | 1.00 | 0.045 | 0.030 | 17.0-19.0 | 8.0-11.0 | --- | --- |
| SAE J405 JUN98 | Type 304H | S30409 | --- | 0.04-0.10 | 2.00 | 0.75 | 0.045 | 0.030 | 18.00-20.00 | 8.00-10.50 | --- | --- |
| ASME SA-240/SA-240M | Type 304N | S30451 | --- | 0.08 | 2.00 | 0.75 | 0.045 | 0.030 | 18.0-20.0 | 8.0-10.5 | --- | N 0.10-0.16 |
| ASME SA-666 | Type 304N | S30451 | --- | 0.08 | 2.00 | 0.75 | 0.045 | 0.030 | 18.0-20.0 | 8.0-10.5 | --- | N 0.10-0.16 |
| ASTM A240/A240M-15a | Type 304N | S30451 | --- | 0.08 | 2.00 | 0.75 | 0.045 | 0.030 | 18.0-20.0 | 8.0-10.5 | --- | N 0.10-0.16 |
| ASTM A666-15 | Type 304N | S30451 | --- | 0.08 | 2.00 | 0.75 | 0.045 | 0.030 | 18.0-20.0 | 8.0-10.5 | --- | N 0.10-0.16 |
| EN 10028-7:2007 | X5CrNiN19-9 | --- | 1.4315 | 0.06 | 2.00 | 1.00 | 0.045 | 0.015 | 18.0-20.0 | 8.0-11.0 | --- | N 0.12-0.22 |
| EN 10088-2:2014 | X5CrNiN19-9 | --- | 1.4315 | 0.06 | 2.00 | 1.00 | 0.045 | 0.015 | 18.0-20.0 | 8.0-11.0 | --- | N 0.12-0.22 |
| GB 3280-92 | Grade 0Cr19Ni9N | --- | --- | 0.08 | 2.50 | 1.00 | 0.035 | 0.030 | 18.00-20.00 | 7.00-10.50 | --- | N 0.10-0.25 |
| GB 4237-92 | Grade 0Cr19Ni9N | --- | --- | 0.08 | 2.50 | 1.00 | 0.035 | 0.030 | 18.00-20.00 | 7.00-10.50 | --- | N 0.10-0.25 |
| GB 4239-91 | Grade 0Cr19Ni9N | --- | --- | 0.08 | 2.50 | 1.00 | 0.035 | 0.030 | 18.00-20.00 | 7.00-10.50 | --- | N 0.10-0.25 |
| ISO 9328-7:2004 | Grade X5CrNiN18-8 | --- | --- | 0.07 | 2.50 | 1.00 | 0.045 | 0.015 | 18.0-20.0 | 8.0-11.0 | --- | N 0.10-0.16 |
| JIS G 4304:2012 | Symbol SUS304N1 | --- | --- | 0.08 | 2.50 | 1.00 | 0.045 | 0.030 | 18.00-20.00 | 7.00-10.50 | --- | N 0.10-0.25 |
| JIS G 4305:2012 | Symbol SUS304N1 | --- | --- | 0.08 | 2.50 | 1.00 | 0.045 | 0.030 | 18.00-20.00 | 7.00-10.50 | --- | N 0.10-0.25 |
| SAE J405 JUN98 | Type 304N | S30451 | --- | 0.08 | 2.00 | 0.75 | 0.045 | 0.030 | 18.00-20.00 | 8.00-10.50 | --- | N 0.10-0.16 |

**8.1 Stainless Steels: Plates, Sheet and Strip**

**8.1.3A Chemical Composition of Austenitic Stainless Steels (Continued)**

| Specification | Designation | UNS No | Steel No | Weight, %, max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| GB 3280-92 | Grade 0Cr19Ni10NbN | --- | --- | 0.08 | 2.50 | 1.00 | 0.035 | 0.030 | 18.00-20.00 | 7.50-10.50 | --- | Nb 0.15; N 0.15-0.30 |
| GB 4237-92 | Grade 0Cr19Ni10NbN | --- | --- | 0.08 | 2.50 | 1.00 | 0.035 | 0.030 | 18.00-20.00 | 7.50-10.50 | --- | Nb 0.15; N 0.15-0.30 |
| GB 4239-91 | Grade 0Cr19Ni10NbN | --- | --- | 0.08 | 2.50 | 1.00 | 0.035 | 0.030 | 18.00-20.00 | 7.50-10.50 | --- | Nb 0.15; N 0.15-0.30 |
| JIS G 4304:2012 | Symbol SUS304N2 | --- | --- | 0.08 | 2.50 | 1.00 | 0.045 | 0.030 | 18.00-20.00 | 7.50-10.50 | --- | Nb 0.15; N 0.15-0.30 |
| | Symbol SUS304N2-X | --- | --- | 0.08 | 2.50 | 1.00 | 0.045 | 0.030 | 18.00-20.00 | 7.50-10.50 | --- | Nb 0.15; N 0.15-0.30 |
| JIS G 4305:2012 | Symbol SUS304N2 | --- | --- | 0.08 | 2.50 | 1.00 | 0.045 | 0.030 | 18.00-20.00 | 7.50-10.50 | --- | Nb 0.15; N 0.15-0.30 |
| ASME SA-240/SA-240M | Type 304LN | S30453 | --- | 0.030 | 2.00 | 0.75 | 0.045 | 0.030 | 18.0-20.0 | 8.0-12.0 | --- | N 0.10-0.16 |
| ASME SA-666 | Type 304LN | S30453 | --- | 0.030 | 2.00 | 0.75 | 0.045 | 0.030 | 18.0-20.0 | 8.0-12.0 | --- | N 0.10-0.16 |
| ASTM A240/A240M-15a | Type 304LN | S30453 | --- | 0.030 | 2.00 | 0.75 | 0.045 | 0.030 | 18.0-20.0 | 8.0-12.0 | --- | N 0.10-0.16 |
| ASTM A666-15 | Type 304LN | S30453 | --- | 0.030 | 2.00 | 0.75 | 0.045 | 0.030 | 18.0-20.0 | 8.0-12.0 | --- | N 0.10-0.16 |
| EN 10028-7:2007 | X2CrNiN18-10 | --- | 1.4311 | 0.030 | 2.00 | 1.00 | 0.045 | 0.015 | 17.5-19.5 | 8.5-11.5 | --- | N 0.12-0.22 |
| EN 10088-2:2014 | X2CrNiN18-10 | --- | 1.4311 | 0.030 | 2.00 | 1.00 | 0.045 | 0.015 | 17.5-19.5 | 8.5-11.5 | --- | N 0.12-0.22 |
| GB 3280-92 | Grade 00Cr18Ni10N | --- | --- | 0.030 | 2.00 | 1.00 | 0.035 | 0.030 | 17.00-19.00 | 8.50-11.50 | --- | N 0.12-0.22 |
| GB 4237-92 | Grade 00Cr18Ni10N | --- | --- | 0.030 | 2.00 | 1.00 | 0.035 | 0.030 | 17.00-19.00 | 8.50-11.50 | --- | N 0.12-0.22 |
| GB 4239-91 | Grade 00Cr18Ni10N | --- | --- | 0.030 | 2.00 | 1.00 | 0.035 | 0.030 | 17.00-19.00 | 8.50-11.50 | --- | N 0.12-0.22 |
| ISO 16143-1:2004 | X2CrNiN18-9 | --- | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 17.5-19.5 | 8.0-10.0 | --- | N 0.12-0.22 |
| ISO 9328-7:2004 | Grade X2CrNiN18-10 | --- | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.015 | 17.5-19.5 | 8.0-11.5 | --- | N 0.12-0.22 |
| JIS G 4304:2012 | Symbol SUS304LN | --- | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 17.00-19.00 | 8.50-11.50 | --- | N 0.12-0.22 |
| JIS G 4305:2012 | Symbol SUS304LN | --- | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 17.00-19.00 | 8.50-11.50 | --- | N 0.12-0.22 |
| SAE J405 JUN98 | Type 304LN | S30453 | --- | 0.030 | 2.00 | 0.75 | 0.045 | 0.030 | 18.00-20.00 | 8.00-12.00 | --- | N 0.10-0.16 |
| ASME SA-240/SA-240M | Type 305 | S30500 | --- | 0.12 | 2.00 | 0.75 | 0.045 | 0.030 | 17.0-19.0 | 10.5-13.0 | --- | --- |
| ASTM A240/A240M-15a | Type 305 | S30500 | --- | 0.12 | 2.00 | 0.75 | 0.045 | 0.030 | 17.0-19.0 | 10.5-13.0 | --- | --- |
| EN 10088-2:2014 | X4CrNi18-12 | --- | 1.4303 | 0.06 | 2.00 | 1.00 | 0.045 | 0.015 | 17.0-19.0 | 11.0-13.0 | --- | N 0.10 |
| GB 3280-92 | Grade 1Cr18Ni12 | --- | --- | 0.12 | 2.00 | 1.00 | 0.035 | 0.030 | 17.00-19.00 | 10.50-13.00 | --- | --- |
| GB 4237-92 | Grade 1Cr18Ni12 | --- | --- | 0.12 | 2.00 | 1.00 | 0.035 | 0.030 | 17.00-19.00 | 10.50-13.00 | --- | --- |
| GB 4239-91 | Grade 1Cr18Ni12 | --- | --- | 0.12 | 2.00 | 1.00 | 0.035 | 0.030 | 17.00-19.00 | 10.50-13.00 | --- | --- |
| JIS G 4304:2012 | Symbol SUS305 | --- | --- | 0.12 | 2.00 | 1.00 | 0.045 | 0.030 | 17.00-19.00 | 10.50-13.00 | --- | --- |
| JIS G 4305:2012 | Symbol SUS305 | --- | --- | 0.12 | 2.00 | 1.00 | 0.045 | 0.030 | 17.00-19.00 | 10.50-13.00 | --- | --- |
| SAE J405 JUN98 | Type 305 | S30500 | --- | 0.12 | 2.00 | 0.75 | 0.045 | 0.030 | 17.00-19.00 | 10.50-13.00 | --- | --- |
| ASME SA-240/SA-240M | --- | S30600 | --- | 0.018 | 2.00 | 3.7-4.3 | 0.020 | 0.020 | 17.0-18.5 | 14.0-15.5 | 0.20 | Cu 0.50 |
| ASTM A240/A240M-15a | --- | S30600 | --- | 0.018 | 2.00 | 3.7-4.3 | 0.020 | 0.020 | 17.0-18.5 | 14.0-15.5 | 0.20 | Cu 0.50 |
| EN 10088-2:2014 | X1CrNiSi18-15-4 | --- | 1.4361 | 0.015 | 2.00 | 3.7-4.5 | 0.025 | 0.010 | 16.5-18.5 | 14.0-16.0 | 0.20 | N 0.10 |
| SAE J405 JUN98 | --- | S30600 | --- | 0.018 | 2.00 | 3.7-4.3 | 0.020 | 0.020 | 17.0-18.5 | 14.0-15.5 | 0.20 | Cu 0.50 |
| GB 4238-92 | Grade 2Cr23Ni13 | --- | --- | 0.20 | 2.00 | 1.00 | 0.035 | 0.030 | 22.00-24.00 | 12.00-15.00 | --- | --- |
| JIS G 4312:2011 | Symbol SUH309 | --- | --- | 0.20 | 2.00 | 1.00 | 0.040 | 0.030 | 22.00-24.00 | 12.00-15.00 | --- | --- |

**8.1 Stainless Steels: Plates, Sheet and Strip**

**8.1.3A Chemical Composition of Austenitic Stainless Steels (Continued)**

| Specification | Designation | UNS No | Steel No | Weight, %, max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASME SA-240/SA-240M | Type 309S | S30908 | --- | 0.08 | 2.00 | 0.75 | 0.045 | 0.030 | 22.0-24.0 | 12.0-15.0 | --- | --- |
| ASTM A240/A240M-15a | Type 309S | S30908 | --- | 0.08 | 2.00 | 0.75 | 0.045 | 0.030 | 22.0-24.0 | 12.0-15.0 | --- | --- |
| EN 10095:1999 | X12CrNi23-13 | --- | 1.4833 | 0.15 | 2.00 | 1.00 | 0.045 | 0.015 | 22.00-24.00 | 12.00-14.00 | --- | N 0.11 |
| GB 3280-92 | Grade 0Cr23Ni13 | --- | --- | 0.08 | 2.00 | 1.50 | 0.035 | 0.030 | 22.00-24.00 | 12.00-15.00 | --- | --- |
| GB 4237-92 | Grade 0Cr23Ni13 | --- | --- | 0.08 | 2.00 | 1.00 | 0.035 | 0.030 | 22.00-24.00 | 12.00-15.00 | --- | --- |
| GB 4238-92 | Grade 0Cr23Ni13 | --- | --- | 0.08 | 2.00 | 1.00 | 0.035 | 0.030 | 22.00-24.00 | 12.00-15.00 | --- | --- |
| GB 4239-91 | Grade 0Cr23Ni13 | --- | --- | 0.08 | 2.00 | 1.00 | 0.035 | 0.030 | 22.00-24.00 | 12.00-15.00 | --- | --- |
| ISO 4955:2005 | X12CrNi23-13 | --- | --- | 0.15 | 2.00 | 1.00 | 0.045 | 0.015 | 22.0-24.0 | 12.0-14.0 | --- | N 0.11 |
| JIS G 4304:2012 | Symbol SUS309S | --- | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 22.00-24.00 | 12.00-15.00 | --- | --- |
| JIS G 4305:2012 | Symbol SUS309S | --- | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 22.00-24.00 | 12.00-15.00 | --- | --- |
| SAE J405 JUN98 | Type 309S | S30908 | --- | 0.08 | 2.00 | 0.75 | 0.045 | 0.030 | 22.00-24.00 | 12.00-15.00 | --- | --- |
| ASME SA-240/SA-240M | Type 309H | S30909 | --- | 0.04-0.10 | 2.00 | 0.75 | 0.045 | 0.030 | 22.0-24.0 | 12.0-15.0 | --- | --- |
| ASTM A240/A240M-15a | Type 309H | S30909 | --- | 0.04-0.10 | 2.00 | 0.75 | 0.045 | 0.030 | 22.0-24.0 | 12.0-15.0 | --- | --- |
| EN 10028-7:2007 | X6CrNi23-13 | --- | 1.4950 | 0.04-0.08 | 2.00 | 0.70 | 0.035 | 0.015 | 22.0-24.0 | 12.0-15.0 | --- | N 0.10 |
| ISO 9328-7:2004 | Grade X6CrNi23-13 | --- | --- | 0.04-0.08 | 2.00 | 0.70 | 0.035 | 0.015 | 22.0-24.0 | 12.0-15.0 | --- | N 0.11 |
| SAE J405 JUN98 | Type 309H | S30909 | --- | 0.04-0.10 | 2.00 | 0.75 | 0.045 | 0.030 | 22.00-24.00 | 12.00-15.00 | --- | --- |
| GB 4238-92 | Grade 1Cr25Ni20Si2 | --- | --- | 0.20 | 1.50 | 1.50-2.50 | 0.035 | 0.030 | 24.00-27.00 | 18.00-21.00 | --- | --- |
| | Grade 2Cr25Ni20 | --- | --- | 0.25 | 2.00 | 1.50 | 0.035 | 0.030 | 24.00-26.00 | 19.00-22.00 | --- | --- |
| JIS G 4312:2011 | Symbol SUH310 | --- | --- | 0.25 | 2.00 | 1.50 | 0.040 | 0.030 | 24.00-26.00 | 19.00-22.00 | --- | --- |
| EN 10095:1999 | X15CrNiSi25-21 | --- | 1.4841 | 0.20 | 2.00 | 1.50-2.50 | 0.045 | 0.015 | 24.00-26.00 | 19.00-22.00 | --- | N 0.11 |
| ASME SA-240/SA-240M | Type 310S | S31008 | --- | 0.08 | 2.00 | 1.50 | 0.045 | 0.030 | 24.0-26.0 | 19.0-22.0 | --- | --- |
| ASTM A240/A240M-15a | Type 310S | S31008 | --- | 0.08 | 2.00 | 1.50 | 0.045 | 0.030 | 24.0-26.0 | 19.0-22.0 | --- | --- |
| EN 10095:1999 | X8CrNi25-21 | --- | 1.4845 | 0.10 | 2.00 | 1.50 | 0.045 | 0.015 | 24.00-26.00 | 19.00-22.00 | --- | N 0.11 |
| GB 3280-92 | Grade 0Cr25Ni20 | --- | --- | 0.08 | 2.00 | 1.00 | 0.035 | 0.030 | 24.00-26.00 | 19.00-22.00 | --- | --- |
| GB 4237-92 | Grade 0Cr25Ni20 | --- | --- | 0.08 | 2.00 | 1.00 | 0.035 | 0.030 | 24.00-26.00 | 19.00-22.00 | --- | --- |
| GB 4238-92 | Grade 0Cr25Ni20 | --- | --- | 0.08 | 2.00 | 1.00 | 0.035 | 0.030 | 24.00-26.00 | 19.00-22.00 | --- | --- |
| GB 4239-91 | Grade 0Cr25Ni20 | --- | --- | 0.08 | 2.00 | 1.50 | 0.035 | 0.030 | 24.00-26.00 | 19.00-22.00 | --- | --- |
| ISO 4955:2005 | X8CrNi25-21 | --- | --- | 0.10 | 2.00 | 1.50 | 0.045 | 0.015 | 24.0-26.0 | 19.0-22.0 | --- | N 0.11 |
| JIS G 4304:2012 | Symbol SUS310S | --- | --- | 0.08 | 2.00 | 1.50 | 0.045 | 0.030 | 24.00-26.00 | 19.00-22.00 | --- | --- |
| JIS G 4305:2012 | Symbol SUS310S | --- | --- | 0.08 | 2.00 | 1.50 | 0.045 | 0.030 | 24.00-26.00 | 19.00-22.00 | --- | --- |
| SAE J405 JUN98 | Type 310S | S31008 | --- | 0.08 | 2.00 | 1.50 | 0.045 | 0.030 | 24.00-26.00 | 19.00-22.00 | --- | --- |
| ASME SA-240/SA-240M | Type 310H | S31009 | --- | 0.04-0.10 | 2.00 | 0.75 | 0.045 | 0.030 | 24.0-26.0 | 19.0-22.0 | --- | --- |
| ASTM A240/A240M-15a | Type 310H | S31009 | --- | 0.04-0.10 | 2.00 | 0.75 | 0.045 | 0.030 | 24.0-26.0 | 19.0-22.0 | --- | --- |
| EN 10028-7:2007 | X6CrNi25-20 | --- | 1.4951 | 0.04-0.08 | 2.00 | 0.70 | 0.035 | 0.015 | 24.0-26.0 | 19.0-22.0 | --- | N 0.10 |
| ISO 9328-7:2004 | Grade X6CrNi25-20 | --- | --- | 0.04-0.08 | 2.00 | 0.70 | 0.035 | 0.015 | 24.0-26.0 | 19.0-22.0 | --- | N 0.11 |
| SAE J405 JUN98 | Type 310H | S31009 | --- | 0.04-0.10 | 2.00 | 0.75 | 0.045 | 0.030 | 24.00-26.00 | 19.00-22.00 | --- | --- |

**8.1 Stainless Steels: Plates, Sheet and Strip**

**8.1.3A Chemical Composition of Austenitic Stainless Steels (Continued)**

| Specification | Designation | UNS No | Steel No | Weight, %, max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASME SA-240/SA-240M | Type 310 MoLN | S31050 | --- | 0.020 | 2.00 | 0.50 | 0.030 | 0.010 | 24.0-26.0 | 20.5-23.5 | 1.60-2.60 | N 0.09-0.15 |
| ASTM A240/A240M-15a | Type 310 MoLN | S31050 | --- | 0.020 | 2.00 | 0.50 | 0.030 | 0.010 | 24.0-26.0 | 20.5-23.5 | 1.60-2.60 | N 0.09-0.15 |
| EN 10028-7:2007 | X1CrNiMoN25-22-2 | --- | 1.4466 | 0.020 | 2.00 | 0.70 | 0.025 | 0.010 | 24.0-26.0 | 21.0-23.0 | 2.00-2.50 | N 0.10-0.16 |
| EN 10088-2:2014 | X1CrNiMoN25-22-2 | --- | 1.4466 | 0.020 | 2.00 | 0.70 | 0.025 | 0.010 | 24.0-26.0 | 21.0-23.0 | 2.00-2.50 | N 0.10-0.16 |
| ISO 16143-1:2004 | X1CrNiMoN25-22-2 | --- | --- | 0.020 | 2.00 | 0.70 | 0.025 | 0.010 | 24.0-26.0 | 21.0-23.0 | 2.00-2.50 | N 0.10-0.16 |
| ISO 9328-7:2004 | Grade X1CrNiMoN25-22-2 | --- | --- | 0.020 | 2.00 | 0.70 | 0.025 | 0.010 | 24.0-26.0 | 21.0-23.0 | 2.00-2.50 | N 0.10-0.16 |
| SAE J405 JUN98 | Type 310 MoLN | S31050 | --- | 0.030 | 2.00 | 0.50 | 0.030 | 0.010 | 24.00-26.00 | 21.00-23.00 | 2.00-3.00 | N 0.10-0.16 |
| ASME SA-240/SA-240M | --- | S31254 | --- | 0.020 | 1.00 | 0.80 | 0.030 | 0.010 | 19.5-20.5 | 17.5-18.5 | 6.0-6.5 | Cu 0.50-1.00; N 0.18-0.22 |
| ASTM A240/A240M-15a | --- | S31254 | --- | 0.020 | 1.00 | 0.80 | 0.030 | 0.010 | 19.5-20.5 | 17.5-18.5 | 6.0-6.5 | Cu 0.50-1.00; N 0.18-0.25 |
| EN 10028-7:2007 | X1CrNiMoCuN20-18-7 | --- | 1.4547 | 0.020 | 1.00 | 0.70 | 0.030 | 0.010 | 19.5-20.5 | 17.5-18.5 | 6.0-7.0 | Cu 0.50-1.00; N 0.18-0.25 |
| EN 10088-2:2014 | X1CrNiMoCuN20-18-7 | --- | 1.4547 | 0.020 | 1.00 | 0.70 | 0.030 | 0.010 | 19.5-20.5 | 17.5-18.5 | 6.0-7.0 | Cu 0.50-1.00; N 0.18-0.25 |
| ISO 9328-7:2004 | Grade X1CrNiMoCuN20-18-7 | --- | --- | 0.020 | 1.00 | 0.70 | 0.030 | 0.010 | 19.5-20.5 | 17.5-18.5 | 6.0-7.0 | Cu 0.50-1.00; N 0.18-0.25 |
| JIS G 4304:2012 | Symbol SUS312L | --- | --- | 0.020 | 1.00 | 0.80 | 0.030 | 0.015 | 19.00-21.00 | 17.50-19.50 | 6.00-7.00 | Cu 0.50-1.00; N 0.16-0.25 |
| JIS G 4305:2012 | Symbol SUS312L | --- | --- | 0.020 | 1.00 | 0.80 | 0.030 | 0.015 | 19.00-21.00 | 17.50-19.50 | 6.00-7.00 | Cu 0.50-1.00; N 0.16-0.25 |
| SAE J405 JUN98 | --- | S31254 | --- | 0.020 | 1.00 | 0.80 | 0.030 | 0.010 | 19.50-20.50 | 17.50-18.50 | 6.00-6.50 | Cu 0.50-1.00; N 0.18-0.22 |
| ASME SA-240/SA-240M | Type 316 | S31600 | --- | 0.08 | 2.00 | 0.75 | 0.045 | 0.030 | 16.0-18.0 | 10.0-14.0 | 2.00-3.00 | N 0.10 |
| ASME SA-666 | Type 316 | S31600 | --- | 0.08 | 2.00 | 0.75 | 0.045 | 0.030 | 16.0-18.0 | 10.0-14.0 | 2.00-3.00 | --- |
| ASTM A240/A240M-15a | Type 316 | S31600 | --- | 0.08 | 2.00 | 0.75 | 0.045 | 0.030 | 16.0-18.0 | 10.0-14.0 | 2.00-3.00 | N 0.10 |
| ASTM A666-15 | Type 316 | S31600 | --- | 0.08 | 2.00 | 0.75 | 0.045 | 0.030 | 16.0-18.0 | 10.0-14.0 | 2.00-3.00 | --- |
| EN 10028-7:2007 | X5CrNiMo17-12-2 | --- | 1.4401 | 0.07 | 2.00 | 1.00 | 0.045 | 0.015 | 16.5-18.5 | 10.0-13.0 | 2.00-2.50 | N 0.10 |
| | X3CrNiMo17-13-3 | --- | 1.4436 | 0.05 | 2.00 | 1.00 | 0.045 | 0.015 | 16.5-18.5 | 10.5-13.0 | 2.50-3.00 | N 0.10 |
| EN 10088-2:2014 | X5CrNiMo17-12-2 | --- | 1.4401 | 0.07 | 2.00 | 1.00 | 0.045 | 0.015 | 16.5-18.5 | 10.0-13.0 | 2.00-2.50 | N 0.10 |
| | X3CrNiMo17-13-3 | --- | 1.4436 | 0.05 | 2.00 | 1.00 | 0.045 | 0.015 | 16.5-18.5 | 10.5-13.0 | 2.50-3.00 | N 0.10 |
| GB 3280-92 | Grade 0Cr17Ni12Mo2 | --- | --- | 0.08 | 2.00 | 1.00 | 0.035 | 0.030 | 16.00-18.00 | 10.00-14.00 | 2.00-3.00 | --- |
| GB 4237-92 | Grade 0Cr17Ni12Mo2 | --- | --- | 0.08 | 2.00 | 1.00 | 0.035 | 0.030 | 16.00-18.00 | 10.00-14.00 | 2.00-3.00 | --- |
| GB 4238-92 | Grade 0Cr17Ni12Mo2 | --- | --- | 0.08 | 2.00 | 1.00 | 0.035 | 0.030 | 16.00-18.00 | 10.00-14.00 | 2.00-3.00 | --- |
| GB 4239-91 | Grade 0Cr17Ni12Mo2 | --- | --- | 0.08 | 2.00 | 1.00 | 0.035 | 0.030 | 16.00-18.00 | 10.00-14.00 | 2.00-3.00 | --- |
| ISO 16143-1:2004 | X5CrNiMo17-12-2 | --- | --- | 0.07 | 2.00 | 1.00 | 0.045 | 0.030 | 16.5-18.5 | 10.0-13.0 | 2.00-3.00 | N 0.11 |
| | X3CrNiMo17-12-3 | --- | --- | 0.05 | 2.00 | 1.00 | 0.045 | 0.030 | 16.5-18.5 | 10.5-13.0 | 2.50-3.00 | N 0.11 |
| ISO 9328-7:2004 | Grade X3CrNiMo17-12-3 | --- | --- | 0.05 | 2.00 | 1.00 | 0.045 | 0.015 | 16.5-18.5 | 10.5-13.0 | 2.50-3.00 | N 0.11 |
| | Grade X5CrNiMo17-12-2 | --- | --- | 0.07 | 2.00 | 1.00 | 0.045 | 0.015 | 16.5-18.5 | 10.0-13.0 | 2.00-3.00 | N 0.11 |
| JIS G 4304:2012 | Symbol SUS316 | --- | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 16.00-18.00 | 10.00-14.00 | 2.00-3.00 | --- |
| JIS G 4305:2012 | Symbol SUS316 | --- | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 16.00-18.00 | 10.00-14.00 | 2.00-3.00 | --- |
| SAE J405 JUN98 | Type 316 | S31600 | --- | 0.08 | 2.00 | 0.75 | 0.045 | 0.030 | 16.00-18.00 | 10.00-14.00 | 2.00-3.00 | N 0.10 |

**8.1 Stainless Steels: Plates, Sheet and Strip**

**8.1.3A Chemical Composition of Austenitic Stainless Steels (Continued)**

| Specification | Designation | UNS No | Steel No | Weight, %, max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASME SA-240/SA-240M | Type 316L | S31603 | --- | 0.030 | 2.00 | 0.75 | 0.045 | 0.030 | 16.0-18.0 | 10.0-14.0 | 2.00-3.00 | N 0.10 |
| ASME SA-666 | Type 316L | S31603 | --- | 0.030 | 2.00 | 0.75 | 0.045 | 0.030 | 16.0-18.0 | 10.0-14.0 | 2.00-3.00 | --- |
| ASTM A240/A240M-15a | Type 316L | S31603 | --- | 0.030 | 2.00 | 0.75 | 0.045 | 0.030 | 16.0-18.0 | 10.0-14.0 | 2.00-3.00 | N 0.10 |
| ASTM A666-15 | Type 316L | S31603 | --- | 0.030 | 2.00 | 0.75 | 0.045 | 0.030 | 16.0-18.0 | 10.0-14.0 | 2.00-3.00 | --- |
| EN 10028-7:2007 | X2CrNiMo17-12-2 | --- | 1.4404 | 0.030 | 2.00 | 1.00 | 0.045 | 0.015 | 16.5-18.5 | 10.0-13.0 | 2.00-2.50 | N 0.10 |
| | X2CrNiMo17-12-3 | --- | 1.4432 | 0.030 | 2.00 | 1.00 | 0.045 | 0.015 | 16.5-18.5 | 10.5-13.0 | 2.50-3.00 | N 0.10 |
| | X2CrNiMo18-14-3 | --- | 1.4435 | 0.030 | 2.00 | 1.00 | 0.045 | 0.015 | 17.0-19.0 | 12.5-15.0 | 2.50-3.00 | N 0.10 |
| EN 10088-2:2014 | X2CrNiMo17-12-2 | --- | 1.4404 | 0.030 | 2.00 | 1.00 | 0.045 | 0.015 | 16.5-18.5 | 10.0-13.0 | 2.00-2.50 | N 0.10 |
| | X2CrNiMo17-12-3 | --- | 1.4432 | 0.030 | 2.00 | 1.00 | 0.045 | 0.015 | 16.5-18.5 | 10.5-13.0 | 2.50-3.00 | N 0.10 |
| | X2CrNiMo18-14-3 | --- | 1.4435 | 0.030 | 2.00 | 1.00 | 0.045 | 0.015 | 17.0-19.0 | 12.5-15.0 | 2.50-3.00 | N 0.10 |
| GB 3280-92 | Grade 00Cr17Ni14Mo2 | --- | --- | 0.030 | 2.00 | 1.00 | 0.035 | 0.030 | 16.00-18.00 | 12.00-15.00 | 2.00-3.00 | --- |
| GB 4237-92 | Grade 00Cr17Ni14Mo2 | --- | --- | 0.030 | 2.00 | 1.00 | 0.035 | 0.030 | 16.00-18.00 | 12.00-15.00 | 2.00-3.00 | --- |
| GB 4239-91 | Grade 00Cr17Ni14Mo2 | --- | --- | 0.030 | 2.00 | 1.00 | 0.035 | 0.030 | 16.00-18.00 | 12.00-15.00 | 2.00-3.00 | --- |
| ISO 16143-1:2004 | X2CrNiMo17-12-2 | --- | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 16.5-18.5 | 10.0-13.0 | 2.00-3.00 | N 0.11 |
| | X2CrNiMo17-12-3 | --- | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 16.5-18.5 | 10.5-13.0 | 2.50-3.00 | N 0.11 |
| | X2CrNiMo18-14-3 | --- | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.015 | 17.0-19.0 | 12.5-15.0 | 2.50-3.00 | N 0.11 |
| ISO 9328-7:2004 | Grade X2CrNiMo17-12-2 | --- | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.015 | 16.5-18.5 | 10.0-13.0 | 2.00-3.00 | N 0.11 |
| | Grade X2CrNiMo17-12-3 | --- | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.015 | 16.5-18.5 | 10.5-13.0 | 2.50-3.00 | N 0.11 |
| | Grade X2CrNiMo18-14-3 | --- | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.015 | 17.0-19.0 | 12.5-15.0 | 2.50-3.00 | N 0.11 |
| JIS G 4304:2012 | Symbol SUS316L | --- | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 16.00-18.00 | 12.00-15.00 | 2.00-3.00 | --- |
| JIS G 4305:2012 | Symbol SUS316L | --- | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 16.00-18.00 | 12.00-15.00 | 2.00-3.00 | --- |
| SAE J405 JUN98 | Type 316L | S31603 | --- | 0.030 | 2.00 | 0.75 | 0.045 | 0.030 | 16.00-18.00 | 10.00-14.00 | 2.00-3.00 | N 0.10 |
| GB 4237-92 | Grade 00Cr18Ni12Mo2Cu2 | --- | --- | 0.030 | 2.00 | 1.00 | 0.035 | 0.030 | 17.00-19.00 | 12.00-16.00 | 1.20-2.75 | Cu 1.00-2.50 |
| GB 4239-91 | Grade 00Cr18Ni14Mo2Cu2 | --- | --- | 0.030 | 2.00 | 1.00 | 0.035 | 0.030 | 17.00-19.00 | 12.00-16.00 | 1.20-2.75 | Cu 1.00-2.50 |
| JIS G 4304:2012 | Symbol SUS316J1L | --- | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 17.00-19.00 | 12.00-16.00 | 1.20-2.75 | Cu 1.00-2.50 |
| JIS G 4305:2012 | Symbol SUS316J1L | --- | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 17.00-19.00 | 12.00-16.00 | 1.20-2.75 | Cu 1.00-2.50 |
| GB 3280-92 | Grade 0Cr18Ni12Mo2Cu2 | --- | --- | 0.08 | 2.00 | 1.00 | 0.035 | 0.030 | 17.00-19.00 | 10.00-14.00 | 1.20-2.75 | Cu 1.00-2.50 |
| GB 4237-92 | Grade 0Cr18Ni12Mo2Cu2 | --- | --- | 0.08 | 2.00 | 1.00 | 0.035 | 0.030 | 17.00-19.00 | 10.00-14.00 | 1.20-2.75 | Cu 1.00-2.50 |
| GB 4239-91 | Grade 0Cr18Ni12Mo2Cu2 | --- | --- | 0.08 | 2.00 | 1.00 | 0.035 | 0.030 | 17.00-19.00 | 10.00-14.00 | 1.20-2.75 | Cu 1.00-2.50 |
| JIS G 4304:2012 | Symbol SUS316J1 | --- | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 17.00-19.00 | 10.00-14.00 | 1.20-2.75 | Cu 1.00-2.50 |
| JIS G 4305:2012 | Symbol SUS316J1 | --- | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 17.00-19.00 | 10.00-14.00 | 1.20-2.75 | Cu 1.00-2.50 |

**8.1 Stainless Steels: Plates, Sheet and Strip**

**8.1.3A Chemical Composition of Austenitic Stainless Steels (Continued)**

| Specification | Designation | UNS No | Steel No | Weight, %, max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASME SA-240/SA-240M | Type 316Ti | S31635 | --- | 0.08 | 2.00 | 0.75 | 0.045 | 0.030 | 16.0-18.0 | 10.0-14.0 | 2.00-3.00 | Ti 5x(C+N) to 0.70; N 0.10 |
| ASTM A240/A240M-15a | Type 316Ti | S31635 | --- | 0.08 | 2.00 | 0.75 | 0.045 | 0.030 | 16.0-18.0 | 10.0-14.0 | 2.00-3.00 | Ti 5x(C+N) to 0.70; N 0.10 |
| EN 10028-7:2007 | X6CrNiMoTi17-12-2 | --- | 1.4571 | 0.08 | 2.00 | 1.00 | 0.045 | 0.015 | 16.5-18.5 | 10.5-13.5 | 2.00-2.50 | Ti [5xC] to 0.70 |
| EN 10088-2:2014 | X6CrNiMoTi17-12-2 | --- | 1.4571 | 0.08 | 2.00 | 1.00 | 0.045 | 0.015 | 16.5-18.5 | 10.5-13.5 | 2.00-2.50 | Ti 5xC to 0.70 |
| GB 3280-92 | Grade 0Cr18Ni12Mo2Ti | --- | --- | 0.08 | 2.00 | 1.00 | 0.035 | 0.030 | 16.00-19.00 | 11.00-14.00 | 1.80-2.50 | Ti 5xC to 0.70 |
| GB 4237-92 | Grade 0Cr18Ni12Mo2Ti | --- | --- | 0.08 | 2.00 | 1.00 | 0.035 | 0.030 | 16.00-19.00 | 11.00-14.00 | 1.80-2.50 | Ti 5xC to 0.07 |
| ISO 16143-1:2004 | X6CrNiMoTi17-12-2 | --- | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 16.5-18.5 | 10.5-13.5 | 2.00-2.50 | Ti 5xC to 0.70 |
| ISO 9328-7:2004 | Grade X6CrNiMoTi17-12-2 | --- | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.015 | 16.5-18.5 | 10.5-13.5 | 2.00-2.50 | Ti 5xC to 0.70 |
| JIS G 4304:2012 | Symbol SUS316Ti | --- | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 16.00-18.00 | 10.00-14.00 | 2.00-3.00 | Ti 5xC min |
| JIS G 4305:2012 | Symbol SUS316Ti | --- | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 16.00-18.00 | 10.00-14.00 | 2.00-3.00 | Ti 5xC min |
| SAE J405 JUN98 | Type 316Ti | S31635 | --- | 0.08 | 2.00 | 0.75 | 0.045 | 0.030 | 16.00-18.00 | 10.00-14.00 | 2.0-3.0 | Ti [5x(C+N)] to 0.70; N 0.10 |
| ASME SA-240/SA-240M | Type 316Cb | S31640 | --- | 0.08 | 2.00 | 0.75 | 0.045 | 0.030 | 16.0-18.0 | 10.0-14.0 | 2.00-3.00 | Cb 10xC to 1.10; N 0.10 |
| ASTM A240/A240M-15a | Type 316Cb | S31640 | --- | 0.08 | 2.00 | 0.75 | 0.045 | 0.030 | 16.0-18.0 | 10.0-14.0 | 2.00-3.00 | Cb 10xC to 1.10 ; N 0.10 |
| EN 10028-7:2007 | X6CrNiMoNb17-12-2 | --- | 1.4580 | 0.08 | 2.00 | 1.00 | 0.045 | 0.015 | 16.5-18.5 | 10.5-13.5 | 2.00-2.50 | Nb 10xC to 1.00 |
| EN 10088-2:2014 | X6CrNiMoNb17-12-2 | --- | 1.4580 | 0.08 | 2.00 | 1.00 | 0.045 | 0.015 | 16.5-18.5 | 10.5-13.5 | 2.00-2.50 | Nb 10xC to 1.00 |
| ISO 9328-7:2004 | Grade X6CrNiMoNb17-12-2 | --- | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.015 | 16.5-18.5 | 10.5-13.5 | 2.00-2.50 | Nb 10xC to 1.00 |
| SAE J405 JUN98 | Type 316Cb | S31640 | --- | 0.08 | 2.00 | 0.75 | 0.045 | 0.030 | 16.00-18.00 | 10.00-14.00 | 2.0-3.0 | Cb 10xC to 1.10; N 0.10 |
| ASME SA-240/SA-240M | Type 316N | S31651 | --- | 0.08 | 2.00 | 0.75 | 0.045 | 0.030 | 16.0-18.0 | 10.0-14.0 | 2.00-3.00 | N 0.10-0.16 |
| ASME SA-666 | Type 316N | S31651 | --- | 0.08 | 2.00 | 0.75 | 0.045 | 0.030 | 16.0-18.0 | 10.0-14.0 | 2.00-3.00 | N 0.10-0.16 |
| ASTM A240/A240M-15a | Type 316N | S31651 | --- | 0.08 | 2.00 | 0.75 | 0.045 | 0.030 | 16.0-18.0 | 10.0-14.0 | 2.00-3.00 | N 0.10-0.16 |
| ASTM A666-15 | Type 316N | S31651 | --- | 0.08 | 2.00 | 0.75 | 0.045 | 0.030 | 16.0-18.0 | 10.0-14.0 | 2.00-3.00 | N 0.10-0.16 |
| GB 3280-92 | Grade 0Cr17Ni12Mo2N | --- | --- | 0.08 | 2.00 | 1.00 | 0.035 | 0.030 | 16.00-18.00 | 10.00-14.00 | 2.00-3.00 | N 0.10-0.22 |
| GB 4237-92 | Grade 0Cr17Ni12Mo2N | --- | --- | 0.08 | 2.00 | 1.00 | 0.035 | 0.030 | 16.00-18.00 | 10.00-14.00 | 2.00-3.00 | N 0.10-0.22 |
| GB 4239-91 | Grade 0Cr17Ni12Mo2N | --- | --- | 0.08 | 2.00 | 1.00 | 0.035 | 0.030 | 16.00-18.00 | 10.00-14.00 | 2.00-3.00 | N 0.10-0.22 |
| JIS G 4304:2012 | Symbol SUS316N | --- | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 16.00-18.00 | 10.00-14.00 | 2.00-3.00 | N 0.10-0.22 |
| JIS G 4305:2012 | Symbol SUS316N | --- | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 16.00-18.00 | 10.00-14.00 | 2.00-3.00 | N 0.10-0.22 |
| SAE J405 JUN98 | Type 316N | S31651 | --- | 0.08 | 2.00 | 0.75 | 0.045 | 0.030 | 16.00-18.00 | 10.00-14.00 | 2.00-3.00 | N 0.10-0.16 |

**8.1 Stainless Steels: Plates, Sheet and Strip**

**8.1.3A Chemical Composition of Austenitic Stainless Steels (Continued)**

| Specification | Designation | UNS No | Steel No | Weight, %, max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASME SA-240/SA-240M | Type 316LN | S31653 | --- | 0.030 | 2.00 | 0.75 | 0.045 | 0.030 | 16.0-18.0 | 10.0-14.0 | 2.00-3.00 | N 0.10-0.16 |
| ASTM A240/A240M-15a | Type 316LN | S31653 | --- | 0.030 | 2.00 | 0.75 | 0.045 | 0.030 | 16.0-18.0 | 10.0-14.0 | 2.00-3.00 | N 0.10-0.16 |
| EN 10028-7:2007 | X2CrNiMoN17-11-2 | --- | 1.4406 | 0.030 | 2.00 | 1.00 | 0.045 | 0.015 | 16.5-18.5 | 10.0-12.5 | 2.00-2.50 | N 0.12-0.22 |
| | X2CrNiMoN17-13-3 | --- | 1.4429 | 0.030 | 2.00 | 1.00 | 0.045 | 0.015 | 16.5-18.5 | 11.0-14.0 | 2.50-3.00 | N 0.12-0.22 |
| EN 10088-2:2014 | X2CrNiMoN17-11-2 | --- | 1.4406 | 0.030 | 2.00 | 1.00 | 0.045 | 0.015 | 16.5-18.5 | 10.0-12.5 | 2.00-2.50 | N 0.12-0.22 |
| | X2CrNiMoN17-13-3 | --- | 1.4429 | 0.030 | 2.00 | 1.00 | 0.045 | 0.015 | 16.5-18.5 | 11.0-14.0 | 2.50-3.00 | N 0.12-0.22 |
| GB 3280-92 | Grade 00Cr17Ni13Mo2N | --- | --- | 0.030 | 2.00 | 1.00 | 0.035 | 0.030 | 16.50-18.50 | 10.50-14.50 | 2.00-3.00 | N 0.12-0.22 |
| GB 4237-92 | Grade 00Cr17Ni13Mo2N | --- | --- | 0.030 | 2.00 | 1.00 | 0.035 | 0.030 | 16.50-18.50 | 10.50-14.50 | 2.00-3.00 | N 0.12-0.22 |
| GB 4239-91 | Grade 00Cr17Ni13Mo2N | --- | --- | 0.030 | 2.00 | 1.00 | 0.035 | 0.030 | 16.50-18.50 | 10.50-14.50 | 2.00-3.00 | N 0.12-0.22 |
| ISO 16143-1:2004 | X2CrNiMoN17-12-3 | --- | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 16.5-18.5 | 10.5-13.0 | 2.50-3.00 | N 0.12-0.22 |
| ISO 9328-7:2004 | Grade X2CrNiMoN17-11-2 | --- | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.015 | 16.5-18.5 | 10.0-12.5 | 2.00-3.00 | N 0.12-0.22 |
| | Grade X2CrNiMoN17-13-3 | --- | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.015 | 16.5-18.5 | 11.0-13.0 | 2.50-3.00 | N 0.12-0.22 |
| JIS G 4304:2012 | Symbol SUS316LN | --- | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 16.50-18.50 | 10.50-14.50 | 2.00-3.00 | N 0.12-0.22 |
| JIS G 4305:2012 | Symbol SUS316LN | --- | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 16.50-18.50 | 10.50-14.50 | 2.00-3.00 | N 0.12-0.22 |
| SAE J405 JUN98 | Type 316LN | S31653 | --- | 0.030 | 2.00 | 0.75 | 0.045 | 0.030 | 16.00-18.00 | 10.00-14.00 | 2.00-3.00 | N 0.10-0.16 |
| ASME SA-240/SA-240M | Type 317 | S31700 | --- | 0.08 | 2.00 | 0.75 | 0.045 | 0.030 | 18.0-20.0 | 11.0-15.0 | 3.0-4.0 | N 0.10 |
| ASTM A240/A240M-15a | Type 317 | S31700 | --- | 0.08 | 2.00 | 0.75 | 0.045 | 0.030 | 18.0-20.0 | 11.0-15.0 | 3.0-4.0 | N 0.10 |
| GB 3280-92 | Grade 0Cr19Ni13Mo3 | --- | --- | 0.08 | 2.00 | 1.00 | 0.035 | 0.030 | 18.00-20.00 | 11.00-15.00 | 3.00-4.00 | --- |
| GB 4237-92 | Grade 0Cr19Ni13Mo3 | --- | --- | 0.08 | 2.00 | 1.00 | 0.035 | 0.030 | 18.00-20.00 | 11.00-15.00 | 3.00-4.00 | --- |
| GB 4238-92 | Grade 0Cr19Ni13Mo3 | --- | --- | 0.08 | 2.00 | 1.00 | 0.035 | 0.030 | 18.00-20.00 | 11.00-15.00 | 3.00-4.00 | --- |
| GB 4239-91 | Grade 0Cr19Ni13Mo3 | --- | --- | 0.08 | 2.00 | 1.00 | 0.035 | 0.030 | 18.00-20.00 | 11.00-15.00 | 3.00-4.00 | --- |
| JIS G 4304:2012 | Symbol SUS317 | --- | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 18.00-20.00 | 11.00-15.00 | 3.00-4.00 | --- |
| JIS G 4305:2012 | Symbol SUS317 | --- | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 18.00-20.00 | 11.00-15.00 | 3.00-4.00 | --- |
| SAE J405 JUN98 | Type 317 | S31700 | --- | 0.08 | 2.00 | 0.75 | 0.045 | 0.030 | 18.00-20.00 | 11.00-15.00 | 3.00-4.00 | N 0.10 |
| GB 3280-92 | Grade 0Cr18Ni16Mo5 | --- | --- | 0.040 | 2.00 | 1.00 | 0.035 | 0.030 | 16.00-19.00 | 15.00-17.00 | 4.00-6.00 | --- |
| GB 4237-92 | Grade 0Cr18Ni16Mo5 | --- | --- | 0.040 | 2.50 | 1.00 | 0.035 | 0.030 | 16.00-19.00 | 15.00-17.00 | 4.00-6.00 | --- |
| GB 4239-91 | Grade 0Cr18Ni16Mo5 | --- | --- | 0.040 | 2.50 | 1.00 | 0.035 | 0.030 | 16.00-19.00 | 15.00-17.00 | 4.00-6.00 | --- |
| JIS G 4304:2012 | Symbol SUS317J1 | --- | --- | 0.040 | 2.50 | 1.00 | 0.045 | 0.030 | 16.00-19.00 | 15.00-17.00 | 4.00-6.00 | --- |
| JIS G 4305:2012 | Symbol SUS317J1 | --- | --- | 0.040 | 2.50 | 1.00 | 0.045 | 0.030 | 16.00-19.00 | 15.00-17.00 | 4.00-6.00 | --- |
| ASME SA-240/SA-240M | Type 317L | S31703 | --- | 0.030 | 2.00 | 0.75 | 0.045 | 0.030 | 18.0-20.0 | 11.0-15.0 | 3.0-4.0 | N 0.10 |
| ASTM A240/A240M-15a | Type 317L | S31703 | --- | 0.030 | 2.00 | 0.75 | 0.045 | 0.030 | 18.0-20.0 | 11.0-15.0 | 3.0-4.0 | N 0.10 |
| EN 10028-7:2007 | X2CrNiMo18-15-4 | --- | 1.4438 | 0.030 | 2.00 | 1.00 | 0.045 | 0.015 | 17.5-19.5 | 13.0-16.0 | 3.0-4.0 | N 0.10 |
| EN 10088-2:2014 | X2CrNiMo18-15-4 | --- | 1.4438 | 0.030 | 2.00 | 1.00 | 0.045 | 0.015 | 17.5-19.5 | 13.0-16.0 | 3.0-4.0 | N 0.10 |
| GB 4237-92 | Grade 00Cr19Ni13Mo3 | --- | --- | 0.030 | 2.00 | 1.00 | 0.035 | 0.030 | 18.00-20.00 | 11.00-15.00 | 3.00-4.00 | --- |
| GB 4239-91 | Grade 00Cr19Ni13Mo3 | --- | --- | 0.030 | 2.00 | 1.00 | 0.035 | 0.030 | 18.00-20.00 | 11.00-15.00 | 3.00-4.00 | --- |
| ISO 9328-7:2004 | Grade X2CrNiMo18-15-4 | --- | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.015 | 17.5-19.5 | 13.0-16.0 | 3.00-4.0 | N 0.11 |
| JIS G 4304:2012 | Symbol SUS317L | --- | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 18.00-20.00 | 11.00-15.00 | 3.00-4.00 | --- |
| JIS G 4305:2012 | Symbol SUS317L | --- | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 18.00-20.00 | 11.00-15.00 | 3.00-4.00 | --- |
| SAE J405 JUN98 | Type 317L | S31703 | --- | 0.030 | 2.00 | 0.75 | 0.045 | 0.030 | 18.00-20.00 | 11.00-15.00 | 3.00-4.00 | N 0.10 |

**8.1 Stainless Steels: Plates, Sheet and Strip**

**8.1.3A Chemical Composition of Austenitic Stainless Steels (Continued)**

| Specification | Designation | UNS No | Steel No | Weight, %, max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASME SA-240/SA-240M | Type 317LMN | S31726 | --- | 0.030 | 2.00 | 0.75 | 0.045 | 0.030 | 17.0-20.0 | 13.5-17.5 | 4.0-5.0 | N 0.10-0.20 |
| ASTM A240/A240M-15a | Type 317LMN | S31726 | --- | 0.030 | 2.00 | 0.75 | 0.045 | 0.030 | 17.0-20.0 | 13.5-17.5 | 4.0-5.0 | N 0.10-0.20 |
| EN 10028-7:2007 | X2CrNiMoN17-13-5 | --- | 1.4439 | 0.030 | 2.00 | 1.00 | 0.045 | 0.015 | 16.5-18.5 | 12.5-14.5 | 4.0-5.0 | N 0.12-0.22 |
| EN 10088-2:2014 | X2CrNiMoN17-13-5 | --- | 1.4439 | 0.030 | 2.00 | 1.00 | 0.045 | 0.015 | 16.5-18.5 | 12.5-14.5 | 4.0-5.0 | N 0.12-0.22 |
| ISO 9328-7:2004 | Grade X2CrNiMoN17-13-5 | --- | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.015 | 16.5-18.5 | 12.5-14.5 | 4.0-5.0 | N 0.12-0.22 |
| SAE J405 JUN98 | --- | S31726 | --- | 0.030 | 2.00 | 0.75 | 0.045 | 0.030 | 17.00-20.00 | 13.50-17.50 | 4.0-5.0 | N 0.10-0.20 |
| ASME SA-240/SA-240M | Type 317LN | S31753 | --- | 0.030 | 2.00 | 0.75 | 0.045 | 0.030 | 18.0-20.0 | 11.0-15.0 | 3.0-4.0 | N 0.10-0.22 |
| ASTM A240/A240M-15a | Type 317LN | S31753 | --- | 0.030 | 2.00 | 0.75 | 0.045 | 0.030 | 18.0-20.0 | 11.0-15.0 | 3.0-4.0 | N 0.10-0.22 |
| EN 10028-7:2007 | X2CrNiMoN18-12-4 | --- | 1.4434 | 0.030 | 2.00 | 1.00 | 0.045 | 0.015 | 16.5-19.5 | 10.5-14.0 | 3.0-4.0 | N 0.10-0.20 |
| EN 10088-2:2014 | X2CrNiMoN18-12-4 | --- | 1.4434 | 0.030 | 2.00 | 1.00 | 0.045 | 0.015 | 16.5-19.5 | 10.5-14.0 | 3.0-4.0 | N 0.10-0.20 |
| ISO 9328-7:2004 | Grade X2CrNiMoN18-12-4 | --- | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.015 | 16.5-19.5 | 10.5-14.0 | 3.00-4.0 | N 0.10-0.20 |
| JIS G 4304:2012 | Symbol SUS317LN | --- | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 18.00-20.00 | 11.00-15.00 | 3.00-4.00 | N 0.10-0.22 |
| JIS G 4305:2012 | Symbol SUS317LN | --- | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 18.00-20.00 | 11.00-15.00 | 3.00-4.00 | N 0.10-0.22 |
| SAE J405 JUN98 | Type 317LN | S31753 | --- | 0.030 | 2.00 | 0.75 | 0.045 | 0.030 | 18.00-20.00 | 11.00-15.00 | 3.00-4.00 | N 0.10-0.22 |
| ASME SA-240/SA-240M | Type 321 | S32100 | --- | 0.08 | 2.00 | 0.75 | 0.045 | 0.030 | 17.0-19.0 | 9.0-12.0 | --- | Ti 5x(C+N) to 0.70; N 0.10 |
| ASTM A240/A240M-15a | Type 321 | S32100 | --- | 0.08 | 2.00 | 0.75 | 0.045 | 0.030 | 17.0-19.0 | 9.0-12.0 | --- | Ti 5x(C+N) to 0.70 ; N 0.10 |
| EN 10028-7:2007 | X6CrNiTi18-10 | --- | 1.4541 | 0.08 | 2.00 | 1.00 | 0.045 | 0.015 | 17.0-19.0 | 9.0-12.0 | --- | Ti 5xC to 0.70 |
| EN 10088-2:2014 | X6CrNiTi18-10 | --- | 1.4541 | 0.08 | 2.00 | 1.00 | 0.045 | 0.015 | 17.0-19.0 | 9.0-12.0 | --- | Ti 5xC to 0.70 |
| GB 3280-92 | Grade 0Cr18Ni10Ti | --- | --- | 0.08 | 2.00 | 1.00 | 0.035 | 0.030 | 17.00-19.00 | 9.00-12.00 | --- | Ti 5xC min. |
| GB 4237-92 | Grade 0Cr18Ni10Ti | --- | --- | 0.08 | 2.00 | 1.00 | 0.035 | 0.030 | 17.00-19.00 | 9.00-12.00 | --- | Ti 5xC min. |
| GB 4238-92 | Grade 0Cr18Ni10Ti | --- | --- | 0.08 | 2.00 | 1.00 | 0.035 | 0.030 | 17.00-19.00 | 9.00-12.00 | --- | Ti 5xC min. |
| GB 4239-91 | Grade 0Cr18Ni10Ti | --- | --- | 0.08 | 2.00 | 1.00 | 0.035 | 0.030 | 17.00-19.00 | 9.00-12.00 | --- | Ti 5xC min. |
| ISO 16143-1:2004 | X6CrNiTi18-10 | --- | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 17.0-19.0 | 9.0-12.0 | --- | Ti 5xC to 0.70 |
| ISO 9328-7:2004 | Grade X6CrNiTi18-10 | --- | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.015 | 17.0-19.0 | 9.0-12.0 | --- | Ti 5xC to 0.70 |
| JIS G 4304:2012 | Symbol SUS321 | --- | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 17.00-19.00 | 9.00-13.00 | --- | Ti 5xC min. |
| JIS G 4305:2012 | Symbol SUS321 | --- | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 17.00-19.00 | 9.00-13.00 | --- | Ti 5xC min. |
| SAE J405 JUN98 | Type 321 | S32100 | --- | 0.08 | 2.00 | 0.75 | 0.045 | 0.030 | 17.00-19.00 | 9.00-12.00 | --- | Ti 5x(C+N) to 0.70; N 0.10 |
| ASME SA-240/SA-240M | Type 321H | S32109 | --- | 0.04-0.10 | 2.00 | 0.75 | 0.045 | 0.030 | 17.0-19.0 | 9.0-12.0 | --- | Ti 4x(C+N) to 0.70 |
| ASTM A240/A240M-15a | Type 321H | S32109 | --- | 0.04-0.10 | 2.00 | 0.75 | 0.045 | 0.030 | 17.0-19.0 | 9.0-12.0 | --- | Ti 4x(C+N) to 0.70 |
| GB 3280-92 | Grade 1Cr18Ni9 | --- | --- | 0.15 | 2.00 | 1.00 | 0.035 | 0.030 | 17.00-19.00 | 8.00-10.00 | --- | Ti 5x(C-0.02) to 0.80 |
| GB 4237-92 | Grade 1Cr18Ni9 | --- | --- | 0.15 | 2.00 | 1.00 | 0.035 | 0.030 | 17.00-19.00 | 8.00-10.00 | --- | Ti 5x(C-0.02) to 0.80 |
| GB 4239-91 | Grade 1Cr18Ni9 | --- | --- | 0.15 | 2.00 | 1.00 | 0.035 | 0.030 | 17.00-19.00 | 8.00-10.00 | --- | Ti 5x(C-0.02) to 0.80 |
| ISO 4955:2005 | X7CrNiTi18-10 | --- | --- | 0.04-0.10 | 2.00 | 1.00 | 0.045 | 0.030 | 17.0-19.0 | 9.0-12.0 | --- | Ti 5xC to 0.80 |
| SAE J405 JUN98 | Type 321H | S32109 | --- | 0.04-0.10 | 2.00 | 0.75 | 0.045 | 0.030 | 17.00-19.00 | 9.00-12.00 | --- | Ti 4x(C+N) to 0.70 |
| EN 10095:1999 | X12NiCrSi35-16 | --- | 1.4864 | 0.15 | 2.00 | 1.00-2.00 | 0.045 | 0.015 | 15.00-17.00 | 33.00-37.00 | --- | N 0.11 |
| GB 4238-92 | Grade 1Cr16Ni35 | --- | --- | 0.15 | 2.00 | 1.50 | 0.035 | 0.030 | 14.00-17.00 | 33.00-37.00 | --- | --- |
| JIS G 4312:2011 | Symbol SUH330 | --- | --- | 0.15 | 2.00 | 1.50 | 0.040 | 0.030 | 14.00-17.00 | 33.00-37.00 | --- | --- |

**8.1 Stainless Steels: Plates, Sheet and Strip**

**8.1.3A Chemical Composition of Austenitic Stainless Steels (Continued)**

| Specification | Designation | UNS No | Steel No | Weight, %, max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| EN 10088-2:2014 | X2CrMoTi17-1 | --- | 1.4513 | 0.025 | 1.00 | 1.00 | 0.040 | 0.015 | 16.0-18.0 | --- | 0.80-1.40 | Ti [4x(C+N)+0.15] to 0.80; N 0.020 |
| GB 3280-92 | Grade 00Cr17Mo | --- | --- | 0.025 | 1.00 | 1.00 | 0.035 | 0.030 | 16.00-19.00 | 0.60 | 0.75-1.25 | Ti 8x(C+N) to 0.80; Nb 8x(C+N) to 0.80; Zr 8x(C+N) to 0.80; (Ti+Nb+Zr) 8x(C+N) to 0.80; N 0.025 |
| GB 4237-92 | Grade 00Cr17Mo | --- | --- | 0.025 | 1.00 | 1.00 | 0.035 | 0.030 | 16.00-19.00 | 0.60 | 0.75-1.25 | Ti 8x(C+N) to 0.80; Nb 8x(C+N) to 0.80; Zr 8x(C+N) to 0.80; (Ti+Nb+Zr) 8x(C+N) to 0.80; N 0.025 |
| GB 4239-91 | Grade 00Cr17Mo | --- | --- | 0.025 | 1.00 | 1.00 | 0.035 | 0.030 | 16.00-19.00 | 0.60 | 0.75-1.25 | Ti 8x(C+N) to 0.80; Nb 8x(C+N) to 0.80; Zr 8x(C+N) to 0.80; (Ti+Nb+Zr) 8x(C+N) to 0.80; N 0.025 |
| JIS G 4304:2012 | Symbol SUS436L | --- | --- | 0.025 | 1.00 | 1.00 | 0.040 | 0.030 | 16.00-19.00 | 0.60 | 0.75-1.50 | Ti, Nb, Zr or their combination 8x(C + N) to 0.80; N 0.025 |
| JIS G 4305:2012 | Symbol SUS436L | --- | --- | 0.025 | 1.00 | 1.00 | 0.040 | 0.030 | 16.00-19.00 | 0.60 | 0.75-1.50 | Ti, Nb, Zr or their combination 8x(C + N) to 0.80; N 0.025 |
| ASME SA-240/SA-240M | Type 347 | S34700 | --- | 0.08 | 2.00 | 0.75 | 0.045 | 0.030 | 17.0-19.0 | 9.0-13.0 | --- | Cb 10xC to 1.00 |
| ASTM A240/A240M-15a | Type 347 | S34700 | --- | 0.08 | 2.00 | 0.75 | 0.045 | 0.030 | 17.0-19.0 | 9.0-13.0 | --- | Cb 10xC to 1.00 |
| EN 10028-7:2007 | X6CrNiNb18-10 | --- | 1.4550 | 0.08 | 2.00 | 1.00 | 0.045 | 0.015 | 17.0-19.0 | 9.0-12.0 | --- | Nb 10xC to 1.00 |
| EN 10088-2:2014 | X6CrNiNb18-10 | --- | 1.4550 | 0.08 | 2.00 | 1.00 | 0.045 | 0.015 | 17.0-19.0 | 9.0-12.0 | --- | Nb 10xC to 1.00 |
| GB 3280-92 | Grade 0Cr18Ni11Nb | --- | --- | 0.08 | 2.00 | 1.00 | 0.035 | 0.030 | 17.00-19.00 | 9.00-13.00 | --- | Nb 10xC min. |
| GB 4237-92 | Grade 0Cr18Ni11Nb | --- | --- | 0.08 | 2.00 | 1.00 | 0.035 | 0.030 | 17.00-19.00 | 9.00-13.00 | --- | Nb 10xC min. |
| GB 4238-92 | Grade 0Cr18Ni11Nb | --- | --- | 0.08 | 2.00 | 1.00 | 0.035 | 0.030 | 17.00-19.00 | 9.00-13.00 | --- | Nb 10xC min. |
| GB 4239-91 | Grade 0Cr18Ni11Nb | --- | --- | 0.08 | 2.00 | 1.00 | 0.035 | 0.030 | 17.00-19.00 | 9.00-13.00 | --- | Nb 10xC min. |
| ISO 16143-1:2004 | X6CrNiNb18-10 | --- | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 17.0-19.0 | 9.0-12.0 | --- | Nb 10xC to 1.00 |
| ISO 9328-7:2004 | Grade X6CrNiNb18-10 | --- | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.015 | 17.0-19.0 | 9.0-12.0 | --- | Nb 10xC to 1.00 |
| JIS G 4304:2012 | Symbol SUS347 | --- | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 17.00-19.00 | 9.00-13.00 | --- | Nb 10xC min. |
| JIS G 4305:2012 | Symbol SUS347 | --- | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 17.00-19.00 | 9.00-13.00 | --- | Nb 10xC min. |
| SAE J405 JUN98 | Type 347 | S34700 | --- | 0.08 | 2.00 | 0.75 | 0.045 | 0.030 | 17.00-19.00 | 9.00-13.00 | --- | Cb 10xC to 1.00 |
| EN 10088-2:2014 | X11CrNiMnN19-8-6 | --- | 1.4369 | 0.07-0.15 | 5.0-7.5 | 0.50-1.00 | 0.030 | 0.015 | 17.5-19.5 | 6.5-8.5 | --- | N 0.20-0.30 |
| EN 10151:2002 | X11CrNiMnN19-8-6 | --- | 1.4369 | 0.07-0.15 | 5.0-7.5 | 0.50-1.00 | 0.030 | 0.015 | 17.5-19.5 | 6.5-8.5 | --- | N 0.20-0.30 |
| ISO 16143-1:2004 | X11CrNiMnN19-8-6 | --- | --- | 0.07-0.15 | 5.0-7.5 | 0.50-1.00 | 0.030 | 0.015 | 17.5-19.5 | 6.5-8.5 | --- | N 0.20-0.30 |
| EN 10028-7:2007 | X6CrNiTiB18-10 | --- | 1.4941 | 0.04-0.08 | 2.00 | 1.00 | 0.035 | 0.015 | 17.0-19.0 | 9.0-12.0 | --- | Ti 5xC to 0.70; B 0.0015-0.0050 |
| EN 10302:2008 | X6CrNiTiB18-10 | --- | 1.4941 | 0.04-0.08 | 2.00 | 1.00 | 0.035 | 0.015 | 17.0-19.0 | 9.0-12.0 | --- | Ti 5xC to 0.80; B 0.0015-0.0050 |
| ISO 9328-7:2004 | Grade X6CrNiTiB18-10 | --- | --- | 0.04-0.08 | 2.00 | 1.00 | 0.035 | 0.015 | 17.0-19.0 | 9.0-12.0 | --- | Ti 5xC to 0.70; B 0.0015-0.0050 |
| GB 3280-92 | Grade 0Cr18Ni13Si4 | --- | --- | 0.08 | 2.00 | 3.00-5.00 | 0.035 | 0.030 | 15.00-20.00 | 11.50-15.00 | --- | --- |
| GB 4237-92 | Grade 0Cr18Ni13Si4 | --- | --- | 0.08 | 2.00 | 3.00-5.00 | 0.035 | 0.030 | 15.00-20.00 | 11.50-15.00 | --- | --- |
| GB 4238-92 | Grade 0Cr18Ni13Si4 | --- | --- | 0.08 | 2.00 | 3.00-5.00 | 0.035 | 0.030 | 15.00-20.00 | 11.50-15.00 | --- | --- |
| GB 4239-91 | Grade 0Cr18Ni13Si4 | --- | --- | 0.08 | 2.00 | 3.00-5.00 | 0.035 | 0.030 | 15.00-20.00 | 11.50-15.00 | --- | --- |
| JIS G 4304:2012 | Symbol SUSXM15J1 | --- | --- | 0.08 | 2.00 | 3.00-5.00 | 0.045 | 0.030 | 15.00-20.00 | 11.50-15.00 | --- | --- |
| JIS G 4305:2012 | Symbol SUSXM15J1 | --- | --- | 0.08 | 2.00 | 3.00-5.00 | 0.045 | 0.030 | 15.00-20.00 | 11.50-15.00 | --- | --- |

**8.1 Stainless Steels: Plates, Sheet and Strip**

**8.1.3A Chemical Composition of Austenitic Stainless Steels (Continued)**

| Specification | Designation | UNS No | Steel No | Weight, %, max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| EN 10088-2:2014 | X8CrMnCuN17-8-3 | --- | 1.4597 | 0.10 | 6.5-9.0 | 2.00 | 0.040 | 0.030 | 15.0-18.0 | 3.00 | 1.00 | Cu 2.00-3.5; N 0.10-0.30 |
| ISO 16143-1:2004 | X8CrMnCuN17-8-3 | --- | --- | 0.10 | 6.5-8.5 | 2.00 | 0.040 | 0.030 | 16.0-18.0 | 2.00 | 1.00 | Cu 2.00-3.5; N 0.15-0.30 |
| ASME SA-240/SA-240M | --- | S31060 | --- | 0.05-0.10 | 1.00 | 0.50 | 0.040 | 0.030 | 22.0-24.0 | 10.0-12.5 | --- | B 0.001-0.01; N 0.18-0.25; (Ce+La) 0.025-0.070 |
| ASTM A240/A240M-15a | --- | S31060 | --- | 0.05-0.10 | 1.00 | 0.50 | 0.040 | 0.030 | 22.0-24.0 | 10.0-12.5 | --- | B 0.001-0.010; N 0.18-0.25; (Ce+La) 0.025-0.070 |
| EN 10302:2008 | X8CrNiNb16-13 | --- | 1.4961 | 0.04-0.10 | 1.50 | 0.30-0.60 | 0.035 | 0.015 | 15.0-17.0 | 12.0-14.0 | --- | Nb 10xC to 1.20 |
| | X6CrNiMoTiB17-13 | --- | 1.4983 | 0.04-0.08 | 2.00 | 0.75 | 0.035 | 0.015 | 16.0-18.0 | 12.0-14.0 | 2.00-2.50 | B 0.0015-0.0060; Ti 5xC to 0.80 |
| EN 10028-7:2007 | X1CrNi25-21 | --- | 1.4335 | 0.020 | 2.00 | 0.25 | 0.025 | 0.010 | 24.0-26.0 | 20.0-22.0 | 0.20 | N 0.10 |
| EN 10088-2:2014 | X1CrNi25-21 | --- | 1.4335 | 0.020 | 2.00 | 0.25 | 0.025 | 0.010 | 24.0-26.0 | 20.0-22.0 | 0.20 | N 0.10 |
| ISO 16143-1:2004 | X1CrNi25-21 | --- | --- | 0.02 | 2.00 | 0.25 | 0.025 | 0.010 | 24.0-26.0 | 20.0-22.0 | 0.20 | N 0.11 |
| ISO 9328-7:2004 | Grade X1CrNi25-21 | --- | --- | 0.020 | 2.00 | 0.25 | 0.025 | 0.010 | 24.0-26.0 | 20.0-22.0 | 0.20 | N 0.11 |
| ASME SA-240/SA-240M | --- | S34565 | --- | 0.030 | 5.00-7.00 | 1.00 | 0.030 | 0.010 | 23.0-25.0 | 16.0-18.0 | 4.0-5.0 | Cb 0.10; N 0.40-0.60 |
| ASTM A240/A240M-15a | --- | S34565 | --- | 0.030 | 5.00-7.00 | 1.00 | 0.030 | 0.010 | 23.0-25.0 | 16.0-18.0 | 4.0-5.0 | Cb 0.10; N 0.40-0.60 |
| EN 10088-2:2014 | X2CrNiMnMoN25-18-6-5 | --- | 1.4565 | 0.030 | 5.0-7.0 | 1.00 | 0.030 | 0.015 | 24.0-26.0 | 16.0-19.0 | 4.0-5.0 | Nb 0.15; N 0.30-0.60 |
| ISO 16143-1:2004 | X2CrNiMnMoN25-18-6-5 | --- | --- | 0.030 | 5.0-7.0 | 1.00 | 0.030 | 0.010 | 24.0-26.0 | 16.0-19.0 | 4.0-5.0 | Nb 0.15; N 0.30-0.60 |
| SAE J405 JUN98 | --- | S34565 | --- | 0.030 | 5.00-7.00 | 1.00 | 0.030 | 0.010 | 23.00-25.00 | 16.00-18.00 | 4.00-5.00 | Cb 0.10; N 0.40-0.60 |
| ASME SA-240/SA-240M | --- | S31266 | --- | 0.030 | 2.00-4.00 | 1.00 | 0.035 | 0.020 | 23.0-25.0 | 21.0-24.0 | 5.2-6.2 | Cu 1.00-2.50; W 1.50-2.50; N 0.35-0.60 |
| ASTM A240/A240M-15a | --- | S31266 | --- | 0.030 | 2.00-4.00 | 1.00 | 0.035 | 0.020 | 23.0-25.0 | 21.0-24.0 | 5.2-6.2 | Cu 1.00-2.50; W 1.50-2.50; N 0.35-0.60 |
| EN 10088-2:2014 | X1CrNiMoCuNW24-22-6 | --- | 1.4659 | 0.020 | 2.00-4.0 | 0.70 | 0.030 | 0.010 | 23.0-25.0 | 21.0-23.0 | 5.5-6.5 | Cu 1.00-2.00; W 1.50-2.50; N 0.35-0.50 |
| SAE J405 JUN98 | --- | S31266 | --- | 0.030 | 2.00-4.00 | 1.00 | 0.035 | 0.020 | 23.00-25.00 | 21.00-24.00 | 5.00-7.00 | Cu 0.50-3.00; W 1.00-3.00; N 0.35-0.60 |
| ASME SA-240/SA-240M | --- | S32654 | --- | 0.020 | 2.00-4.00 | 0.50 | 0.030 | 0.005 | 24.0-25.0 | 21.0-23.0 | 7.0-8.0 | Cu 0.30-0.60; N 0.45-0.55 |
| ASTM A240/A240M-15a | --- | S32654 | --- | 0.020 | 2.00-4.00 | 0.50 | 0.030 | 0.005 | 24.0-25.0 | 21.0-23.0 | 7.0-8.0 | Cu 0.30-0.60; N 0.45-0.55 |
| EN 10088-2:2014 | X1CrNiMoCuN24-22-8 | --- | 1.4652 | 0.020 | 2.00-4.0 | 0.50 | 0.030 | 0.005 | 23.0-25.0 | 21.0-23.0 | 7.0-8.0 | Cu 0.30-0.60; N 0.45-0.55 |
| ISO 16143-1:2004 | X1CrNiMoCuN24-22-8 | --- | --- | 0.020 | 2.0-4.0 | 0.50 | 0.030 | 0.005 | 23.0-25.0 | 21.0-23.0 | 7.0-8.0 | Cu 0.30- 0.60; N 0.45-0.55 |
| SAE J405 JUN98 | --- | S32654 | --- | 0.020 | 2.00-4.00 | 0.50 | 0.030 | 0.005 | 24.00-25.00 | 21.00-23.00 | 7.00-8.00 | Cu 0.30-0.60; N 0.45-0.55 |
| EN 10095:1999 | X8CrNiTi18-10 | --- | 1.4878 | 0.10 | 2.00 | 1.00 | 0.045 | 0.015 | 17.00-19.00 | 9.00-12.00 | --- | Ti 5xC to 0.80 |
| GB 3280-92 | Grade 1Cr18Ni9Ti | --- | --- | 0.12 | 2.00 | 1.00 | 0.035 | 0.030 | 17.00-19.00 | 8.00-11.00 | --- | Ti 5x(C-0.02) to 0.80 |
| GB 4237-92 | Grade 1Cr18Ni9Ti | --- | --- | 0.12 | 2.00 | 1.00 | 0.035 | 0.030 | 17.00-19.00 | 8.00-11.00 | --- | Ti 5x(C-0.02) to 0.80 |
| GB 4238-92 | Grade 1Cr18Ni9Ti | --- | --- | 0.12 | 2.00 | 1.00 | 0.035 | 0.030 | 17.00-19.00 | 8.00-11.00 | --- | Ti 5x(C-0.02) to 0.80 |
| GB 4239-91 | Grade 1Cr18Ni9Ti | --- | --- | 0.12 | 2.00 | 1.00 | 0.035 | 0.030 | 17.00-19.00 | 8.00-11.00 | --- | Ti 5x(C-0.02) to 0.80 |
| ASME SA-240/SA-240M | Type 347H | S34709 | --- | 0.04-0.10 | 2.00 | 0.75 | 0.045 | 0.030 | 17.0-19.0 | 9.0-13.0 | --- | Cb 8xC to 1.00 |
| ASTM A240/A240M-15a | Type 347H | S34709 | --- | 0.04-0.10 | 2.00 | 0.75 | 0.045 | 0.030 | 17.0-19.0 | 9.0-13.0 | --- | Cb 8xC to 1.00 |
| ISO 4955:2005 | X7CrNiNb18-10 | --- | --- | 0.04-0.10 | 2.00 | 1.00 | 0.045 | 0.030 | 17.0-19.0 | 9.0-12.0 | --- | Nb 10xC to 1.20 |
| SAE J405 JUN98 | Type 347H | S34709 | --- | 0.04-0.10 | 2.00 | 0.75 | 0.045 | 0.030 | 17.00-19.00 | 9.00-13.00 | --- | Cb 8xC to 1.00 |
| EN 10028-7:2007 | X3CrNiMoBN17-13-3 | --- | 1.4910 | 0.04 | 2.00 | 0.75 | 0.035 | 0.015 | 16.0-18.0 | 12.0-14.0 | 2.00-3.00 | N 0.10-0.18; B 0.0015-0.0050 |
| EN 10302:2008 | X3CrNiMoBN17-13-3 | --- | 1.4910 | 0.04 | 2.00 | 0.75 | 0.035 | 0.015 | 16.0-18.0 | 12.0-14.0 | 2.00-3.00 | N 0.10-0.18; B 0.0015-0.0050 |
| ISO 9328-7:2004 | Grade X3CrNiMoBN17-13-3 | --- | --- | 0.04 | 2.00 | 0.75 | 0.035 | 0.015 | 16.0-18.0 | 12.0-14.0 | 2.00-3.00 | N 0.10-0.18; B 0.0015-0.0050 |

**8.1 Stainless Steels: Plates, Sheet and Strip**

**8.1.3A Chemical Composition of Austenitic Stainless Steels (Continued)**

| Specification | Designation | UNS No | Steel No | Weight, %, max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| EN 10028-7:2007 | X8CrNiNb16-13 | --- | 1.4961 | 0.04-0.10 | 1.50 | 0.30-0.60 | 0.035 | 0.015 | 15.0-17.0 | 12.0-14.0 | --- | Nb 10xC to 1.20 |
| ISO 9328-7:2004 | Grade X8CrNiNb16-13 | --- | --- | 0.04-0.10 | 1.50 | 0.30-0.60 | 0.035 | 0.050 | 15.0-17.0 | 12.0-14.0 | --- | Nb 10xC to 1.20 |
| GB 4238-92 | Grade 0Cr15Ni25Ti2MoAlVB | --- | --- | 0.08 | 2.00 | 1.00 | 0.035 | 0.030 | 13.00-16.00 | 24.00-27.00 | 1.00-1.50 | V 0.10-0.50; Al 0.35 min.; Ti 1.90-2.35; B 0.001-0.010 |
| JIS G 4312:2011 | Symbol SUH660 | --- | --- | 0.08 | 2.00 | 1.00 | 0.040 | 0.030 | 13.50-16.00 | 24.00-27.00 | 1.00-1.50 | V 0.10-0.50; Al 0.35; Ti 1.90-2.35; B 0.001-0.010 |
| EN 10302:2008 | X6NiCrTiMoVB25-15-2 | --- | 1.4980 | 0.030-0.08 | 1.00-2.00 | 1.00 | 0.025 | 0.015 | 13.5-16.0 | 24.0-27.0 | 1.00-1.50 | V 0.10-0.50; Al 0.35; Ti 1.90-2.30; B 0.0030-0.010 |
| EN 10028-7:2007 | X5NiCrAlTi31-20 | --- | 1.4958 | 0.03-0.08 | 1.50 | 0.70 | 0.015 | 0.010 | 19.0-22.0 | 30.0-32.5 | --- | (Al+Ti) 0.70 max.; (Ni+Co) 30.0 to 32.5; Al 0.20-0.50; Cu 0.50; Ti 0.20-0.50; Co 0.50; Nb 0.10; N 0.030 |
| EN 10302:2008 | X5NiCrAlTi31-20 | --- | 1.4958 | 0.030-0.08 | 1.50 | 0.70 | 0.015 | 0.010 | 19.0-22.0 | 30.0-32.5 | --- | Al 0.20-0.50; Cu 0.50; Ti 0.20-0.50; Nb 0.10 |
| ISO 9328-7:2004 | Grade X5NiCrAlTi31-20 | --- | --- | 0.03-0.08 | 1.50 | 0.70 | 0.015 | 0.010 | 19.0-22.0 | 30.0-32.5 | --- | (Al+Ti) 0.70 max.; (Ni+Co) 30.0 to 32.5; Al 0.20-0.50; Cu 0.50; Ti 0.20-0.50; Co 1.00; Nb 0.10; N 0.11 |
| EN 10302:2008 | X12CrCoNi21-20 | --- | 1.4971 | 0.08-0.16 | 2.00 | 1.00 | 0.035 | 0.015 | 20.0-22.5 | 19.0-21.0 | 2.50-3.5 | W 2.00-3.00; Co 18.5-21.0; Nb 0.75-1.25; N 0.10-0.20 |
| JIS G 4312:2011 | Symbol SUH661 | --- | --- | 0.08-0.16 | 1.00-2.00 | 1.00 | 0.040 | 0.030 | 20.00-22.50 | 19.00-21.00 | 2.50-3.50 | W 2.00-3.00; Co 18.50-21.00; Nb 0.75-1.25; N 0.10-0.20 |
| ASME SA-240/SA-240M | Type 800 | N08800 | --- | 0.10 | 1.50 | 1.00 | 0.045 | 0.015 | 19.0-23.0 | 30.0-35.0 | --- | Al 0.15-0.60; Cu 0.75; Ti 0.15-0.60; Fe 39.5 min. |
| ASTM A240/A240M-15a | Type 800 | N08800 | --- | 0.10 | 1.50 | 1.00 | 0.045 | 0.015 | 19.0-23.0 | 30.0-35.0 | --- | Al 0.15-0.60; Cu 0.75; Ti 0.15-0.60; Fe 39.5 min |
| EN 10095:1999 | X10NiCrAlTi32-21 | --- | 1.4876 | 0.12 | 2.00 | 1.00 | 0.030 | 0.015 | 19.00-23.00 | 30.00-34.00 | --- | Al 0.15-0.60; Ti 0.15-0.60 |
| SAE J405 JUN98 | --- | N08800 | --- | 0.10 | 1.50 | 1.00 | 0.045 | 0.015 | 19.0-23.0 | 30.0-35.0 | --- | Al 0.15-0.60; Cu 0.75; Ti 0.15-0.60 |
| ASME SA-240/SA-240M | Type 800H | N08810 | --- | 0.05-0.10 | 1.50 | 1.00 | 0.045 | 0.015 | 19.0-23.0 | 30.0-35.0 | --- | Al 0.15-0.60; Cu 0.75; Ti 0.15-0.60; Fe 39.5 min. |
| | --- | N08811 | --- | 0.06-0.10 | 1.50 | 1.00 | 0.040 | 0.015 | 19.0-23.0 | 30.0-35.0 | --- | Al 0.15-0.60; Cu 0.75; Ti 0.15-0.60; Fe 39.5 min.; (Al+Ti) 0.85-1.20 |
| ASTM A240/A240M-15a | Type 800H | N08810 | --- | 0.05-0.10 | 1.50 | 1.00 | 0.045 | 0.015 | 19.0-23.0 | 30.0-35.0 | --- | Al 0.15-0.60; Cu 0.75; Ti 0.15-0.60; Fe 39.5 min. |
| | --- | N08811 | --- | 0.06-0.10 | 1.50 | 1.00 | 0.040 | 0.015 | 19.0-23.0 | 30.0-35.0 | --- | Al 0.15-0.60; Cu 0.75; Ti 0.15-0.60; Fe 39.5 min.; (Al+Ti) 0.85-1.20 |
| EN 10028-7:2007 | X8NiCrAlTi32-21 | --- | 1.4959 | 0.05-0.10 | 1.50 | 0.70 | 0.015 | 0.010 | 19.0-22.0 | 30.0-34.0 | --- | (Ni+Co) 30.0 to 34.0; Al 0.25-0.65; Cu 0.50; Ti 0.25-0.65; Co 0.50; N 0.030 |
| ISO 4955:2005 | X8NiCrAlTi32-21 | --- | --- | 0.05-0.10 | 1.50 | 1.00 | 0.015 | 0.015 | 19.0-23.0 | 30.0-34.0 | --- | Al 0.15-0.60; Cu 0.70; Ti 0.15-0.60 |
| ISO 9328-7:2004 | Grade X8NiCrAlTi32-21 | --- | --- | 0.05-0.10 | 1.50 | 0.70 | 0.015 | 0.010 | 19.0-22.0 | 30.0-34.0 | --- | (Ni+Co) 30.0 to 34.0; Al 0.25-0.65; Cu 0.50; Ti 0.25-0.65; Co 1.00; N 0.11 |
| SAE J405 JUN98 | --- | N08810 | --- | 0.05-0.10 | 1.50 | 1.00 | 0.045 | 0.015 | 19.0-23.0 | 30.0-35.0 | --- | Al 0.15-0.60; Cu 0.75; Ti 0.15-0.60 |

**8.1 Stainless Steels: Plates, Sheet and Strip**

**8.1.3A Chemical Composition of Austenitic Stainless Steels (Continued)**

| Specification | Designation | UNS No | Steel No | Weight, %, max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| EN 10028-7:2007 | X1CrNiMoCuN25-25-5 | --- | 1.4537 | 0.020 | 2.00 | 0.70 | 0.030 | 0.010 | 24.0-26.0 | 24.0-27.0 | 4.7-5.7 | Cu 1.00-2.00; N 0.17-0.25 |
| EN 10088-2:2014 | X1CrNiMoCuN25-25-5 | --- | 1.4537 | 0.020 | 2.00 | 0.70 | 0.030 | 0.010 | 24.0-26.0 | 24.0-27.0 | 4.7-5.7 | Cu 1.00-2.00; N 0.17-0.25 |
| ISO 9328-7:2004 | Grade X1CrNiMoCuN25-25-5 | --- | --- | 0.020 | 2.00 | 0.70 | 0.030 | 0.010 | 24.0-26.0 | 24.0-27.0 | 4.7-5.7 | Cu 1.00-2.00; N 0.17-0.25 |
| ASME SA-240/SA-240M | --- | N08367 | --- | 0.030 | 2.00 | 1.00 | 0.040 | 0.030 | 20.0-22.0 | 23.5-25.5 | 6.0-7.0 | Cu 0.75; N 0.18-0.25 |
| | --- | N08926 | --- | 0.020 | 2.00 | 0.50 | 0.030 | 0.010 | 19.0-21.0 | 24.0-26.0 | 6.00-7.00 | Cu 0.50-1.50; N 0.15-0.25 |
| | --- | S31277 | --- | 0.020 | 3.00 | 0.50 | 0.030 | 0.010 | 20.5-23.0 | 26.0-28.0 | 6.5-8.0 | Cu 0.50-1.50; N 0.30-0.40 |
| ASTM A240/A240M-15a | --- | N08367 | --- | 0.030 | 2.00 | 1.00 | 0.040 | 0.030 | 20.0-22.0 | 23.5-25.5 | 6.0-7.0 | Cu 0.75; N 0.18-0.25 |
| | --- | N08926 | --- | 0.020 | 2.00 | 0.50 | 0.030 | 0.010 | 19.0-21.0 | 24.0-26.0 | 6.00-7.00 | Cu 0.50-1.50; N 0.15-0.25 |
| | --- | S31277 | --- | 0.020 | 3.00 | 0.50 | 0.030 | 0.010 | 20.5-23.0 | 26.0-28.0 | 6.5-8.0 | Cu 0.50-1.50; N 0.30-0.40 |
| ASTM B688-96 (2014) | --- | N08366 | --- | 0.035 | 2.00 | 1.00 | 0.040 | 0.030 | 20.00-22.00 | 23.50-25.50 | 6.00-7.00 | --- |
| | --- | N08367 | --- | 0.030 | 2.00 | 1.00 | 0.040 | 0.030 | 20.00-22.00 | 23.50-25.50 | 6.00-7.00 | Cu 0.75; N 0.18-0.25 |
| EN 10028-7:2007 | X1NiCrMoCuN25-20-7 | --- | 1.4529 | 0.020 | 1.00 | 0.50 | 0.030 | 0.010 | 19.0-21.0 | 24.0-26.0 | 6.0-7.0 | Cu 0.50-1.50; N 0.15-0.25 |
| EN 10088-2:2014 | X1NiCrMoCuN25-20-7 | --- | 1.4529 | 0.020 | 1.00 | 0.50 | 0.030 | 0.010 | 19.0-21.0 | 24.0-26.0 | 6.0-7.0 | Cu 0.50-1.50; N 0.15-0.25 |
| ISO 9328-7:2004 | Grade X1NiCrMoCuN25-20-7 | --- | --- | 0.020 | 2.00 | 0.75 | 0.030 | 0.010 | 19.0-21.0 | 24.0-26.0 | 6.0-7.0 | Cu 0.50-1.50; N 0.15-0.25 |
| JIS G 4304:2012 | Symbol SUS836L | --- | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 19.00-24.00 | 24.00-26.00 | 5.00-7.00 | N 0.25 |
| JIS G 4305:2012 | Symbol SUS836L | --- | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 19.00-24.00 | 24.00-26.00 | 5.00-7.00 | N 0.25 |
| SAE J405 JUN98 | --- | N08367 | --- | 0.030 | 2.00 | 1.00 | 0.040 | 0.030 | 20.00-22.00 | 23.50-25.50 | 6.00-7.00 | Cu 0.75; N 0.18-0.25 |
| | --- | N08926 | --- | 0.020 | 2.00 | 0.50 | 0.030 | 0.010 | 19.00-21.00 | 24.00-26.00 | 6.0-7.0 | Cu 0.5-1.5; N 0.15-0.25 |
| ASME SA-240/SA-240M | Type 904L | N08904 | --- | 0.020 | 2.00 | 1.00 | 0.045 | 0.035 | 19.0-23.0 | 23.0-28.0 | 4.00-5.00 | Cu 1.00-2.00; N 0.10 |
| ASTM A240/A240M-15a | Type 904L | N08904 | --- | 0.020 | 2.00 | 1.00 | 0.045 | 0.035 | 19.0-23.0 | 23.0-28.0 | 4.00-5.00 | Cu 1.00-2.00; N 0.10 |
| EN 10028-7:2007 | X1NiCrMoCu25-20-5 | --- | 1.4539 | 0.020 | 2.00 | 0.70 | 0.030 | 0.010 | 19.0-21.0 | 24.0-26.0 | 4.0-5.0 | Cu 1.20-2.00; N 0.15 |
| EN 10088-2:2014 | X1NiCrMoCu25-20-5 | --- | 1.4539 | 0.020 | 2.00 | 0.70 | 0.030 | 0.010 | 19.0-21.0 | 24.0-26.0 | 4.0-5.0 | Cu 1.20-2.00; N 0.15 |
| ISO 16143-1:2004 | X1NiCrMoCu25-20-5 | --- | --- | 0.020 | 2.00 | 0.75 | 0.035 | 0.015 | 19.0-22.0 | 23.5-26.0 | 4.0-5.0 | Cu 1.20-2.00; N 0.15 |
| ISO 9328-7:2004 | Grade X1NiCrMoCu25-20-5 | --- | --- | 0.020 | 2.00 | 0.70 | 0.030 | 0.010 | 19.0-21.0 | 24.0-26.0 | 4.0-5.0 | Cu 1.20-2.00; N 0.15 |
| JIS G 4304:2012 | Symbol SUS890L | --- | --- | 0.020 | 2.00 | 1.00 | 0.045 | 0.030 | 19.00-23.00 | 23.00-28.00 | 4.00-5.00 | Cu 1.00-2.00 |
| JIS G 4305:2012 | Symbol SUS890L | --- | --- | 0.020 | 2.00 | 1.00 | 0.045 | 0.030 | 19.00-23.00 | 23.00-28.00 | 4.00-5.00 | Cu 1.00-2.00 |
| SAE J405 JUN98 | Type 904L | N08904 | --- | 0.020 | 2.00 | 1.00 | 0.045 | 0.035 | 19.00-23.00 | 23.00-28.00 | 4.0-5.0 | Cu 1.0-2.0; N 0.10 |
| EN 10028-7:2007 | X1NiCrMoCu31-27-4 | --- | 1.4563 | 0.020 | 2.00 | 0.70 | 0.030 | 0.010 | 26.0-28.0 | 30.0-32.0 | 3.0-4.0 | Cu 0.70-1.50; N 0.10 |
| EN 10088-2:2014 | X1NiCrMoCu31-27-4 | --- | 1.4563 | 0.020 | 2.00 | 0.70 | 0.030 | 0.010 | 26.0-28.0 | 30.0-32.0 | 3.0-4.0 | Cu 0.70-1.50; N 0.10 |
| ISO 16143-1:2004 | X1NiCrMoCu31-27-4 | --- | --- | 0.020 | 2.00 | 0.70 | 0.030 | 0.010 | 26.0-28.0 | 30.0-32.0 | 3.0-4.0 | Cu 0.70- 1.50; N 0.11 |
| ISO 9328-7:2004 | Grade X1NiCrMoCu31-27-4 | --- | --- | 0.020 | 2.00 | 0.70 | 0.030 | 0.010 | 26.0-28.0 | 30.0-32.0 | 3.00-4.0 | Cu 0.70-1.50; N 0.11 |

**8.1 Stainless Steels: Plate, Sheet and Strip**

**8.1.3B Mechanical Properties of Austenitic Stainless Steels**

| Specification | Designation | UNS No | Steel No | Section Thickness/Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation % min | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | | | |
| ASME SA-240/SA-240M | Type 201-1 | S20100 | --- | --- | --- | 260 | 38 | 515 | 75 | 40 | Q+SA | 217 max. HB; 95 max. HRB |
| | Type 201-2 | S20100 | --- | --- | --- | 310 | 45 | 655 | 95 | 40 | Q+SA | 241 max. HB; 100 max. HRB |
| ASME SA-666 | Type 201-1 | S20100 | --- | --- | --- | 260 | 38 | 515 L | 75 L | 40 L | A | 217 max. HB; 95 max. HRB |
| | Type 201-2 | S20100 | --- | --- | --- | 310 | 45 | 655 L | 95 L | 40 L | A | 241 max. HB; 100 max. HRB |
| ASTM A240/A240M-15a | Type 201-1 | S20100 | --- | --- | --- | 260 | 38 | 515 | 75 | 40 | SA | 217 max. HBW; 95 max. HRBW |
| | Type 201-2 | S20100 | --- | --- | --- | 310 | 45 | 655 | 95 | 40 | SA | 241 max. HBW; 100 max. HRBW |
| ASTM A666-15 | Type 201-1 | S20100 | --- | --- | --- | 260 | 38 | 515 L | 75 L | 40 L | A | 217 max. HB; 95 max. HRB |
| | Type 201-2 | S20100 | --- | --- | --- | 310 | 45 | 655 L | 95 L | 40 L | A | 241 max. HB; 100 max. HRB |
| EN 10088-2:2014 | X12CrMnNiN17-7-5 | --- | 1.4372 | t ≤ 8 | --- | 350 | --- | 680-880 | --- | 45 T | SA | --- |
| | | | | t ≤ 13.5 | --- | 330 | --- | 680-880 | --- | 45 T | SA | see standard for |
| | | | | t ≤ 75 | --- | 330 | --- | 680-880 | --- | 40 T | SA | impact data |
| GB 3280-92 | Grade 1Cr17Mn6Ni5N | --- | --- | --- | --- | 245 | --- | 635 | --- | 40 | ST | 241 max. HB; 100 max. HRB |
| GB 4237-92 | Grade 1Cr17Mn6Ni5N | --- | --- | --- | --- | 245 | --- | 635 | --- | 40 | ST | 241 max. HB; 100 max. HRB |
| GB 4239-91 | Grade 1Cr17Mn6Ni5N | --- | --- | --- | --- | 245 | --- | 635 | --- | 40 | ST | 100 max. HRB |
| ISO 16143-1:2004 | X12CrMnNiN17-7-5 | --- | --- | t ≤ 8 | --- | 350 | --- | 750-950 | --- | 45 T | SA | --- |
| | | | | t ≤ 13.5 | --- | 330 | --- | 750-950 | --- | 45 T | SA | --- |
| | | | | t ≤ 75 | --- | 330 | --- | 750-950 | --- | 40 T | SA | --- |

**8.1 Stainless Steels: Plate, Sheet and Strip**

**8.1.3B Mechanical Properties of Austenitic Stainless Steels (Continued)**

| Specification | Designation | UNS No | Steel No | Section Thickness/Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation % min | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | | | |
| ASME SA-240/SA-240M | Type 201L | S20103 | --- | --- | --- | 260 | 38 | 655 | 95 | 40 | Q+SA | 217 max. HB; 95 max. HRB |
| ASME SA-666 | Type 201L | S20103 | --- | --- | --- | 260 | 38 | 655 L | 95 L | 40 L | A | 217 max. HB; 95 max. HRB |
| ASTM A240/A240M-15a | Type 201L | S20103 | --- | --- | --- | 260 | 38 | 655 | 95 | 40 | SA | 217 max. HBW; 95 max. HRBW |
| ASTM A666-15 | Type 201L | S20103 | --- | --- | --- | 260 | 38 | 655 L | 95 L | 40 L | A | 217 max. HB; 95 max. HRB |
| EN 10088-2:2014 | X2CrMnNiN17-7-5 | --- | 1.4371 | t ≤ 8 | --- | 300 | --- | 650-850 | --- | 45 T | SA | --- |
| | | | | t ≤ 13.5 | --- | 280 | --- | 650-850 | --- | 45 T | SA | see standard for |
| | | | | t ≤ 75 | --- | 280 | --- | 630-830 | --- | 35 T | SA | impact data |
| ASME SA-240/SA-240M | Type 201LN | S20153 | --- | --- | --- | 310 | 45 | 655 | 95 | 45 | Q+SA | 241 max. HB; 100 max. HRB |
| ASME SA-666 | Type 201LN | S20153 | --- | --- | --- | 310 | 45 | 655 L | 95 L | 45 L | A | 241 max. HB; 100 max. HRB |
| ASTM A240/A240M-15a | Type 201LN | S20153 | --- | --- | --- | 310 | 45 | 655 | 95 | 45 | SA | 241 max. HBW; 100 max. HRBW |
| ASTM A666-15 | Type 201LN | S20153 | --- | --- | --- | 310 | 45 | 655 L | 95 L | 45 L | A | 241 max. HB; 100 max. HRB |
| ASME SA-240/SA-240M | Type 202 | S20200 | --- | --- | --- | 260 | 38 | 620 | 90 | 40 | Q+SA | 241 max. HB |
| ASME SA-666 | Type 202 | S20200 | --- | --- | --- | 260 | 38 | 620 L | 90 L | 40 L | A | 241 max. HB |
| ASTM A240/A240M-15a | Type 202 | S20200 | --- | --- | --- | 260 | 38 | 620 | 90 | 40 | SA | 241 max. HB |
| ASTM A666-15 | Type 202 | S20200 | --- | --- | --- | 260 | 38 | 620 L | 90 L | 40 L | A | 241 max. HB |
| EN 10088-2:2014 | X12CrMnNiN18-9-5 | --- | 1.4373 | t ≤ 8 | --- | 340 | --- | 680-880 | --- | 45 T | SA | --- |
| | | | | t ≤ 13.5 | --- | 320 | --- | 680-880 | --- | 45 T | SA | see standard for |
| | | | | t ≤ 75 | --- | 320 | --- | 600-800 | --- | 35 T | SA | impact data |
| GB 3280-92 | Grade 1Cr18Mn8Ni5N | --- | --- | --- | --- | 245 | --- | 590 | --- | 40 | ST | 207 max. HB; 95 max. HRB |
| GB 4237-92 | Grade 1Cr18Mn8Ni5N | --- | --- | --- | --- | 245 | --- | 590 | --- | 40 | ST | 207 max. HB; 95 max. HRB |
| GB 4239-91 | Grade 1Cr18Mn8Ni5N | --- | --- | --- | --- | 245 | --- | 590 | --- | 40 | ST | 95 max. HRB |

**8.1 Stainless Steels: Plate, Sheet and Strip**

**8.1.3B Mechanical Properties of Austenitic Stainless Steels (Continued)**

| Specification | Designation | UNS No | Steel No | Section Thickness/Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation % min | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | | | |
| ASME SA-240/SA-240M | Type 301 | S30100 | --- | --- | --- | 205 | 30 | 515 | 75 | 40 | Q+SA | 217 max. HB; 95 max. HRB |
| ASME SA-666 | Type 301 | S30100 | --- | --- | --- | 205 | 30 | 515 L | 75 L | 40 L | A | 217 max. HB; 95 max. HRB |
| ASTM A240/A240M-15a | Type 301 | S30100 | --- | --- | --- | 205 | 30 | 515 | 75 | 40 | SA | 217 max. HBW; 95 max. HRBW |
| ASTM A666-15 | Type 301 | S30100 | --- | --- | --- | 205 | 30 | 515 L | 75 L | 40 L | A | 217 max. HB; 95 max. HRB |
| EN 10088-2:2014 | X10CrNi18-8 | --- | 1.4310 | t ≤ 8 | --- | 250 | --- | 600-950 | --- | 40 T | SA | --- |
| | X5CrNi17-7 | --- | 1.4319 | t ≤ 3 | --- | 230 | --- | 550-750 | --- | 45 T | SA | --- |
| | | | | t ≤ 6 | --- | 230 | --- | 550-750 | --- | 45 T | SA | --- |
| GB 3280-92 | Grade 1Cr17Ni7 | --- | --- | --- | --- | 205 | --- | 520 | --- | 40 | --- | 187 max. HB; 90 max. HRB |
| | | | | --- | --- | 510 | --- | 865 | --- | 25 | WH | --- |
| | | | | t < 0.4 | --- | 755 | --- | 1030 | --- | 9 | WH | --- |
| | | | | t < 0.4 | --- | 930 | --- | 1210 | --- | 3 | WH | --- |
| | | | | t < 0.4 | --- | 960 | --- | 1270 | --- | 3 | WH | --- |
| | | | | t < 0.4 | --- | 960 | --- | 1270 | --- | 4 | WH | --- |
| | | | | t < 0.4 | --- | 960 | --- | 1270 | --- | 5 | WH | --- |
| | | | | 0.4 < t < 0.8 | --- | 930 | --- | 1210 | --- | 5 | WH | --- |
| | | | | t > 0.4 | --- | 755 | --- | 1030 | --- | 10 | WH | --- |
| | | | | t ≥ 0.8 | --- | 930 | --- | 1210 | --- | 7 | WH | --- |
| | Grade 1Cr17Ni8 | --- | --- | --- | --- | 205 | --- | 570 | --- | 45 | ST | 187 max. HB; 90 max. HRB |
| GB 4239-91 | Grade 1Cr17Ni7 | --- | --- | --- | --- | 205 | --- | 520 | --- | 40 | ST | 90 max. HRB |
| | | | | --- | --- | 510 | --- | 865 | --- | 25 | WH | 90 max. HRB |
| | | | | t < 0.4 | --- | 755 | --- | 1030 | --- | 9 | WH | 90 max. HRB |
| | | | | t < 0.4 | --- | 930 | --- | 1205 | --- | 3 | WH | 90 max. HRB |
| | | | | t < 0.4 | --- | 960 | --- | 1275 | --- | 3 | WH | 90 max. HRB |
| | | | | 0.4 ≤ t < 0.8 | --- | 930 | --- | 1205 | --- | 5 | WH | 90 max. HRB |
| | | | | 0.4 ≤ t < 0.8 | --- | 960 | --- | 1275 | --- | 4 | WH | 90 max. HRB |
| | | | | t ≥ 0.4 | --- | 755 | --- | 1030 | --- | 10 | WH | 90 max. HRB |
| | | | | t ≥ 0.8 | --- | 930 | --- | 1205 | --- | 7 | WH | 90 max. HRB |
| | | | | t ≥ 0.8 | --- | 960 | --- | 1275 | --- | 5 | WH | 90 max. HRB |
| | Grade 1Cr17Ni8 | --- | --- | --- | --- | 205 | --- | 570 | --- | 45 | ST | 90 max. HRB |

Note: This section continued on next page

**8.1 Stainless Steels: Plate, Sheet and Strip**

**8.1.3B Mechanical Properties of Austenitic Stainless Steels (Continued)**

| Specification | Designation | UNS No | Steel No | Section Thickness/Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | % min | | |
| ISO 16143-1:2004 | X10CrNi18-8 | --- | --- | t ≤ 8 | --- | 250 | --- | 600-800 | --- | 40 T | SA | --- |
| | | | | t ≤ 13.5 | --- | 230 | --- | 600-800 | --- | 40 T | SA | --- |
| JIS G 4304:2012 | Symbol SUS301 | --- | --- | --- | --- | 205 | --- | 520 | --- | 40 | ST | 207 max. HBW; 95 max. HRBW; 218 max. HV |
| | Symbol SUS301J1 | --- | --- | --- | --- | 205 | --- | 570 | --- | 45 | ST | 187 max. HBW; 90 max. HRBW; 200 max. HV |
| JIS G 4305:2012 | Symbol SUS301 | --- | --- | --- | --- | 205 | --- | 520 | --- | 40 | ST | 207 max. HBW; 95 max. HRBW; 218 max. HV |
| | | | | t < 0.4 | --- | 510 | --- | 860 | --- | 25 | T | --- |
| | | | | t < 0.4 | --- | 755 | --- | 1030 | --- | 9 | T | --- |
| | | | | t < 0.4 | --- | 930 | --- | 1210 | --- | 3 | T | --- |
| | | | | t < 0.4 | --- | 960 | --- | 1270 | --- | 3 | T | --- |
| | | | | 0.4 ≤ t < 0.8 | --- | 510 | --- | 860 | --- | 25 | T | --- |
| | | | | 0.4 ≤ t < 0.8 | --- | 755 | --- | 1030 | --- | 10 | T | --- |
| | | | | 0.4 ≤ t < 0.8 | --- | 930 | --- | 1210 | --- | 5 | T | --- |
| | | | | 0.4 ≤ t < 0.8 | --- | 960 | --- | 1270 | --- | 4 | T | --- |
| | | | | t ≥ 0.8 | --- | 510 | --- | 860 | --- | 25 | T | --- |
| | | | | t ≥ 0.8 | --- | 755 | --- | 1030 | --- | 10 | T | --- |
| | | | | t ≥ 0.8 | --- | 930 | --- | 1210 | --- | 7 | T | --- |
| | | | | t ≥ 0.8 | --- | 960 | --- | 1270 | --- | 5 | T | --- |
| | Symbol SUS301J1 | --- | --- | --- | --- | 205 | --- | 570 | --- | 45 | ST | 187 max. HBW; 90 max. HRBW; 200 max. HV |
| ASME SA-240/SA-240M | Type 301L | S30103 | --- | --- | --- | 220 | 32 | 550 | 80 | 45 | Q+SA | 241 max. HB; 100 max. HRB |
| ASME SA-666 | Type 301L | S30103 | --- | --- | --- | 220 | 32 | 550 L | 80 L | 45 L | A | 241 max. HB; 100 max. HRB |
| ASTM A240/A240M-15a | Type 301L | S30103 | --- | --- | --- | 220 | 32 | 550 | 80 | 45 | SA | 241 max. HBW; 100 max. HRBW |
| ASTM A666-15 | Type 301L | S30103 | --- | --- | --- | 220 | 32 | 550 L | 80 L | 45 L | A | 241 max. HB; 100 max. HRB |
| JIS G 4304:2012 | Symbol SUS301L | --- | --- | --- | --- | 215 | --- | 550 | --- | 45 | ST | 207 max. HBW; 95 max. HRBW; 218 max. HV |

Note: This section continued on next page

**8.1 Stainless Steels: Plate, Sheet and Strip**

**8.1.3B Mechanical Properties of Austenitic Stainless Steels (Continued)**

| Specification | Designation | UNS No | Steel No | Section Thickness/Diameter mm | Section Thickness/Diameter in. | Yield Strength, min. MPa | Yield Strength, min. ksi | Tensile Strength, min. MPa | Tensile Strength, min. ksi | Elongation % min | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| JIS G 4305:2012 | Symbol SUS301L | --- | --- | --- | --- | 215 | --- | 550 | --- | 45 | ST | 207 max. HBW; 95 max. HRBW; 218 max. HV |
| | | | | --- | --- | 345 | --- | 690 | --- | 40 | T | --- |
| | | | | --- | --- | 410 | --- | 760 | --- | 35 | T | --- |
| | | | | --- | --- | 480 | --- | 820 | --- | 25 | T | --- |
| | | | | --- | --- | 685 | --- | 930 | --- | 20 | T | --- |
| ASME SA-240/SA-240M | Type 301LN | S30153 | --- | --- | --- | 240 | 35 | 550 | 80 | 45 | Q+SA | 241 max. HB; 100 max. HRB |
| ASME SA-666 | Type 301LN | S30153 | --- | --- | --- | 240 | 35 | 550 L | 80 L | 45 L | A | 241 max. HB; 100 max. HRB |
| ASTM A240/A240M-15a | Type 301LN | S30153 | --- | --- | --- | 240 | 35 | 550 | 80 | 45 | SA | 241 max. HBW; 100 max. HRBW |
| ASTM A666-15 | Type 301LN | S30153 | --- | --- | --- | 240 | 35 | 550 L | 80 L | 45 L | A | 241 max. HB; 100 max. HRB |
| EN 10028-7:2007 | X2CrNiN18-7 | --- | 1.4318 | t ≤ 3 | --- | 350 | --- | 650-850 | --- | 35 T | SA | see standard for impact data |
| | | | | t ≤ 8 | --- | 350 | --- | 650-850 | --- | 40 T | SA | |
| | | | | t ≤ 13.5 | --- | 330 | --- | 650-850 | --- | 40 T | SA | |
| | | | | t ≤ 75 | --- | 330 | --- | 650-850 | --- | 40 T | SA | |
| EN 10088-2:2014 | X2CrNiN18-7 | --- | 1.4318 | t ≤ 8 | --- | 350 | --- | 650-850 | --- | 40 T | SA | --- |
| | | | | t ≤ 13.5 | --- | 330 | --- | 650-850 | --- | 40 T | SA | see standard for impact data |
| | | | | t ≤ 75 | --- | 330 | --- | 630-830 | --- | 45 T | SA | |
| ISO 9328-7:2004 | Grade X2CrNiN18-7 | --- | --- | t ≤ 6 | --- | 350 | --- | 650-850 | --- | 40 T | SA | --- |
| | | | | t ≤ 12 | --- | 330 | --- | 650-850 | --- | 40 T | SA | see standard for impact data |
| | | | | t ≤ 75 | --- | 330 | --- | 650-850 | --- | 40 T | SA | |
| ASME SA-240/SA-240M | Type 302 | S30200 | --- | --- | --- | 205 | 30 | 515 | 75 | 40 | Q+SA | 201 max. HB; 92 max. HRB |
| ASME SA-666 | Type 302 | S30200 | --- | --- | --- | 205 | 30 | 515 L | 75 L | 40 L | A | 201 max. HB; 92 max. HRB |
| ASTM A240/A240M-15a | Type 302 | S30200 | --- | --- | --- | 205 | 30 | 515 | 75 | 40 | SA | 201 max. HBW; 92 max. HRBW |
| ASTM A666-15 | Type 302 | S30200 | --- | --- | --- | 205 | 30 | 515 L | 75 L | 40 L | A | 201 max. HB; 92 max. HRB |
| JIS G 4304:2012 | Symbol SUS303 | --- | --- | --- | --- | 205 | --- | 520 | --- | 35 | ST | 187 max. HBW; 90 max. HRBW; 200 max. HV |

**8.1 Stainless Steels: Plate, Sheet and Strip**

**8.1.3B Mechanical Properties of Austenitic Stainless Steels (Continued)**

| Specification | Designation | UNS No | Steel No | Section Thickness/Diameter mm | Section Thickness/Diameter in. | Yield Strength, min. MPa | Yield Strength, min. ksi | Tensile Strength, min. MPa | Tensile Strength, min. ksi | Elongation % min | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GB 3280-92 | Grade 1Cr18Ni9Si3 | --- | --- | --- | --- | 205 | --- | 520 | --- | 40 | ST | 207 max. HB; 95 max. HRB |
| GB 4237-92 | Grade 1Cr18Ni9Si3 | --- | --- | --- | --- | 205 | --- | 502 | --- | 40 | ST | 207 max. HB; 95 max. HRB |
| GB 4238-92 | Grade 1Cr18Ni9Si3 | --- | --- | --- | --- | 205 | --- | 520 | --- | 40 | ST | 207 max. HB; 95 max. HRB |
| GB 4239-91 | Grade 1Cr18Ni9Si3 | --- | --- | --- | --- | 205 | --- | 520 | --- | 40 | ST | 95 max. HRB |
| JIS G 4304:2012 | Symbol SUS302B | --- | --- | --- | --- | 205 | --- | 520 | --- | 40 | ST | 207 max. HBW; 95 max. HRBW; 218 max. HV |
| JIS G 4305:2012 | Symbol SUS302B | --- | --- | --- | --- | 205 | --- | 520 | --- | 40 | ST | 207 max. HBW; 95 max. HRBW; 218 max. HV |
| ASME SA-240/SA-240M | Type 304 | S30400 | --- | --- | --- | 205 | 30 | 515 | 75 | 40 | Q+SA | 201 max. HB; 92 max. HRB |
| ASME SA-666 | Type 304 | S30400 | --- | --- | --- | 205 | 30 | 515 L | 75 L | 40 L | A | 201 max. HB; 92 max. HRB |
| ASTM A240/A240M-15a | Type 304 | S30400 | --- | --- | --- | 205 | 30 | 515 | 75 | 40 | SA | 201 max. HBW; 92 max. HRBW |
| ASTM A666-15 | Type 304 | S30400 | --- | --- | --- | 205 | 30 | 515 L | 75 L | 40 L | A | 201 max. HB; 92 max. HRB |
| EN 10028-7:2007 | X5CrNi18-10 | --- | 1.4301 | t ≤ 8 | --- | 230 | --- | 540-750 | --- | 45 T | SA | see standard for impact data |
| | | | | t ≤ 13.5 | --- | 210 | --- | 520-720 | --- | 45 T | SA | |
| | | | | t ≤ 75 | --- | 210 | --- | 520-720 | --- | 45 T | SA | |
| EN 10088-2:2014 | X5CrNi18-10 | --- | 1.4301 | t ≤ 8 | --- | 230 | --- | 540-750 | --- | 45 T | SA | --- |
| | | | | t ≤ 13.5 | --- | 210 | --- | 520-720 | --- | 45 T | SA | see standard for impact data |
| | | | | t ≤ 75 | --- | 210 | --- | 520-720 | --- | 45 T | SA | |
| GB 3280-92 | Grade 0Cr18Ni9 | --- | --- | --- | --- | 205 | --- | 520 | --- | 40 | ST | 187 max. HB; 90 max. HRB |
| GB 4237-92 | Grade 0Cr18Ni9 | --- | --- | --- | --- | 205 | --- | 520 | --- | 40 | ST | 187 max. HB; 90 max. HRB |
| GB 4238-92 | Grade 0Cr18Ni9 | --- | --- | --- | --- | 205 | --- | 520 | --- | 40 | ST | 187 max. HB; 90 max. HRB |
| GB 4239-91 | Grade 0Cr18Ni9 | --- | --- | --- | --- | 205 | --- | 520 | --- | 40 | ST | 90 max. HRB |
| ISO 16143-1:2004 | X5CrNi18-9 | --- | --- | t ≤ 8 | --- | 230 | --- | 540-740 | --- | 45 T | SA | --- |
| | | | | t ≤ 13.5 | --- | 210 | --- | 540-740 | --- | 45 T | SA | --- |
| | | | | t ≤ 75 | --- | 210 | --- | 520-720 | --- | 45 T | SA | --- |
| ISO 9328-7:2004 | Grade X5CrNi18-9 | --- | --- | t ≤ 6 | --- | 230 | --- | 540-750 | --- | 45 T | SA | --- |
| | | | | t ≤ 12 | --- | 210 | --- | 520-720 | --- | 45 T | SA | see standard for impact data |
| | | | | t ≤ 75 | --- | 210 | --- | 520-720 | --- | 45 T | SA | |

Note: This section continued on next page

**8.1 Stainless Steels: Plate, Sheet and Strip**

**8.1.3B Mechanical Properties of Austenitic Stainless Steels (Continued)**

| Specification | Designation | UNS No | Steel No | Section Thickness/Diameter mm | Section Thickness/Diameter in. | Yield Strength, min. MPa | Yield Strength, min. ksi | Tensile Strength, min. MPa | Tensile Strength, min. ksi | Elongation % min | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| JIS G 4304:2012 | Symbol SUS304 | --- | --- | --- | --- | 205 | --- | 520 | --- | 40 | ST | 187 max. HBW; 90 max. HRBW; 200 max. HV |
| JIS G 4305:2012 | Symbol SUS304 | --- | --- | --- | --- | 205 | --- | 520 | --- | 40 | ST | 187 max. HBW; 90 max. HRBW; 200 max. HV |
| ISO 16143-1:2004 | X6CrNiCu17-8-2 | --- | --- | t ≤ 8 | --- | 155 | --- | 450 | --- | 40 T | SA | --- |
| | | | | t ≤ 13.5 | --- | 155 | --- | 450 | --- | 40 T | SA | --- |
| | | | | t ≤ 75 | --- | 155 | --- | 450 | --- | 40 T | SA | --- |
| JIS G 4304:2012 | Symbol SUS304J1 | --- | --- | --- | --- | 155 | --- | 450 | --- | 40 | ST | 187 max. HBW; 90 max. HRBW; 200 max. HV |
| JIS G 4305:2012 | Symbol SUS304J1 | --- | --- | --- | --- | 155 | --- | 450 | --- | 40 | ST | 187 max. HBW; 90 max. HRBW; 200 max. HV |
| ASME SA-240/SA-240M | Type 304L | S30403 | --- | --- | --- | 170 | 25 | 485 | 70 | 40 | Q+SA | 201 max. HB; 92 max. HRB |
| ASME SA-666 | Type 304L | S30403 | --- | --- | --- | 170 | 25 | 485 L | 70 L | 40 L | A | 201 max. HB; 92 max. HRB |
| ASTM A240/A240M-15a | Type 304L | S30403 | --- | --- | --- | 170 | 25 | 485 | 70 | 40 | SA | 201 max. HBW; 92 max. HRBW |
| ASTM A666-15 | Type 304L | S30403 | --- | --- | --- | 170 | 25 | 485 L | 70 L | 40 L | A | 201 max. HB; 92 max. HRB |
| EN 10028-7:2007 | X2CrNi19-11 | --- | 1.4306 | t ≤ 8 | --- | 220 | --- | 520-670 | --- | 45 T | SA | see standard for impact data |
| | | | | t ≤ 13.5 | --- | 200 | --- | 520-670 | --- | 45 T | SA | |
| | | | | t ≤ 75 | --- | 200 | --- | 500-650 | --- | 45 T | SA | |
| | X2CrNi18-9 | --- | 1.4307 | t ≤ 8 | --- | 220 | --- | 520-670 | --- | 45 T | SA | see standard for impact data |
| | | | | t ≤ 13.5 | --- | 200 | --- | 520-670 | --- | 45 T | SA | |
| | | | | t ≤ 75 | --- | 200 | --- | 500-650 | --- | 45 T | SA | |
| EN 10088-2:2014 | X2CrNi19-11 | --- | 1.4306 | t ≤ 8 | --- | 220 | --- | 520-700 | --- | 45 T | SA | --- |
| | | | | t ≤ 13.5 | --- | 200 | --- | 520-700 | --- | 45 T | SA | see standard for impact data |
| | | | | t ≤ 75 | --- | 200 | --- | 500-700 | --- | 45 T | SA | |
| | X2CrNi18-9 | --- | 1.4307 | t ≤ 8 | --- | 220 | --- | 520-700 | --- | 45 T | SA | --- |
| | | | | t ≤ 13.5 | --- | 200 | --- | 520-700 | --- | 45 T | SA | see standard for impact data |
| | | | | t ≤ 75 | --- | 200 | --- | 500-700 | --- | 45 T | SA | |
| GB 3280-92 | Grade 00Cr19Ni10 | --- | --- | --- | --- | 177 | --- | 480 | --- | 40 | ST | 187 max. HB; 90 max. HRB |
| | Grade 00Cr19Ni13Mo3 | --- | --- | --- | --- | 177 | --- | 480 | --- | 40 | ST | 187 max. HB; 90 max. HRB |

Note: This section continued on next page

**8.1 Stainless Steels: Plate, Sheet and Strip**

**8.1.3B Mechanical Properties of Austenitic Stainless Steels (Continued)**

| Specification | Designation | UNS No | Steel No | Section Thickness/Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation % min | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | | | |
| GB 4237-92 | Grade 00Cr19Ni10 | --- | --- | --- | --- | 177 | --- | 480 | --- | 40 | ST | 187 min. HB; 90 max. HRB |
| GB 4239-91 | Grade 00Cr19Ni10 | --- | --- | --- | --- | 175 | --- | 480 | --- | 40 | ST | 90 max. HRB |
| ISO 16143-1:2004 | X2CrNi18-9 | --- | --- | t ≤ 8 | --- | 220 | --- | 520-720 | --- | 45 T | SA | --- |
| | | | | t ≤ 8 | --- | 175 | --- | 480-680 | --- | 45 T | SA | --- |
| | | | | t ≤ 13.5 | --- | 200 | --- | 520-720 | --- | 45 T | SA | --- |
| | | | | t ≤ 75 | --- | 200 | --- | 500-700 | --- | 45 T | SA | --- |
| | X2CrNi19-11 | --- | --- | t ≤ 8 | --- | 220 | --- | 520-720 | --- | 45 T | SA | --- |
| | | | | t ≤ 13.5 | --- | 200 | --- | 520-720 | --- | 45 T | SA | --- |
| | | | | t ≤ 75 | --- | 200 | --- | 500-700 | --- | 45 T | SA | --- |
| ISO 9328-7:2004 | Grade X2CrNi18-9 | --- | --- | t ≤ 6 | --- | 220 | --- | 520-670 | --- | 45 T | SA | --- |
| | | | | t ≤ 12 | --- | 200 | --- | 520-670 | --- | 45 T | SA | see standard for impact data |
| | | | | t ≤ 75 | --- | 200 | --- | 500-650 | --- | 45 T | SA | |
| | Grade X2CrNi19-11 | --- | --- | t ≤ 6 | --- | 220 | --- | 520-670 | --- | 45 T | SA | --- |
| | | | | t ≤ 12 | --- | 200 | --- | 520-670 | --- | 45 T | SA | see standard for impact data |
| | | | | t ≤ 75 | --- | 200 | --- | 500-650 | --- | 45 T | SA | |
| JIS G 4304:2012 | Symbol SUS304L | --- | --- | --- | --- | 175 | --- | 480 | --- | 40 | ST | 187 max. HBW; 90 max. HRBW; 200 max. HV |
| JIS G 4305:2012 | Symbol SUS304L | --- | --- | --- | --- | 175 | --- | 480 | --- | 40 | ST | 187 max. HBW; 90 max. HRBW; 200 max. HV |
| ASME SA-240/SA-240M | Type 304H | S30409 | --- | --- | --- | 205 | 30 | 515 | 75 | 40 | Q+SA | 201 max. HB; 92 max. HRB |
| ASTM A240/A240M-15a | Type 304H | S30409 | --- | --- | --- | 205 | 30 | 515 | 75 | 40 | SA | 201 max. HBW; 92 max. HRBW |
| EN 10028-7:2007 | X6CrNi18-10 | --- | 1.4948 | t ≤ 8 | --- | 230 | --- | 530-740 | --- | 45 T | SA | see standard for impact data |
| | | | | t ≤ 13.5 | --- | 210 | --- | 510-710 | --- | 45 T | SA | |
| | | | | t ≤ 75 | --- | 190 | --- | 510-710 | --- | 45 T | SA | |
| ISO 9328-7:2004 | Grade X6CrNi18-10 | --- | --- | t ≤ 6 | --- | 230 | --- | 530-740 | --- | 45 T | SA | --- |
| | | | | t ≤ 12 | --- | 210 | --- | 510-710 | --- | 45 T | SA | see standard for impact data |
| | | | | t ≤ 75 | --- | 190 | --- | 510-710 | --- | 45 T | SA | |
| ISO 4955:2005 | X7CrNi18-9 | --- | --- | 0.5 ≤ t < 3 | --- | 195 | --- | 500-700 | --- | 37 L, 37 T | SA | 192 max. HB |
| | | | | 1.5 ≤ t ≤ 25 | --- | 195 | --- | 500-700 | --- | 40 | SA | 192 max. HB |
| | | | | 3 ≤ t ≤ 75 | --- | 195 | --- | 500-700 | --- | 40 L, 40 T | SA | 192 max. HB |
| | | | | t ≤ 100 | --- | 195 | --- | 500-700 | --- | 40 | SA | 192 max. HB |
| | | | | 5 ≤ t ≤ 160 | --- | 195 | --- | 500-700 | --- | 40 | SA | 192 max. HB |

**8.1 Stainless Steels: Plate, Sheet and Strip**

**8.1.3B Mechanical Properties of Austenitic Stainless Steels (Continued)**

| Specification | Designation | UNS No | Steel No | Section Thickness/Diameter mm | Section Thickness/Diameter in. | Yield Strength, min. MPa | Yield Strength, min. ksi | Tensile Strength, min. MPa | Tensile Strength, min. ksi | Elongation % min | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ASME SA-240/SA-240M | Type 304N | S30451 | --- | --- | --- | 240 | 35 | 550 | 80 | 30 | Q+SA | 217 max. HB; 95 max. HRB |
| ASME SA-666 | Type 304N | S30451 | --- | --- | --- | 240 | 35 | 550 L | 80 L | 30 L | A | 217 max. HB; 95 max. HRB |
| ASTM A240/A240M-15a | Type 304N | S30451 | --- | --- | --- | 240 | 35 | 550 | 80 | 30 | SA | 217 max. HBW; 95 max. HRBW |
| ASTM A666-15 | Type 304N | S30451 | --- | --- | --- | 240 | 35 | 550 L | 80 L | 30 L | A | 217 max. HB; 95 max. HRB |
| EN 10028-7:2007 | X5CrNiN19-9 | --- | 1.4315 | t ≤ 8 | --- | 290 | --- | 550-750 | --- | 40 T | SA | see standard for impact data |
| | | | | t ≤ 13.5 | --- | 270 | --- | 550-750 | --- | 40 T | SA | |
| | | | | t ≤ 75 | --- | 270 | --- | 550-750 | --- | 40 T | SA | |
| EN 10088-2:2014 | X5CrNiN19-9 | --- | 1.4315 | t ≤ 8 | --- | 290 | --- | 500-750 | --- | 40 T | SA | see standard for impact data |
| | | | | t ≤ 13.5 | --- | 270 | --- | 500-750 | --- | 40 T | SA | |
| | | | | t ≤ 75 | --- | 270 | --- | 500-750 | --- | 40 T | SA | |
| GB 3280-92 | Grade 0Cr19Ni9N | --- | --- | --- | --- | 275 | --- | 550 | --- | 35 | ST | 217 max. HB; 95 max. HRB |
| GB 4237-92 | Grade 0Cr19Ni9N | --- | --- | --- | --- | 275 | --- | 550 | --- | 35 | ST | 217 max. HB; 95 max. HRB |
| GB 4239-91 | Grade 0Cr19Ni9N | --- | --- | --- | --- | 275 | --- | 550 | --- | 35 | ST | 95 max. HRB |
| ISO 9328-7:2004 | Grade X5CrNiN18-8 | --- | --- | t ≤ 6 | --- | 290 | --- | 550-750 | --- | 40 T | SA | --- |
| | | | | t ≤ 12 | --- | 270 | --- | 550-750 | --- | 40 T | SA | see standard for impact data |
| | | | | t ≤ 75 | --- | 270 | --- | 550-750 | --- | 40 T | SA | |
| JIS G 4304:2012 | Symbol SUS304N1 | --- | --- | --- | --- | 275 | --- | 550 | --- | 35 | ST | 217 max. HBW; 95 max. HRBW; 220 max. HV |
| JIS G 4305:2012 | Symbol SUS304N1 | --- | --- | --- | --- | 275 | --- | 550 | --- | 35 | ST | 217 max. HBW; 95 max. HRBW; 220 max. HV |
| GB 3280-92 | Grade 0Cr19Ni10NbN | --- | --- | --- | --- | 345 | --- | 685 | --- | 35 | ST | 250 max. HB; 100 max. HRB |
| GB 4237-92 | Grade 0Cr19Ni10NbN | --- | --- | --- | --- | 345 | --- | 685 | --- | 35 | ST | 250 max. HB; 100 max. HRB |
| GB 4239-91 | Grade 0Cr19Ni10NbN | --- | --- | --- | --- | 345 | --- | 685 | --- | 35 | ST | 100 max. HRB |
| JIS G 4304:2012 | Symbol SUS304N2 | --- | --- | --- | --- | 345 | --- | 690 | --- | 35 | ST | 248 max. HBW; 100 max. HRBW; 260 max. HV |
| | Symbol SUS304N2-X | --- | --- | --- | --- | 450 | --- | 720 | --- | 25 | ST | 230-325 HBW |
| JIS G 4305:2012 | Symbol SUS304N2 | --- | --- | --- | --- | 345 | --- | 690 | --- | 35 | ST | 248 max. HBW; 100 max. HRBW; 260 max. HV |

**8.1 Stainless Steels: Plate, Sheet and Strip**

**8.1.3B Mechanical Properties of Austenitic Stainless Steels (Continued)**

| Specification | Designation | UNS No | Steel No | Section Thickness/Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation % min | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | | | |
| ASME SA-240/SA-240M | Type 304LN | S30453 | --- | --- | --- | 205 | 30 | 515 | 75 | 40 | Q+SA | 217 max. HB; 95 max. HRB |
| ASME SA-666 | Type 304LN | S30453 | --- | --- | --- | 205 | 30 | 515 L | 75 L | 40 L | A | 217 max. HB; 95 max. HRB |
| ASTM A240/A240M-15a | Type 304LN | S30453 | --- | --- | --- | 205 | 30 | 515 | 75 | 40 | SA | 217 max. HBW; 95 max. HRBW |
| ASTM A666-15 | Type 304LN | S30453 | --- | --- | --- | 205 | 30 | 515 L | 75 L | 40 L | A | 217 max. HB; 95 max. HRB |
| EN 10028-7:2007 | X2CrNiN18-10 | --- | 1.4311 | t ≤ 8 | --- | 290 | --- | 550-750 | --- | 40 T | SA | see standard for impact data |
| | | | | t ≤ 13.5 | --- | 270 | --- | 550-750 | --- | 40 T | SA | |
| | | | | t ≤ 75 | --- | 270 | --- | 550-750 | --- | 40 T | SA | |
| EN 10088-2:2014 | X2CrNiN18-10 | --- | 1.4311 | t ≤ 8 | --- | 290 | --- | 550-750 | --- | 40 T | SA | --- |
| | | | | t ≤ 13.5 | --- | 270 | --- | 550-750 | --- | 40 T | SA | see standard for impact data |
| | | | | t ≤ 75 | --- | 270 | --- | 550-750 | --- | 40 T | SA | |
| GB 3280-92 | Grade 00Cr18Ni10N | --- | --- | --- | --- | 245 | --- | 550 | --- | 40 | ST | 217 max. HB; 95 max. HRB |
| GB 4237-92 | Grade 00Cr18Ni10N | --- | --- | --- | --- | 245 | --- | 550 | --- | 40 | ST | 217 max. HB; 95 max. HRB |
| GB 4239-91 | Grade 00Cr18Ni10N | --- | --- | --- | --- | 245 | --- | 550 | --- | 40 | ST | 95 max. HRB |
| ISO 16143-1:2004 | X2CrNiN18-9 | --- | --- | t ≤ 8 | --- | 290 | --- | 550-750 | --- | 40 T | SA | --- |
| | | | | t ≤ 13.5 | --- | 270 | --- | 550-750 | --- | 40 T | SA | --- |
| | | | | t ≤ 75 | --- | 270 | --- | 530-730 | --- | 40 T | SA | --- |
| ISO 9328-7:2004 | Grade X2CrNiN18-10 | --- | --- | t ≤ 6 | --- | 290 | --- | 550-750 | --- | 40 T | SA | --- |
| | | | | t ≤ 12 | --- | 270 | --- | 550-750 | --- | 40 T | SA | see standard for impact data |
| | | | | t ≤ 75 | --- | 270 | --- | 550-750 | --- | 40 T | SA | |
| JIS G 4304:2012 | Symbol SUS304LN | --- | --- | --- | --- | 245 | --- | 550 | --- | 40 | ST | 217 max. HBW; 95 max. HRBW; 220 max. HV |
| JIS G 4305:2012 | Symbol SUS304LN | --- | --- | --- | --- | 245 | --- | 550 | --- | 40 | ST | 217 max. HBW; 95 max. HRBW; 220 max. HV |

**8.1 Stainless Steels: Plate, Sheet and Strip**

**8.1.3B Mechanical Properties of Austenitic Stainless Steels (Continued)**

| Specification | Designation | UNS No | Steel No | Section Thickness/Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation % min | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | | | |
| ASME SA-240/SA-240M | Type 305 | S30500 | --- | --- | --- | 170 | 25 | 485 | 70 | 40 | Q+SA | 183 max. HB; 88 max. HRB |
| ASTM A240/A240M-15a | Type 305 | S30500 | --- | --- | --- | 170 | 25 | 485 | 70 | 40 | SA | 183 max. HBW; 88 max. HRBW |
| EN 10088-2:2014 | X4CrNi18-12 | --- | 1.4303 | t ≤ 8 | --- | 220 | --- | 500-650 | --- | 45 T | SA | --- |
| GB 3280-92 | Grade 1Cr18Ni12 | --- | --- | --- | --- | 177 | --- | 480 | --- | 40 | ST | 187 max. HB; 90 max. HRB |
| GB 4237-92 | Grade 1Cr18Ni12 | --- | --- | --- | --- | 177 | --- | 480 | --- | 40 | ST | 187 max. HB; 90 max. HRB |
| GB 4239-91 | Grade 1Cr18Ni12 | --- | --- | --- | --- | 175 | --- | 480 | --- | 40 | ST | 90 max. HRB |
| JIS G 4304:2012 | Symbol SUS305 | --- | --- | --- | --- | 175 | --- | 480 | --- | 40 | ST | 187 max. HBW; 90 max. HRBW; 200 max. HV |
| JIS G 4305:2012 | Symbol SUS305 | --- | --- | --- | --- | 175 | --- | 480 | --- | 40 | ST | 187 max. HBW; 90 max. HRBW; 200 max. HV |
| ASME SA-240/SA-240M | --- | S30600 | --- | --- | --- | 240 | 35 | 540 | 78 | 40 | Q+SA | --- |
| ASTM A240/A240M-15a | --- | S30600 | --- | --- | --- | 240 | 35 | 540 | 78 | 40 | SA | --- |
| EN 10088-2:2014 | X1CrNiSi18-15-4 | --- | 1.4361 | t ≤ 75 | --- | 220 | --- | 530-730 | --- | 40 T | SA | see standard for impact data |
| GB 4238-92 | Grade 2Cr23Ni13 | --- | --- | --- | --- | 205 | --- | 560 | --- | 40 | ST | 201 max. HB; 95 max. HRB |
| JIS G 4312:2011 | Symbol SUH309 | --- | --- | --- | --- | 205 | --- | 560 | --- | 40 | ST | 201 max. HBW; 95 max. HRBW; 210 max. HV |

**8.1 Stainless Steels: Plate, Sheet and Strip**

**8.1.3B Mechanical Properties of Austenitic Stainless Steels (Continued)**

| Specification | Designation | UNS No | Steel No | Section Thickness/Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation % min | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | | | |
| ASME SA-240/SA-240M | Type 309S | S30908 | --- | --- | --- | 205 | 30 | 515 | 75 | 40 | Q+SA | 217 max. HB; 95 max. HRB |
| ASTM A240/A240M-15a | Type 309S | S30908 | --- | --- | --- | 205 | 30 | 515 | 75 | 40 | SA | 217 max. HBW; 95 max. HRBW |
| EN 10095:1999 | X12CrNi23-13 | --- | 1.4833 | 0.5 ≤ t < 3 | --- | 210 | --- | 500-700 | --- | 33 L, 33 T | SA | 192 max. HB |
| | | | | t ≤ 25 | --- | 210 | --- | 500-700 L | --- | 35 L | SA | 192 max. HB |
| | | | | 3 ≤ t ≤ 75 | --- | 210 | --- | 500-700 | --- | 35 L, 35 T | SA | 192 max. HB |
| | | | | t ≤ 160 | --- | 210 | --- | 500-700 L | --- | 35 L | SA | 192 max. HB |
| GB 3280-92 | Grade 0Cr23Ni13 | --- | --- | --- | --- | 205 | --- | 520 | --- | 40 | ST | 187 max. HB; 90 max. HRB |
| GB 4237-92 | Grade 0Cr23Ni13 | --- | --- | --- | --- | 205 | --- | 520 | --- | 40 | ST | 187 max. HB; 90 max. HRB |
| GB 4238-92 | Grade 0Cr23Ni13 | --- | --- | --- | --- | 205 | --- | 520 | --- | 40 | ST | 187 max. HB; 90 max. HRB |
| GB 4239-91 | Grade 0Cr23Ni13 | --- | --- | --- | --- | 205 | --- | 520 | --- | 40 | ST | 90 max. HRB |
| ISO 4955:2005 | X12CrNi23-13 | --- | --- | 0.5 ≤ t < 3 | --- | 210 | --- | --- | --- | 33 L, 33 T | SA | 192 max. HB |
| | | | | 1.5 ≤ t ≤ 25 | --- | 210 | --- | --- | --- | 35 | SA | 192 max. HB |
| | | | | 3 ≤ t ≤ 75 | --- | 210 | --- | --- | --- | 35 L, 35 T | SA | 192 max. HB |
| | | | | t ≤ 100 | --- | 210 | --- | --- | --- | 35 | SA | 192 max. HB |
| | | | | 5 ≤ t ≤ 160 | --- | 210 | --- | --- | --- | 35 | SA | 192 max. HB |
| JIS G 4304:2012 | Symbol SUS309S | --- | --- | --- | --- | 205 | --- | 520 | --- | 40 | ST | 187 max. HBW; 90 max. HRBW; 200 max. HV |
| JIS G 4305:2012 | Symbol SUS309S | --- | --- | --- | --- | 205 | --- | 520 | --- | 40 | ST | 187 max. HBW; 90 max. HRBW; 200 max. HV |
| ASME SA-240/SA-240M | Type 309H | S30909 | --- | --- | --- | 205 | 30 | 515 | 75 | 40 | Q+SA | 217 max. HB; 95 max. HRB |
| ASTM A240/A240M-15a | Type 309H | S30909 | --- | --- | --- | 205 | 30 | 515 | 75 | 40 | SA | 217 max. HBW; 95 max. HRBW |
| EN 10028-7:2007 | X6CrNi23-13 | --- | 1.4950 | t ≤ 8 | --- | 220 | --- | 530-730 | --- | 35 T | SA | see standard for impact data |
| | | | | t ≤ 13.5 | --- | 200 | --- | 510-710 | --- | 35 T | SA | |
| | | | | t ≤ 75 | --- | 200 | --- | 510-710 | --- | 35 T | SA | |
| ISO 9328-7:2004 | Grade X6CrNi23-13 | --- | --- | t ≤ 6 | --- | 220 | --- | 530-730 | --- | 35 T | SA | --- |
| | | | | t ≤ 12 | --- | 200 | --- | 510-710 | --- | 35 T | SA | see standard for impact data |
| | | | | t ≤ 75 | --- | 200 | --- | 510-710 | --- | 35 T | SA | |

**8.1 Stainless Steels: Plate, Sheet and Strip**

**8.1.3B Mechanical Properties of Austenitic Stainless Steels (Continued)**

| Specification | Designation | UNS No | Steel No | Section Thickness/Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | % min | | |
| GB 4238-92 | Grade 1Cr25Ni20Si2 | --- | --- | --- | --- | --- | --- | 540 | --- | 35 | ST | --- |
| | Grade 2Cr25Ni20 | --- | --- | --- | --- | 205 | --- | 590 | --- | 35 | ST | 201 max. HB; 95 max. HRB |
| JIS G 4312:2011 | Symbol SUH310 | --- | --- | --- | --- | 205 | --- | 590 | --- | 35 | ST | 201 max. HBW; 95 max. HRBW; 210 max. HV |
| EN 10095:1999 | X15CrNiSi25-21 | --- | 1.4841 | 0.5 ≤ t < 3 | --- | 230 | --- | 550-750 | --- | 28 L, 28 T | SA | 223 max. HB |
| | | | | t ≤ 25 | --- | 230 | --- | 550-750 L | --- | 30 L | SA | 223 max. HB |
| | | | | 3 ≤ t ≤ 75 | --- | 230 | --- | 550-750 | --- | 30 L, 30 T | SA | 223 max. HB |
| | | | | t ≤ 160 | --- | 230 | --- | 550-750 L | --- | 30 L | SA | 223 max. HB |
| ASME SA-240/SA-240M | Type 310S | S31008 | --- | --- | --- | 205 | 30 | 515 | 75 | 40 | Q+SA | 217 max. HB; 95 max. HRB |
| ASTM A240/A240M-15a | Type 310S | S31008 | --- | --- | --- | 205 | 30 | 515 | 75 | 40 | SA | 217 max. HBW; 95 max. HRBW |
| EN 10095:1999 | X8CrNi25-21 | --- | 1.4845 | 0.5 ≤ t < 3 | --- | 210 | --- | 500-700 | --- | 33 L, 33 T | SA | 192 max. HB |
| | | | | t ≤ 25 | --- | 210 | --- | 500-700 L | --- | 35 L | SA | 192 max. HB |
| | | | | 3 ≤ t ≤ 75 | --- | 210 | --- | 500-700 | --- | 35 L, 35 T | SA | 192 max. HB |
| | | | | t ≤ 160 | --- | 210 | --- | 500-700 L | --- | 35 L | SA | 192 max. HB |
| GB 3280-92 | Grade 0Cr25Ni20 | --- | --- | --- | --- | 205 | --- | 520 | --- | 40 | ST | 187 max. HB; 90 max. HRB |
| GB 4237-92 | Grade 0Cr25Ni20 | --- | --- | --- | --- | 205 | --- | 520 | --- | 40 | ST | 187 max. HB; 90 max. HRB |
| GB 4238-92 | Grade 0Cr25Ni20 | --- | --- | --- | --- | 205 | --- | 520 | --- | 40 | ST | 187 max. HB; 90 max. HRB |
| GB 4239-91 | Grade 0Cr25Ni20 | --- | --- | --- | --- | 205 | --- | 520 | --- | 40 | ST | 90 max. HRB |
| ISO 4955:2005 | X8CrNi25-21 | --- | --- | 0.5 ≤ t < 3 | --- | 210 | --- | --- | --- | 33 L, 33 T | SA | 192 max. HB |
| | | | | 1.5 ≤ t ≤ 25 | --- | 210 | --- | --- | --- | 35 | SA | 192 max. HB |
| | | | | 3 ≤ t ≤ 75 | --- | 210 | --- | --- | --- | 35 L, 35 T | SA | 192 max. HB |
| | | | | t ≤ 100 | --- | 210 | --- | --- | --- | 35 | SA | 192 max. HB |
| | | | | 5 ≤ t ≤ 160 | --- | 210 | --- | --- | --- | 35 | SA | 192 max. HB |
| JIS G 4304:2012 | Symbol SUS310S | --- | --- | --- | --- | 205 | --- | 520 | --- | 40 | ST | 187 max. HBW; 90 max. HRBW; 200 max. HV |
| JIS G 4305:2012 | Symbol SUS310S | --- | --- | --- | --- | 205 | --- | 520 | --- | 40 | ST | 187 max. HBW; 90 max. HRBW; 200 max. HV |

**8.1 Stainless Steels: Plate, Sheet and Strip**

**8.1.3B Mechanical Properties of Austenitic Stainless Steels (Continued)**

| Specification | Designation | UNS No | Steel No | Section Thickness/Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation % min | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | | | |
| ASME SA-240/SA-240M | Type 310H | S31009 | --- | --- | --- | 205 | 30 | 515 | 75 | 40 | Q+SA | 217 max. HB; 95 max. HRB |
| ASTM A240/A240M-15a | Type 310H | S31009 | --- | --- | --- | 205 | 30 | 515 | 75 | 40 | SA | 217 max. HBW; 95 max. HRBW |
| EN 10028-7:2007 | X6CrNi25-20 | --- | 1.4951 | t ≤ 8 | --- | 220 | --- | 530-730 | --- | 35 T | SA | see standard for impact data |
| | | | | t ≤ 13.5 | --- | 200 | --- | 510-710 | --- | 35 T | SA | |
| | | | | t ≤ 75 | --- | 200 | --- | 510-710 | --- | 35 T | SA | |
| ISO 9328-7:2004 | Grade X6CrNi25-20 | --- | --- | t ≤ 6 | --- | 220 | --- | 530-730 | --- | 35 T | SA | --- |
| | | | | t ≤ 12 | --- | 200 | --- | 510-710 | --- | 35 T | SA | see standard for |
| | | | | t ≤ 75 | --- | 200 | --- | 510-710 | --- | 35 T | SA | impact data |
| ASME SA-240/SA-240M | Type 310 MoLN | S31050 | --- | --- | t ≤ 0.25 | 270 | 39 | 580 | 84 | 25 | Q+SA | 217 max. HB; 95 max. HRB |
| | | | | --- | t > 0.25 | 255 | 37 | 540 | 78 | 25 | Q+SA | 217 max. HB; 95 max. HRB |
| ASTM A240/A240M-15a | Type 310 MoLN | S31050 | --- | --- | t ≤ 0.25 | 270 | 39 | 580 | 84 | 25 | SA | 217 max. HBW; 95 max. HRBW |
| | | | | --- | t > 0.25 | 255 | 37 | 540 | 78 | 25 | SA | 217 max. HBW; 95 max. HRBW |
| EN 10028-7:2007 | X1CrNiMoN25-22-2 | --- | 1.4466 | t ≤ 75 | --- | 250 | --- | 540-740 | --- | 40 T | SA | see standard for impact data |
| EN 10088-2:2014 | X1CrNiMoN25-22-2 | --- | 1.4466 | t ≤ 75 | --- | 250 | --- | 540-740 | --- | 40 T | SA | see standard for impact data |
| ISO 16143-1:2004 | X1CrNiMoN25-22-2 | --- | --- | t ≤ 75 | --- | 250 | --- | 540-740 | --- | 40 T | SA | --- |
| ISO 9328-7:2004 | Grade X1CrNiMoN25-22-2 | --- | --- | t ≤ 75 | --- | 250 | --- | 540-740 | --- | 40 T | SA | see standard for impact data |

**8.1 Stainless Steels: Plate, Sheet and Strip**

**8.1.3B Mechanical Properties of Austenitic Stainless Steels (Continued)**

| Specification | Designation | UNS No | Steel No | Section Thickness/Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | % min | | |
| ASME SA-240/SA-240M | --- | S31254 | --- | --- | --- | 310 | 45 | 690 | 100 | 35 | Q+SA | 223 max. HB; 96 max. HRB |
| | | | | --- | --- | 310 | 45 | 655 | 95 | 35 | Q+SA | 223 max. HB; 96 max. HRB |
| ASTM A240/A240M-15a | --- | S31254 | --- | --- | --- | 310 | 45 | 690 | 100 | 35 | SA | 223 max. HBW; 96 max. HRBW |
| | | | | --- | --- | 310 | 45 | 655 | 95 | 35 | SA | 223 max. HBW; 96 max. HRBW |
| EN 10028-7:2007 | X1CrNiMoCuN20-18-7 | --- | 1.4547 | t ≤ 8 | --- | 320 | --- | 650-850 | --- | 35 T | SA | see standard for impact data |
| | | | | t ≤ 13.5 | --- | 300 | --- | 650-850 | --- | 35 T | SA | |
| | | | | t ≤ 75 | --- | 300 | --- | 650-850 | --- | 40 T | SA | |
| EN 10088-2:2014 | X1CrNiMoCuN20-18-7 | --- | 1.4547 | t ≤ 8 | --- | 320 | --- | 650-850 | --- | 35 T | SA | --- |
| | | | | t ≤ 13.5 | --- | 300 | --- | 650-850 | --- | 35 T | SA | see standard for impact data |
| | | | | t ≤ 75 | --- | 300 | --- | 650-850 | --- | 40 T | SA | |
| ISO 9328-7:2004 | Grade X1CrNiMoCuN20-18-7 | --- | --- | t ≤ 6 | --- | 320 | --- | 650-850 | --- | 35 T | SA | --- |
| | | | | t ≤ 12 | --- | 300 | --- | 650-850 | --- | 35 T | SA | see standard for impact data |
| | | | | t ≤ 75 | --- | 300 | --- | 650-850 | --- | 40 T | SA | |
| JIS G 4304:2012 | Symbol SUS312L | --- | --- | --- | --- | 300 | --- | 650 | --- | 35 | ST | 223 max. HBW; 96 max. HRBW; 230 max. HV |
| JIS G 4305:2012 | Symbol SUS312L | --- | --- | --- | --- | 300 | --- | 650 | --- | 35 | ST | 223 max. HBW; 96 max. HRBW; 230 max. HV |
| ASME SA-240/SA-240M | Type 316 | S31600 | --- | --- | --- | 205 | 30 | 515 | 75 | 40 | Q+SA | 217 max. HB; 95 max. HRB |
| ASME SA-666 | Type 316 | S31600 | --- | --- | --- | 205 | 30 | 515 L | 75 L | 40 L | A | 217 max. HB; 95 max. HRB |
| ASTM A240/A240M-15a | Type 316 | S31600 | --- | --- | --- | 205 | 30 | 515 | 75 | 40 | SA | 217 max. HBW; 95 max. HRBW |
| ASTM A666-15 | Type 316 | S31600 | --- | --- | --- | 205 | 30 | 515 L | 75 L | 40 L | A | 217 max. HB; 95 max. HRB |
| EN 10028-7:2007 | X5CrNiMo17-12-2 | --- | 1.4401 | t ≤ 8 | --- | 240 | --- | 530-680 | --- | 40 T | SA | see standard for impact data |
| | | | | t ≤ 13.5 | --- | 220 | --- | 530-680 | --- | 40 T | SA | |
| | | | | t ≤ 75 | --- | 220 | --- | 520-670 | --- | 45 T | SA | |
| | X3CrNiMo17-13-3 | --- | 1.4436 | t ≤ 8 | --- | 240 | --- | 550-700 | --- | 40 T | SA | see standard for impact data |
| | | | | t ≤ 13.5 | --- | 220 | --- | 550-700 | --- | 40 T | SA | |
| | | | | t ≤ 75 | --- | 220 | --- | 530-730 | --- | 40 T | SA | |

Note: This section continued on next page

**8.1 Stainless Steels: Plate, Sheet and Strip**

**8.1.3B Mechanical Properties of Austenitic Stainless Steels (Continued)**

| Specification | Designation | UNS No | Steel No | Section Thickness/Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation % min | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | | | |
| EN 10088-2:2014 | X5CrNiMo17-12-2 | --- | 1.4401 | t ≤ 8 | --- | 240 | --- | 530-680 | --- | 40 T | SA | --- |
| | | | | t ≤ 13.5 | --- | 220 | --- | 530-680 | --- | 40 T | SA | see standard for impact data |
| | | | | t ≤ 75 | --- | 220 | --- | 520-670 | --- | 45 T | SA | |
| | X3CrNiMo17-13-3 | --- | 1.4436 | t ≤ 8 | --- | 240 | --- | 550-700 | --- | 40 T | SA | --- |
| | | | | t ≤ 13.5 | --- | 220 | --- | 550-700 | --- | 40 T | SA | see standard for impact data |
| | | | | t ≤ 75 | --- | 220 | --- | 530-730 | --- | 40 T | SA | |
| GB 3280-92 | Grade 0Cr17Ni12Mo2 | --- | --- | --- | --- | 205 | --- | 520 | --- | 40 | ST | 187 max. HB; 90 max. HRB |
| GB 4237-92 | Grade 0Cr17Ni12Mo2 | --- | --- | --- | --- | 205 | --- | 520 | --- | 40 | ST | 187 max. HB; 90 max. HRB |
| GB 4238-92 | Grade 0Cr17Ni12Mo2 | --- | --- | --- | --- | 205 | --- | 520 | --- | 40 | ST | 187 max. HB; 90 max. HRB |
| GB 4239-91 | Grade 0Cr17Ni12Mo2 | --- | --- | --- | --- | 205 | --- | 520 | --- | 40 | ST | 90 max. HRB |
| ISO 16143-1:2004 | X5CrNiMo17-12-2 | --- | --- | t ≤ 8 | --- | 240 | --- | 530-730 | --- | 40 T | SA | --- |
| | | | | t ≤ 8 | --- | 205 | --- | 520-720 | --- | 40 T | SA | --- |
| | | | | t ≤ 13.5 | --- | 220 | --- | 530-730 | --- | 40 T | SA | --- |
| | | | | t ≤ 75 | --- | 220 | --- | 510-710 | --- | 40 T | SA | --- |
| | X3CrNiMo17-12-3 | --- | --- | t ≤ 8 | --- | 240 | --- | 530-730 | --- | 40 T | SA | --- |
| | | | | t ≤ 13.5 | --- | 220 | --- | 530-730 | --- | 40 T | SA | --- |
| | | | | t ≤ 75 | --- | 220 | --- | 510-710 | --- | 40 T | SA | --- |
| ISO 9328-7:2004 | Grade X3CrNiMo17-12-3 | --- | --- | t ≤ 6 | --- | 240 | --- | 550-700 | --- | 40 T | SA | --- |
| | | | | t ≤ 12 | --- | 220 | --- | 550-700 | --- | 40 T | SA | see standard for impact data |
| | | | | t ≤ 75 | --- | 220 | --- | 530-730 | --- | 40 T | SA | |
| | Grade X5CrNiMo17-12-2 | --- | --- | t ≤ 6 | --- | 240 | --- | 530-680 | --- | 40 T | SA | --- |
| | | | | t ≤ 12 | --- | 220 | --- | 530-680 | --- | 40 T | SA | see standard for impact data |
| | | | | t ≤ 75 | --- | 220 | --- | 520-670 | --- | 45 T | SA | |
| JIS G 4304:2012 | Symbol SUS316 | --- | --- | --- | --- | 205 | --- | 520 | --- | 40 | ST | 187 max. HBW; 90 max. HRBW; 200 max. HV |
| JIS G 4305:2012 | Symbol SUS316 | --- | --- | --- | --- | 205 | --- | 520 | --- | 40 | ST | 187 max. HBW; 90 max. HRBW; 200 max. HV |

**8.1 Stainless Steels: Plate, Sheet and Strip**

**8.1.3B Mechanical Properties of Austenitic Stainless Steels (Continued)**

| Specification | Designation | UNS No | Steel No | Section Thickness/Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation % min | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | | | |
| ASME SA-240/SA-240M | Type 316L | S31603 | --- | --- | --- | 170 | 25 | 485 | 70 | 40 | Q+SA | 217 max. HB; 95 max. HRB |
| ASME SA-666 | Type 316L | S31603 | --- | --- | --- | 170 | 25 | 485 L | 70 L | 40 L | A | 217 max. HB; 95 max. HRB |
| ASTM A240/A240M-15a | Type 316L | S31603 | --- | --- | --- | 170 | 25 | 485 | 70 | 40 | SA | 217 max. HBW; 95 max. HRBW |
| ASTM A666-15 | Type 316L | S31603 | --- | --- | --- | 170 | 25 | 485 L | 70 L | 40 L | A | 217 max. HB; 95 max. HRB |
| EN 10028-7:2007 | X2CrNiMo17-12-2 | --- | 1.4404 | t ≤ 8 | --- | 240 | --- | 530-680 | --- | 40 T | SA | see standard for impact data |
| | | | | t ≤ 13.5 | --- | 220 | --- | 530-680 | --- | 40 T | SA | |
| | | | | t ≤ 75 | --- | 220 | --- | 520-670 | --- | 45 T | SA | |
| | X2CrNiMo17-12-3 | --- | 1.4432 | t ≤ 8 | --- | 240 | --- | 550-700 | --- | 40 T | SA | see standard for impact data |
| | | | | t ≤ 13.5 | --- | 220 | --- | 550-700 | --- | 40 T | SA | |
| | | | | t ≤ 75 | --- | 220 | --- | 520-670 | --- | 45 T | SA | |
| | X2CrNiMo18-14-3 | --- | 1.4435 | t ≤ 8 | --- | 240 | --- | 550-700 | --- | 40 T | SA | see standard for impact data |
| | | | | t ≤ 13.5 | --- | 220 | --- | 550-700 | --- | 40 T | SA | |
| | | | | t ≤ 75 | --- | 220 | --- | 520-670 | --- | 45 T | SA | |
| EN 10088-2:2014 | X2CrNiMo17-12-2 | --- | 1.4404 | t ≤ 8 | --- | 240 | --- | 530-680 | --- | 40 T | SA | --- |
| | | | | t ≤ 13.5 | --- | 220 | --- | 530-680 | --- | 40 T | SA | see standard for impact data |
| | | | | t ≤ 75 | --- | 220 | --- | 520-670 | --- | 45 T | SA | |
| | X2CrNiMo17-12-3 | --- | 1.4432 | t ≤ 8 | --- | 240 | --- | 550-700 | --- | 40 T | SA | --- |
| | | | | t ≤ 13.5 | --- | 220 | --- | 550-700 | --- | 40 T | SA | see standard for impact data |
| | | | | t ≤ 75 | --- | 220 | --- | 520-670 | --- | 45 T | SA | |
| | X2CrNiMo18-14-3 | --- | 1.4435 | t ≤ 8 | --- | 240 | --- | 550-700 | --- | 40 T | SA | --- |
| | | | | t ≤ 13.5 | --- | 220 | --- | 550-700 | --- | 40 T | SA | see standard for impact data |
| | | | | t ≤ 75 | --- | 220 | --- | 520-670 | --- | 45 T | SA | |
| GB 3280-92 | Grade 00Cr17Ni14Mo2 | --- | --- | --- | --- | 177 | --- | 480 | --- | 40 | ST | 187 max. HB; 90 max. HRB |
| GB 4237-92 | Grade 00Cr17Ni14Mo2 | --- | --- | --- | --- | 177 | --- | 480 | --- | 40 | ST | 187 max. HB; 90 max. HRB |
| GB 4239-91 | Grade 00Cr17Ni14Mo2 | --- | --- | --- | --- | 175 | --- | 480 | --- | 40 | ST | 90 max. HRB |

Note: This section continued on next page

**8.1 Stainless Steels: Plate, Sheet and Strip**

**8.1.3B Mechanical Properties of Austenitic Stainless Steels (Continued)**

| Specification | Designation | UNS No | Steel No | Section Thickness/Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | % min | | |
| ISO 16143-1:2004 | X2CrNiMo17-12-2 | --- | --- | t ≤ 8 | --- | 240 | --- | 530-730 | --- | 40 T | SA | --- |
| | | | | t ≤ 8 | --- | 175 | --- | 480-680 | --- | 40 T | SA | --- |
| | | | | t ≤ 13.5 | --- | 220 | --- | 530-730 | --- | 40 T | SA | --- |
| | | | | t ≤ 75 | --- | 220 | --- | 510-710 | --- | 40 T | SA | --- |
| | X2CrNiMo17-12-3 | --- | --- | t ≤ 8 | --- | 240 | --- | 530-730 | --- | 40 T | SA | --- |
| | | | | t ≤ 13.5 | --- | 220 | --- | 530-730 | --- | 40 T | SA | --- |
| | | | | t ≤ 75 | --- | 220 | --- | 510-710 | --- | 40 T | SA | --- |
| | X2CrNiMo18-14-3 | --- | --- | t ≤ 6 | --- | 240 | --- | 550-750 | --- | 40 T | SA | --- |
| | | | | t ≤ 12 | --- | 220 | --- | 550-750 | --- | 40 T | SA | --- |
| | | | | t ≤ 75 | --- | 220 | --- | 520-720 | --- | 45 T | SA | --- |
| ISO 9328-7:2004 | Grade X2CrNiMo17-12-2 | --- | --- | t ≤ 6 | --- | 240 | --- | 530-680 | --- | 40 T | SA | --- |
| | | | | t ≤ 12 | --- | 220 | --- | 530-680 | --- | 40 T | SA | see standard for |
| | | | | t ≤ 75 | --- | 220 | --- | 520-670 | --- | 45 T | SA | impact data |
| | Grade X2CrNiMo17-12-3 | --- | --- | t ≤ 6 | --- | 240 | --- | 550-700 | --- | 40 T | SA | --- |
| | | | | t ≤ 12 | --- | 220 | --- | 550-700 | --- | 40 T | SA | see standard for |
| | | | | t ≤ 75 | --- | 220 | --- | 520-670 | --- | 45 T | SA | impact data |
| | Grade X2CrNiMo18-14-3 | --- | --- | t ≤ 6 | --- | 240 | --- | 550-700 | --- | 40 T | SA | --- |
| | | | | t ≤ 12 | --- | 220 | --- | 550-700 | --- | 40 T | SA | see standard for |
| | | | | t ≤ 75 | --- | 220 | --- | 520-670 | --- | 45 T | SA | impact data |
| JIS G 4304:2012 | Symbol SUS316L | --- | --- | --- | --- | 175 | --- | 480 | --- | 40 | ST | 187 max. HBW; 90 max. HRBW; 200 max. HV |
| JIS G 4305:2012 | Symbol SUS316L | --- | --- | --- | --- | 175 | --- | 480 | --- | 40 | ST | 187 max. HBW; 90 max. HRBW; 200 max. HV |
| GB 4237-92 | Grade 00Cr18Ni12Mo2Cu2 | --- | --- | --- | --- | 177 | --- | 480 | --- | 35 | ST | 187 max. HB; 90 max. HRB |
| GB 4239-91 | Grade 00Cr18Ni14Mo2Cu2 | --- | --- | --- | --- | 175 | --- | 480 | --- | 40 | ST | 90 max. HRB |
| JIS G 4304:2012 | Symbol SUS316J1L | --- | --- | --- | --- | 175 | --- | 480 | --- | 40 | ST | 187 max. HBW; 90 max. HRBW; 200 max. HV |
| JIS G 4305:2012 | Symbol SUS316J1L | --- | --- | --- | --- | 175 | --- | 480 | --- | 40 | ST | 187 max. HBW; 90 max. HRBW; 200 max. HV |
| GB 3280-92 | Grade 0Cr18Ni12Mo2Cu2 | --- | --- | --- | --- | 205 | --- | 520 | --- | 40 | ST | 187 max. HB; 90 max. HRB |
| GB 4237-92 | Grade 0Cr18Ni12Mo2Cu2 | --- | --- | --- | --- | 205 | --- | 520 | --- | 35 | ST | 187 max. HB; 90 max. HRB |
| GB 4239-91 | Grade 0Cr18Ni12Mo2Cu2 | --- | --- | --- | --- | 205 | --- | 520 | --- | 40 | ST | 90 max. HRB |

Note: This section continued on next page

**8.1 Stainless Steels: Plate, Sheet and Strip**

**8.1.3B Mechanical Properties of Austenitic Stainless Steels (Continued)**

| Specification | Designation | UNS No | Steel No | Section Thickness/Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation % min | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | | | |
| JIS G 4304:2012 | Symbol SUS316J1 | --- | --- | --- | --- | 205 | --- | 520 | --- | 40 | ST | 187 max. HBW; 90 max. HRBW; 200 max. HV |
| JIS G 4305:2012 | Symbol SUS316J1 | --- | --- | --- | --- | 205 | --- | 520 | --- | 40 | ST | 187 max. HBW; 90 max. HRBW; 200 max. HV |
| ASME SA-240/SA-240M | Type 316Ti | S31635 | --- | --- | --- | 205 | 30 | 515 | 75 | 40 | Q+SA | 217 max. HB; 95 max. HRB |
| ASTM A240/A240M-15a | Type 316Ti | S31635 | --- | --- | --- | 205 | 30 | 515 | 75 | 40 | SA | 217 max. HBW; 95 max. HRBW |
| EN 10028-7:2007 | X6CrNiMoTi17-12-2 | --- | 1.4571 | t ≤ 8 | --- | 240 | --- | 540-690 | --- | 40 T | SA | see standard for impact data |
| | | | | t ≤ 13.5 | --- | 220 | --- | 540-690 | --- | 40 T | SA | |
| | | | | t ≤ 75 | --- | 220 | --- | 520-670 | --- | 40 T | SA | |
| EN 10088-2:2014 | X6CrNiMoTi17-12-2 | --- | 1.4571 | t ≤ 8 | --- | 240 | --- | 540-690 | --- | 40 T | SA | --- |
| | | | | t ≤ 13.5 | --- | 220 | --- | 540-690 | --- | 40 T | SA | see standard for |
| | | | | t ≤ 75 | --- | 220 | --- | 520-670 | --- | 40 T | SA | impact data |
| GB 3280-92 | Grade 0Cr18Ni12Mo2Ti | --- | --- | --- | --- | 205 | --- | 530 | --- | 35 | ST | 187 max. HB; 90 max. HRB |
| GB 4237-92 | Grade 0Cr18Ni12Mo2Ti | --- | --- | --- | --- | 205 | --- | 530 | --- | 37 | ST | 187 max. HB; 90 max. HRB |
| ISO 16143-1:2004 | X6CrNiMoTi17-12-2 | --- | --- | t ≤ 8 | --- | 240 | --- | 530-730 | --- | 40 T | SA | --- |
| | | | | t ≤ 13.5 | --- | 220 | --- | 530-730 | --- | 40 T | SA | --- |
| | | | | t ≤ 75 | --- | 220 | --- | 510-710 | --- | 40 T | SA | --- |
| ISO 9328-7:2004 | Grade X6CrNiMoTi17-12-2 | --- | --- | t ≤ 6 | --- | 240 | --- | 540-690 | --- | 40 T | SA | --- |
| | | | | t ≤ 12 | --- | 220 | --- | 540-690 | --- | 40 T | SA | see standard for |
| | | | | t ≤ 75 | --- | 220 | --- | 520-670 | --- | 40 T | SA | impact data |
| JIS G 4304:2012 | Symbol SUS316Ti | --- | --- | --- | --- | 205 | --- | 520 | --- | 40 | ST | 187 max. HBW; 90 max. HRBW; 200 max. HV |
| JIS G 4305:2012 | Symbol SUS316Ti | --- | --- | --- | --- | 205 | --- | 520 | --- | 40 | ST | 187 max. HBW; 90 max. HRBW; 200 max. HV |
| ASME SA-240/SA-240M | Type 316Cb | S31640 | --- | --- | --- | 205 | 30 | 515 | 75 | 30 | Q+SA | 217 max. HB; 95 max. HRB |
| ASTM A240/A240M-15a | Type 316Cb | S31640 | --- | --- | --- | 205 | 30 | 515 | 75 | 30 | SA | 217 max. HBW; 95 max. HRBW |
| EN 10028-7:2007 | X6CrNiMoNb17-12-2 | --- | 1.4580 | t ≤ 75 | --- | 220 | --- | 520-720 | --- | 40 T | SA | see standard for impact data |
| EN 10088-2:2014 | X6CrNiMoNb17-12-2 | --- | 1.4580 | t ≤ 75 | --- | 220 | --- | 520-720 | --- | 40 T | SA | see standard for impact data |
| ISO 9328-7:2004 | Grade X6CrNiMoNb17-12-2 | --- | --- | t ≤ 75 | --- | 220 | --- | 520-720 | --- | 40 T | SA | see standard for impact data |

**8.1 Stainless Steels: Plate, Sheet and Strip**

**8.1.3B Mechanical Properties of Austenitic Stainless Steels (Continued)**

| Specification | Designation | UNS No | Steel No | Section Thickness/Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation % min | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | | | |
| ASME SA-240/SA-240M | Type 316N | S31651 | --- | --- | --- | 240 | 35 | 550 | 80 | 35 | Q+SA | 217 max. HB; 95 max. HRB |
| ASME SA-666 | Type 316N | S31651 | --- | --- | --- | 240 | 35 | 550 L | 80 L | 35 L | A | 217 max. HB; 95 max. HRB |
| ASTM A240/A240M-15a | Type 316N | S31651 | --- | --- | --- | 240 | 35 | 550 | 80 | 35 | SA | 217 max. HBW; 95 max. HRBW |
| ASTM A666-15 | Type 316N | S31651 | --- | --- | --- | 240 | 35 | 550 L | 80 L | 35 L | A | 217 max. HB; 95 max. HRB |
| GB 3280-92 | Grade 0Cr17Ni12Mo2N | --- | --- | --- | --- | 275 | --- | 550 | --- | 35 | ST | 217 max. HB; 95 max. HRB |
| GB 4237-92 | Grade 0Cr17Ni12Mo2N | --- | --- | --- | --- | 275 | --- | 550 | --- | 35 | ST | 217 max. HB; 95 max. HRB |
| GB 4239-91 | Grade 0Cr17Ni12Mo2N | --- | --- | --- | --- | 275 | --- | 550 | --- | 35 | ST | 95 max. HRB |
| JIS G 4304:2012 | Symbol SUS316N | --- | --- | --- | --- | 275 | --- | 550 | --- | 35 | ST | 217 max. HBW; 95 max. HRBW; 220 max. HV |
| JIS G 4305:2012 | Symbol SUS316N | --- | --- | --- | --- | 275 | --- | 550 | --- | 35 | ST | 217 max. HBW; 95 max. HRBW; 220 max. HV |

**8.1 Stainless Steels: Plate, Sheet and Strip**

**8.1.3B Mechanical Properties of Austenitic Stainless Steels (Continued)**

| Specification | Designation | UNS No | Steel No | Section Thickness/Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation % min | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | | | |
| ASME SA-240/SA-240M | Type 316LN | S31653 | --- | --- | --- | 205 | 30 | 515 | 75 | 40 | Q+SA | 217 max. HB; 95 max. HRB |
| ASTM A240/A240M-15a | Type 316LN | S31653 | --- | --- | --- | 205 | 30 | 515 | 75 | 40 | SA | 217 max. HBW; 95 max. HRBW |
| EN 10028-7:2007 | X2CrNiMoN17-11-2 | --- | 1.4406 | t ≤ 8 | --- | 300 | --- | 580-780 | --- | 40 T | SA | see standard for impact data |
| | | | | t ≤ 13.5 | --- | 280 | --- | 580-780 | --- | 40 T | SA | |
| | | | | t ≤ 75 | --- | 280 | --- | 580-780 | --- | 40 T | SA | |
| | X2CrNiMoN17-13-3 | --- | 1.4429 | t ≤ 8 | --- | 300 | --- | 580-780 | --- | 35 T | SA | see standard for impact data |
| | | | | t ≤ 13.5 | --- | 280 | --- | 580-780 | --- | 35 T | SA | |
| | | | | t ≤ 75 | --- | 280 | --- | 580-780 | --- | 40 T | SA | |
| EN 10088-2:2014 | X2CrNiMoN17-11-2 | --- | 1.4406 | t ≤ 8 | --- | 300 | --- | 580-780 | --- | 40 T | SA | --- |
| | | | | t ≤ 13.5 | --- | 280 | --- | 580-780 | --- | 40 T | SA | see standard for impact data |
| | | | | t ≤ 75 | --- | 280 | --- | 580-780 | --- | 40 T | SA | |
| | X2CrNiMoN17-13-3 | --- | 1.4429 | t ≤ 8 | --- | 300 | --- | 580-780 | --- | 35 T | SA | --- |
| | | | | t ≤ 13.5 | --- | 280 | --- | 580-780 | --- | 35 T | SA | see standard for impact data |
| | | | | t ≤ 75 | --- | 280 | --- | 580-780 | --- | 40 T | SA | |
| GB 3280-92 | Grade 00Cr17Ni13Mo2N | --- | --- | --- | --- | 245 | --- | 550 | --- | 40 | ST | 217 max. HB; 95 max. HRB |
| GB 4237-92 | Grade 00Cr17Ni13Mo2N | --- | --- | --- | --- | 245 | --- | 550 | --- | 40 | ST | 217 max. HB; 95 max. HRB |
| GB 4239-91 | Grade 00Cr17Ni13Mo2N | --- | --- | --- | --- | 245 | --- | 550 | --- | 40 | ST | 95 max. HRB |
| ISO 16143-1:2004 | X2CrNiMoN17-12-3 | --- | --- | t ≤ 8 | --- | 300 | --- | 580-780 | --- | 35 T | SA | --- |
| | | | | t ≤ 13.5 | --- | 280 | --- | 580-780 | --- | 35 T | SA | --- |
| | | | | t ≤ 75 | --- | 280 | --- | 580-780 | --- | 40 T | SA | --- |
| ISO 9328-7:2004 | Grade X2CrNiMoN17-11-2 | --- | --- | t ≤ 6 | --- | 300 | --- | 580-780 | --- | 40 T | SA | --- |
| | | | | t ≤ 12 | --- | 280 | --- | 580-780 | --- | 40 T | SA | see standard for impact data |
| | | | | t ≤ 75 | --- | 280 | --- | 580-780 | --- | 40 T | SA | |
| | Grade X2CrNiMoN17-13-3 | --- | --- | t ≤ 6 | --- | 300 | --- | 580-780 | --- | 35 T | SA | --- |
| | | | | t ≤ 12 | --- | 280 | --- | 580-780 | --- | 35 T | SA | see standard for impact data |
| | | | | t ≤ 75 | --- | 280 | --- | 580-780 | --- | 40 T | SA | |
| JIS G 4304:2012 | Symbol SUS316LN | --- | --- | --- | --- | 245 | --- | 550 | --- | 40 | ST | 217 max. HBW; 95 max. HRBW; 220 max. HV |
| JIS G 4305:2012 | Symbol SUS316LN | --- | --- | --- | --- | 245 | --- | 550 | --- | 40 | ST | 217 max. HBW; 95 max. HRBW; 220 max. HV |

**8.1 Stainless Steels: Plate, Sheet and Strip**

**8.1.3B Mechanical Properties of Austenitic Stainless Steels (Continued)**

| Specification | Designation | UNS No | Steel No | Section Thickness/Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation % min | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | | | |
| ASME SA-240/SA-240M | Type 317 | S31700 | --- | --- | --- | 205 | 30 | 515 | 75 | 35 | SA | 217 max. HB; 95 max. HRB |
| ASTM A240/A240M-15a | Type 317 | S31700 | --- | --- | --- | 205 | 30 | 515 | 75 | 35 | SA | 217 max. HBW; 95 max. HRBW |
| GB 3280-92 | Grade 0Cr19Ni13Mo3 | --- | --- | --- | --- | 205 | --- | 520 | --- | 40 | ST | 187 max. HB; 90 max. HRB |
| GB 4237-92 | Grade 0Cr19Ni13Mo3 | --- | --- | --- | --- | 205 | --- | 520 | --- | 35 | ST | 187 max. HB; 90 max. HRB |
| GB 4238-92 | Grade 0Cr19Ni13Mo3 | --- | --- | --- | --- | 205 | --- | 520 | --- | 40 | ST | 187 max. HB; 90 max. HRB |
| GB 4239-91 | Grade 0Cr19Ni13Mo3 | --- | --- | --- | --- | 205 | --- | 520 | --- | 40 | ST | 90 max. HRB |
| JIS G 4304:2012 | Symbol SUS317 | --- | --- | --- | --- | 205 | --- | 520 | --- | 40 | ST | 187 max. HBW; 90 max. HRBW; 200 max. HV |
| JIS G 4305:2012 | Symbol SUS317 | --- | --- | --- | --- | 205 | --- | 520 | --- | 40 | ST | 187 max. HBW; 90 max. HRBW; 200 max. HV |
| GB 3280-92 | Grade 0Cr18Ni16Mo5 | --- | --- | --- | --- | 177 | --- | 480 | --- | 40 | ST | 187 max. HB; 90 max. HRB |
| GB 4237-92 | Grade 0Cr18Ni16Mo5 | --- | --- | --- | --- | 177 | --- | 480 | --- | 35 | ST | 187 max. HB; 90 max. HRB |
| GB 4239-91 | Grade 0Cr18Ni16Mo5 | --- | --- | --- | --- | 175 | --- | 480 | --- | 40 | ST | 90 max. HRB |
| JIS G 4304:2012 | Symbol SUS317J1 | --- | --- | --- | --- | 175 | --- | 480 | --- | 40 | ST | 187 max. HBW; 90 max. HRBW; 200 max. HV |
| JIS G 4305:2012 | Symbol SUS317J1 | --- | --- | --- | --- | 175 | --- | 480 | --- | 40 | ST | 187 max. HBW; 90 max. HRBW; 200 max. HV |
| ASME SA-240/SA-240M | Type 317L | S31703 | --- | --- | --- | 205 | 30 | 515 | 75 | 40 | Q+SA | 217 max. HB; 95 max. HRB |
| ASTM A240/A240M-15a | Type 317L | S31703 | --- | --- | --- | 205 | 30 | 515 | 75 | 40 | SA | 217 max. HBW; 95 max. HRBW |
| EN 10028-7:2007 | X2CrNiMo18-15-4 | --- | 1.4438 | t ≤ 8 | --- | 240 | --- | 550-700 | --- | 35 T | SA | see standard for impact data |
| | | | | t ≤ 13.5 | --- | 220 | --- | 550-700 | --- | 35 T | SA | |
| | | | | t ≤ 75 | --- | 220 | --- | 520-720 | --- | 40 T | SA | |
| EN 10088-2:2014 | X2CrNiMo18-15-4 | --- | 1.4438 | t ≤ 8 | --- | 240 | --- | 550-700 | --- | 35 T | SA | --- |
| | | | | t ≤ 13.5 | --- | 220 | --- | 550-700 | --- | 35 T | SA | see standard for impact data |
| | | | | t ≤ 75 | --- | 220 | --- | 520-720 | --- | 40 T | SA | |
| GB 4237-92 | Grade 00Cr19Ni13Mo3 | --- | --- | --- | --- | 177 | --- | 480 | --- | 35 | ST | 187 max. HB; 90 max. HRB |
| GB 4239-91 | Grade 00Cr19Ni13Mo3 | --- | --- | --- | --- | 175 | --- | 480 | --- | 40 | ST | 90 max. HRB |

Note: This section continued on next page

**8.1 Stainless Steels: Plate, Sheet and Strip**

**8.1.3B Mechanical Properties of Austenitic Stainless Steels (Continued)**

| Specification | Designation | UNS No | Steel No | Section Thickness/Diameter mm | Section Thickness/Diameter in. | Yield Strength, min. MPa | Yield Strength, min. ksi | Tensile Strength, min. MPa | Tensile Strength, min. ksi | Elongation % min | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ISO 9328-7:2004 | Grade X2CrNiMo18-15-4 | --- | --- | t ≤ 6 | --- | 240 | --- | 550-700 | --- | 35 T | SA | --- |
| | | | | t ≤ 12 | --- | 220 | --- | 550-700 | --- | 35 T | SA | see standard for impact data |
| | | | | t ≤ 75 | --- | 220 | --- | 520-720 | --- | 40 T | SA | |
| JIS G 4304:2012 | Symbol SUS317L | --- | --- | --- | --- | 175 | --- | 480 | --- | 40 | ST | 187 max. HBW; 90 max. HRBW; 200 max. HV |
| JIS G 4305:2012 | Symbol SUS317L | --- | --- | --- | --- | 175 | --- | 480 | --- | 40 | ST | 187 max. HBW; 90 max. HRBW; 200 max. HV |
| ASME SA-240/SA-240M | Type 317LMN | S31726 | --- | --- | --- | 240 | 35 | 550 | 80 | 40 | Q+SA | 223 max. HB; 96 max. HRB |
| ASTM A240/A240M-15a | Type 317LMN | S31726 | --- | --- | --- | 240 | 35 | 550 | 80 | 40 | SA | 223 max. HBW; 96 max. HRBW |
| EN 10028-7:2007 | X2CrNiMoN17-13-5 | --- | 1.4439 | t ≤ 8 | --- | 290 | --- | 580-780 | --- | 35 T | SA | see standard for impact data |
| | | | | t ≤ 13.5 | --- | 270 | --- | 580-780 | --- | 35 T | SA | |
| | | | | t ≤ 75 | --- | 270 | --- | 580-780 | --- | 40 T | SA | |
| EN 10088-2:2014 | X2CrNiMoN17-13-5 | --- | 1.4439 | t ≤ 8 | --- | 290 | --- | 580-780 | --- | 35 T | SA | --- |
| | | | | t ≤ 13.5 | --- | 270 | --- | 580-780 | --- | 35 T | SA | see standard for impact data |
| | | | | t ≤ 75 | --- | 270 | --- | 580-780 | --- | 40 T | SA | |
| ISO 9328-7:2004 | Grade X2CrNiMoN17-13-5 | --- | --- | t ≤ 6 | --- | 290 | --- | 580-780 | --- | 35 T | SA | --- |
| | | | | t ≤ 12 | --- | 270 | --- | 580-780 | --- | 35 T | SA | see standard for impact data |
| | | | | t ≤ 75 | --- | 270 | --- | 580-780 | --- | 40 T | SA | see standard for impact data |
| ASME SA-240/SA-240M | Type 317LN | S31753 | --- | --- | --- | 240 | 35 | 550 | 80 | 40 | Q+SA | 217 max. HB; 95 max. HRB |
| ASTM A240/A240M-15a | Type 317LN | S31753 | --- | --- | --- | 240 | 35 | 550 | 80 | 40 | SA | 217 max. HBW; 95 max. HRBW |
| EN 10028-7:2007 | X2CrNiMoN18-12-4 | --- | 1.4434 | t ≤ 8 | --- | 290 | --- | 570-770 | --- | 35 T | SA | see standard for impact data |
| | | | | t ≤ 13.5 | --- | 270 | --- | 570-770 | --- | 35 T | SA | |
| | | | | t ≤ 75 | --- | 270 | --- | 540-740 | --- | 40 T | SA | |
| EN 10088-2:2014 | X2CrNiMoN18-12-4 | --- | 1.4434 | t ≤ 8 | --- | 290 | --- | 570-770 | --- | 35 T | SA | --- |
| | | | | t ≤ 13.5 | --- | 270 | --- | 570-770 | --- | 35 T | SA | see standard for impact data |
| | | | | t ≤ 75 | --- | 270 | --- | 540-740 | --- | 40 T | SA | |
| ISO 9328-7:2004 | Grade X2CrNiMoN18-12-4 | --- | --- | t ≤ 6 | --- | 290 | --- | 570-770 | --- | 35 T | SA | --- |
| | | | | t ≤ 12 | --- | 270 | --- | 570-770 | --- | 35 T | SA | see standard for impact data |
| | | | | t ≤ 75 | --- | 270 | --- | 540-740 | --- | 40 T | SA | |

Note: This section continued on next page

**8.1 Stainless Steels: Plate, Sheet and Strip**

**8.1.3B Mechanical Properties of Austenitic Stainless Steels (Continued)**

| Specification | Designation | UNS No | Steel No | Section Thickness/Diameter mm | Section Thickness/Diameter in. | Yield Strength, min. MPa | Yield Strength, min. ksi | Tensile Strength, min. MPa | Tensile Strength, min. ksi | Elongation % min | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| JIS G 4304:2012 | Symbol SUS317LN | --- | --- | --- | --- | 245 | --- | 550 | --- | 40 | ST | 217 max. HBW; 95 max. HRBW; 220 max. HV |
| JIS G 4305:2012 | Symbol SUS317LN | --- | --- | --- | --- | 245 | --- | 550 | --- | 40 | ST | 217 max. HBW; 95 max. HRBW; 220 max. HV |
| ASME SA-240/SA-240M | Type 321 | S32100 | --- | --- | --- | 205 | 30 | 515 | 75 | 40 | Q+SA | 217 max. HB; 95 max. HRB |
| ASTM A240/A240M-15a | Type 321 | S32100 | --- | --- | --- | 205 | 30 | 515 | 75 | 40 | SA | 217 max. HBW; 95 max. HRBW |
| EN 10028-7:2007 | X6CrNiTi18-10 | --- | 1.4541 | t ≤ 8 | --- | 220 | --- | 520-720 | --- | 40 T | SA | see standard for impact data |
| | | | | t ≤ 13.5 | --- | 200 | --- | 520-720 | --- | 40 T | SA | |
| | | | | t ≤ 75 | --- | 200 | --- | 500-700 | --- | 40 T | SA | |
| EN 10088-2:2014 | X6CrNiTi18-10 | --- | 1.4541 | t ≤ 8 | --- | 220 | --- | 520-720 | --- | 40 T | SA | --- |
| | | | | t ≤ 13.5 | --- | 200 | --- | 520-720 | --- | 40 T | SA | see standard for impact data |
| | | | | t ≤ 75 | --- | 200 | --- | 500-700 | --- | 40 T | SA | |
| GB 3280-92 | Grade 0Cr18Ni10Ti | --- | --- | --- | --- | 205 | --- | 520 | --- | 40 | ST | 187 max. HB; 90 max. HRB |
| GB 4237-92 | Grade 0Cr18Ni10Ti | --- | --- | --- | --- | 205 | --- | 520 | --- | 40 | ST | 187 max. HB; 90 max. HRB |
| GB 4238-92 | Grade 0Cr18Ni10Ti | --- | --- | --- | --- | 205 max. | --- | 520 | --- | 40 | ST | 187 max. HB; 90 max. HRB |
| GB 4239-91 | Grade 0Cr18Ni10Ti | --- | --- | --- | --- | 205 | --- | 520 | --- | 40 | ST | 90 max. HRB |
| ISO 16143-1:2004 | X6CrNiTi18-10 | --- | --- | t ≤ 8 | --- | 220 | --- | 520-720 | --- | 40 T | SA | --- |
| | | | | t ≤ 13.5 | --- | 200 | --- | 520-720 | --- | 40 T | SA | --- |
| | | | | t ≤ 75 | --- | 200 | --- | 500-700 | --- | 40 T | SA | --- |
| ISO 9328-7:2004 | Grade X6CrNiTi18-10 | --- | --- | t ≤ 6 | --- | 220 | --- | 520-720 | --- | 40 T | SA | --- |
| | | | | t ≤ 12 | --- | 200 | --- | 520-720 | --- | 40 T | SA | see standard for impact data |
| | | | | t ≤ 75 | --- | 200 | --- | 500-700 | --- | 40 T | SA | |
| JIS G 4304:2012 | Symbol SUS321 | --- | --- | --- | --- | 205 | --- | 520 | --- | 40 | ST | 187 max. HBW; 90 max. HRBW; 200 max. HV |
| JIS G 4305:2012 | Symbol SUS321 | --- | --- | --- | --- | 205 | --- | 520 | --- | 40 | ST | 187 max. HBW; 90 max. HRBW; 200 max. HV |

**8.1 Stainless Steels: Plate, Sheet and Strip**

**8.1.3B Mechanical Properties of Austenitic Stainless Steels (Continued)**

| Specification | Designation | UNS No | Steel No | Section Thickness/Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | % min | | |
| ASME SA-240/SA-240M | Type 321H | S32109 | --- | --- | --- | 205 | 30 | 515 | 75 | 40 | Q+SA | 217 max. HB; 95 max. HRB |
| ASTM A240/A240M-15a | Type 321H | S32109 | --- | --- | --- | 205 | 30 | 515 | 75 | 40 | SA | 217 max. HBW; 95 max. HRBW |
| GB 3280-92 | Grade 1Cr18Ni9 | --- | --- | --- | --- | 205 | --- | 520 | --- | 40 | ST | 187 max. HB; 90 max. HRB |
| GB 4237-92 | Grade 1Cr18Ni9 | --- | --- | --- | --- | 205 | --- | 520 | --- | 40 | ST | 187 max. HB; 90 max. HRB |
| GB 4239-91 | Grade 1Cr18Ni9 | --- | --- | --- | --- | 205 | --- | 520 | --- | 40 | ST | 90 max. HRB |
| | | | | --- | --- | --- | --- | 785 | --- | 20 | WH | 90 max. HRB |
| | | | | --- | --- | --- | --- | 980 | --- | 10 | WH | 90 max. HRB |
| | | | | --- | --- | --- | --- | 1130 | --- | 5 | WH | 90 max. HRB |
| ISO 4955:2005 | X7CrNiTi18-10 | --- | --- | 0.5 ≤ t < 3 | --- | 190 | --- | 510-710 | --- | 40 L, 40 T | SA | 215 max. HB |
| | | | | 1.5 ≤ t ≤ 25 | --- | 190 | --- | 510-710 | --- | 40 | SA | 215 max. HB |
| | | | | 3 ≤ t ≤ 75 | --- | 190 | --- | 510-710 | --- | 40 L, 40 T | SA | 215 max. HB |
| | | | | t ≤ 100 | --- | 190 | --- | 510-710 | --- | 40 | SA | 215 max. HB |
| | | | | 5 ≤ t ≤ 160 | --- | 190 | --- | 510-710 | --- | 40 | SA | 215 max. HB |
| EN 10095:1999 | X12NiCrSi35-16 | --- | 1.4864 | 0.5 ≤ t < 3 | --- | 230 | --- | 550-750 | --- | 28 L, 28 T | SA | 223 max. HB |
| | | | | t ≤ 25 | --- | 230 | --- | 550-750 L | --- | 30 L | SA | 223 max. HB |
| | | | | 3 ≤ t ≤ 75 | --- | 230 | --- | 550-750 | --- | 30 L, 30 T | SA | 223 max. HB |
| | | | | t ≤ 160 | --- | 230 | --- | 550-750 L | --- | 30 L | SA | 223 max. HB |
| GB 4238-92 | Grade 1Cr16Ni35 | --- | --- | --- | --- | 205 | --- | 560 | --- | 35 | ST | 201 max. HB; 95 max. HRB |
| JIS G 4312:2011 | Symbol SUH330 | --- | --- | --- | --- | 205 | --- | 560 | --- | 35 | ST | 201 max. HBW; 95 max. HRBW; 210 max. HV |

**8.1 Stainless Steels: Plate, Sheet and Strip**

**8.1.3B Mechanical Properties of Austenitic Stainless Steels (Continued)**

| Specification | Designation | UNS No | Steel No | Section Thickness/Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation % min | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | | | |
| EN 10088-2:2014 | X2CrMoTi17-1 | --- | 1.4513 | t ≤ 8 | --- | 200 | --- | 400-550 | --- | 23 L, 23 T | A | --- |
| GB 3280-92 | Grade 00Cr17Mo | --- | --- | --- | --- | 245 | --- | 410 | --- | 20 | A | 217 max. HB; 96 max. HRB |
| GB 4237-92 | Grade 00Cr17Mo | --- | --- | --- | --- | 245 | --- | 410 | --- | 20 | A | 217 max. HB; 96 max. HRB |
| GB 4239-91 | Grade 00Cr17Mo | --- | --- | --- | --- | 245 | --- | 410 | --- | 20 | A | 96 max. HRB |
| JIS G 4304:2012 | Symbol SUS436L | --- | --- | --- | --- | 245 | --- | 410 | --- | 20 | A | 217 max. HBW; 96 max. HRBW; 230 max. HV |
| JIS G 4305:2012 | Symbol SUS436L | --- | --- | --- | --- | 245 | --- | 410 | --- | 20 | A | 217 max. HBW; 96 max. HRBW; 230 max. HV |
| ASME SA-240/SA-240M | Type 347 | S34700 | --- | --- | --- | 205 | 30 | 515 | 75 | 40 | Q+SA | 201 max. HB; 92 max. HRB |
| ASTM A240/A240M-15 | Type 347 | S34700 | --- | --- | --- | 205 | 30 | 515 | 75 | 40 | SA | 201 max. HBW; 92 max. HRBW |
| EN 10028-7:2007 | X6CrNiNb18-10 | --- | 1.4550 | t ≤ 13.5 | --- | 200 | --- | 520-720 | --- | 40 T | SA | see standard for impact data |
| | | | | t ≤ 75 | --- | 200 | --- | 500-700 | --- | 40 T | SA | |
| EN 10088-2:2014 | X6CrNiNb18-10 | --- | 1.4550 | t ≤ 8 | --- | 220 | --- | 520-720 | --- | 40 T | SA | --- |
| | | | | t ≤ 13.5 | --- | 200 | --- | 520-720 | --- | 40 T | SA | see standard for impact data |
| | | | | t ≤ 75 | --- | 200 | --- | 500-700 | --- | 40 T | SA | |
| GB 3280-92 | Grade 0Cr18Ni11Nb | --- | --- | --- | --- | 205 | --- | 520 | --- | 40 | ST | 187 max. HB; 90 max. HRB |
| GB 4237-92 | Grade 0Cr18Ni11Nb | --- | --- | --- | --- | 205 | --- | 520 | --- | 40 | ST | 187 max. HB; 90 max. HRB |
| GB 4238-92 | Grade 0Cr18Ni11Nb | --- | --- | --- | --- | 205 | --- | 520 | --- | 40 | ST | 187 max. HB; 90 max. HRB |
| GB 4239-91 | Grade 0Cr18Ni11Nb | --- | --- | --- | --- | 205 | --- | 520 | --- | 40 | ST | 90 max. HRB |
| ISO 16143-1:2004 | X6CrNiNb18-10 | --- | --- | t ≤ 8 | --- | 220 | --- | 520-720 | --- | 40 T | SA | --- |
| | | | | t ≤ 13.5 | --- | 200 | --- | 520-720 | --- | 40 T | SA | --- |
| | | | | t ≤ 75 | --- | 200 | --- | 500-700 | --- | 40 T | SA | --- |
| ISO 9328-7:2004 | Grade X6CrNiNb18-10 | --- | --- | t ≤ 75 | --- | 200 | --- | 500-700 | --- | 40 T | SA | see standard for impact data |
| JIS G 4304:2012 | Symbol SUS347 | --- | --- | --- | --- | 205 | --- | 520 | --- | 40 | ST | 187 max. HBW; 90 max. HRBW; 200 max. HV |
| JIS G 4305:2012 | Symbol SUS347 | --- | --- | --- | --- | 205 | --- | 520 | --- | 40 | ST | 187 max. HBW; 90 max. HRBW; 200 max. HV |
| EN 10088-2:2014 | X11CrNiMnN19-8-6 | --- | 1.4369 | t ≤ 4 | --- | 340 | --- | 750-950 | --- | 35 T | SA | --- |
| EN 10151:2002 | X11CrNiMnN19-8-6 | --- | 1.4369 | 0.05 ≤ t ≤ 1.00 | --- | --- | --- | 700-1700 | --- | --- | CW | 300-475 HV |
| ISO 16143-1:2004 | X11CrNiMnN19-8-6 | --- | --- | t ≤ 4 | --- | 340 | --- | 750-950 | --- | 35 T | SA | --- |

**8.1 Stainless Steels: Plate, Sheet and Strip**

**8.1.3B Mechanical Properties of Austenitic Stainless Steels (Continued)**

| Specification | Designation | UNS No | Steel No | Section Thickness/Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation % min | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | | | |
| EN 10028-7:2007 | X6CrNiTiB18-10 | --- | 1.4941 | t ≤ 8 | --- | 220 | --- | 510-710 | --- | 40 T | SA | see standard for impact data |
| | | | | t ≤ 13.5 | --- | 200 | --- | 510-710 | --- | 40 T | SA | |
| | | | | t ≤ 75 | --- | 200 | --- | 490-690 | --- | 40 T | SA | |
| EN 10302:2008 | X6CrNiTiB18-10 | --- | 1.4941 | --- | --- | 195 | --- | 490-680 | --- | 35 | SA | --- |
| ISO 9328-7:2004 | Grade X6CrNiTiB18-10 | --- | --- | t ≤ 6 | --- | 220 | --- | 510-710 | --- | 40 T | SA | --- |
| | | | | t ≤ 12 | --- | 200 | --- | 510-710 | --- | 40 T | SA | see standard for impact data |
| | | | | t ≤ 75 | --- | 200 | --- | 490-690 | --- | 40 T | SA | |
| GB 3280-92 | Grade 0Cr18Ni13Si4 | --- | --- | --- | --- | 205 | --- | 520 | --- | 40 | ST | 207 max. HB; 95 max. HRB |
| GB 4237-92 | Grade 0Cr18Ni13Si4 | --- | --- | --- | --- | 205 | --- | 520 | --- | 40 | ST | 207 max. HB; 95 max. HRB |
| GB 4238-92 | Grade 0Cr18Ni13Si4 | --- | --- | --- | --- | 205 | --- | 520 | --- | 40 | ST | 207 max. HB; 95 max. HRB |
| GB 4239-91 | Grade 0Cr18Ni13Si4 | --- | --- | --- | --- | 205 | --- | 520 | --- | 40 | ST | 95 max. HRB |
| JIS G 4304:2012 | Symbol SUSXM15J1 | --- | --- | --- | --- | 205 | --- | 520 | --- | 40 | ST | 207 max. HBW; 95 max. HRBW; 218 max. HV |
| JIS G 4305:2012 | Symbol SUSXM15J1 | --- | --- | --- | --- | 205 | --- | 520 | --- | 40 | ST | 207 max. HBW; 95 max. HRBW; 218 max. HV |
| EN 10088-2:2014 | X8CrMnCuNB17-8-3 | --- | 1.4597 | t ≤ 8 | --- | 300 | --- | 580-780 | --- | 40 T | SA | --- |
| | | | | t ≤ 13.5 | --- | 300 | --- | 580-780 | --- | 40 T | SA | see standard for impact data |
| ISO 16143-1:2004 | X8CrMnCuN17-8-3 | --- | --- | t ≤ 8 | --- | 300 | --- | 580-780 | --- | 40 T | SA | --- |
| | | | | t ≤ 13.5 | --- | 300 | --- | 580-780 | --- | 40 T | SA | --- |
| ASME SA-240/SA-240M | --- | S31060 | --- | --- | --- | 280 | 41 | 600 | 87 | 40 | Q+SA | 217 max. HB; 95 max. HRB |
| ASTM A240/A240M-15a | --- | S31060 | --- | --- | --- | 280 | 41 | 600 | 87 | 40 | SA | 217 max. HBW; 95 max. HRBW |
| EN 10302:2008 | X8CrNiNb16-13 | --- | 1.4961 | --- | --- | 200 | --- | 510-690 | --- | 35 | SA | --- |
| | X6CrNiMoTiB17-13 | --- | 1.4983 | --- | --- | 205 | --- | 530-730 | --- | 35 | SA | --- |

**8.1 Stainless Steels: Plate, Sheet and Strip**

**8.1.3B Mechanical Properties of Austenitic Stainless Steels (Continued)**

| Specification | Designation | UNS No | Steel No | Section Thickness/Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation % min | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | | | |
| EN 10028-7:2007 | X1CrNi25-21 | --- | 1.4335 | t ≤ 75 | --- | 200 | --- | 470-670 | --- | 40 T | SA | see standard for impact data |
| EN 10088-2:2014 | X1CrNi25-21 | --- | 1.4335 | t ≤ 75 | --- | 200 | --- | 470-670 | --- | 40 T | SA | see standard for impact data |
| ISO 16143-1:2004 | X1CrNi25-21 | --- | --- | t ≤ 75 | --- | 200 | --- | 470-670 | --- | 40 T | SA | --- |
| ISO 9328-7:2004 | Grade X1CrNi25-21 | --- | --- | t ≤ 75 | --- | 200 | --- | 470-670 | --- | 40 T | SA | see standard for impact data |
| ASME SA-240/SA-240M | --- | S34565 | --- | --- | --- | 415 | 60 | 795 | 115 | 35 | Q+SA | 241 max. HB; 100 max. HRB |
| ASTM A240/A240M-15a | --- | S34565 | --- | --- | --- | 415 | 60 | 795 | 115 | 35 | SA | 241 max. HBW; 100 max. HRBW |
| EN 10088-2:2014 | X2CrNiMnMoN25-18-6-5 | --- | 1.4565 | t ≤ 6 | --- | 420 | --- | 800-950 | --- | 30 T | SA | see standard for impact data |
| | | | | t ≤ 10 | --- | 420 | --- | 800-950 | --- | 30 T | SA | |
| | | | | t ≤ 40 | --- | 420 | --- | 800-950 | --- | 30 T | SA | |
| ISO 16143-1:2004 | X2CrNiMnMoN25-18-6-5 | --- | --- | t ≤ 6 | --- | 420 | --- | 800-1000 | --- | 35 T | SA | --- |
| | | | | t ≤ 10 | --- | 420 | --- | 800-1000 | --- | 35 T | SA | --- |
| | | | | t ≤ 40 | --- | 420 | --- | 800-1000 | --- | 35 T | SA | --- |
| ASME SA-240/SA-240M | --- | S31266 | --- | --- | --- | 420 | 61 | 750 | 109 | 35 | Q+SA | --- |
| ASTM A240/A240M-15a | --- | S31266 | --- | --- | --- | 420 | 61 | 750 | 109 | 35 | SA | --- |
| EN 10088-2:2014 | X1CrNiMoCuNW24-22-6 | --- | 1.4659 | t ≤ 75 | --- | 420 | --- | 800-1000 | --- | 40 T | SA | see standard for impact data |
| ASME SA-240/SA-240M | --- | S32654 | --- | --- | --- | 430 | 62 | 750 | 109 | 40 | Q+SA | 250 max. HB |
| ASTM A240/A240M-15a | --- | S32654 | --- | --- | --- | 430 | 62 | 750 | 109 | 40 | SA | 250 max. HBW |
| EN 10088-2:2014 | X1CrNiMoCuN24-22-8 | --- | 1.4652 | t ≤ 8 | --- | 430 | --- | 750-1000 | --- | 40 T | SA | --- |
| | | | | t ≤ 13.5 | --- | 430 | --- | 750-1000 | --- | 40 T | SA | see standard for impact data |
| | | | | t ≤ 15 | --- | 430 | --- | 750-1000 | --- | 40 T | SA | |
| ISO 16143-1:2004 | X1CrNiMoCuN24-22-8 | --- | --- | t ≤ 8 | --- | 430 | --- | 750-950 | --- | 40 T | SA | --- |
| | | | | t ≤ 13.5 | --- | 430 | --- | 750-950 | --- | 40 T | SA | --- |
| | | | | t ≤ 75 | --- | 430 | --- | 750-950 | --- | 40 T | SA | --- |

**8.1 Stainless Steels: Plate, Sheet and Strip**

**8.1.3B Mechanical Properties of Austenitic Stainless Steels (Continued)**

| Specification | Designation | UNS No | Steel No | Section Thickness/Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation % min | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | | | |
| EN 10095:1999 | X8CrNiTi18-10 | --- | 1.4878 | 0.5 ≤ t < 3 | --- | 190 | --- | 500-720 | --- | 40 L, 40 T | SA | 215 max. HB |
| | | | | t ≤ 25 | --- | 190 | --- | 500-720 L | --- | 40 L | SA | 215 max. HB |
| | | | | 3 ≤ t ≤ 75 | --- | 190 | --- | 500-720 | --- | 40 L, 40 T | SA | 215 max. HB |
| | | | | t ≤ 160 | --- | 190 | --- | 500-720 L | --- | 40 L | SA | 215 max. HB |
| GB 4238-92 | Grade 1Cr18Ni9Ti | --- | --- | --- | --- | 205 | --- | 520 | --- | 40 | ST | 187 max. HB; 90 max. HRB |
| GB 3280-92 | Grade 1Cr18Ni9Ti | --- | --- | --- | --- | 205 | --- | 520 | --- | 40 | ST | 187 max. HB; 90 max. HRB |
| GB 4237-92 | Grade 1Cr18Ni9Ti | --- | --- | --- | --- | 205 | --- | 520 | --- | 40 | ST | 187 max. HB; 90 max. HRB |
| GB 4239-91 | Grade 1Cr18Ni9Ti | --- | --- | --- | --- | 205 | --- | 540 | --- | 40 | ST | 90 max. HRB |
| | | | | --- | --- | --- | --- | 735 | --- | 20 | WH | 90 max. HRB |
| | | | | --- | --- | --- | --- | 885 | --- | 7 | WH | 90 max. HRB |
| ASME SA-240/SA-240M | Type 347H | S34709 | --- | --- | --- | 205 | 30 | 515 | 75 | 40 | Q+SA | 201 max. HB; 92 max. HRB |
| ASTM A240/A240M-15a | Type 347H | S34709 | --- | --- | --- | 205 | 30 | 515 | 75 | 40 | SA | 201 max. HBW; 92 max. HRBW |
| ISO 4955:2005 | X7CrNiNb18-10 | --- | --- | 0.5 ≤ t < 3 | --- | 205 | --- | 510-710 | --- | 28 L, 28 T | SA | 192 max. HB |
| | | | | 1.5 ≤ t ≤ 25 | --- | 205 | --- | 510-710 | --- | 30 | SA | 192 max. HB |
| | | | | 3 ≤ t ≤ 75 | --- | 205 | --- | 510-710 | --- | 30 L, 30 T | SA | 192 max. HB |
| | | | | t ≤ 100 | --- | 205 | --- | 510-710 | --- | 30 | SA | 192 max. HB |
| | | | | 5 ≤ t ≤ 160 | --- | 205 | --- | 510-710 | --- | 30 | SA | 192 max. HB |
| EN 10028-7:2007 | X3CrNiMoBN17-13-3 | --- | 1.4910 | t ≤ 3 | --- | 300 | --- | 580-780 | --- | 35 T | SA | see standard for impact data |
| | | | | t ≤ 8 | --- | 300 | --- | 580-780 | --- | 40 T | SA | |
| | | | | t ≤ 13.5 | --- | 260 | --- | 550-750 | --- | 40 T | SA | |
| | | | | t ≤ 75 | --- | 260 | --- | 550-750 | --- | 40 T | SA | |
| EN 10302:2008 | X3CrNiMoBN17-13-3 | --- | 1.4910 | --- | --- | 260 | --- | 550-750 | --- | 35 | SA | --- |
| ISO 9328-7:2004 | Grade X3CrNiMoBN17-13-3 | --- | --- | t ≤ 6 | --- | 300 | --- | 580-780 | --- | 40 T | SA | --- |
| | | | | t ≤ 12 | --- | 260 | --- | 550-750 | --- | 40 T | SA | see standard for impact data |
| | | | | t ≤ 75 | --- | 260 | --- | 550-750 | --- | 40 T | SA | see standard for impact data |
| EN 10028-7:2007 | X8CrNiNb16-13 | --- | 1.4961 | t ≤ 75 | --- | 200 | --- | 510-690 | --- | 35 T | SA | see standard for impact data |
| ISO 9328-7:2004 | Grade X8CrNiNb16-13 | --- | --- | t ≤ 75 | --- | 200 | --- | 510-690 | --- | 35 T | SA | see standard for impact data |

**8.1 Stainless Steels: Plate, Sheet and Strip**

**8.1.3B Mechanical Properties of Austenitic Stainless Steels (Continued)**

| Specification | Designation | UNS No | Steel No | Section Thickness/Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation % min | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | | | |
| GB 4238-92 | Grade 0Cr15Ni25Ti2MoAlVB | --- | --- | --- | --- | --- | --- | 725 max. | --- | 25 | ST | 192 max. HB; 91 max. HRB |
| | | | | --- | --- | 590 | --- | 900 | --- | 15 | see standard | 248 min. HB; 101 min. HRB |
| JIS G 4312:2011 | Symbol SUH660 | --- | --- | --- | --- | --- | --- | 730 | --- | 25 | ST | 192 max. HBW; 91 max. HRBW; 202 max. HV |
| | | | | --- | --- | 590 | --- | 900 | --- | 15 | see standard | 248 min. HBW; 24 min. HRC; 261 min. HV |
| EN 10302:2008 | X6NiCrTiMoVB25-15-2 | --- | 1.4980 | --- | --- | 600 | --- | 900-1150 | --- | 15 | PH | --- |
| EN 10028-7:2007 | X5NiCrAlTi31-20 | --- | 1.4958 | t ≤ 75 | --- | 170 | --- | 500-750 | --- | 30 T | SA | see standard for impact data |
| | | | | t ≤ 75 | --- | 210 | --- | 500-750 | --- | 30 T | A | |
| EN 10302:2008 | X5NiCrAlTi31-20 | --- | 1.4958 | --- | --- | 170 | --- | 500-750 | --- | 35 | SA | --- |
| | | | | --- | --- | 210 | --- | 500-750 | --- | 35 | A | --- |
| ISO 9328-7:2004 | Grade X5NiCrAlTi31-20 | --- | --- | t ≤ 75 | --- | 170 | --- | 500-750 | --- | 30 T | SA | see standard for impact data |
| | | | | t ≤ 75 | --- | 210 | --- | 500-750 | --- | 30 T | A | |
| EN 10302:2008 | X12CrCoNi21-20 | --- | 1.4971 | --- | --- | 300 | --- | 690-900 | --- | 30 | SA | --- |
| JIS G 4312:2011 | Symbol SUH661 | --- | --- | --- | --- | 315 | --- | 690 | --- | 35 | ST | 248 max. HBW; 100 max. HRBW; 261 max. HV |
| | | | | --- | --- | 345 | --- | 760 | --- | 30 | see standard | 192 min. HBW; 91 min. HRBW; 202 min. HV |
| ASME SA-240/SA-240M | Type 800 | N08800 | --- | t > 0.50 | t > 0.020 | 205 | 30 | 520 | 75 | 30 | Q+SA | --- |
| ASTM A240/A240M-15a | Type 800 | N08800 | --- | t > 0.50 | t > 0.020 | 205 | 30 | 520 | 75 | 30 | SA | --- |
| EN 10095:1999 | X10NiCrAlTi32-21 | --- | 1.4876 | 0.5 ≤ t < 3 | --- | 170 | --- | 450-680 | --- | 28 L, 28 T | SA | 192 max. HB |
| | | | | t ≤ 25 | --- | 170 | --- | 450-680 L | --- | 30 L | SA | 192 max. HB |
| | | | | 3 ≤ t ≤ 75 | --- | 170 | --- | 450-680 | --- | 30 L, 30 T | SA | 192 max. HB |
| | | | | t ≤ 160 | --- | 170 | --- | 450-680 L | --- | 30 L | SA | 192 max. HB |

**8.1 Stainless Steels: Plate, Sheet and Strip**

**8.1.3B Mechanical Properties of Austenitic Stainless Steels (Continued)**

| Specification | Designation | UNS No | Steel No | Section Thickness/Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation % min | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | | | |
| ASME SA-240/SA-240M | Type 800H | N08810 | --- | t > 0.50 | t > 0.020 | 170 | 25 | 450 | 65 | 30 | Q+SA | --- |
| | --- | N08811 | --- | --- | --- | 170 | 25 | 450 | 65 | 30 | Q+SA | --- |
| ASTM A240/A240M-15a | Type 800H | N08810 | --- | t > 0.50 | t > 0.020 | 170 | 25 | 450 | 65 | 30 | SA | --- |
| | --- | N08811 | --- | --- | --- | 170 | 25 | 450 | 65 | 30 | SA | --- |
| EN 10028-7:2007 | X8NiCrAlTi32-21 | --- | 1.4959 | t ≤ 75 | --- | 170 | --- | 500-750 | --- | 30 T | SA | see standard for impact data |
| ISO 4955:2005 | X8NiCrAlTi32-21 | --- | --- | 0.5 ≤ t < 3 | --- | 170 | --- | 450-680 | --- | 28 L, 28 T | SA | 192 max. HB |
| | | | | 1.5 ≤ t ≤ 25 | --- | 170 | --- | 450-680 | --- | 30 | SA | 192 max. HB |
| | | | | 3 ≤ t ≤ 75 | --- | 170 | --- | 450-680 | --- | 30 L, 30 T | SA | 192 max. HB |
| | | | | t ≤ 100 | --- | 170 | --- | 450-680 | --- | 30 | SA | 192 max. HB |
| | | | | 5 ≤ t ≤ 160 | --- | 170 | --- | 450-680 | --- | 30 | SA | 192 max. HB |
| ISO 9328-7:2004 | Grade X8NiCrAlTi32-21 | --- | --- | t ≤ 75 | --- | 170 | --- | 500-750 | --- | 30 T | SA | see standard for impact data |
| EN 10028-7:2007 | X1CrNiMoCuN25-25-5 | --- | 1.4537 | t ≤ 75 | --- | 290 | --- | 600-800 | --- | 40 T | SA | see standard for impact data |
| EN 10088-2:2014 | X1CrNiMoCuN25-25-5 | --- | 1.4537 | t ≤ 75 | --- | 290 | --- | 600-800 | --- | 40 T | SA | see standard for impact data |
| ISO 9328-7:2004 | Grade X1CrNiMoCuN25-25-5 | --- | --- | t ≤ 75 | --- | 290 | --- | 600-800 | --- | 40 T | SA | see standard for impact data |
| ASME SA-240/SA-240M | --- | N08367 | --- | --- | --- | 310 | 45 | 655 | 95 | 30 | Q+SA | 241 max. HB |
| | | | | --- | --- | 310 | 45 | 690 | 100 | 30 | Q+SA | 100 max. HRB |
| | --- | N08926 | --- | --- | --- | 295 | 43 | 650 | 94 | 35 | Q+SA | --- |
| | --- | S31277 | --- | --- | --- | 360 | 52 | 770 | 112 | 40 | Q+SA | --- |
| ASTM A240/A240M-15a | --- | N08367 | --- | --- | --- | 310 | 45 | 690 | 100 | 30 | SA | 100 max. HRBW |
| | | | | --- | --- | 310 | 45 | 655 | 65 | 30 | SA | 241 max. HBW |
| | --- | N08926 | --- | --- | --- | 295 | 43 | 650 | 94 | 35 | SA | --- |
| | --- | S31277 | --- | --- | --- | 360 | 52 | 770 | 112 | 40 | SA | --- |
| ASTM B688-96 (2014) | --- | N08366 | --- | 0.40 ≤ t ≤ 4.8 | 0.015 ≤ t ≤ 0.1875 | 240 | 35 | 515 L | 75 L | 30 | --- | 95 max. HRB |
| | | | | t > 4.8 | t > 0.1875 | 240 | 35 | 515 L | 75 L | 30 | --- | 212 max. HBN |
| | --- | N08367 | --- | 0.40 ≤ t ≤ 4.8 | 0.015 ≤ t ≤ 0.1875 | 310 | 45 | 690 L | 100 L | 30 | --- | 100 max. HRB |
| | | | | t > 4.8 | t > 0.1875 | 310 | 45 | 655 L | 95 L | 30 | --- | 240 max. HBN |
| EN 10028-7:2007 | X1NiCrMoCuN25-20-7 | --- | 1.4529 | t ≤ 75 | --- | 300 | --- | 650-850 | --- | 40 T | SA | see standard for impact data |
| EN 10088-2:2014 | X1NiCrMoCuN25-20-7 | --- | 1.4529 | t ≤ 75 | --- | 300 | --- | 650-850 | --- | 40 T | SA | see standard for impact data |
| ISO 9328-7:2004 | Grade X1NiCrMoCuN25-20-7 | --- | --- | t ≤ 75 | --- | 300 | --- | 650-850 | --- | 40 T | SA | see standard for impact data |

Note: This section continued on next page

**8.1 Stainless Steels: Plate, Sheet and Strip**

**8.1.3B Mechanical Properties of Austenitic Stainless Steels (Continued)**

| Specification | Designation | UNS No | Steel No | Section Thickness/Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation % min | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | | | |
| JIS G 4304:2012 | Symbol SUS836L | --- | --- | --- | --- | 275 | --- | 640 | --- | 40 | ST | 217 max. HBW; 96 max. HRBW; 230 max. HV |
| JIS G 4305:2012 | Symbol SUS836L | --- | --- | --- | --- | 275 | --- | 640 | --- | 40 | ST | 217 max. HBW; 96 max. HRBW; 230 max. HV |
| ASME SA-240/SA-240M | Type 904L | N08904 | --- | --- | --- | 220 | 31 | 490 | 71 | 35 | Q+SA | 90 max. HRB |
| ASTM A240/A240M-15a | Type 904L | N08904 | --- | --- | --- | 220 | 31 | 490 | 71 | 35 | SA | 90 max. HRBW |
| EN 10028-7:2007 | X1NiCrMoCu25-20-5 | --- | 1.4539 | t ≤ 8 | --- | 240 | --- | 530-730 | --- | 35 T | SA | see standard for impact data |
| | | | | t ≤ 13.5 | --- | 220 | --- | 530-730 | --- | 35 T | SA | |
| | | | | t ≤ 75 | --- | 220 | --- | 520-720 | --- | 35 T | SA | |
| EN 10088-2:2014 | X1NiCrMoCu25-20-5 | --- | 1.4539 | t ≤ 8 | --- | 240 | --- | 530-730 | --- | 35 T | SA | --- |
| | | | | t ≤ 13.5 | --- | 220 | --- | 530-730 | --- | 35 T | SA | see standard for impact data |
| | | | | t ≤ 75 | --- | 220 | --- | 520-720 | --- | 35 T | SA | |
| ISO 16143-1:2004 | X1NiCrMoCu25-20-5 | --- | --- | t ≤ 6 | --- | 240 | --- | 530-730 | --- | 35 T | SA | --- |
| | | | | t ≤ 12 | --- | 220 | --- | 530-730 | --- | 35 T | SA | --- |
| | | | | t ≤ 75 | --- | 220 | --- | 510-710 | --- | 35 T | SA | --- |
| ISO 9328-7:2004 | Grade X1NiCrMoCu25-20-5 | --- | --- | t ≤ 6 | --- | 240 | --- | 530-730 | --- | 35 T | SA | --- |
| | | | | t ≤ 12 | --- | 220 | --- | 530-730 | --- | 35 T | SA | see standard for impact data |
| | | | | t ≤ 75 | --- | 220 | --- | 520-720 | --- | 35 T | SA | |
| JIS G 4304:2012 | Symbol SUS890L | --- | --- | --- | --- | 215 | --- | 490 | --- | 35 | ST | 187 max. HBW; 90 max. HRBW; 200 max. HV |
| JIS G 4305:2012 | Symbol SUS890L | --- | --- | --- | --- | 215 | --- | 490 | --- | 35 | ST | 187 max. HBW; 90 max. HRBW; 200 max. HV |
| EN 10028-7:2007 | X1NiCrMoCu31-27-4 | --- | 1.4563 | t ≤ 75 | --- | 220 | --- | 500-700 | --- | 40 T | SA | see standard for impact data |
| EN 10088-2:2014 | X1NiCrMoCu31-27-4 | --- | 1.4563 | t ≤ 75 | --- | 220 | --- | 500-700 | --- | 40 T | SA | see standard for impact data |
| ISO 16143-1:2004 | X1NiCrMoCu31-27-4 | --- | --- | t ≤ 75 | --- | 220 | --- | 500-700 | --- | 40 T | SA | --- |
| ISO 9328-7:2004 | Grade X1NiCrMoCu31-27-4 | --- | --- | t ≤ 75 | --- | 220 | --- | 500-700 | --- | 40 T | SA | see standard for impact data |

**8.1 Stainless Steels: Plates, Sheet and Strip**

**8.1.4A Chemical Composition of Precipitation-Hardening Stainless Steels**

| Specification | Designation | UNS No | Steel No | Weight, %, max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASME SA-693 | Type 630 | S17400 | --- | 0.07 | 1.00 | 1.00 | 0.040 | 0.030 | 15.00-17.50 | 3.00-5.00 | --- | (Cb+Ta) 0.15 to 0.45; Cu 3.00-5.00 |
| ASTM A693-13 | Type 630 | S17400 | --- | 0.07 | 1.00 | 1.00 | 0.040 | 0.030 | 15.0-17.5 | 3.0-5.0 | --- | (Cb+Ta) 0.15 to 0.45; Cu 3.0-5.0 |
| EN 10088-2:2014 | X5CrNiCuNb16-4 | --- | 1.4542 | 0.07 | 1.50 | 0.70 | 0.040 | 0.015 | 15.0-17.0 | 3.0-5.0 | 0.60 | Nb 5xC to 0.45; Cu 3.0-5.0 |
| JIS G 4304:2012 | Symbol SUS630 | --- | --- | 0.07 | 1.00 | 1.00 | 0.040 | 0.030 | 15.00-17.50 | 3.00-5.00 | --- | Nb 0.15-0.45; Cu 3.00-5.00 |
| JIS G 4305:2012 | Symbol SUS630 | --- | --- | 0.07 | 1.00 | 1.00 | 0.040 | 0.030 | 15.00-17.50 | 3.00-5.00 | --- | Nb 0.15-0.45; Cu 3.00-5.00 |
| ASME SA-693 | Type 631 | S17700 | --- | 0.09 | 1.00 | 1.00 | 0.040 | 0.030 | 16.00-18.00 | 6.50-7.75 | --- | Al 0.75-1.50 |
| ASTM A693-13 | Type 631 | S17700 | --- | 0.09 | 1.00 | 1.00 | 0.040 | 0.030 | 16.0-18.0 | 6.5-7.7 | --- | Al 0.75-1.50 |
| EN 10088-2:2014 | X7CrNiAl17-7 | --- | 1.4568 | 0.09 | 1.00 | 0.70 | 0.040 | 0.015 | 16.0-18.0 | 6.5-7.8 | --- | Al 0.70-1.50 |
| GB 4237-92 | Grade 0Cr17Ni7Al | --- | --- | 0.09 | 1.00 | 1.00 | 0.035 | 0.030 | 16.00-18.00 | 6.50-7.75 | --- | Al 0.75-1.50 |
| GB 4238-92 | Grade 0Cr17Ni7Al | --- | --- | 0.09 | 1.00 | 1.00 | 0.035 | 0.030 | 16.00-18.00 | 6.50-7.75 | --- | Al 0.75-1.50; Cu 0.50 |
| GB 4239-91 | Grade 0Cr17Ni7Al | --- | --- | 0.09 | 1.00 | 1.00 | 0.035 | 0.030 | 16.00-18.00 | 6.50-7.75 | --- | Al 0.75-1.00 |
| ISO 16143-1:2004 | X7CrNiAl17-7 | --- | --- | 0.09 | 1.00 | 0.70 | 0.040 | 0.015 | 16.0-18.0 | 6.5-7.8 | --- | Al 0.70-1.50 |
| JIS G 4304:2012 | Symbol SUS631 | --- | --- | 0.09 | 1.00 | 1.00 | 0.040 | 0.030 | 16.00-18.00 | 6.50-7.75 | --- | Al 0.75-1.50 |
| JIS G 4305:2012 | Symbol SUS631 | --- | --- | 0.09 | 1.00 | 1.00 | 0.040 | 0.030 | 16.00-18.00 | 6.50-7.75 | --- | Al 0.75-1.50 |

**8.1 Stainless Steels: Plate, Sheet and Strip**

**8.1.4B Mechanical Properties of Precipitation-Hardening Stainless Steels**

| Specification | Designation | UNS No | Steel No | Section Thickness/Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation | Heat | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | % min | Treatment | |
| ASME SA-693 | Type 630 | S17400 | --- | 0.38 ≤ t ≤ 102 | 0.015 ≤ t ≤ 4.0 | --- | --- | --- | --- | --- | ST | 363 max. HB; 38 max. HRC |
| | | | | t < 4.762 | t < 0.1875 | 1170 | 170 | 1310 L | 190 L | 5 T | PH 900°F/482°C | 40-48 HRC |
| | | | | t < 4.762 | t < 0.1875 | 1070 | 155 | 1170 L | 170 L | 5 T | PH 925°F/496°C | 38-48 HRC |
| | | | | t < 4.762 | t < 0.1875 | 1000 | 145 | 1070 L | 155 L | 5 T | PH 1025°F/552°C | 35-43 HRC |
| | | | | t < 4.762 | t < 0.1875 | 860 | 125 | 1000 L | 145 L | 5 T | PH 1075°F/579°C | 31-40 HRC |
| | | | | t < 4.762 | t < 0.1875 | 790 | 115 | 965 L | 140 L | 5 T | PH 1100°F/593°C | 31-40 HRC |
| | | | | t < 4.762 | t < 0.1875 | 725 | 105 | 930 L | 135 L | 8 T | PH 1150°F/621°C | 28-38 HRC |
| | | | | t < 4.762 | t < 0.1875 | 515 | 75 | 790 L | 115 L | 9 T | PH 1400°F+1150°F/ 760°C+621°C | 255-331 HB; 26-36 HRC |
| | | | | 4.762 ≤ t ≤ 15.88 | 0.1875 ≤ t ≤ 0.625 | 1170 | 170 | 1310 L | 190 L | 8 T | PH 900°F/482°C | 388-477 HB; 40-48 HRC |
| | | | | 4.762 ≤ t ≤ 15.88 | 0.1875 ≤ t ≤ 0.625 | 1070 | 155 | 1170 L | 170 L | 8 T | PH 925°F/496°C | 375-477 HB; 38-47 HRC |
| | | | | 4.762 ≤ t ≤ 15.88 | 0.1875 ≤ t ≤ 0.625 | 1000 | 145 | 1070 L | 155 L | 8 T | PH 1025°F/552°C | 321-415 HB; 33-42 HRC |
| | | | | 4.762 ≤ t ≤ 15.88 | 0.1875 ≤ t ≤ 0.625 | 860 | 125 | 1000 L | 145 L | 9 T | PH 1075°F/579°C | 293-375 HB; 29-38 HRC |
| | | | | 4.762 ≤ t ≤ 15.88 | 0.1875 ≤ t ≤ 0.625 | 790 | 115 | 965 L | 140 L | 10 T | PH 1100°F/593°C | 293-375 HB; 29-38 HRC |
| | | | | 4.762 ≤ t ≤ 15.88 | 0.1875 ≤ t ≤ 0.625 | 725 | 105 | 930 L | 135 L | 10 T | PH 1150°F/621°C | 269-352 HB; 26-36 HRC |
| | | | | 4.762 ≤ t ≤ 15.88 | 0.1875 ≤ t ≤ 0.625 | 515 | 75 | 790 L | 115 L | 11 T | PH 1400°F+1150°F/ 760°C+621°C | 248-321 HB; 24-34 HRC |
| | | | | 15.90 ≤ t ≤ 102 | 0.626 ≤ t ≤ 4.0 | 1170 | 170 | 1310 L | 190 L | 10 T | PH 900°F/482°C | 388-477 HB; 40-48 HRC |
| | | | | 15.90 ≤ t ≤ 102 | 0.626 ≤ t ≤ 4.0 | 1070 | 155 | 1170 L | 170 L | 10 T | PH 925°F/496°C | 375-477 HB; 38-47 HRC |
| | | | | 15.90 ≤ t ≤ 102 | 0.626 ≤ t ≤ 4.0 | 1000 | 145 | 1070 L | 155 L | 12 T | PH 1025°F/552°C | 321-415 HB; 33-42 HRC |
| | | | | 15.88 ≤ t ≤ 102 | 0.626 ≤ t ≤ 4.0 | 860 | 125 | 1000 L | 145 L | 13 T | PH 1075°F/579°C | 293-375 HB; 29-38 HRC |
| | | | | 15.88 ≤ t ≤ 102 | 0.626 ≤ t ≤ 4.0 | 790 | 115 | 965 L | 140 L | 14 T | PH 1100°F/593°C | 293-375 HB; 29-38 HRC |
| | | | | 15.88 ≤ t ≤ 102 | 0.626 ≤ t ≤ 4.0 | 725 | 105 | 930 L | 135 L | 16 T | PH 1150°F/621°C | 269-352 HB; 26-36 HRC |
| | | | | 15.88 ≤ t ≤ 102 | 0.626 ≤ t ≤ 4.0 | 515 | 75 | 790 L | 115 L | 18 T | PH 1400°F+1150°F/ 760°C+621°C) | 248-321 HB; 24-34 HRC |

Note: This section continued on next page

**8.1 Stainless Steels: Plate, Sheet and Strip**

**8.1.4B Mechanical Properties of Precipitation-Hardening Stainless Steels (Continued)**

| Specification | Designation | UNS No | Steel No | Section Thickness/Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation | Heat | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | % min | Treatment | |
| ASTM A693-13 | Type 630 | S17400 | --- | 0.38 ≤ t ≤ 102 | 0.015 ≤ t ≤ 4.0 | --- | --- | --- | --- | --- | ST | 363 max. HB; 38 max. HRC |
| | | | | t < 4.762 | t < 0.1875 | 1170 | 170 | 1310 L | 190 L | 5 T | PH 900°F/482°C | 40-48 HRC |
| | | | | t < 4.762 | t < 0.1875 | 1070 | 155 | 1170 L | 170 L | 5 T | PH 925°F/496°C | 38-46 HRC |
| | | | | t < 4.762 | t < 0.1875 | 1000 | 145 | 1070 L | 155 L | 5 T | PH 1025°F/552°C | 35-43 HRC |
| | | | | t < 4.762 | t < 0.1875 | 860 | 125 | 1000 L | 145 L | 5 T | PH 1075°F/579°C | 31-40 HRC |
| | | | | t < 4.762 | t < 0.1875 | 790 | 115 | 965 L | 140 L | 5 T | PH 1100°F/593°C | 31-40 HRC |
| | | | | t < 4.762 | t < 0.1875 | 725 | 105 | 930 L | 135 L | 8 T | PH 1150°F/621°C | 28-38 HRC |
| | | | | t < 4.762 | t < 0.1875 | 515 | 75 | 790 L | 115 L | 9 T | PH 1400°F+1150°F/ 760°C+621°C | 255-331 HB; 26-36 HRC |
| | | | | 4.762 ≤ t ≤ 15.88 | 0.1875 ≤ t ≤ 0.625 | 1170 | 170 | 1310 L | 190 L | 8 T | PH 900°F/482°C | 388-477 HB; 40-48 HRC |
| | | | | 4.762 ≤ t ≤ 15.88 | 0.1875 ≤ t ≤ 0.625 | 1070 | 155 | 1170 L | 170 L | 8 T | PH 925°F/496°C | 375-477 HB; 38-47 HRC |
| | | | | 4.762 ≤ t ≤ 15.88 | 0.1875 ≤ t ≤ 0.625 | 1000 | 145 | 1070 L | 155 L | 8 T | PH 1025°F/552°C | 321-415 HB; 33-42 HRC |
| | | | | 4.762 ≤ t ≤ 15.88 | 0.1875 ≤ t ≤ 0.625 | 860 | 125 | 1000 L | 145 L | 9 T | PH 1075°F/579°C | 293-375 HB; 29-38 HRC |
| | | | | 4.762 ≤ t ≤ 15.88 | 0.1875 ≤ t ≤ 0.625 | 790 | 115 | 965 L | 140 L | 10 T | PH 1100°F/593°C | 293-375 HB; 29-38 HRC |
| | | | | 4.762 ≤ t ≤ 15.88 | 0.1875 ≤ t ≤ 0.625 | 725 | 105 | 930 L | 135 L | 10 T | PH 1150°F/621°C | 269-352 HB; 26-36 HRC |
| | | | | 4.762 ≤ t ≤ 15.88 | 0.1875 ≤ t ≤ 0.625 | 515 | 75 | 790 L | 115 L | 11 T | PH 1400°F+1150°F/ 760°C+621°C | 248-321 HB; 24-34 HRC |
| | | | | 15.90 ≤ t ≤ 102 | 0.626 ≤ t ≤ 4.0 | 1170 | 170 | 1310 L | 190 L | 10 T | PH 900°F/482°C | 388-477 HB; 40-48 HRC |
| | | | | 15.90 ≤ t ≤ 102 | 0.626 ≤ t ≤ 4.0 | 1070 | 155 | 1170 L | 170 L | 10 T | PH 925°F/496°C | 375-477 HB; 38-47 HRC |
| | | | | 15.90 ≤ t ≤ 102 | 0.626 ≤ t ≤ 4.0 | 1000 | 145 | 1070 L | 155 L | 12 T | PH 1025°F/552°C | 321-415 HB; 33-42 HRC |
| | | | | 15.88 ≤ t ≤ 102 | 0.626 ≤ t ≤ 4.0 | 860 | 125 | 1000 L | 145 L | 13 T | PH 1075°F/579°C | 293-375 HB; 29-38 HRC |
| | | | | 15.88 ≤ t ≤ 102 | 0.626 ≤ t ≤ 4.0 | 790 | 115 | 965 L | 140 L | 14 T | PH 1100°F/593°C | 293-375 HB; 29-38 HRC |
| | | | | 15.88 ≤ t ≤ 102 | 0.626 ≤ t ≤ 4.0 | 725 | 105 | 930 L | 135 L | 16 T | PH 1150°F/621°C | 269-352 HB; 26-36 HRC |
| | | | | 15.88 ≤ t ≤ 102 | 0.626 ≤ t ≤ 4.0 | 515 | 75 | 790 L | 115 L | 18 T | PH 1400°F+1150°F/ 760°C+621°C) | 248-321 HB; 24-34 HRC |

Note: This section continued on next page

**8.1 Stainless Steels: Plate, Sheet and Strip**

**8.1.4B Mechanical Properties of Precipitation-Hardening Stainless Steels (Continued)**

| Specification | Designation | UNS No | Steel No | Section Thickness/Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | % min | | |
| EN 10088-2:2014 | X5CrNiCuNb16-4 | --- | 1.4542 | t ≤ 8 | --- | 700 | --- | 900 | --- | 6 L, 6 T | PH (P900) | --- |
| | | | | t ≤ 8 | --- | 1150 | --- | 1300 | --- | 3 L, 3 T | PH (P1300) | --- |
| | | | | t ≤ 8 | --- | --- | --- | 1275 max. | --- | 5 L, 5 T | SA | --- |
| | | | | t ≤ 50 | --- | --- | --- | 1050 max. | --- | --- | see standard | --- |
| | | | | t ≤ 50 | --- | 800 | --- | 950-1150 | --- | 12 L, 12 T | PH (P950) | --- |
| | | | | t ≤ 50 | --- | 600 | --- | 850-1050 | --- | 14 L, 14 T | PH (P850) | --- |
| | | | | t ≤ 50 | --- | 1000 | --- | 1070-1270 | --- | 10 L, 10 T | PH (P1070) | --- |
| JIS G 4304:2012 | Symbol SUS630 | --- | --- | --- | --- | --- | --- | --- | --- | --- | PH (S) | 363 max. HBW; 38 max. HRC |
| | | | | t ≤ 5 | --- | 725 | --- | 930 | --- | 8 | PH (H1150) | 277 min. HBW; 28 min. HRC |
| | | | | t ≤ 5 | --- | 860 | --- | 1000 | --- | 5 | PH (H1075) | 302 min. HBW; 31 min. HRC |
| | | | | t ≤ 5 | --- | 1000 | --- | 1070 | --- | 5 | PH (H1025) | 331 min. HBW; 35 min. HRC |
| | | | | t ≤ 5 | --- | 1175 | --- | 1310 | --- | 5 | PH (H900) | 375 min. HBW; 40 min. HRC |
| | | | | 5 < t ≤ 15 | --- | 725 | --- | 930 | --- | 10 | PH (H1150) | 277 min. HBW; 28 min. HRC |
| | | | | 5 < t ≤ 15 | --- | 860 | --- | 1000 | --- | 9 | PH (H1075) | 302 min. HBW; 31 min. HRC |
| | | | | 5 < t ≤ 15 | --- | 1000 | --- | 1070 | --- | 8 | PH (H1025) | 331 min. HBW; 35 min. HRC |
| | | | | 5 < t ≤ 15 | --- | 1175 | --- | 1310 | --- | 8 | PH (H900) | 375 min. HBW; 40 min. HRC |
| | | | | t > 15 | --- | 725 | --- | 930 | --- | 16 | PH (H1150) | 277 min. HBW; 28 min. HRC |
| | | | | t > 15 | --- | 860 | --- | 1000 | --- | 13 | PH (H1075) | 302 min. HBW; 31 min. HRC |
| | | | | t > 15 | --- | 1000 | --- | 1070 | --- | 12 | PH (H1025) | 331 min. HBW; 35 min. HRC |
| | | | | t > 15 | --- | 1175 | --- | 1310 | --- | 10 | PH (H900) | 375 min. HBW; 40 min. HRC |

Note: This section continued on next page

**8.1 Stainless Steels: Plate, Sheet and Strip**

**8.1.4B Mechanical Properties of Precipitation-Hardening Stainless Steels (Continued)**

| Specification | Designation | UNS No | Steel No | Section Thickness/Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation | Heat | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | % min | Treatment | |
| JIS G 4305:2012 | Symbol SUS630 | --- | --- | --- | --- | --- | --- | --- | --- | --- | PH (S) | 363 max. HBW; 38 max. HRC |
| | | | | t ≤ 5 | --- | 1175 | --- | 1310 | --- | 5 | PH (H900) | 375 min. HBW |
| | | | | t ≤ 5 | --- | 1000 | --- | 1070 | --- | 5 | PH (H1025) | 331 min. HBW |
| | | | | t ≤ 5 | --- | 860 | --- | 1000 | --- | 5 | PH (H1075) | 302 min. HBW; 31 min. HRC |
| | | | | t ≤ 5 | --- | 725 | --- | 930 | --- | 8 | PH (H1150) | 277 min. HBW; 28 min. HRC |
| | | | | 5 < t ≤ 15 | --- | 1175 | --- | 1310 | --- | 8 | PH (H900) | 375 min. HBW |
| | | | | 5 < t ≤ 15 | --- | 1000 | --- | 1070 | --- | 8 | PH (H1025) | 331 min. HBW |
| | | | | 5 < t ≤ 15 | --- | 860 | --- | 1000 | --- | 9 | PH (H1075) | 302 min. HBW; 31 min. HRC |
| | | | | 5 < t ≤ 15 | --- | 725 | --- | 930 | --- | 10 | PH (H1150) | 277 min. HBW; 28 min. HRC |
| | | | | t > 15 | --- | 1175 | --- | 1310 | --- | 10 | PH (H900) | 375 min. HBW |
| | | | | t > 15 | --- | 1000 | --- | 1070 | --- | 12 | PH (H1025) | 331 min. HBW |
| | | | | t > 15 | --- | 860 | --- | 1000 | --- | 13 | PH (H1075) | 302 min. HBW; 31 min. HRC |
| | | | | t > 15 | --- | 725 | --- | 930 | --- | 16 | PH (H1150) | 277 min. HBW; 28 min. HRC |

**8.1 Stainless Steels: Plate, Sheet and Strip**

**8.1.4B Mechanical Properties of Precipitation-Hardening Stainless Steels (Continued)**

| Specification | Designation | UNS No | Steel No | Section Thickness/Diameter mm | Section Thickness/Diameter in. | Yield Strength, min. MPa | Yield Strength, min. ksi | Tensile Strength, min. MPa | Tensile Strength, min. ksi | Elongation % min | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ASME SA-693 | Type 631 | S17700 | --- | 0.038 ≤ t ≤ 0.124 | 0.0015 ≤ t ≤ 0.0049 | 1035 | 150 | 1240 L | 180 L | 3 T | PH 1400°F+55°F+ 1050°F/760°C+15°C +566°C | 38 min. HRC |
| | | | | 0.038 ≤ t ≤ 0.124 | 0.0015 ≤ t ≤ 0.0049 | 1310 | 190 | 1450 L | 210 L | 1 T | PH 1750°F+(-100)°F +950°F/954°C+ (-73)°C+510°C | 44 min. HRC |
| | | | | 0.127 ≤ t ≤ 0.251 | 0.0050 ≤ t ≤ 0.0099 | 1035 | 150 | 1240 L | 180 L | 4 T | PH 1400°F+55°F+ 1050°F/760°C+15°C +566°C | 38 min. HRC |
| | | | | 0.127 ≤ t ≤ 0.251 | 0.0050 ≤ t ≤ 0.0099 | 1310 | 190 | 1450 L | 210 L | 2 T | PH 1750°F+(-100)°F +950°F/954°C+ (-73)°C+510°C | 44 min. HRC |
| | | | | t ≤ 0.25 | t ≤ 0.010 | 450 max. | 65 max. | 1035 max. L | 150 max. L | --- | ST | --- |
| | | | | 0.25 ≤ t ≤ 0.505 | 0.010 ≤ t ≤ 0.0199 | 1035 | 150 | 1240 L | 180 L | 5 T | PH 1400°F+55°F+ 1050°F/760°C+ 15°C+566°C | 38 min. HRC |
| | | | | 0.25 ≤ t ≤ 0.505 | 0.010 ≤ t ≤ 0.0199 | 1310 | 190 | 1450 L | 210 L | 3 T | PH 1750°F+(-100)°F +950°F/954°C +(-73)°C+510°C | 44 min. HRC |
| | | | | 0.038 ≤ t ≤ 1.27 | 0.0015 ≤ t ≤ 0.050 | 1205 | 175 | 1380 L | 200 L | 1 T | CR | 41 min. HRC |
| | | | | 0.038 ≤ t ≤ 1.27 | 0.0015 ≤ t ≤ 0.050 | 1580 | 230 | 1655 L | 240 L | 1 T | CR+PH 900°F/482°C | 46 min. HRC |
| | | | | 0.51 ≤ t ≤ 4.760 | 0.020 ≤ t ≤ 0.1874 | 1035 | 150 | 1240 L | 180 L | 6 T | PH 1400°F+55°F +1050°F/760°C +15°C+566°C | 38 min. HRC |
| | | | | 0.51 ≤ t ≤ 4.760 | 0.020 ≤ t ≤ 0.1874 | 1310 | 190 | 1450 L | 210 L | 4 T | PH 1750°F+(-100)°F +950°F/954°C +(-73)°C+510°C | 44 min. HRC |
| | | | | 4.762 ≤ t ≤ 15.88 | 0.1875 ≤ t ≤ 0.625 | 965 | 140 | 1170 L | 170 L | 7 T | PH 1400°F+55°F +1050°F/760°C +15°C+566°C | 352 min. HB; 38 min. HRC |
| | | | | 4.762 ≤ t ≤ 15.88 | 0.1875 ≤ t ≤ 0.625 | 1240 | 180 | 1380 L | 200 L | 6 T | PH 1750°F+(-100)°F +950°F/954°C +(-73)°C+510°C | 401 min. HB; 43 min. HRC |
| | | | | 0.25 < t ≤ 102 | 0.010 < t ≤ 4.0 | 380 max. | 55 max. | 1035 max. L | 150 max. L | 20 | ST | 92 max. HRB |

Note: This section continued on next page.

**8.1 Stainless Steels: Plate, Sheet and Strip**

**8.1.4B Mechanical Properties of Precipitation-Hardening Stainless Steels (Continued)**

| Specification | Designation | UNS No | Steel No | Section Thickness/Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | % min | | |
| ASTM A693-13 | Type 631 | S17700 | --- | 0.038 ≤ t ≤ 0.124 | 0.0015 ≤ t ≤ 0.0049 | 1035 | 150 | 1240 L | 180 L | 3 T | PH 1400°F+55°F+ 1050°F/760°C+15°C +566°C | 38 min. HRC |
| | | | | 0.038 ≤ t ≤ 0.124 | 0.0015 ≤ t ≤ 0.0049 | 1310 | 190 | 1450 L | 210 L | 1 T | PH 1750°F+(-100)°F +950°F/954°C+ (-73)°C+510°C | 44 min. HRC |
| | | | | 0.127 ≤ t ≤ 0.251 | 0.0050 ≤ t ≤ 0.0099 | 1035 | 150 | 1240 L | 180 L | 4 T | PH 1400°F+55°F+ 1050°F/760°C+15°C +566°C | 38 min. HRC |
| | | | | 0.127 ≤ t ≤ 0.251 | 0.0050 ≤ t ≤ 0.0099 | 1310 | 190 | 1450 L | 210 L | 2 T | PH 1750°F+(-100)°F +950°F/954°C+ (-73)°C+510°C | 44 min. HRC |
| | | | | t ≤ 0.25 | t ≤ 0.010 | 450 max. | 65 max. | 1035 max. L | 150 max. L | --- | ST | --- |
| | | | | 0.25 ≤ t ≤ 0.505 | 0.010 ≤ t ≤ 0.0199 | 1035 | 150 | 1240 L | 180 L | 5 T | PH 1400°F+55°F+ 1050°F/760°C+ 15°C+566°C | 38 min. HRC |
| | | | | 0.25 ≤ t ≤ 0.505 | 0.010 ≤ t ≤ 0.0199 | 1310 | 190 | 1450 L | 210 L | 3 T | PH 1750°F+(-100)°F +950°F/954°C +(-73)°C+510°C | 44 min. HRC |
| | | | | 0.038 ≤ t ≤ 1.27 | 0.0015 ≤ t ≤ 0.050 | 1205 | 175 | 1380 L | 200 L | 1 T | CR | 41 min. HRC |
| | | | | 0.038 ≤ t ≤ 1.27 | 0.0015 ≤ t ≤ 0.050 | 1580 | 230 | 1655 L | 240 L | 1 T | CR+PH 900°F/482°C | 46 min. HRC |
| | | | | 0.51 ≤ t ≤ 4.760 | 0.020 ≤ t ≤ 0.1874 | 1035 | 150 | 1240 L | 180 L | 6 T | PH 1400°F+55°F +1050°F/760°C +15°C+566°C | 38 min. HRC |
| | | | | 0.51 ≤ t ≤ 4.760 | 0.020 ≤ t ≤ 0.1874 | 1310 | 190 | 1450 L | 210 L | 4 T | PH 1750°F+(-100)°F +950°F/954°C +(-73)°C+510°C | 44 min. HRC |
| | | | | 4.762 ≤ t ≤ 15.88 | 0.1875 ≤ t ≤ 0.625 | 965 | 140 | 1170 L | 170 L | 7 T | PH 1400°F+55°F +1050°F/760°C +15°C+566°C | 352 min. HB; 38 min. HRC |
| | | | | 4.762 ≤ t ≤ 15.88 | 0.1875 ≤ t ≤ 0.625 | 1240 | 180 | 1380 L | 200 L | 6 T | PH 1750°F+(-100)°F +950°F/954°C +(-73)°C+510°C | 401 min. HB; 43 min. HRC |
| | | | | 0.25 < t ≤ 102 | 0.010 < t ≤ 4.0 | 380 max. | 55 max. | 1035 max. L | 150 max. L | 20 | ST | 92 max. HRB |
| EN 10088-2:2014 | X7CrNiAl17-7 | --- | 1.4568 | t ≤ 8 | --- | --- | --- | 1030 max. | --- | 19 L, 19 T | SA | --- |
| | | | | t ≤ 8 | --- | 1310 | --- | 1450 | --- | 2 L, 2 T | PH (P1450) | --- |

Note: This section continued on next page

**8.1 Stainless Steels: Plate, Sheet and Strip**

**8.1.4B Mechanical Properties of Precipitation-Hardening Stainless Steels (Continued)**

| Specification | Designation | UNS No | Steel No | Section Thickness/Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation % min | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | | | |
| GB 4237-92 | Grade 0Cr17Ni7Al | --- | --- | --- | --- | 380 max. | --- | 1030 max. | --- | 20 | ST | 190 max. HB; 92 max. HRB |
| | | | | t ≤ 3 | --- | 960 | --- | 1140 | --- | 3 | ST | --- |
| | | | | t ≤ 3 | --- | 1030 | --- | 1230 | --- | --- | ST | --- |
| | | | | t > 3 | --- | 960 | --- | 1140 | --- | 5 | ST | --- |
| | | | | t > 3 | --- | 1030 | --- | 1230 | --- | 4 | ST | --- |
| GB 4238-92 | Grade 0Cr17Ni7Al | --- | --- | --- | --- | 380 max. | --- | 1030 max. | --- | 20 | ST | 190 max. HB; 92 max. HRB |
| | | | | t ≤ 3 | --- | 960 | --- | 1140 | --- | 3 | ST | --- |
| | | | | t ≤ 3 | --- | 1030 | --- | 1230 | --- | --- | ST | --- |
| | | | | t > 3 | --- | 960 | --- | 1140 | --- | 5 | ST | --- |
| | | | | t > 3 | --- | 1030 | --- | 1230 | --- | 4 | ST | --- |
| GB 4239-91 | Grade 0Cr17Ni7Al | --- | --- | --- | --- | 380 max. | --- | 1030 max. | --- | 20 | ST | 92 max. HRB |
| | | | | t ≤ 3 | --- | 960 | --- | 1140 | --- | 3 | ST | --- |
| | | | | t ≤ 3 | --- | 1030 | --- | --- | --- | --- | ST | --- |
| | | | | t > 3 | --- | 960 | --- | 1140 | --- | 5 | ST | --- |
| | | | | t > 3 | --- | 1030 | --- | 1225, 1225 | --- | 4 | ST | --- |
| ISO 16143-1:2004 | X7CrNiAl17-7 | --- | --- | t ≤ 8 | --- | --- | --- | 1030 max. | --- | 19 | SA | --- |
| | | | | t ≤ 8 | --- | 1200 | --- | 1300 | --- | --- | PH (+P1300) | --- |
| | | | | t ≤ 8 | --- | 1310 | --- | 1450 | --- | 2 | PH (+P1450) | --- |
| JIS G 4304:2012 | Symbol SUS631 | --- | --- | --- | --- | 380 max. | --- | 1030 max. | --- | 20 | PH (S) | 192 max. HBW; 92 max. HRBW |
| | | | | t ≤ 3 | --- | 1030 | --- | 1230 | --- | --- | PH (RH950) | 40 min. HRC; 392 min. HV |
| | | | | t ≤ 3 | --- | 960 | --- | 1140 | --- | 3 | PH (TH1050) | 35 min. HRC; 345 min. HV |
| | | | | t > 3 | --- | 1030 | --- | 1230 | --- | 4 | PH (RH950) | 40 min. HRC; 392 min. HV |
| | | | | t > 3 | --- | 960 | --- | 1140 | --- | 5 | PH (TH1050) | 35 min. HRC; 345 min. HV |
| JIS G 4305:2012 | Symbol SUS631 | --- | --- | --- | --- | 380 max. | --- | 1030 max. | --- | 20 | PH (S) | 192 max. HBW; 92 max. HRBW |
| | | | | t ≤ 3 | --- | 960 | --- | 1140 | --- | 3 | PH (TH1050) | 35 min. HRC; 345 min. HV |
| | | | | t ≤ 3 | --- | 1030 | --- | 1230 | --- | --- | PH (RH950) | 40 min. HRC; 392 min. HV |
| | | | | t > 3 | --- | 960 | --- | 1140 | --- | 5 | PH (TH1050) | 35 min. HRC; 345 min. HV |
| | | | | t > 3 | --- | 1030 | --- | 1230 | --- | 4 | PH (RH950) | 40 min. HRC; 392 min. HV |

**8.1 Stainless Steels: Plates, Sheet and Strip**

**8.1.5A Chemical Composition of Duplex (Ferritic-Austenitic) Stainless Steels**

| Specification | Designation | UNS No | Steel No | Weight, %, max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| EN 10088-2:2014 | X2CrNiMoSi18-5-3 | --- | 1.4424 | 0.030 | 1.20-2.00 | 1.40-2.00 | 0.035 | 0.015 | 18.0-19.0 | 4.5-5.2 | 2.50-3.0 | N 0.05-0.10 |
| GB 3280-92 | Grade 00Cr18Ni5Mo3Si2 | --- | --- | 0.03 | 1.00-2.00 | 1.30-2.00 | 0.030 | 0.030 | 18.00-19.50 | 4.50-5.50 | 2.50-3.00 | N 0.10 |
| GB 4237-92 | Grade 00Cr18Ni5Mo3Si2 | --- | --- | 0.03 | 1.00-2.00 | 1.30-2.00 | 0.030 | 0.030 | 18.0-19.5 | 4.5-5.5 | 2.5-3.0 | N 0.10 |
| ASME SA-240/SA-240M | --- | S31803 | --- | 0.030 | 2.00 | 1.00 | 0.030 | 0.020 | 21.0-23.0 | 4.5-6.5 | 2.5-3.5 | N 0.08-0.20 |
| | Type 2205 | S32205 | --- | 0.030 | 2.00 | 1.00 | 0.030 | 0.020 | 22.0-23.0 | 4.5-6.5 | 3.0-3.5 | N 0.14-0.20 |
| ASTM A240/A240M-15a | --- | S31803 | --- | 0.030 | 2.00 | 1.00 | 0.030 | 0.020 | 21.0-23.0 | 4.5-6.5 | 2.5-3.5 | N 0.08-0.20 |
| | Type 2205 | S32205 | --- | 0.030 | 2.00 | 1.00 | 0.030 | 0.020 | 22.0-23.0 | 4.5-6.5 | 3.0-3.5 | N 0.14-0.20 |
| EN 10028-7:2007 | X2CrNiMoN22-5-3 | --- | 1.4462 | 0.030 | 2.00 | 1.00 | 0.035 | 0.015 | 21.0-23.0 | 4.5-6.5 | 2.50-3.5 | N 0.10-0.22 |
| EN 10088-2:2014 | X2CrNiMoN22-5-3 | --- | 1.4462 | 0.030 | 2.00 | 1.00 | 0.035 | 0.015 | 21.0-23.0 | 4.5-6.5 | 2.50-3.5 | N 0.10-0.22 |
| ISO 16143-1:2004 | X2CrNiMoN22-5-3 | --- | --- | 0.030 | 2.00 | 1.00 | 0.035 | 0.015 | 21.0-23.0 | 4.5-6.5 | 2.5-3.5 | N 0.10-0.22 |
| ISO 9328-7:2004 | Grade X2CrNiMoN22-5-3 | --- | --- | 0.030 | 2.00 | 1.00 | 0.035 | 0.015 | 21.0-23.0 | 4.5-6.5 | 2.5-3.5 | N 0.10-0.22 |
| JIS G 4304:2012 | Symbol SUS329J3L | --- | --- | 0.030 | 2.00 | 1.00 | 0.040 | 0.030 | 21.00-24.00 | 4.50-6.50 | 2.50-3.50 | N 0.08-0.20 |
| JIS G 4305:2012 | Symbol SUS329J3L | --- | --- | 0.030 | 2.00 | 1.00 | 0.040 | 0.030 | 21.00-24.00 | 4.50-6.50 | 2.50-3.50 | N 0.08-0.20 |
| SAE J405 JUN98 | --- | S31803 | --- | 0.030 | 2.00 | 1.00 | 0.030 | 0.020 | 21.0-23.0 | 4.50-6.50 | 2.50-3.50 | N 0.08-0.20 |
| | --- | S32205 | --- | 0.030 | 2.00 | 1.00 | 0.030 | 0.020 | 22.0-23.0 | 4.50-6.50 | 3.00-3.50 | N 0.14-0.20 |
| ASME SA-240/SA-240M | Type 2304 | S32304 | --- | 0.030 | 2.50 | 1.00 | 0.040 | 0.030 | 21.5-24.5 | 3.0-5.5 | 0.05-0.60 | Cu 0.05-0.60; N 0.05-0.20 |
| ASTM A240/A240M-15a | Type 2304 | S32304 | --- | 0.030 | 2.50 | 1.00 | 0.040 | 0.030 | 21.5-24.5 | 3.0-5.5 | 0.05-0.60 | Cu 0.05-0.60; N 0.05-0.20 |
| EN 10028-7:2007 | X2CrNiN23-4 | --- | 1.4362 | 0.030 | 2.00 | 1.00 | 0.035 | 0.015 | 22.0-24.0 | 3.5-5.5 | 0.10-0.60 | Cu 0.10-0.60; N 0.05-0.20 |
| EN 10088-2:2014 | X2CrNiN23-4 | --- | 1.4362 | 0.030 | 2.00 | 1.00 | 0.035 | 0.015 | 22.0-24.5 | 3.5-5.5 | 0.10-0.60 | Cu 0.10-0.60; N 0.05-0.20 |
| ISO 16143-1:2004 | X2CrNiN23-4 | --- | --- | 0.030 | 2.00 | 1.00 | 0.035 | 0.015 | 22.0-24.0 | 3.5-5.5 | 0.10-0.60 | Cu 0.10-0.60; N 0.05-0.20 |
| ISO 9328-7:2004 | Grade X2CrNiN23-4 | --- | --- | 0.030 | 2.00 | 1.00 | 0.035 | 0.015 | 22.0-24.0 | 3.5-5.5 | 0.10-0.60 | Cu 0.10-0.60; N 0.05-0.20 |
| SAE J405 JUN98 | --- | S32304 | --- | 0.030 | 2.50 | 1.00 | 0.040 | 0.030 | 21.5-24.5 | 3.00-5.00 | 0.05-0.60 | Cu 0.05-3.00; N 0.05-0.20 |
| ASME SA-240/SA-240M | --- | S32520 | --- | 0.030 | 1.50 | 0.80 | 0.035 | 0.020 | 24.0-26.0 | 5.5-8.0 | 3.0-4.0 | Cu 0.50-2.00; N 0.20-0.35 |
| ASTM A240/A240M-15a | --- | S32520 | --- | 0.030 | 1.50 | 0.80 | 0.035 | 0.020 | 24.0-26.0 | 5.5-8.0 | 3.0-4.0 | Cu 0.50-2.00; N 0.20-0.35 |
| EN 10028-7:2007 | X2CrNiMoCuN25-6-3 | --- | 1.4507 | 0.030 | 2.00 | 0.70 | 0.035 | 0.015 | 24.0-26.0 | 6.0-8.0 | 3.0-4.0 | Cu 1.00-2.50; N 0.20-0.30 |
| EN 10088-2:2014 | X2CrNiMoCuN25-6-3 | --- | 1.4507 | 0.030 | 2.00 | 0.70 | 0.035 | 0.015 | 24.0-26.0 | 6.0-8.0 | 3.0-4.0 | Cu 1.00-2.50; N 0.20-0.30 |
| ISO 16143-1:2004 | X2CrNiMoCuN25-6-3 | --- | --- | 0.030 | 2.00 | 0.70 | 0.035 | 0.015 | 24.0-26.0 | 5.0-7.5 | 2.5-4.0 | Cu 1.00-2.50; N 0.15-0.30 |
| ISO 9328-7:2004 | Grade X2CrNiMoCuN25-6-3 | --- | --- | 0.030 | 2.00 | 0.70 | 0.035 | 0.015 | 24.0-26.0 | 5.0-7.5 | 2.5-4.0 | Cu 1.00-2.50; N 0.15-0.30 |
| SAE J405 JUN98 | --- | S32520 | --- | 0.030 | 1.50 | 0.80 | 0.035 | 0.020 | 24.00-26.00 | 5.50-8.00 | 3.00-5.00 | Cu 0.50-3.00; N 0.20-0.35 |
| GB 4239-91 | Grade 00Cr24Ni6Mo3N | --- | --- | 0.03 | 1.50 | 1.00 | 0.040 | 0.030 | 22.00-26.00 | 4.50-7.50 | 2.50-4.00 | N 0.08-0.30 |
| JIS G 4304:2012 | Symbol SUS329J4L | --- | --- | 0.030 | 1.50 | 1.00 | 0.040 | 0.030 | 24.00-26.00 | 5.50-7.50 | 2.50-3.50 | N 0.08-0.30 |
| JIS G 4305:2012 | Symbol SUS329J4L | --- | --- | 0.030 | 1.50 | 1.00 | 0.040 | 0.030 | 24.00-26.00 | 5.50-7.50 | 2.50-3.50 | N 0.08-0.30 |

**8.1 Stainless Steels: Plates, Sheet and Strip**

**8.1.5A Chemical Composition of Duplex (Ferritic-Austenitic) Stainless Steels (Continued)**

| Specification | Designation | UNS No | Steel No | Weight, %, max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASME SA-240/SA-240M | Type 2507 | S32750 | --- | 0.030 | 1.20 | 0.80 | 0.035 | 0.020 | 24.0-26.0 | 6.0-8.0 | 3.0-5.0 | Cu 0.50; N 0.24-0.32 |
| ASTM A240/A240M-15a | Type 2507 | S32750 | --- | 0.030 | 1.20 | 0.80 | 0.035 | 0.020 | 24.0-26.0 | 6.0-8.0 | 3.0-5.0 | Cu 0.50; N 0.24-0.32; [Cr+(3.3xMo)+(16xN)] = 41 min. |
| EN 10028-7:2007 | X2CrNiMoN25-7-4 | --- | 1.4410 | 0.030 | 2.00 | 1.00 | 0.035 | 0.015 | 24.0-26.0 | 6.0-8.0 | 3.0-4.5 | N 0.24-0.35 |
| EN 10088-2:2014 | X2CrNiMoN25-7-4 | --- | 1.4410 | 0.030 | 2.00 | 1.00 | 0.035 | 0.015 | 24.0-26.0 | 6.0-8.0 | 3.0-4.5 | N 0.24-0.35 |
| ISO 16143-1:2004 | X2CrNiMoN25-7-4 | --- | --- | 0.030 | 2.00 | 1.00 | 0.035 | 0.015 | 24.0-26.0 | 6.0-8.0 | 3.0-4.5 | N 0.24-0.35 |
| ISO 9328-7:2004 | Grade X2CrNiMoN25-7-4 | --- | --- | 0.030 | 2.00 | 1.00 | 0.035 | 0.015 | 24.0-26.0 | 6.0-8.0 | 3.0-4.5 | N 0.24-0.35 |
| SAE J405 JUN98 | --- | S32750 | --- | 0.030 | 1.20 | 0.80 | 0.035 | 0.020 | 24.0-26.0 | 6.00-8.00 | 3.00-5.00 | Cu 0.50; N 0.24-0.32 |
| ASME SA-240/SA-240M | --- | S32760 | --- | 0.030 | 1.00 | 1.00 | 0.030 | 0.010 | 24.0-26.0 | 6.0-8.0 | 3.0-4.0 | [Cr+(3.3xMo)+(16xN)] = 40 min.; Cu 0.50-1.00; W 0.50-1.00; N 0.20-0.30 |
| ASTM A240/A240M-15a | --- | S32760 | --- | 0.030 | 1.00 | 1.00 | 0.030 | 0.010 | 24.0-26.0 | 6.0-8.0 | 3.0-4.0 | [Cr+(3.3xMo)+(16xN)] = 40 min; Cu 0.50-1.00; W 0.50-1.00; N 0.20-0.30 |
| EN 10028-7:2007 | X2CrNiMoCuWN25-7-4 | --- | 1.4501 | 0.030 | 1.00 | 1.00 | 0.035 | 0.015 | 24.0-26.0 | 6.0-8.0 | 3.0-4.0 | Cu 0.50-1.00; W 0.50-1.00; N 0.20-0.30 |
| EN 10088-2:2014 | X2CrNiMoCuWN25-7-4 | --- | 1.4501 | 0.030 | 1.00 | 1.00 | 0.035 | 0.015 | 24.0-26.0 | 6.0-8.0 | 3.0-4.0 | Cu 0.50-1.00; W 0.50-1.00; N 0.20-0.30 |
| ISO 16143-1:2004 | X2CrNiMoCuWN25-7-4 | --- | --- | 0.030 | 1.00 | 1.00 | 0.035 | 0.015 | 24.0-26.0 | 6.0-8.0 | 3.0-4.0 | Cu 0.50-1.00; W 0.50-1.00; N 0.20-0.30 |
| ISO 9328-7:2004 | Grade X2CrNiMoCuWN25-7-4 | --- | --- | 0.030 | 1.00 | 1.00 | 0.035 | 0.015 | 24.0-26.0 | 6.0-8.0 | 3.0-4.0 | Cu 0.50-1.00; W 0.50-1.00; N 0.20-0.30 |
| SAE J405 JUN98 | --- | S32760 | --- | 0.030 | 1.00 | 1.00 | 0.030 | 0.010 | 24.00-26.00 | 6.00-8.00 | 3.00-4.00 | [Cr+(3.3xMo)+(16xN)] 40 min.; Cu 0.50-1.00; W 0.50-1.00; N 0.20-0.30 |
| ASME SA-240/SA-240M | Type 329 | S32900 | --- | 0.08 | 1.00 | 0.75 | 0.040 | 0.030 | 23.0-28.0 | 2.0-5.00 | 1.00-2.00 | --- |
| ASTM A240/A240M-15a | Type 329 | S32900 | --- | 0.08 | 1.00 | 0.75 | 0.040 | 0.030 | 23.0-28.0 | 2.0-5.00 | 1.00-2.00 | --- |
| GB 3280-92 | Grade 0Cr26Ni5Mo2 | --- | --- | 0.08 | 1.50 | 1.00 | 0.035 | 0.030 | 23.00-28.00 | 3.00-6.00 | 1.00-3.00 | --- |
| GB 4237-92 | Grade 0Cr26Ni5Mo2 | --- | --- | 0.08 | 1.50 | 1.00 | 0.035 | 0.030 | 23.00-28.00 | 3.00-6.00 | 1.00-3.00 | --- |
| GB 4239-91 | Grade 0Cr26Ni5Mo2 | --- | --- | 0.08 | 1.50 | 1.00 | 0.035 | 0.030 | 23.00-28.00 | 3.00-6.00 | 1.00-3.00 | --- |
| JIS G 4304:2012 | Symbol SUS329J1 | --- | --- | 0.08 | 1.50 | 1.00 | 0.040 | 0.030 | 23.00-28.00 | 3.00-6.00 | 1.00-3.00 | --- |
| JIS G 4305:2012 | Symbol SUS329J1 | --- | --- | 0.08 | 1.50 | 1.00 | 0.040 | 0.030 | 23.00-28.00 | 3.00-6.00 | 1.00-3.00 | --- |
| SAE J405 JUN98 | Type 329 | S32900 | --- | 0.08 | 1.00 | 0.75 | 0.040 | 0.030 | 23.00-28.00 | 2.50-5.00 | 1.0-2.0 | --- |
| ASME SA-240/SA-240M | --- | S32906 | --- | 0.030 | 0.80-1.50 | 0.80 | 0.030 | 0.030 | 28.0-30.0 | 5.8-7.5 | 1.50-2.60 | Cu 0.80; N 0.30-0.40 |
| ASTM A240/A240M-15a | --- | S32906 | --- | 0.030 | 0.80-1.50 | 0.80 | 0.030 | 0.030 | 28.0-30.0 | 5.8-7.5 | 1.50-2.60 | Cu 0.80; N 0.30-0.40 |
| EN 10088-2:2014 | X2CrNiMoN29-7-2 | --- | 1.4477 | 0.030 | 0.80-1.50 | 0.50 | 0.030 | 0.015 | 28.0-30.0 | 5.8-7.5 | 1.50-2.60 | Cu 0.80; N 0.30-0.40 |

**8.1 Stainless Steels: Plate, Sheet and Strip**

**8.1.5B Mechanical Properties of Duplex (Ferritic-Austenitic) Stainless Steels**

| Specification | Designation | UNS No | Steel No | Section Thickness/Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation % min | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | | | |
| EN 10088-2:2014 | X2CrNiMoSi18-5-3 | --- | 1.4424 | t ≤ 8 | --- | 450 | --- | 700-900 | --- | 25 L, 25 T | SA | see standard for impact data |
| | | | | t ≤ 13.5 | --- | 450 | --- | 700-900 | --- | 25 L, 25 T | SA | |
| | | | | t ≤ 75 | --- | 400 | --- | 680-900 | --- | 25 L, 25 T | SA | |
| GB 3280-92 | Grade 00Cr18Ni5Mo3Si2 | --- | --- | --- | --- | 390 | --- | 590 | --- | 20 | ST | 30 max. HRB |
| GB 4237-92 | Grade 00Cr18Ni5Mo3Si2 | --- | --- | --- | --- | 390 | --- | 590 | --- | 20 | ST | --- |
| ASME SA-240/SA-240M | --- | S31803 | --- | --- | --- | 450 | 65 | 620 | 90 | 25 | Q+SA | 293 max. HB; 31 max. HRC |
| | Type 2205 | S32205 | --- | --- | --- | 450 | 65 | 655 | 95 | 25 | Q+SA | 293 max. HB; 31 max. HRC |
| ASTM A240/A240M-15a | --- | S31803 | --- | --- | --- | 450 | 65 | 620 | 90 | 25 | SA | 293 max. HBW; 31 max. HRC |
| | Type 2205 | S32205 | --- | --- | --- | 450 | 65 | 655 | 95 | 25 | SA | 293 max. HBW; 31 max. HRC |
| EN 10028-7:2007 | X2CrNiMoN22-5-3 | --- | 1.4462 | t ≤ 8 | --- | 485 | --- | 700-950 | --- | 20 L, 20 T | SA | see standard for impact data |
| | | | | t ≤ 13.5 | --- | 445 | --- | 700-950 | --- | 25 L, 25 T | SA | |
| | | | | t ≤ 75 | --- | 445 | --- | 640-480 | --- | 25 L, 25 T | SA | |
| EN 10088-2:2014 | X2CrNiMoN22-5-3 | --- | 1.4462 | t ≤ 8 | --- | 500 | --- | 700-950 | --- | 20 L, 20 T | SA | --- |
| | | | | t ≤ 13.5 | --- | 460 | --- | 700-950 | --- | 25 L, 25 T | SA | see standard for impact data |
| | | | | t ≤ 75 | --- | 460 | --- | 640-840 | --- | 25 L, 25 T | SA | |
| ISO 16143-1:2004 | X2CrNiMoN22-5-3 | --- | --- | t ≤ 6 | --- | 480 | --- | 660 | --- | 20 L, 20 T | SA | --- |
| | | | | t ≤ 12 | --- | 460 | --- | 660 | --- | 20 L, 20 T | SA | --- |
| | | | | t ≤ 75 | --- | 460 | --- | 640 | --- | 20 L, 20 T | SA | --- |
| ISO 9328-7:2004 | Grade X2CrNiMoN22-5-3 | --- | --- | t ≤ 6 | --- | 465 | --- | 660-950 | --- | 20 L, 20 T | SA | --- |
| | | | | t ≤ 12 | --- | 445 | --- | 660-950 | --- | 25 L, 25 T | SA | see standard for impact data |
| | | | | t ≤ 75 | --- | 445 | --- | 640-840 | --- | 25 L, 25 T | SA | |
| JIS G 4304:2012 | Symbol SUS329J3L | --- | --- | --- | --- | 450 | --- | 620 | --- | 18 | ST | 302 max. HBW; 32 max. HRC; 320 max. HV |
| JIS G 4305:2012 | Symbol SUS329J3L | --- | --- | --- | --- | 450 | --- | 620 | --- | 18 | ST | 302 max. HBW; 32 max. HRC; 320 max. HV |

**8.1 Stainless Steels: Plate, Sheet and Strip**

**8.1.5B Mechanical Properties of Duplex (Ferritic-Austenitic) Stainless Steels (Continued)**

| Specification | Designation | UNS No | Steel No | Section Thickness/Diameter mm | Section Thickness/Diameter in. | Yield Strength, min. MPa | Yield Strength, min. ksi | Tensile Strength, min. MPa | Tensile Strength, min. ksi | Elongation % min | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ASME SA-240/SA-240M | Type 2304 | S32304 | --- | --- | --- | 400 | 58 | 600 | 87 | 25 | Q+SA | 290 max. HB; 32 max. HRC |
| ASTM A240/A240M-15a | Type 2304 | S32304 | --- | --- | --- | 400 | 58 | 600 | 87 | 25 | SA | 290 max. HBW; 32 max. HRC |
| EN 10028-7:2007 | X2CrNiN23-4 | --- | 1.4362 | t ≤ 8 | --- | 405 | --- | 600-850 | --- | 20 L, 20 T | SA | see standard for impact data |
| | | | | t ≤ 13.5 | --- | 385 | --- | 600-850 | --- | 20 L, 20 T | SA | |
| | | | | t ≤ 75 | --- | 385 | --- | 630-800 | --- | 25 L, 25 T | SA | |
| EN 10088-2:2014 | X2CrNiN23-4 | --- | 1.4362 | t ≤ 8 | --- | 450 | --- | 650-850 | --- | 20 L, 20 T | SA | --- |
| | | | | t ≤ 13.5 | --- | 400 | --- | 650-850 | --- | 20 L, 20 T | SA | see standard for impact data |
| | | | | t ≤ 75 | --- | 400 | --- | 630-800 | --- | 25 L, 25 T | SA | |
| ISO 16143-1:2004 | X2CrNiN23-4 | --- | --- | t ≤ 6 | --- | 420 | --- | 600 | --- | 20 L, 20 T | SA | --- |
| | | | | t ≤ 12 | --- | 400 | --- | 600 | --- | 20 L, 20 T | SA | --- |
| | | | | t ≤ 75 | --- | 400 | --- | 630 | --- | 25 L, 25 T | SA | --- |
| ISO 9328-7:2004 | Grade X2CrNiN23-4 | --- | --- | t ≤ 6 | --- | 405 | --- | 600-850 | --- | 20 L, 20 T | SA | --- |
| | | | | t ≤ 12 | --- | 385 | --- | 600-850 | --- | 20 L, 20 T | SA | see standard for impact data |
| | | | | t ≤ 75 | --- | 385 | --- | 630-800 | --- | 25 L, 25 T | SA | |
| ASME SA-240/SA-240M | --- | S32520 | --- | --- | --- | 550 | 80 | 770 | 112 | 25 | Q+SA | 310 max. HB |
| ASTM A240/A240M-15a | --- | S32520 | --- | --- | --- | 550 | 80 | 770 | 112 | 25 | SA | 310 max. HBW; 32 max. HRC |
| EN 10028-7:2007 | X2CrNiMoCuN25-6-3 | --- | 1.4507 | t ≤ 8 | --- | 495 | --- | 690-940 | --- | 20 L, 20 T | SA | see standard for impact data |
| | | | | t ≤ 13.5 | --- | 475 | --- | 690-940 | --- | 20 L, 20 T | SA | |
| | | | | t ≤ 75 | --- | 475 | --- | 690-890 | --- | 25 L, 25 T | SA | |
| EN 10088-2:2014 | X2CrNiMoCuN25-6-3 | --- | 1.4507 | t ≤ 8 | --- | 550 | --- | 750-1000 | --- | 20 L, 20 T | SA | --- |
| | | | | t ≤ 13.5 | --- | 530 | --- | 750-1000 | --- | 20 L, 20 T | SA | see standard for impact data |
| | | | | t ≤ 75 | --- | 530 | --- | 730-930 | --- | 25 L, 25 T | SA | |
| ISO 16143-1:2004 | X2CrNiMoCuN25-6-3 | --- | --- | t ≤ 8 | --- | 550 | --- | 750 | --- | 17 L, 17 T | SA | --- |
| | | | | t ≤ 13.5 | --- | 530 | --- | 750 | --- | 17 L, 17 T | SA | --- |
| | | | | t ≤ 75 | --- | 530 | --- | 730 | --- | 25 L, 25 T | SA | --- |
| ISO 9328-7:2004 | Grade X2CrNiMoCuN25-6-3 | --- | --- | t ≤ 6 | --- | 495 | --- | 690-940 | --- | 20 L, 20 T | SA | --- |
| | | | | t ≤ 12 | --- | 475 | --- | 690-940 | --- | 20 L, 20 T | SA | see standard for impact data |
| | | | | t ≤ 75 | --- | 475 | --- | 690-890 | --- | 25 L, 25 T | SA | |

**8.1 Stainless Steels: Plate, Sheet and Strip**

**8.1.5B Mechanical Properties of Duplex (Ferritic-Austenitic) Stainless Steels (Continued)**

| Specification | Designation | UNS No | Steel No | Section Thickness/Diameter mm | Section Thickness/Diameter in. | Yield Strength, min. MPa | Yield Strength, min. ksi | Tensile Strength, min. MPa | Tensile Strength, min. ksi | Elongation % min | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GB 4239-91 | Grade 00Cr24Ni6Mo3N | --- | --- | --- | --- | 450 | --- | 620 | --- | 18 | ST | --- |
| JIS G 4304:2012 | Symbol SUS329J4L | --- | --- | --- | --- | 450 | --- | 620 | --- | 18 | ST | 302 max. HBW; 32 max. HRC; 320 max. HV |
| JIS G 4305:2012 | Symbol SUS329J4L | --- | --- | --- | --- | 450 | --- | 620 | --- | 18 | ST | 302 max. HBW; 32 max. HRC; 320 max. HV |
| ASME SA-240/SA-240M | Type 2507 | S32750 | --- | --- | --- | 550 | 80 | 795 | 116 | 15 | Q+SA | 310 max. HB; 32 max. HRC |
| ASTM A240/A240M-15a | Type 2507 | S32750 | --- | --- | --- | 550 | 80 | 795 | 116 | 15 | SA | 310 max. HBW; 32 max. HRC |
| EN 10028-7:2007 | X2CrNiMoN25-7-4 | --- | 1.4410 | t ≤ 8 | --- | 535 | --- | 750-1000 | --- | 20 L, 20 T | SA | see standard for impact data |
| | | | | t ≤ 13.5 | --- | 515 | --- | 750-1000 | --- | 20 L, 20 T | SA | |
| | | | | t ≤ 75 | --- | 515 | --- | 730-930 | --- | 20 L, 20 T | SA | |
| EN 10088-2:2014 | X2CrNiMoN25-7-4 | --- | 1.4410 | t ≤ 8 | --- | 550 | --- | 750-1000 | --- | 20 L, 20 T | SA | --- |
| | | | | t ≤ 13.5 | --- | 530 | --- | 750-1000 | --- | 20 L, 20 T | SA | see standard for impact data |
| | | | | t ≤ 75 | --- | 530 | --- | 730-930 | --- | 20 L, 20 T | SA | |
| ISO 16143-1:2004 | X2CrNiMoN25-7-4 | --- | --- | t ≤ 6 | --- | 550 | --- | 750 | --- | 15 L, 15 T | SA | --- |
| | | | | t ≤ 12 | --- | 530 | --- | 750 | --- | 15 L, 15 T | SA | --- |
| | | | | t ≤ 75 | --- | 530 | --- | 730 | --- | 20 L, 20 T | SA | --- |
| ISO 9328-7:2004 | Grade X2CrNiMoN25-7-4 | --- | --- | t ≤ 6 | --- | 535 | --- | 750-1000 | --- | 20 L, 20 T | SA | --- |
| | | | | t ≤ 12 | --- | 515 | --- | 750-1000 | --- | 20 L, 20 T | SA | see standard for impact data |
| | | | | t ≤ 75 | --- | 515 | --- | 730-930 | --- | 20 L, 20 T | SA | |
| ASME SA-240/SA-240M | --- | S32760 | --- | --- | --- | 550 | 80 | 750 | 108 | 25 | Q+SA | 270 max. HB |
| ASTM A240/A240M-15a | --- | S32760 | --- | --- | --- | 550 | 80 | 750 | 108 | 25 | SA | 270 max. HBW; 28 max. HRC |
| EN 10028-7:2007 | X2CrNiMoCuWN25-7-4 | --- | 1.4501 | t ≤ 75 | --- | 515 | --- | 730-930 | --- | 25 L, 25 T | SA | see standard for impact data |
| EN 10088-2:2014 | X2CrNiMoCuWN25-7-4 | --- | 1.4501 | t ≤ 75 | --- | 530 | --- | 730-930 | --- | 25 L, 25 T | SA | see standard for impact data |
| ISO 16143-1:2004 | X2CrNiMoCuWN25-7-4 | --- | --- | t ≤ 75 | --- | 530 | --- | 730 | --- | 25 L, 25 T | SA | --- |
| ISO 9328-7:2004 | Grade X2CrNiMoCuWN25-7-4 | --- | --- | t ≤ 75 | --- | 515 | --- | 730-930 | --- | 25 L, 25 T | SA | see standard for impact data |

**8.1 Stainless Steels: Plate, Sheet and Strip**

**8.1.5B Mechanical Properties of Duplex (Ferritic-Austenitic) Stainless Steels (Continued)**

| Specification | Designation | UNS No | Steel No | Section Thickness/Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation % min | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | | | |
| ASME SA-240/SA-240M | Type 329 | S32900 | --- | --- | --- | 485 | 70 | 620 | 90 | 15 | Q+SA | 269 max. HB; 28 max. HRC |
| ASTM A240/A240M-15a | Type 329 | S32900 | --- | --- | --- | 485 | 70 | 620 | 90 | 15 | SA | 269 max. HBW; 28 max. HRC |
| GB 3280-92 | Grade 0Cr26Ni5Mo2 | --- | --- | --- | --- | 390 | --- | 590 | --- | 18 | ST | 277 max. HB; 29 max. HRB |
| GB 4237-92 | Grade 0Cr26Ni5Mo2 | --- | --- | --- | --- | 390 | --- | 590 | --- | 18 | ST | 277 max. HB |
| GB 4239-91 | Grade 0Cr26Ni5Mo2 | --- | --- | --- | --- | 390 | --- | 590 | --- | 18 | ST | --- |
| JIS G 4304:2012 | Symbol SUS329J1 | --- | --- | --- | --- | 390 | --- | 590 | --- | 18 | ST | 277 max. HBW; 29 max. HRC; 292 max. HV |
| JIS G 4305:2012 | Symbol SUS329J1 | --- | --- | --- | --- | 390 | --- | 590 | --- | 18 | ST | 277 max. HBW; 29 max. HRC; 292 max. HV |
| ASME SA-240/SA-240M | --- | S32906 | --- | t < 10.0 | t < 0.4 | 650 | 94 | 800 | 166 | 25.0 | Q+SA | 310 max. HB; 32 max. HRC |
| | | | | t ≥ 10.0 | t ≥ 0.4 | 550 | 80 | 750 | 109 | 25.0 | Q+SA | 310 max. HB; 32 max. HRC |
| ASTM A240/A240M-15a | --- | S32906 | --- | t < 10.0 | t < 0.4 | 650 | 94 | 800 | 166 | 25.0 | SA | 310 max. HBW; 32 max. HRC |
| | | | | t ≥ 10.0 | t ≥ 0.4 | 550 | 80 | 750 | 109 | 25.0 | SA | 310 max. HBW; 32 max. HRC |
| EN 10088-2:2014 | X2CrNiMoN29-7-2 | --- | 1.4477 | t ≤ 8 | --- | 650 | --- | 800-1050 | --- | 20 L, 20 T | SA | --- |
| | | | | t ≤ 13.5 | --- | 550 | --- | 750-1000 | --- | 20 L, 20 T | SA | see standard for impact data |
| | | | | t ≤ 75 | --- | 550 | --- | 750-1000 | --- | 20 L, 20 T | SA | |

**8.2 Stainless Steels: Bar**

**8.2.1A Chemical Composition of Martensitic Stainless Steels**

| Specification | Designation | UNS No | Steel No | Weight, %, max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASME SA-276 | Type 403 | S40300 | --- | 0.15 | 1.00 | 0.50 | 0.040 | 0.030 | 11.50-13.00 | --- | --- | --- |
| ASME SA-479/SA-479M | Type 403 | S40300 | --- | 0.15 | 1.00 | 0.50 | 0.040 | 0.030 | 11.5-13.0 | --- | --- | --- |
| ASTM A276/A276M-15 | Type 403 | S40300 | --- | 0.15 | 1.00 | 0.50 | 0.040 | 0.030 | 11.5-13.0 | --- | --- | --- |
| ASTM A479/A479M-14 | Type 403 | S40300 | --- | 0.15 | 1.00 | 0.50 | 0.040 | 0.030 | 11.5-13.0 | --- | --- | --- |
| GB 1220-92 | Grade 1Cr12 | --- | --- | 0.15 | 1.00 | 0.50 | 0.035 | 0.030 | 11.50-13.00 | 0.60 | --- | --- |
| GB 4226-84 | Grade 1Cr12 | --- | --- | 0.15 | 1.00 | 0.50 | 0.035 | 0.030 | 11.50-13.00 | 0.60 | --- | --- |
| JIS G 4303:2012 | Symbol SUS403 | --- | --- | 0.15 | 1.00 | 0.50 | 0.040 | 0.030 | 11.50-13.00 | 0.60 | --- | --- |
| JIS G 4318:1998 A1:2007 | Symbol SUS403 | --- | --- | 0.15 | 1.00 | 0.50 | 0.040 | 0.030 | 11.50-13.00 | 0.60 | --- | --- |
| ASME SA-240/SA-240M | Type 410 | S41000 | --- | 0.08-0.15 | 1.00 | 1.00 | 0.040 | 0.030 | 11.5-13.5 | 0.75 | --- | --- |
| ASME SA-276 | Type 410 | S41000 | --- | 0.15 | 1.00 | 1.00 | 0.040 | 0.030 | 11.50-13.50 | --- | --- | --- |
| ASME SA-479/SA-479M | Type 410 | S41000 | --- | 0.15 | 1.00 | 1.00 | 0.040 | 0.030 | 11.5-13.5 | --- | --- | --- |
| ASTM A240/A240M-15a | Type 410 | S41000 | --- | 0.08-0.15 | 1.00 | 1.00 | 0.040 | 0.030 | 11.5-13.5 | 0.75 | --- | --- |
| ASTM A276/A276M-15 | Type 410 | S41000 | --- | 0.08-0.15 | 1.00 | 1.00 | 0.040 | 0.030 | 11.5-13.5 | --- | --- | --- |
| ASTM A479/A479M-14 | Type 410 | S41000 | --- | 0.15 | 1.00 | 1.00 | 0.040 | 0.030 | 11.5-13.5 | --- | --- | --- |
| EN 10088-3:2014 | X12Cr13 | --- | 1.4006 | 0.08-0.15 | 1.50 | 1.00 | 0.040 | 0.030 | 11.5-13.5 | 0.75 | --- | --- |
| EN 10263-5:2001 | X12Cr13 | --- | 1.4006 | 0.08-0.15 | 1.50 | 1.00 | 0.040 | 0.030 | 11.50-13.50 | 0.75 | --- | --- |
| GB 1220-92 | Grade 1Cr13 | --- | --- | 0.15 | 1.00 | 1.00 | 0.035 | 0.030 | 11.50-13.50 | 0.60 | --- | --- |
| GB 1221-92 | Grade 1Cr13 | --- | --- | 0.15 | 1.00 | 1.00 | 0.035 | 0.030 | 11.50-13.50 | 0.60 | --- | --- |
| GB 4226-84 | Grade 1Cr13 | --- | --- | 0.15 | 1.00 | 1.00 | 0.035 | 0.030 | 11.50-13.50 | 0.60 | --- | --- |
| ISO 4954:1993 | Type X 12 Cr 13 E | --- | --- | 0.09-0.15 | 1.00 | 1.00 | 0.040 | 0.030 | 11.5-13.5 | 1.0 | --- | --- |
| JIS G 4303:2012 | Symbol SUS410 | --- | --- | 0.15 | 1.00 | 1.00 | 0.040 | 0.030 | 11.50-13.50 | 0.60 | --- | --- |
| JIS G 4318:1998 A1:2007 | Symbol SUS410 | --- | --- | 0.15 | 1.00 | 1.00 | 0.040 | 0.030 | 11.50-13.50 | 0.60 | --- | --- |
| GB 1220-92 | Grade 1Cr13Mo | --- | --- | 0.08-0.18 | 1.00 | 0.60 | 0.035 | 0.030 | 11.50-14.00 | 0.60 | 0.30-0.60 | --- |
| GB 1221-92 | Grade 1Cr13Mo | --- | --- | 0.08-0.18 | 1.00 | 0.60 | 0.035 | 0.030 | 11.50-14.00 | 0.60 | --- | Cu 0.30 |
| JIS G 4303:2012 | Symbol SUS410J1 | --- | --- | 0.08-0.18 | 1.00 | 0.60 | 0.040 | 0.030 | 11.50-14.00 | 0.60 | 0.30-0.60 | --- |
| ASTM A582/A582M-12e1 | Type 416 | S41600 | --- | 0.15 | 1.25 | 1.00 | 0.06 | 0.15 min. | 12.0-14.0 | --- | --- | --- |
| GB 1220-92 | Grade Y1Cr13 | --- | --- | 0.15 | 1.25 | 1.00 | 0.060 | 0.15 min. | 12.00-14.00 | 0.60 | 0.60 | --- |
| GB 4226-84 | Grade Y1Cr13 | --- | --- | 0.15 | 1.25 | 1.00 | 0.060 | 0.15 | 12.00-14.00 | 0.60 | 0.60 | --- |
| JIS G 4303:2012 | Symbol SUS416 | --- | --- | 0.15 | 1.25 | 1.00 | 0.060 | 0.15 min. | 12.00-14.00 | 0.60 | 0.60 | --- |
| JIS G 4318:1998 A1:2007 | Symbol SUS416 | --- | --- | 0.15 | 1.25 | 1.00 | 0.060 | 0.15 min. | 12.00-14.00 | 0.60 | 0.60 | --- |
| EN 10088-3:2014 | X12CrS13 | --- | 1.4005 | 0.06-0.15 | 1.50 | 1.00 | 0.040 | 0.15-0.35 | 12.0-14.0 | --- | 0.60 | --- |

**8.2 Stainless Steels: Bar**

**8.2.1A Chemical Composition of Martensitic Stainless Steels (Continued)**

| Specification | Designation | UNS No | Steel No | Weight, %, max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASME SA-276 | Type 420 | S42000 | --- | 0.15 min. | 1.00 | 1.00 | 0.040 | 0.030 | 12.00-14.00 | --- | --- | --- |
| ASTM A276/A276M-15 | Type 420 | S42000 | --- | 0.15 min. | 1.00 | 1.00 | 0.040 | 0.030 | 12.0-14.0 | --- | --- | --- |
| EN 10088-3:2014 | X20Cr13 | --- | 1.4021 | 0.16-0.25 | 1.50 | 1.00 | 0.040 | 0.030 | 12.0-14.0 | --- | --- | --- |
| GB 1220-92 | Grade 2Cr13 | --- | --- | 0.16-0.25 | 1.00 | 1.00 | 0.035 | 0.030 | 12.00-14.00 | 0.60 | --- | --- |
| GB 1221-92 | Grade 2Cr13 | --- | --- | 0.16-0.25 | 1.00 | 1.00 | 0.035 | 0.030 | 12.00-14.00 | 0.60 | --- | --- |
| GB 4226-84 | Grade 2Cr13 | --- | --- | 0.16-1.25 | 1.00 | 1.00 | 0.035 | 0.030 | 12.00-14.00 | 0.60 | --- | --- |
| JIS G 4303:2012 | Symbol SUS420J1 | --- | --- | 0.16-0.25 | 1.00 | 1.00 | 0.040 | 0.030 | 12.00-14.00 | 0.60 | --- | --- |
| JIS G 4318:1998 A1:2007 | Symbol SUS420J1 | --- | --- | 0.16-0.25 | 1.00 | 1.00 | 0.040 | 0.030 | 12.00-14.00 | 0.60 | --- | --- |
| ASTM A582/A582M-12e1 | Type 420F | S42020 | --- | 0.30-0.40 | 1.25 | 1.00 | 0.06 | 0.15 min. | 12.0-14.0 | 0.50 | --- | Cu 0.60 |
| EN 10088-3:2014 | X30Cr13 | --- | 1.4028 | 0.26-0.35 | 1.50 | 1.00 | 0.040 | 0.030 | 12.0-14.0 | --- | --- | --- |
| GB 1220-92 | Grade 3Cr13 | --- | --- | 0.26-0.35 | 1.00 | 1.00 | 0.035 | 0.030 | 12.00-14.00 | 0.60 | --- | --- |
| GB 4226-84 | Grade 3Cr13 | --- | --- | 0.26-0.40 | 1.00 | 1.00 | 0.035 | 0.030 | 12.00-14.00 | 0.60 | --- | --- |
| JIS G 4303:2012 | Symbol SUS420J2 | --- | --- | 0.26-0.40 | 1.00 | 1.00 | 0.040 | 0.030 | 12.00-14.00 | 0.60 | --- | --- |
| JIS G 4318:1998 A1:2007 | Symbol SUS420J2 | --- | --- | 0.26-0.40 | 1.00 | 1.00 | 0.040 | 0.030 | 12.00-14.00 | 0.60 | --- | --- |
| EN 10088-3:2014 | X29CrS13 | --- | 1.4029 | 0.25-0.32 | 1.50 | 1.00 | 0.040 | 0.15-0.25 | 12.0-13.5 | --- | 0.60 | --- |
| GB 1220-92 | Grade Y3Cr13 | --- | --- | 0.26-0.40 | 1.25 | 1.00 | 0.060 | 0.15 min. | 12.00-14.00 | 0.60 | 0.60 | --- |
| GB 4226-84 | Grade Y3Cr13 | --- | --- | 0.26-0.40 | 1.25 | 1.00 | 0.060 | 0.15 min. | 12.00-14.00 | 0.60 | 0.60 | --- |
| JIS G 4303:2012 | Symbol SUS420F | --- | --- | 0.26-0.40 | 1.25 | 1.00 | 0.060 | 0.15 min. | 12.00-14.00 | 0.60 | 0.60 | --- |
| JIS G 4318:1998 A1:2007 | Symbol SUS420F | --- | --- | 0.26-0.40 | 1.25 | 1.00 | 0.060 | 0.15 min. | 12.00-14.00 | 0.60 | 0.60 | --- |
| ASME SA-276 | Type 431 | S43100 | --- | 0.20 | 1.00 | 1.00 | 0.040 | 0.030 | 15.00-17.00 | 1.25-2.50 | --- | --- |
| ASME SA-479/SA-479M | Type 431 | S43100 | --- | 0.20 | 1.00 | 1.00 | 0.040 | 0.030 | 15.0-17.0 | 1.25-2.50 | --- | --- |
| ASTM A276/A276M-15 | Type 431 | S43100 | --- | 0.20 | 1.00 | 1.00 | 0.040 | 0.030 | 15.0-17.0 | 1.25-2.50 | --- | --- |
| ASTM A479/A479M-14 | Type 431 | S43100 | --- | 0.20 | 1.00 | 1.00 | 0.040 | 0.030 | 15.0-17.0 | 1.25-2.50 | --- | --- |
| EN 10088-3:2014 | X17CrNi16-2 | --- | 1.4057 | 0.12-0.22 | 1.50 | 1.00 | 0.040 | 0.030 | 15.0-17.0 | 1.50-2.50 | --- | --- |
| ISO 4954:1993 | Type X 19 CrNi 16 2 E | --- | --- | 0.14-0.23 | 1.00 | 1.00 | 0.040 | 0.030 | 15.0-17.5 | 1.5-2.5 | --- | --- |
| JIS G 4303:2012 | Symbol SUS431 | --- | --- | 0.20 | 1.00 | 1.00 | 0.040 | 0.030 | 15.00-17.00 | 1.25-2.50 | --- | --- |
| ASME SA-276 | Type 440A | S44002 | --- | 0.60-0.75 | 1.00 | 1.00 | 0.040 | 0.030 | 16.00-18.00 | --- | 0.75 | --- |
| ASTM A276/A276M-15 | Type 440A | S44002 | --- | 0.60-0.75 | 1.00 | 1.00 | 0.040 | 0.030 | 16.0-18.0 | --- | 0.75 | --- |
| EN 10088-3:2014 | X70CrMo15 | --- | 1.4109 | 0.60-0.75 | 1.00 | 0.70 | 0.040 | 0.030 | 14.0-16.0 | --- | 0.40-0.80 | --- |
| GB 1220-92 | Grade 7Cr17 | --- | --- | 0.60-0.75 | 1.00 | 1.00 | 0.035 | 0.030 | 16.00-18.00 | 0.60 | 0.75 | --- |
| JIS G 4303:2012 | Symbol SUS440A | --- | --- | 0.60-0.75 | 1.00 | 1.00 | 0.040 | 0.030 | 16.00-18.00 | 0.60 | 0.75 | --- |
| ASME SA-276 | Type 440B | S44003 | --- | 0.75-0.95 | 1.00 | 1.00 | 0.040 | 0.030 | 16.00-18.00 | --- | 0.75 | --- |
| ASTM A276/A276M-15 | Type 440B | S44003 | --- | 0.75-0.95 | 1.00 | 1.00 | 0.040 | 0.030 | 16.0-18.0 | --- | 0.75 | --- |
| GB 1220-92 | Grade 8Cr17 | --- | --- | 0.75-0.95 | 1.00 | 1.00 | 0.035 | 0.030 | 16.00-18.00 | 0.60 | 0.75 | --- |
| JIS G 4303:2012 | Symbol SUS440B | --- | --- | 0.75-0.95 | 1.00 | 1.00 | 0.040 | 0.030 | 16.00-18.00 | 0.60 | 0.75 | --- |

**8.2 Stainless Steels: Bar**

**8.2.1A Chemical Composition of Martensitic Stainless Steels (Continued)**

| Specification | Designation | UNS No | Steel No | Weight, %, max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASME SA-276 | Type 440C | S44004 | --- | 0.95-1.20 | 1.00 | 1.00 | 0.040 | 0.030 | 16.00-18.00 | --- | 0.75 | --- |
| ASTM A276/A276M-15 | Type 440C | S44004 | --- | 0.95-1.20 | 1.00 | 1.00 | 0.040 | 0.030 | 16.0-18.0 | --- | 0.75 | --- |
| GB 1220-92 | Grade 11Cr17 | --- | --- | 0.95-1.20 | 1.00 | 1.00 | 0.035 | 0.030 | 16.00-18.00 | 0.60 | 0.75 | --- |
| GB 4226-84 | Grade 11Cr17 | --- | --- | 0.95-1.20 | 1.00 | 1.00 | 0.035 | 0.030 | 16.00-18.00 | 0.60 | 0.75 | --- |
| JIS G 4303:2012 | Symbol SUS440C | --- | --- | 0.95-1.20 | 1.00 | 1.00 | 0.040 | 0.030 | 16.00-18.00 | 0.60 | 0.75 | --- |
| JIS G 4318:1998 A1:2007 | Symbol SUS440C | --- | --- | 0.95-1.20 | 1.00 | 1.00 | 0.040 | 0.030 | 16.00-18.00 | 0.60 | 0.75 | --- |
| EN 10088-3:2014 | X105CrMo17 | --- | 1.4125 | 0.95-1.20 | 1.00 | 1.00 | 0.040 | 0.030 | 16.0-18.0 | --- | 0.40-0.80 | --- |
| ASTM A565/A565M-10 | Grade XM-32 | S64152 | --- | 0.08-0.15 | 0.50-0.90 | 0.35 | 0.025 | 0.025 | 11.00-12.50 | 2.00-3.00 | 1.50-2.00 | V 0.25-0.40; N 0.01-0.05 |
| EN 10269:2013 | X12CrNiMoV12-3 | --- | 1.4938 | 0.08-0.15 | 0.40-0.90 | 0.50 | 0.025 | 0.015 | 11.0-12.5 | 2.00-3.00 | 1.50-2.00 | V 0.25-0.40; N 0.020-0.040 |
| EN 10302:2008 | X12CrNiMoV12-3 | --- | 1.4938 | 0.08-0.15 | 0.40-0.90 | 0.50 | 0.025 | 0.015 | 11.0-12.5 | 2.00-3.00 | 1.50-2.00 | V 0.25-0.40; N 0.020-0.040 |
| EN 10269:2013 | X19CrMoNbVN11-1 | --- | 1.4913 | 0.17-0.23 | 0.40-0.90 | 0.50 | 0.025 | 0.015 | 10.0-11.5 | 0.20-0.60 | 0.50-0.80 | V 0.10-0.30; Nb 0.25-0.55; N 0.05-0.10; Al 0.020; B 0.0015 |
| GB 1221-92 | Grade 2Cr12MoVNbN | --- | --- | 0.15-0.20 | 0.50-1.00 | 0.50 | 0.035 | 0.030 | 10.00-13.00 | 0.60 | 0.30-0.90 | V 0.10-0.40; Nb 0.20-0.60; N 0.05-0.10 |
| JIS G 4311:2011 | Symbol SUH600 | --- | --- | 0.15-0.20 | 0.50-1.00 | 0.50 | 0.040 | 0.030 | 10.00-13.00 | 0.60 | 0.30-0.90 | V 0.10-0.40; Nb 0.20-0.60; N 0.05-0.10; Cu 0.30 |
| ASTM A565/A565M-10 | Grade 616 | S42200 | --- | 0.20-0.25 | 0.50-1.00 | 0.50 | 0.025 | 0.025 | 11.00-12.50 | 0.50-1.00 | 0.90-1.25 | V 0.20-0.30; W 0.90-1.25 |
| GB 1221-92 | Grade 2Cr12NiMoWV | --- | --- | 0.20-0.25 | 0.50-1.00 | 0.50 | 0.035 | 0.030 | 11.00-13.00 | 0.50-1.00 | 0.75-1.25 | V 0.20-0.40; W 0.70-1.25 |
| JIS G 4311:2011 | Symbol SUH616 | --- | --- | 0.20-0.25 | 0.50-1.00 | 0.50 | 0.040 | 0.030 | 11.00-13.00 | 0.50-1.00 | 0.75-1.25 | V 0.20-0.30; Cu 0.30; W 0.75-1.25 |
| ASME SA-276 | --- | S41500 | --- | 0.05 | 0.50-1.00 | 0.60 | 0.030 | 0.030 | 11.50-14.00 | 3.50-5.50 | 0.50-1.00 | --- |
| ASME SA-479/SA-479M | --- | S41500 | --- | 0.05 | 0.50-1.00 | 0.60 | 0.030 | 0.030 | 11.5-14.0 | 3.5-5.5 | 0.50-1.00 | --- |
| ASTM A276/A276M-15 | --- | S41500 | --- | 0.05 | 0.50-1.00 | 0.60 | 0.030 | 0.030 | 11.5-14.0 | 3.5-5.5 | 0.50-1.00 | --- |
| ASTM A479/A479M-14 | --- | S41500 | --- | 0.05 | 0.50-1.00 | 0.60 | 0.030 | 0.030 | 11.5-14.0 | 3.5-5.5 | 0.50-1.00 | --- |
| EN 10088-3:2014 | X3CrNiMo13-4 | --- | 1.4313 | 0.05 | 1.50 | 0.70 | 0.040 | 0.015 | 12.0-14.0 | 3.5-4.5 | 0.30-0.70 | N 0.020 min. |
| ISO 16143-2:2004 | X3CrNiMo13-4 | --- | --- | 0.05 | 0.50-1.00 | 0.70 | 0.040 | 0.015 | 12.0-14.0 | 3.5-4.5 | 0.30-1.00 | --- |
| EN 10088-3:2014 | X39Cr13 | --- | 1.4031 | 0.36-0.42 | 1.00 | 1.00 | 0.040 | 0.030 | 12.5-14.5 | --- | --- | --- |
| GB 1220-92 | Grade 4Cr13 | --- | --- | 0.36-0.45 | 0.80 | 0.60 | 0.035 | 0.030 | 12.00-14.00 | 0.60 | --- | --- |
| ASTM A582/A582M-12e1 | Type 440F | S44020 | --- | 0.95-1.20 | 1.25 | 1.00 | 0.06 | 0.15 min. | 16.0-18.0 | 0.50 | --- | Cu 0.60 |
| GB 1220-92 | Grade Y11Cr17 | --- | --- | 0.95-1.20 | 1.25 | 1.00 | 0.060 | 0.15 min. | 16.00-18.00 | 0.60 | 0.75 | --- |
| JIS G 4303:2012 | Symbol SUS440F | --- | --- | 0.95-1.20 | 1.25 | 1.00 | 0.060 | 0.15 min. | 16.00-18.00 | 0.60 | 0.75 | --- |
| EN 10088-3:2014 | X90CrMoV18 | --- | 1.4112 | 0.85-0.95 | 1.00 | 1.00 | 0.040 | 0.030 | 17.0-19.0 | --- | 0.90-1.30 | V 0.07-0.12 |
| GB 1220-92 | Grade 9Cr18MoV | --- | --- | 0.85-0.95 | 0.80 | 0.80 | 0.035 | 0.030 | 17.00-19.00 | 0.60 | 1.00-1.30 | V 0.07-0.12 |
| GB 1221-92 | Grade 8Cr20Si2Ni | --- | --- | 0.75-0.85 | 0.20-0.60 | 1.75-2.25 | 0.030 | 0.030 | 19.00-20.50 | 1.15-1.65 | --- | --- |
| JIS G 4311:2011 | Symbol SUH4 | --- | --- | 0.75-0.85 | 0.20-0.60 | 1.75-2.25 | 0.030 | 0.030 | 19.00-20.50 | 1.15-1.65 | --- | Cu 0.30 |

**8.2 Stainless Steels: Bar**

**8.2.1B Mechanical Properties of Martensitic Stainless Steels**

| Specification | Designation | UNS No | Steel No | Section Thickness/Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation % min | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | | | |
| ASME SA-276 | Type 403 | S40300 | --- | --- | --- | 275 | 40 | 480 | 70 | 20 | A and HF | --- |
| | | | | --- | --- | 275 | 40 | 480 | 70 | 16 | A and CF | --- |
| | | | | --- | --- | 550 | 80 | 690 | 100 | 15 | H+T and HF | --- |
| | | | | --- | --- | 550 | 80 | 690 | 100 | 12 | H+T and CF | --- |
| | | | | --- | --- | 620 | 90 | 830 | 120 | 12 | H+T and HF | --- |
| | | | | --- | --- | 620 | 90 | 830 | 120 | 12 | H+T and CF | --- |
| ASME SA-479/SA-479M | Type 403 | S40300 | --- | --- | --- | 275 | 40 | 485 | 70 | 20 | A | 223 max. HB |
| | | | | --- | --- | 275 | 40 | 485 | 70 | 20 | T | 223 max. HB |
| | | | | --- | --- | 585 | 85 | 760 | 110 | 15 | T | 269 max. HB |
| | | | | --- | --- | 690 | 100 | 895 | 130 | 12 | T | 331 max. HB |
| ASTM A276/A276M-15 | Type 403 | S40300 | --- | --- | --- | 275 | 40 | 480 | 70 | 20 | A+HF | --- |
| | | | | --- | --- | 275 | 40 | 480 | 70 | 16 | A+CF | --- |
| | | | | --- | --- | 550 | 80 | 690 | 100 | 15 | H+T and HF | --- |
| | | | | --- | --- | 550 | 80 | 690 | 100 | 12 | H+T and CF | --- |
| | | | | --- | --- | 620 | 90 | 830 | 120 | 12 | H+T and HF | --- |
| | | | | --- | --- | 620 | 90 | 830 | 120 | 12 | H+T and CF | --- |
| ASTM A479/A479M-14 | Type 403 | S40300 | --- | --- | --- | 275 | 40 | 485 | 70 | 20 | A | 223 max. HB |
| | | | | --- | --- | 275 | 40 | 485 | 70 | 20 | T | 223 max. HB |
| | | | | --- | --- | 585 | 85 | 760 | 110 | 15 | T | 269 max. HB |
| | | | | --- | --- | 690 | 100 | 895 | 130 | 12 | T | 331 max. HB |
| GB 1220-92 | Grade 1Cr12 | --- | --- | t ≤ 75 | --- | 390 | --- | 590 | --- | 25 | Q+T | 170 min. HB; 118 J @ RT |
| | | | | t ≤ 75 | --- | --- | --- | --- | --- | --- | A | 200 max. HB |
| JIS G 4303:2012 | Symbol SUS403 | --- | --- | d ≤ 75 | --- | --- | --- | --- | --- | --- | A | 200 max. HBW; 93 max. HRBW; 210 max. HV |
| | | | | d ≤ 75 | --- | 390 | --- | 590 | --- | 25 | Q+T | 170 min. HBW; 87 min. HRBW; 178 min. HV |

**8.2 Stainless Steels: Bar**

**8.2.1B Mechanical Properties of Martensitic Stainless Steels (Continued)**

| Specification | Designation | UNS No | Steel No | Section Thickness/Diameter mm | Section Thickness/Diameter in. | Yield Strength, min. MPa | Yield Strength, min. ksi | Tensile Strength, min. MPa | Tensile Strength, min. ksi | Elongation % min | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ASME SA-240/SA-240M | Type 410 | S41000 | --- | --- | --- | 205 | 30 | 450 | 65 | 20 | see standard | 217 max. HB; 96 max. HRB |
| ASME SA-276 | Type 410 | S41000 | --- | --- | --- | 275 | 40 | 480 | 70 | 20 | A and HF | --- |
| | | | | --- | --- | 275 | 40 | 480 | 70 | 16 | A and CF | --- |
| | | | | --- | --- | 550 | 80 | 690 | 100 | 15 | H+T and HF | --- |
| | | | | --- | --- | 550 | 80 | 690 | 100 | 12 | H+T and CF | --- |
| | | | | --- | --- | 620 | 90 | 830 | 120 | 12 | H+T and HF | --- |
| | | | | --- | --- | 620 | 90 | 830 | 120 | 12 | H+T and CF | --- |
| ASME SA-479/SA-479M | Type 410 | S41000 | --- | --- | --- | 275 | 40 | 485 | 70 | 20 | A | 223 max. HB |
| | | | | --- | --- | 275 | 40 | 485 | 70 | 20 | T | 223 max. HB |
| | | | | --- | --- | 585 | 85 | 760 | 110 | 15 | T | 269 max. HB |
| | | | | --- | --- | 690 | 100 | 895 | 130 | 12 | T | 331 max. HB |
| ASTM A240/A240M-15a | Type 410 | S41000 | --- | --- | --- | 205 | 30 | 450 | 65 | 20 | --- | 217 max. HBW; 96 max. HRBW |
| ASTM A276/A276M-15 | Type 410 | S41000 | --- | --- | --- | 275 | 40 | 480 | 70 | 20 | A+HF | --- |
| | | | | --- | --- | 275 | 40 | 480 | 70 | 16 | A+CF | --- |
| | | | | --- | --- | 550 | 80 | 690 | 100 | 15 | H+T and HF | --- |
| | | | | --- | --- | 550 | 80 | 690 | 100 | 12 | H+T and CF | --- |
| | | | | --- | --- | 620 | 90 | 830 | 120 | 12 | H+T and HF | --- |
| | | | | --- | --- | 620 | 90 | 830 | 120 | 12 | H+T and CF | --- |
| ASTM A479/A479M-14 | Type 410 | S41000 | --- | --- | --- | 275 | 40 | 485 | 70 | 20 | A | 223 max. HB |
| | | | | --- | --- | 275 | 40 | 485 | 70 | 20 | T | 223 max. HB |
| | | | | --- | --- | 585 | 85 | 760 | 110 | 15 | T | 269 max. HB |
| | | | | --- | --- | 690 | 100 | 895 | 130 | 12 | T | 331 max. HB |

Note: This section continued on next page

**8.2 Stainless Steels: Bar**

**8.2.1B Mechanical Properties of Martensitic Stainless Steels (Continued)**

| Specification | Designation | UNS No | Steel No | Section Thickness/Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation % min | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | | | |
| EN 10088-3:2014 | X12Cr13 | --- | 1.4006 | --- | --- | --- | --- | 730 max. | --- | --- | A | 220 max. HBW |
| | | | | 0.50 < d ≤ 1.00 | --- | --- | --- | 1100 max. | --- | 10 | A+PH | --- |
| | | | | 1.00 < d ≤ 3.00 | --- | --- | --- | 1050 max. | --- | 10 | A+PH | --- |
| | | | | 3.00 < d ≤ 5.00 | --- | --- | --- | 1000 max. | --- | 10 | A+PH | --- |
| | | | | t ≤ 10 | --- | --- | --- | 880 | --- | --- | A | 280 max. HB |
| | | | | t ≤ 10 | --- | 550 | --- | 700-1000 | --- | 9 L | Q+T | --- |
| | | | | 10 < t ≤ 16 | --- | --- | --- | 880 | --- | --- | A | 280 max. HB |
| | | | | 10 < t ≤ 16 | --- | 500 | --- | 700-1000 | --- | 9 L | Q+T | --- |
| | | | | 5.00 < d ≤ 16.00 | --- | --- | --- | 950 max. | --- | 15 | A+PH | --- |
| | | | | 16 < t ≤ 40 | --- | --- | --- | 800 | --- | --- | A | 250 max. HB |
| | | | | 16 < t ≤ 40 | --- | 450 | --- | 650-930 | --- | 10 L | Q+T | L: 25 J @ RT |
| | | | | 40 < t ≤ 63 | --- | --- | --- | 760 | --- | --- | A | 230 max. HB |
| | | | | 40 < t ≤ 63 | --- | 450 | --- | 650-880 | --- | 10 L | Q+T | L: 25 J @ RT |
| | | | | t ≤ 160 | --- | 450 | --- | 650-850 | --- | 15 L | Q+T | L: 25 J @ RT |
| | | | | 63 < t ≤ 160 | --- | --- | --- | 730 | --- | --- | A | 220 max. HB |
| | | | | 63 < t ≤ 160 | --- | 450 | --- | 650-850 | --- | 15 L | Q+T | L: 25 J @ RT |
| | | | | d ≥ 0.05 | --- | --- | --- | 500-700 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 600-800 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 700-900 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 800-1000 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 900-1100 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1000-1250 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1100-1350 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1200-1450 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1400-1700 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1600-1900 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1800-2100 | --- | --- | --- | --- |

Note: This section continued on next page

**8.2 Stainless Steels: Bar**

**8.2.1B Mechanical Properties of Martensitic Stainless Steels (Continued)**

| Specification | Designation | UNS No | Steel No | Section Thickness/Diameter mm | Section Thickness/Diameter in. | Yield Strength, min. MPa | Yield Strength, min. ksi | Tensile Strength, min. MPa | Tensile Strength, min. ksi | Elongation % min | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| EN 10263-5:2001 | X12Cr13 | --- | 1.4006 | 2 < d ≤ 5 | --- | --- | --- | 600 max. L | --- | --- | CD+A | --- |
| | | | | 2 < d ≤ 5 | --- | --- | --- | 660 max. L | --- | --- | CD+A | --- |
| | | | | 5 < d ≤ 10 | --- | --- | --- | 600 max. L | --- | --- | A | --- |
| | | | | 5 < d ≤ 10 | --- | --- | --- | 720 max. L | --- | --- | A | --- |
| | | | | 5 < d ≤ 10 | --- | --- | --- | 600 max. L | --- | --- | CD+A | --- |
| | | | | 5 < d ≤ 10 | --- | --- | --- | 640 max. L | --- | --- | CD+A | --- |
| | | | | 10 < d ≤ 25 | --- | --- | --- | 600 max. L | --- | --- | A | --- |
| | | | | 10 < d ≤ 25 | --- | --- | --- | 700 max. L | --- | --- | A | --- |
| | | | | 10 < d ≤ 25 | --- | --- | --- | 600 max. L | --- | --- | CD+A | --- |
| | | | | 25 < d ≤ 100 | --- | --- | --- | 600 max. L | --- | --- | A | --- |
| GB 1220-92 | Grade 1Cr13 | --- | --- | t ≤ 75 | --- | 345 | --- | 540 | --- | 25 | Q+T | 159 min. HB; 78 J @ RT |
| | | | | t ≤ 75 | --- | --- | --- | --- | --- | --- | A | 200 max. HB |
| GB 1221-92 | Grade 1Cr13 | --- | --- | t ≤ 75 | --- | 345 | --- | 540 | --- | 25 | Q+T | 159 min. HB; 78 J @ RT |
| | | | | t ≤ 75 | --- | --- | --- | --- | --- | --- | A | 200 max. HB |
| ISO 4954:1993 | Type X 12 Cr 13 E | --- | --- | 2 ≤ d ≤ 100 | --- | --- | --- | 600 max. | --- | --- | A, CW | --- |
| | | | | 2 ≤ d ≤ 100 | --- | --- | --- | 640 max. | --- | --- | A, CW | --- |
| JIS G 4303:2012 | Symbol SUS410 | --- | --- | d ≤ 75 | --- | --- | --- | --- | --- | --- | A | 200 max. HBW; 93 max. HRBW; 210 max. HV |
| | | | | d ≤ 75 | --- | 345 | --- | 540 | --- | 25 | Q+T | 159 min. HBW; 84 min. HRBW; 166 min. HV |
| GB 1220-92 | Grade 1Cr13Mo | --- | --- | t ≤ 75 | --- | 490 | --- | 685 | --- | 20 | Q+T | 192 min. HB; 78 J @ RT |
| | | | | t ≤ 75 | --- | --- | --- | --- | --- | --- | A | 200 max. HB |
| GB 1221-92 | Grade 1Cr13Mo | --- | --- | t ≤ 75 | --- | 490 | --- | 685 | --- | 20 | Q+T | 192 min. HB; 78 J @ RT |
| | | | | t ≤ 75 | --- | --- | --- | --- | --- | --- | A | 200 max. HB |
| JIS G 4303:2012 | Symbol SUS410J1 | --- | --- | d ≤ 75 | --- | --- | --- | --- | --- | --- | A | 200 max. HBW; 93 max. HRBW; 210 max. HV |
| | | | | d ≤ 75 | --- | 490 | --- | 690 | --- | 20 | Q+T | 192 min. HBW; 92 min. HRBW; 200 min. HV |

**8.2 Stainless Steels: Bar**

**8.2.1B Mechanical Properties of Martensitic Stainless Steels (Continued)**

| Specification | Designation | UNS No | Steel No | Section Thickness/Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | % min | | |
| ASTM A582/A582M-12e1 | Type 416 | S41600 | --- | --- | --- | --- | --- | --- | --- | --- | A | 262 max. HBW |
| | | | | --- | --- | --- | --- | --- | --- | --- | T | 248-302 HBW |
| | | | | --- | --- | --- | --- | --- | --- | --- | H | 293-352 HBW |
| GB 1220-92 | Grade Y1Cr13 | --- | --- | t ≤ 75 | --- | 345 | --- | 540 | --- | 25 | Q+T | 159 min. HB; 78 J @ RT |
| | | | | t ≤ 75 | --- | --- | --- | --- | --- | --- | A | 200 max. HB |
| JIS G 4303:2012 | Symbol SUS416 | --- | --- | d ≤ 75 | --- | --- | --- | --- | --- | --- | A | 200 max. HBW; 93 max. HRBW; 210 max. HV |
| | | | | d ≤ 75 | --- | 345 | --- | 540 | --- | 17 | Q+T | 159 min. HBW; 84 min. HRBW; 166 min. HV |
| EN 10088-3:2014 | X12CrS13 | --- | 1.4005 | --- | --- | --- | --- | 730 max. | --- | --- | A | 220 max. HBW |
| | | | | 0.50 < d ≤ 1.00 | --- | --- | --- | 1100 max. | --- | 10 | A+PH | --- |
| | | | | 1.00 < d ≤ 3.00 | --- | --- | --- | 1050 max. | --- | 10 | A+PH | --- |
| | | | | 3.00 < d ≤ 5.00 | --- | --- | --- | 1000 max. | --- | 10 | A+PH | --- |
| | | | | t ≤ 10 | --- | --- | --- | 880 | --- | --- | A | 280 max. HB |
| | | | | t ≤ 10 | --- | 550 | --- | 700-1000 | --- | 8 L | Q+T | --- |
| | | | | 10 < t ≤ 16 | --- | --- | --- | 880 | --- | --- | A | 280 max. HB |
| | | | | 10 < t ≤ 16 | --- | 500 | --- | 700-1000 | --- | 8 L | Q+T | --- |
| | | | | 5.00 < d ≤ 16.00 | --- | --- | --- | 950 max. | --- | 15 | A+PH | --- |
| | | | | 16 < t ≤ 40 | --- | --- | --- | 800 | --- | --- | A | 250 max. HB |
| | | | | 16 < t ≤ 40 | --- | 450 | --- | 650-930 | --- | 10 L | Q+T | --- |
| | | | | 40 < t ≤ 63 | --- | --- | --- | 760 | --- | --- | A | 230 max. HB |
| | | | | 40 < t ≤ 63 | --- | 450 | --- | 650-880 | --- | 10 L | Q+T | --- |
| | | | | t ≤ 160 | --- | 450 | --- | 650-850 | --- | 12 L | Q+T | --- |
| | | | | 63 < t ≤ 160 | --- | --- | --- | 730 | --- | --- | A | 220 max. HB |
| | | | | 63 < t ≤ 160 | --- | 450 | --- | 650-850 | --- | 12 L | Q+T | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 500-700 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 600-800 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 700-900 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 800-1000 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 900-1100 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1000-1250 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1100-1350 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1200-1450 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1400-1700 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1600-1900 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1800-2100 | --- | --- | --- | --- |

**8.2 Stainless Steels: Bar**

**8.2.1B Mechanical Properties of Martensitic Stainless Steels (Continued)**

| Specification | Designation | UNS No | Steel No | Section Thickness/Diameter mm | Section Thickness/Diameter in. | Yield Strength, min. MPa | Yield Strength, min. ksi | Tensile Strength, min. MPa | Tensile Strength, min. ksi | Elongation % min | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ASME SA-276 | Type 420 | S42000 | --- | --- | --- | --- | --- | --- | --- | --- | A and HF | 241 max. HB |
| | | | | --- | --- | --- | --- | --- | --- | --- | A and CF | 255 max. HB |
| ASTM A276/A276M-15 | Type 420 | S42000 | --- | --- | --- | --- | --- | --- | --- | --- | A+HF | 241 max. HBW |
| | | | | --- | --- | --- | --- | --- | --- | --- | A+CF | 255 max. HBW |
| EN 10088-3:2014 | X20Cr13 | --- | 1.4021 | --- | --- | --- | --- | 760 max. | --- | --- | A | 230 max. HBW |
| | | | | 0.50 < d ≤ 1.00 | --- | --- | --- | 1100 max. | --- | 10 | A+PH | --- |
| | | | | 1.00 < d ≤ 3.00 | --- | --- | --- | 1050 max. | --- | 10 | A+PH | --- |
| | | | | 3.00 < d ≤ 5.00 | --- | --- | --- | 1000 max. | --- | 10 | A+PH | --- |
| | | | | t ≤ 10 | --- | --- | --- | 910 | --- | --- | A | 290 max. HB |
| | | | | t ≤ 10 | --- | 600 | --- | 750-1000 | --- | 8 L | Q+T | --- |
| | | | | 10 < t ≤ 16 | --- | --- | --- | 910 | --- | --- | A | 290 max. HB |
| | | | | 10 < t ≤ 16 | --- | 550 | --- | 750-1000 | --- | 8 L | Q+T | --- |
| | | | | 5.00 < d ≤ 16.00 | --- | --- | --- | 950 max. | --- | 15 | A+PH | --- |
| | | | | 16 < t ≤ 40 | --- | --- | --- | 850 | --- | --- | A | 260 max. HB |
| | | | | 16 < t ≤ 40 | --- | 500 | --- | 700-950 | --- | 10 L | Q+T | L: 25 J @ RT |
| | | | | 40 < t ≤ 63 | --- | --- | --- | 800 | --- | --- | A | 250 max. HB |
| | | | | 40 < t ≤ 63 | --- | 500 | --- | 700-900 | --- | 12 L | Q+T | L: 25 J @ RT |
| | | | | t ≤ 160 | --- | 600 | --- | 800-950 | --- | 12 L | Q+T | L: 20 J @ RT |
| | | | | t ≤ 160 | --- | 500 | --- | 700-850 | --- | 13 L | Q+T | L: 25 J @ RT |
| | | | | 63 < t ≤ 160 | --- | --- | --- | 760 | --- | --- | A | 230 max. HB |
| | | | | 63 < t ≤ 160 | --- | 500 | --- | 700-850 | --- | 13 L | Q+T | L: 25 J @ RT |
| | | | | d ≥ 0.05 | --- | --- | --- | 500-700 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 600-800 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 700-900 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 800-1000 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 900-1100 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1000-1250 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1100-1350 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1200-1450 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1400-1700 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1600-1900 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1800-2100 | --- | --- | --- | --- |
| GB 1220-92 | Grade 2Cr13 | --- | --- | t ≤ 75 | --- | 440 | --- | 635 | --- | 20 | Q+T | 192 min. HB; 63 J @ RT |
| | | | | t ≤ 75 | --- | --- | --- | --- | --- | --- | A | 223 max. HB |
| GB 1221-92 | Grade 2Cr13 | --- | --- | t ≤ 75 | --- | 440 | --- | 635 | --- | 20 | Q+T | 192 min. HB; 63 J @ RT |
| | | | | t ≤ 75 | --- | --- | --- | --- | --- | --- | A | 223 max. HB |

Note: This section continued on next page

**8.2 Stainless Steels: Bar**

**8.2.1B Mechanical Properties of Martensitic Stainless Steels (Continued)**

| Specification | Designation | UNS No | Steel No | Section Thickness/Diameter mm | Section Thickness/Diameter in. | Yield Strength, min. MPa | Yield Strength, min. ksi | Tensile Strength, min. MPa | Tensile Strength, min. ksi | Elongation % min | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| JIS G 4303:2012 | Symbol SUS420J1 | --- | --- | d ≤ 75 | --- | --- | --- | --- | --- | --- | A | 223 max. HBW; 97 max. HRBW; 234 max. HV |
| | | | | d ≤ 75 | --- | 440 | --- | 640 | --- | 20 | Q+T | 192 min. HBW; 92 min. HRBW; 200 min. HV |
| ASTM A582/A582M-12e1 | Type 420F | S42020 | --- | --- | --- | --- | --- | --- | --- | --- | A | 262 max. HBW |
| EN 10088-3:2014 | X30Cr13 | --- | 1.4028 | --- | --- | --- | --- | 800 max. | --- | --- | A | 245 max. HBW |
| | | | | 0.50 < d ≤ 1.00 | --- | --- | --- | 1100 max. | --- | 10 | A+PH | --- |
| | | | | 1.00 < d ≤ 3.00 | --- | --- | --- | 1050 max. | --- | 10 | A+PH | --- |
| | | | | 3.00 < d ≤ 5.00 | --- | --- | --- | 1000 max. | --- | 10 | A+PH | --- |
| | | | | t ≤ 10 | --- | --- | --- | 950 | --- | --- | A | 305 max. HB |
| | | | | t ≤ 10 | --- | 700 | --- | 900-1050 | --- | 7 L | Q+T | --- |
| | | | | 10 < t ≤ 16 | --- | --- | --- | 950 | --- | --- | A | 305 max. HB |
| | | | | 10 < t ≤ 16 | --- | 650 | --- | 900-1150 | --- | 7 L | Q+T | --- |
| | | | | 5.00 < d ≤ 16.00 | --- | --- | --- | 950 max. | --- | 15 | A+PH | --- |
| | | | | 16 < t ≤ 40 | --- | --- | --- | 900 | --- | --- | A | 280 max. HB |
| | | | | 16 < t ≤ 40 | --- | 650 | --- | 850-1100 | --- | 9 L | Q+T | L: 12 J @ RT |
| | | | | 40 < t ≤ 63 | --- | --- | --- | 840 | --- | --- | A | 260 max. HB |
| | | | | 40 < t ≤ 63 | --- | 650 | --- | 850-1050 | --- | 9 L | Q+T | L: 12 J @ RT |
| | | | | t ≤ 160 | --- | 650 | --- | 850-1000 | --- | 10 L | Q+T | L: 12 J @ RT |
| | | | | 63 < t ≤ 160 | --- | --- | --- | 800 | --- | --- | A | 245 max. HB |
| | | | | 63 < t ≤ 160 | --- | 650 | --- | 850-1000 | --- | 10 L | Q+T | L: 15 J @ RT |
| | | | | d ≥ 0.05 | --- | --- | --- | 500-700 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 600-800 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 700-900 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 800-1000 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 900-1100 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1000-1250 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1100-1350 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1200-1450 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1400-1700 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1600-1900 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1800-2100 | --- | --- | --- | --- |
| GB 1220-92 | Grade 3Cr13 | --- | --- | t ≤ 75 | --- | 540 | --- | 735 | --- | 12 | Q+T | 217 min. HB; 24 J @ RT |
| | | | | t ≤ 75 | --- | --- | --- | --- | --- | --- | A | 235 max. HB |

Note: This section continued on next page

**8.2 Stainless Steels: Bar**

**8.2.1B Mechanical Properties of Martensitic Stainless Steels (Continued)**

| Specification | Designation | UNS No | Steel No | Section Thickness/Diameter mm | Section Thickness/Diameter in. | Yield Strength, min. MPa | Yield Strength, min. ksi | Tensile Strength, min. MPa | Tensile Strength, min. ksi | Elongation % min | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| JIS G 4303:2012 | Symbol SUS420J2 | --- | --- | d ≤ 75 | --- | --- | --- | --- | --- | --- | A | 235 max. HBW; 99 max. HRBW; 247 max. HV |
| | | | | d ≤ 75 | --- | 540 | --- | 740 | --- | 12 | Q+T | 217 min. HBW; 95 min. HRBW; 220 min. HV |
| EN 10088-3:2014 | X29CrS13 | --- | 1.4029 | t ≤ 10 | --- | --- | --- | 950 | --- | --- | A | 305 max. HB |
| | | | | t ≤ 10 | --- | 750 | --- | 900-1100 | --- | 8 L | Q+T | --- |
| | | | | 10 < t ≤ 16 | --- | --- | --- | 950 | --- | --- | A | 305 max. HB |
| | | | | 10 < t ≤ 16 | --- | 700 | --- | 900-1100 | --- | 8 L | Q+T | --- |
| | | | | 16 < t ≤ 40 | --- | --- | --- | 900 | --- | --- | A | 280 max. HB |
| | | | | 16 < t ≤ 40 | --- | 650 | --- | 850-1100 | --- | 10 L | Q+T | --- |
| | | | | 40 < t ≤ 63 | --- | --- | --- | 840 | --- | --- | A | 260 max. HB |
| | | | | 40 < t ≤ 63 | --- | 650 | --- | 850-1050 | --- | 10 L | Q+T | --- |
| | | | | t ≤ 160 | --- | --- | --- | 800 max. | --- | --- | A | 245 max. HBW |
| | | | | t ≤ 160 | --- | 650 | --- | 850-1000 | --- | 9 L | Q+T | --- |
| | | | | 63 < t ≤ 160 | --- | --- | --- | 800 | --- | --- | A | 245 max. HB |
| | | | | 63 < t ≤ 160 | --- | 650 | --- | 850-1000 | --- | 12 L | Q+T | --- |
| GB 1220-92 | Grade Y3Cr13 | --- | --- | t ≤ 75 | --- | 540 | --- | 735 | --- | 12 | Q+T | 217 min. HB; 24 J @ RT |
| | | | | t ≤ 75 | --- | --- | --- | --- | --- | --- | A | 235 max. HB |
| JIS G 4303:2012 | Symbol SUS420F | --- | --- | d ≤ 75 | --- | --- | --- | --- | --- | --- | A | 235 max. HBW; 99 max. HRBW; 247 max. HV |
| | | | | d ≤ 75 | --- | 540 | --- | 740 | --- | 8 | Q+T | 217 min. HBW; 95 min. HRBW; 220 min. HV |
| ASME SA-276 | Type 431 | S43100 | --- | --- | --- | --- | --- | --- | --- | --- | A and HF or A and CF | 285 max. HB |
| ASME SA-479/SA-479M | Type 431 | S43100 | --- | --- | --- | --- | --- | --- | --- | --- | A | 277 max. HB |
| | | | | --- | --- | 620 | 90 | 795 | 115 | 15 | T | 321 max. HB |
| ASTM A276/A276M-15 | Type 431 | S43100 | --- | --- | --- | --- | --- | --- | --- | --- | A+HF; or A+CF | 285 max. HBW |
| ASTM A479/A479M-14 | Type 431 | S43100 | --- | --- | --- | --- | --- | --- | --- | --- | A | 277 max. HB |
| | | | | --- | --- | 620 | 90 | 795 | 115 | 15 | T | 321 max. HB |

Note: This section continued on next page

**8.2 Stainless Steels: Bar**

**8.2.1B Mechanical Properties of Martensitic Stainless Steels (Continued)**

| Specification | Designation | UNS No | Steel No | Section Thickness/Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation % min | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | | | |
| EN 10088-3:2014 | X17CrNi16-2 | --- | 1.4057 | --- | --- | --- | --- | 950 max. | --- | --- | A | 295 max. HBW |
| | | | | 0.50 < d ≤ 1.00 | --- | --- | --- | 1100 max. | --- | 10 | A+PH | --- |
| | | | | 1.00 < d ≤ 3.00 | --- | --- | --- | 1050 max. | --- | 10 | A+PH | --- |
| | | | | 3.00 < d ≤ 5.00 | --- | --- | --- | 1000 max. | --- | 10 | A+PH | --- |
| | | | | t ≤ 10 | --- | --- | --- | 1050 | --- | --- | A | 330 max. HB |
| | | | | t ≤ 10 | --- | 750 | --- | 850-1100 | --- | 7 L | Q+T | --- |
| | | | | 10 < t ≤ 16 | --- | --- | --- | 1050 | --- | --- | A | 330 max. HB |
| | | | | 10 < t ≤ 16 | --- | 700 | --- | 850-1100 | --- | 7 L | Q+T | --- |
| | | | | 5.00 < d ≤ 16.00 | --- | --- | --- | 950 max. | --- | 15 | A+PH | --- |
| | | | | 16 < t ≤ 40 | --- | --- | --- | 1000 | --- | --- | A | 310 max. HB |
| | | | | 16 < t ≤ 40 | --- | 650 | --- | 800-1050 | --- | 9 L | Q+T | L: 25 J @ RT |
| | | | | t ≤ 60 | --- | 700 | --- | 900-1050 | --- | 12 L | Q+T | L: 16 J @ RT |
| | | | | t ≤ 60 | --- | 600 | --- | 800-950 | --- | 14 L | Q+T | L: 25 J @ RT |
| | | | | 40 < t ≤ 63 | --- | --- | --- | 950 | --- | --- | A | 295 max. HB |
| | | | | 40 < t ≤ 63 | --- | 650 | --- | 800-1000 | --- | 12 L | Q+T | L: 25 J @ RT |
| | | | | 60 < t ≤ 160 | --- | 700 | --- | 900-1050 | --- | 10 L | Q+T | L: 15 J @ RT |
| | | | | 60 < t ≤ 160 | --- | 600 | --- | 800-950 | --- | 12 L | Q+T | L: 20 J @ RT |
| | | | | 63 < t ≤ 160 | --- | --- | --- | 950 | --- | --- | A | 295 max. HB |
| | | | | 63 < t ≤ 160 | --- | 650 | --- | 800-950 | --- | 12 L | Q+T | L: 16 J @ RT |
| | | | | d ≥ 0.05 | --- | --- | --- | 500-700 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 600-800 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 700-900 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 800-1000 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 900-1100 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1000-1250 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1100-1350 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1200-1450 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1400-1700 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1600-1900 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1800-2100 | --- | --- | --- | --- |
| ISO 4954:1993 | Type X 19 CrNi 16 2 E | --- | --- | 2 ≤ d ≤ 100 | --- | --- | --- | 800 max. | --- | --- | A, CW | --- |
| | | | | 2 ≤ d ≤ 100 | --- | --- | --- | 840 max. | --- | --- | A, CW | --- |
| JIS G 4303:2012 | Symbol SUS431 | --- | --- | d ≤ 75 | --- | --- | --- | --- | --- | --- | A | 302 max. HBW; 32 max. HRC; 320 max. HV |
| | | | | d ≤ 75 | --- | 590 | --- | 780 | --- | 15 | Q+T | 229 min. HBW; 98 min. HRBW; 241 min. HV |

**8.2 Stainless Steels: Bar**

**8.2.1B Mechanical Properties of Martensitic Stainless Steels (Continued)**

| Specification | Designation | UNS No | Steel No | Section Thickness/Diameter mm | Section Thickness/Diameter in. | Yield Strength, min. MPa | Yield Strength, min. ksi | Tensile Strength, min. MPa | Tensile Strength, min. ksi | Elongation % min | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ASME SA-276 | Type 440A | S44002 | --- | --- | --- | --- | --- | --- | --- | --- | A and HF | 269 max. HB |
| | | | | --- | --- | --- | --- | --- | --- | --- | A and CF | 285 max. HB |
| ASTM A276/A276M-15 | Type 440A | S44002 | --- | --- | --- | --- | --- | --- | --- | --- | A+HF | 269 max. HBW |
| | | | | --- | --- | --- | --- | --- | --- | --- | A+CF | 285 max. HBW |
| EN 10088-3:2014 | X70CrMo15 | --- | 1.4109 | t ≤ 100 | --- | --- | --- | 900 max. | --- | --- | A | 280 max. HBW |
| GB 1220-92 | Grade 7Cr17 | --- | --- | t ≤ 75 | --- | --- | --- | --- | --- | --- | Q+T | --- |
| | | | | t ≤ 75 | --- | --- | --- | --- | --- | --- | A | 255 max. HB |
| JIS G 4303:2012 | Symbol SUS440A | --- | --- | d ≤ 75 | --- | --- | --- | --- | --- | --- | A | 255 max. HBW; 25 max. HRC; 269 max. HV |
| | | | | d ≤ 75 | --- | --- | --- | --- | --- | --- | Q+T | 54 min. HRBW; 577 min. HV |
| ASME SA-276 | Type 440B | S44003 | --- | --- | --- | --- | --- | --- | --- | --- | A and HF | 269 max. HB |
| | | | | --- | --- | --- | --- | --- | --- | --- | A and CF | 285 max. HB |
| ASTM A276/A276M-15 | Type 440B | S44003 | --- | --- | --- | --- | --- | --- | --- | --- | A+HF | 269 max. HBW |
| | | | | --- | --- | --- | --- | --- | --- | --- | A+CF | 285 max. HBW |
| GB 1220-92 | Grade 8Cr17 | --- | --- | t ≤ 75 | --- | --- | --- | --- | --- | --- | Q+T | --- |
| | | | | t ≤ 75 | --- | --- | --- | --- | --- | --- | A | 255 max. HB |
| JIS G 4303:2012 | Symbol SUS440B | --- | --- | d ≤ 75 | --- | --- | --- | --- | --- | --- | A | 255 max. HBW; 25 max. HRC; 269 max. HV |
| | | | | d ≤ 75 | --- | --- | --- | --- | --- | --- | Q+T | 56 min. HRBW; 613 min. HV |
| ASME SA-276 | Type 440C | S44004 | --- | --- | --- | --- | --- | --- | --- | --- | A and HF | 269 max. HB |
| | | | | --- | --- | --- | --- | --- | --- | --- | A and CF | 285 max. HB |
| ASTM A276/A276M-15 | Type 440C | S44004 | --- | --- | --- | --- | --- | --- | --- | --- | A+HF | 269 max. HBW |
| | | | | --- | --- | --- | --- | --- | --- | --- | A+CF | 285 max. HBW |
| GB 1220-92 | Grade 11Cr17 | --- | --- | t ≤ 75 | --- | --- | --- | --- | --- | --- | Q+T | --- |
| | | | | t ≤ 75 | --- | --- | --- | --- | --- | --- | A | 269 max. HB |
| JIS G 4303:2012 | Symbol SUS440C | --- | --- | d ≤ 75 | --- | --- | --- | --- | --- | --- | A | 269 max. HBW; 28 max. HRC; 284 max. HV |
| | | | | d ≤ 75 | --- | --- | --- | --- | --- | --- | Q+T | 58 min. HRC; 653 min. HV |
| EN 10088-3:2014 | X105CrMo17 | --- | 1.4125 | t ≤ 100 | --- | --- | --- | --- | --- | --- | A | 285 max. HBW |
| ASTM A565/A565M-10 | Grade XM-32 | S64152 | --- | --- | --- | --- | --- | --- | --- | --- | A | 311 max. HB |
| | | | | --- | --- | 795 | 115 | 1000 L | 145 L | 15 | HT | 302-352 HB; 40 J @ RT |
| EN 10269:2013 | X12CrNiMoV12-3 | --- | 1.4938 | d ≤ 160 | --- | 760 | --- | 930-1130 L | --- | 14 L | Q+T | L: 40 J @ 20°C |
| | | | | --- | --- | --- | --- | --- | --- | --- | A | 311 max. HBW |
| EN 10302:2008 | X12CrNiMoV12-3 | --- | 1.4938 | --- | --- | 760 | --- | 930-1130 | --- | 14 | Q+T | --- |

**8.2 Stainless Steels: Bar**

**8.2.1B Mechanical Properties of Martensitic Stainless Steels (Continued)**

| Specification | Designation | UNS No | Steel No | Section Thickness/Diameter mm | Section Thickness/Diameter in. | Yield Strength, min. MPa | Yield Strength, min. ksi | Tensile Strength, min. MPa | Tensile Strength, min. ksi | Elongation % min | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| EN 10269:2013 | X19CrMoNbVN11-1 | --- | 1.4913 | d ≤ 160 | --- | 750 | --- | 900-1050 L | --- | 12 L | Q+T | L: 20 J @ 20°C |
| | | | | --- | --- | --- | --- | --- | --- | --- | A | 302 max. HBW |
| GB 1221-92 | Grade 2Cr12MoVNbN | --- | --- | t ≤ 75 | --- | 685 | --- | 835 | --- | 15 | Q+T | 321 max. HB |
| | | | | t ≤ 75 | --- | --- | --- | --- | --- | --- | A | 269 max. HB |
| JIS G 4311:2011 | Symbol SUH600 | --- | --- | --- | --- | --- | --- | --- | --- | --- | A | 269 max. HBW |
| | | | | t ≤ 75 | --- | 685 | --- | 830 | --- | 15 | Q+T | 321 max. HBW |
| ASTM A565/A565M-10 | Grade 616 | S42200 | --- | --- | --- | --- | --- | --- | --- | --- | A | 248 max. HB |
| | | | | --- | --- | --- | --- | --- | --- | --- | HT | 285 max. HB |
| | | | | --- | --- | 760 | 110 | 965 L | 140 L | 13 | HT | 302-352 HB; 11 J @ RT |
| | | | | --- | --- | 585 | 85 | 825 L | 120 L | 17 | HT | 241-285 HB |
| GB 1221-92 | Grade 2Cr12NiMoWV | --- | --- | t ≤ 75 | --- | 735 | --- | 885 | --- | 10 | Q+T | 341 max. HB |
| | | | | t ≤ 75 | --- | --- | --- | --- | --- | --- | A | 269 max. HB |
| JIS G 4311:2011 | Symbol SUH616 | --- | --- | --- | --- | --- | --- | --- | --- | --- | A | 269 max. HBW |
| | | | | t ≤ 75 | --- | 735 | --- | 880 | --- | 10 | Q+T | 341 max. HBW |
| ASME SA-276 | --- | S41500 | --- | --- | --- | 620 | 90 | 795 | 115 | 15 | H+T and HF or H+T and CF | 295 max. HB |
| ASME SA-479/SA-479M | --- | S41500 | --- | --- | --- | 620 | 90 | 795 | 115 | 15 | N+T | 293 max. HB |
| ASTM A276/A276M-15 | --- | S41500 | --- | --- | --- | 620 | 90 | 795 | 115 | 15 | H+T and HF or H+T and CF | 295 max. HBW |
| ASTM A479/A479M-14 | --- | S41500 | --- | --- | --- | 620 | 90 | 795 | 115 | 15 | N+T | 293 max. HB |
| EN 10088-3:2014 | X3CrNiMo13-4 | --- | 1.4313 | --- | --- | --- | --- | 1100 max. | --- | --- | A | 320 max. HBW |
| | | | | t ≤ 160 | --- | 800 | --- | 900-1100 | --- | 12 L | Q+T | L: 50 J @ RT |
| | | | | t ≤ 160 | --- | 620 | --- | 780-980 | --- | 15 L | Q+T | L: 70 J @ RT |
| | | | | t ≤ 160 | --- | 520 | --- | 700-850 | --- | 15 L | Q+T | L: 70 J @ RT |
| | | | | 160 < t ≤ 250 | --- | 800 | --- | 900-1100 | --- | 10 T | Q+T | T: 40 J @ RT |
| | | | | 160 < t ≤ 250 | --- | 620 | --- | 780-980 | --- | 12 T | Q+T | T: 50 J @ RT |
| | | | | 160 < t ≤ 250 | --- | 520 | --- | 700-850 | --- | 12 T | Q+T | T: 50 J @ RT |
| ISO 16143-2:2004 | X3CrNiMo13-4 | --- | --- | --- | --- | --- | --- | 1100 max. | --- | --- | A | 320 max. HBW |
| | | | | t ≤ 160 | --- | 800 | --- | 900-1100 | --- | 12 L | Q+T | --- |
| | | | | t ≤ 160 | --- | 620 | --- | 780-980 | --- | 15 L | Q+T | --- |
| | | | | t ≤ 160 | --- | 520 | --- | 700-800 | --- | 15 L | Q+T | --- |

**8.2 Stainless Steels: Bar**

**8.2.1B Mechanical Properties of Martensitic Stainless Steels (Continued)**

| Specification | Designation | UNS No | Steel No | Section Thickness/Diameter mm | Section Thickness/Diameter in. | Yield Strength, min. MPa | Yield Strength, min. ksi | Tensile Strength, min. MPa | Tensile Strength, min. ksi | Elongation % min | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| EN 10088-3:2014 | X39Cr13 | --- | 1.4031 | --- | --- | --- | --- | 800 max. | --- | --- | A | 245 max. HBW |
| | | | | t ≤ 10 | --- | --- | --- | 950 | --- | --- | A | 305 max. HB |
| | | | | t ≤ 10 | --- | 700 | --- | 850-1100 | --- | 7 L | Q+T | --- |
| | | | | 10 < t ≤ 16 | --- | --- | --- | 950 | --- | --- | A | 305 max. HB |
| | | | | 10 < t ≤ 16 | --- | 700 | --- | 850-1100 | --- | 7 L | Q+T | --- |
| | | | | 16 < t ≤ 40 | --- | --- | --- | 900 | --- | --- | A | 280 max. HB |
| | | | | 16 < t ≤ 40 | --- | 650 | --- | 800-1050 | --- | 8 L | Q+T | L: 12 J @ RT |
| | | | | 40 < t ≤ 63 | --- | --- | --- | 840 | --- | --- | A | 260 max. HB |
| | | | | 40 < t ≤ 63 | --- | 650 | --- | 800-1000 | --- | 8 L | Q+T | L: 12 J @ RT |
| | | | | t ≤ 160 | --- | 650 | --- | 800-1000 | --- | 10 L | Q+T | L: 12 J @ RT |
| | | | | 63 < t ≤ 160 | --- | --- | --- | 800 | --- | --- | A | 245 max. HB |
| | | | | 63 < t ≤ 160 | --- | 650 | --- | 800-1000 | --- | 10 L | Q+T | L: 12 J @ RT |
| GB 1220-92 | Grade 4Cr13 | --- | --- | t ≤ 75 | --- | --- | --- | --- | --- | --- | Q+T | --- |
| | | | | t ≤ 75 | --- | --- | --- | --- | --- | --- | A | 201 max. HB |
| ASTM A582/A582M-12e1 | Type 440F | S44020 | --- | --- | --- | --- | --- | --- | --- | --- | A | 285 max. HB |
| GB 1220-92 | Grade Y11Cr17 | --- | --- | t ≤ 75 | --- | --- | --- | --- | --- | --- | Q+T | --- |
| | | | | t ≤ 75 | --- | --- | --- | --- | --- | --- | A | 269 max. HB |
| JIS G 4303:2012 | Symbol SUS440F | --- | --- | d ≤ 75 | --- | --- | --- | --- | --- | --- | A | 269 max. HBW; 28 max. HRC; 284 max. HV |
| | | | | d ≤ 75 | --- | --- | --- | --- | --- | --- | Q+T | 58 min. HRC; 653 min. HV |
| EN 10088-3:2014 | X90CrMoV18 | --- | 1.4112 | t ≤ 100 | --- | --- | --- | --- | --- | --- | A | 265 max. HBW |
| GB 1220-92 | Grade 9Cr18MoV | --- | --- | t ≤ 75 | --- | --- | --- | --- | --- | --- | Q+T | --- |
| | | | | t ≤ 75 | --- | --- | --- | --- | --- | --- | A | 269 max. HB |
| GB 1221-92 | Grade 8Cr20Si2Ni | --- | --- | t ≤ 75 | --- | 685 | --- | 885 | --- | 10 | Q+T | 262 min. HB; 8 J @ RT |
| | | | | t ≤ 75 | --- | --- | --- | --- | --- | --- | A | 321 max. HB |
| JIS G 4311:2011 | Symbol SUH4 | --- | --- | --- | --- | --- | --- | --- | --- | --- | A | 321 max. HBW |
| | | | | t ≤ 75 | --- | 685 | --- | 880 | --- | 10 | Q+T | 262 min. HBW |

**8.2 Stainless Steels: Bar**

**8.2.2A Chemical Composition of Ferritic Stainless Steels**

| Specification | Designation | UNS No | Steel No | Weight, %, max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| EN 10088-3:2014 | X6Cr13 | --- | 1.4000 | 0.08 | 1.00 | 1.00 | 0.040 | 0.030 | 12.0-14.0 | --- | --- | --- |
| ISO 4955:2005 | X6Cr13 | --- | --- | 0.08 | 1.00 | 1.00 | 0.040 | 0.030 | 12.0-14.0 | 1.00 | --- | --- |
| ASME SA-276 | Type 405 | S40500 | --- | 0.08 | 1.00 | 1.00 | 0.040 | 0.030 | 11.50-14.50 | --- | --- | Al 0.10-0.30 |
| ASME SA-479/SA-479M | Type 405 | S40500 | --- | 0.08 | 1.00 | 1.00 | 0.040 | 0.030 | 11.5-14.5 | 0.50 | --- | Al 0.10-0.30 |
| ASTM A276/A276M-15 | Type 405 | S40500 | --- | 0.08 | 1.00 | 1.00 | 0.040 | 0.030 | 11.5-14.5 | 0.50 | --- | Al 0.10-0.30 |
| ASTM A479/A479M-14 | Type 405 | S40500 | --- | 0.08 | 1.00 | 1.00 | 0.040 | 0.030 | 11.5-14.5 | 0.50 | --- | Al 0.10-0.30 |
| GB 1220-92 | Grade 0Cr13Al | --- | --- | 0.08 | 1.00 | 1.00 | 0.035 | 0.030 | 11.50-14.50 | 0.60 | --- | Al 0.10-0.30 |
| GB 1221-92 | Grade 0Cr13Al | --- | --- | 0.08 | 1.00 | 1.00 | 0.040 | 0.030 | 11.50-14.50 | --- | --- | Al 0.10-0.30 |
| JIS G 4303:2012 | Symbol SUS405 | --- | --- | 0.08 | 1.00 | 1.00 | 0.040 | 0.030 | 11.50-14.50 | 0.60 | --- | Al 0.10-0.30 |
| EN 10088-3:2014 | X2CrNi12 | --- | 1.4003 | 0.030 | 1.50 | 1.00 | 0.040 | 0.030 | 10.5-12.5 | 0.30-1.00 | --- | N 0.030 |
| GB 1220-92 | Grade 00Cr12 | --- | --- | 0.030 | 1.00 | 1.00 | 0.035 | 0.030 | 11.00-13.00 | 0.60 | --- | --- |
| GB 1221-92 | Grade 00Cr12 | --- | --- | 0.030 | 1.00 | 1.00 | 0.040 | 0.030 | 11.00-13.00 | --- | --- | --- |
| JIS G 4303:2012 | Symbol SUS410L | --- | --- | 0.030 | 1.00 | 1.00 | 0.040 | 0.030 | 11.00-13.50 | 0.60 | --- | --- |
| EN 10088-3:2014 | X6Cr17 | --- | 1.4016 | 0.08 | 1.00 | 1.00 | 0.040 | 0.030 | 16.0-18.0 | --- | --- | --- |
| EN 10263-5:2001 | X6Cr17 | --- | 1.4016 | 0.08 | 1.00 | 1.00 | 0.040 | 0.030 | 16.00-18.00 | --- | --- | --- |
| ISO 4954:1993 | Type X 6 Cr 17 E | --- | --- | 0.08 | 1.00 | 1.00 | 0.040 | 0.030 | 16.0-18.0 | 1.0 | --- | --- |
| ISO 4955:2005 | X6Cr17 | --- | --- | 0.08 | 1.00 | 1.00 | 0.040 | 0.030 | 16.0-18.0 | 1.00 | --- | --- |
| ASME SA-276 | Type 430 | S43000 | --- | 0.12 | 1.00 | 1.00 | 0.040 | 0.030 | 16.00-18.00 | --- | --- | --- |
| ASME SA-479/SA-479M | Type 430 | S43000 | --- | 0.12 | 1.00 | 1.00 | 0.040 | 0.030 | 16.0-18.0 | --- | --- | --- |
| ASTM A276/A276M-15 | Type 430 | S43000 | --- | 0.12 | 1.00 | 1.00 | 0.040 | 0.030 | 16.0-18.0 | --- | --- | --- |
| ASTM A479/A479M-14 | Type 430 | S43000 | --- | 0.12 | 1.00 | 1.00 | 0.040 | 0.030 | 16.0-18.0 | --- | --- | --- |
| GB 1220-92 | Grade 1Cr17 | --- | --- | 0.12 | 1.00 | 0.75 | 0.035 | 0.030 | 16.00-18.00 | 0.60 | --- | --- |
| GB 1221-92 | Grade 1Cr17 | --- | --- | 0.12 | 1.00 | 0.75 | 0.040 | 0.030 | 16.00-18.00 | --- | --- | --- |
| GB 4226-84 | Grade 1Cr17 | --- | --- | 0.12 | 1.00 | 0.75 | 0.035 | 0.030 | 16.00-18.00 | 0.60 | --- | --- |
| JIS G 4303:2012 | Symbol SUS430 | --- | --- | 0.12 | 1.00 | 0.75 | 0.040 | 0.030 | 16.00-18.00 | 0.60 | --- | --- |
| JIS G 4318:1998 A1:2007 | Symbol SUS430 | --- | --- | 0.12 | 1.00 | 0.75 | 0.040 | 0.030 | 16.00-18.00 | 0.60 | --- | --- |
| ASTM A582/A582M-12e1 | Type 430F | S43020 | --- | 0.12 | 1.25 | 1.00 | 0.06 | 0.15 min. | 16.0-18.0 | --- | --- | --- |
| EN 10088-3:2014 | X6CrMoS17 | --- | 1.4105 | 0.08 | 1.50 | 1.50 | 0.040 | 0.15-0.35 | 16.0-18.0 | --- | 0.20-0.60 | --- |
| GB 1220-92 | Grade Y1Cr17 | --- | --- | 0.12 | 1.25 | 1.00 | 0.060 | 0.15 min. | 16.00-18.00 | 0.60 | 0.60 | --- |
| GB 4226-84 | Grade Y1Cr17 | --- | --- | 0.12 | 1.25 | 1.00 | 0.060 | 0.15 min. | 16.00-18.00 | 0.60 | 0.60 | --- |
| ISO 16143-2:2004 | X7CrS17 | --- | --- | 0.09 | 1.50 | 1.50 | 0.040 | 0.15 min. | 16.0-18.0 | --- | 0.60 | --- |
| JIS G 4303:2012 | Symbol SUS430F | --- | --- | 0.12 | 1.25 | 1.00 | 0.060 | 0.15 min. | 16.00-18.00 | 0.60 | 0.60 | --- |
| JIS G 4318:1998 A1:2007 | Symbol SUS430F | --- | --- | 0.12 | 1.25 | 1.00 | 0.060 | 0.15 min. | 16.00-18.00 | 0.60 | 0.60 | --- |
| ASTM A582/A582M-12e1 | --- | S18235 | --- | 0.025 | 0.50 | 1.00 | 0.030 | 0.15-0.35 | 17.5-18.5 | 1.00 | 2.00-2.50 | (C+N) 0.035 max.; Ti 0.30-1.00; N 0.025 |
| EN 10088-3:2014 | X2CrMoTiS18-2 | --- | 1.4523 | 0.030 | 0.50 | 1.00 | 0.040 | 0.15-0.35 | 17.5-19.0 | --- | 2.00-2.50 | Ti [4x(C+N)+0.15] to 0.80; (C+N) 0.040 max. |

**8.2 Stainless Steels: Bar**

**8.2.2A Chemical Composition of Ferritic Stainless Steels (Continued)**

| Specification | Designation | UNS No | Steel No | Weight, %, max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| EN 10088-3:2014 | X6CrMo17-1 | --- | 1.4113 | 0.08 | 1.00 | 1.00 | 0.040 | 0.030 | 16.0-18.0 | --- | 0.90-1.40 | --- |
| EN 10263-5:2001 | X6CrMo17-1 | --- | 1.4113 | 0.08 | 1.00 | 1.00 | 0.040 | 0.030 | 16.00-18.00 | --- | 0.90-1.40 | --- |
| GB 1220-92 | Grade 1Cr17Mo | --- | --- | 0.12 | 1.00 | 1.00 | 0.035 | 0.030 | 16.00-18.00 | 0.60 | 0.75-1.25 | --- |
| ISO 4954:1993 | Type X 6 CrMo 17 1 E | --- | --- | 0.08 | 1.00 | 1.00 | 0.040 | 0.030 | 16.0-18.0 | 1.0 | 0.90-1.30 | --- |
| JIS G 4303:2012 | Symbol SUS434 | --- | --- | 0.12 | 1.00 | 1.00 | 0.040 | 0.030 | 16.00-18.00 | 0.60 | 0.75-1.25 | --- |
| ASME SA-276 | Type XM-27 | S44627 | --- | 0.010 | 0.40 | 0.40 | 0.020 | 0.020 | 25.00-27.50 | 0.50 | 0.75-1.50 | (Ni+Cu) 0.50 max.; Cu 0.20; Cb 0.05-0.20; N 0.015 |
| ASME SA-479/SA-479M | Type XM-27 | S44627 | --- | 0.010 | 0.40 | 0.40 | 0.020 | 0.020 | 25.0-27.5 | 0.50 | 0.75-1.50 | (Ni+Cu) 0.50 max.; Cu 0.20; Cb 0.05-0.20; N 0.015 |
| ASTM A276/A276M-15 | Type XM-27 | S44627 | --- | 0.010 | 0.40 | 0.40 | 0.020 | 0.020 | 25.0-27.5 | 0.50 | 0.75-1.50 | (Ni+Cu) 0.50 max.; Cu 0.20; Cb 0.05-0.20; N 0.015 |
| ASTM A479/A479M-14 | Type XM-27 | S44627 | --- | 0.010 | 0.40 | 0.40 | 0.020 | 0.020 | 25.0-27.5 | 0.50 | 0.75-1.50 | (Ni+Cu) 0.50 max.; Cu 0.20; Cb 0.05-0.20; N 0.015 |
| GB 1220-92 | Grade 00Cr27Mo | --- | --- | 0.010 | 0.40 | 0.40 | 0.030 | 0.020 | 25.00-27.50 | 0.50 | 0.75-1.50 | (Ni+Cu) 0.50 max.; Cu 0.20; N 0.015 |
| JIS G 4303:2012 | Symbol SUSXM27 | --- | --- | 0.010 | 0.40 | 0.40 | 0.030 | 0.020 | 25.00-27.50 | 0.50 | 0.75-1.50 | (Ni+Cu) 0.50 max.; Cu 0.20; N 0.015 |
| ASME SA-276 | Type 446 | S44600 | --- | 0.20 | 1.50 | 1.00 | 0.040 | 0.030 | 23.00-27.00 | --- | --- | N 0.25 |
| ASTM A276/A276M-15 | Type 446 | S44600 | --- | 0.20 | 1.50 | 1.00 | 0.040 | 0.030 | 23.0-27.0 | 0.75 | --- | N 0.25 |
| EN 10095:1999 | X18CrN28 | --- | 1.4749 | 0.15-0.20 | 1.00 | 1.00 | 0.040 | 0.015 | 26.00-29.00 | --- | --- | N 0.15-0.25 |
| GB 1221-92 | Grade 2Cr25N | --- | --- | 0.20 | 1.50 | 1.00 | 0.040 | 0.030 | 23.00-27.00 | --- | --- | Cu 0.30; N 0.25 |
| JIS G 4311:2011 | Symbol SUH446 | --- | --- | 0.20 | 1.50 | 1.00 | 0.040 | 0.030 | 23.00-27.00 | 0.60 | --- | Cu 0.30; N 0.25 |
| ASME SA-276 | --- | S44700 | --- | 0.010 | 0.30 | 0.20 | 0.025 | 0.020 | 28.00-30.00 | 0.15 | 3.50-4.20 | (C+N) 0.025 max.; Cu 0.15; N 0.020 |
| ASME SA-479/SA-479M | --- | S44700 | --- | 0.010 | 0.30 | 0.20 | 0.025 | 0.020 | 28.0-30.0 | 0.15 | 3.5-4.2 | (C+N) 0.025 max.; Cu 0.15; N 0.020 |
| ASTM A276/A276M-15 | --- | S44700 | --- | 0.010 | 0.30 | 0.20 | 0.025 | 0.020 | 28.0-30.0 | 0.15 | 3.5-4.2 | (C+N) 0.025 max.; Cu 0.15; N 0.020 |
| ASTM A479/A479M-14 | --- | S44700 | --- | 0.010 | 0.30 | 0.20 | 0.025 | 0.020 | 28.0-30.0 | 0.15 | 3.5-4.2 | (C+N) 0.025 max.; Cu 0.15; N 0.020 |
| GB 1220-92 | Grade 00Cr30Mo2 | --- | --- | 0.010 | 0.40 | 0.40 | 0.030 | 0.020 | 28.50-32.00 | 0.50 | 1.50-2.50 | (Ni+Cu) 0.50 max.; Cu 0.20; N 0.015 |
| JIS G 4303:2012 | Symbol SUS447J1 | --- | --- | 0.010 | 0.40 | 0.40 | 0.030 | 0.020 | 28.50-32.00 | 0.50 | 1.50-2.50 | (Ni+Cu) 0.50 max.; Cu 0.20; N 0.015 |

**8.2 Stainless Steels: Bar**

**8.2.2B Mechanical Properties of Ferritic Stainless Steels**

| Specification | Designation | UNS No | Steel No | Section Thickness/Diameter mm | Section Thickness/Diameter in. | Yield Strength, min. MPa | Yield Strength, min. ksi | Tensile Strength, min. MPa | Tensile Strength, min. ksi | Elongation % min | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| EN 10088-3:2014 | X6Cr13 | --- | 1.4000 | t ≤ 25 | --- | 230 | --- | 400-630 | --- | 20 L | A | 200 max. HBW |
| ISO 4955:2005 | X6Cr13 | --- | --- | 0.5 ≤ t < 3 | --- | 230 | --- | 400-630 | --- | 18 L, 18 T | A | 197 max. HB |
| | | | | 3 ≤ t ≤ 12 | --- | 230 | --- | 400-630 | --- | 20 L, 18 T | A | 197 max. HB |
| | | | | 5 ≤ t ≤ 15 | --- | 230 | --- | 400-630 | --- | 20 | A | 197 max. HB |
| | | | | 5 ≤ t ≤ 25 | --- | 230 | --- | 400-630 | --- | 20 | A | 197 max. HB |
| | | | | 1.5 ≤ t ≤ 25 | --- | 230 | --- | 400-630 | --- | 20 | A | 197 max. HB |
| ASME SA-276 | Type 405 | S40500 | --- | --- | --- | --- | --- | --- | --- | --- | A and HF | 207 max. HB |
| | | | | --- | --- | --- | --- | --- | --- | --- | A and CF | 217 max. HB |
| ASME SA-479/SA-479M | Type 405 | S40500 | --- | --- | --- | 170 | 25 | 415 | 60 | 20 | A | 207 max. HB |
| ASTM A276/A276M-15 | Type 405 | S40500 | --- | --- | --- | --- | --- | --- | --- | --- | A+HF | 207 max. HBW |
| | | | | --- | --- | --- | --- | --- | --- | --- | A+CF | 217 max. HBW |
| ASTM A479/A479M-14 | Type 405 | S40500 | --- | --- | --- | 170 | 25 | 415 | 60 | 20 | A | 207 max. HB |
| GB 1220-92 | Grade 0Cr13Al | --- | --- | t ≤ 75 | --- | 177 | --- | 410 | --- | 20 | A | 183 max. HB; 78 J @ RT |
| GB 1221-92 | Grade 0Cr13Al | --- | --- | t ≤ 75 | --- | 177 | --- | 410 | --- | 20 | A | 183 min. HB |
| JIS G 4303:2012 | Symbol SUS405 | --- | --- | d ≤ 75 | --- | 175 | --- | 410 | --- | 20 | A | 183 max. HBW; 90 max. HRBW; 200 max. HV |
| EN 10088-3:2014 | X2CrNi12 | --- | 1.4003 | t ≤ 100 | --- | 260 | --- | 450-600 | --- | 20 L | --- | 200 max. HBW |
| GB 1220-92 | Grade 00Cr12 | --- | --- | t ≤ 75 | --- | 196 | --- | 265 | --- | 22 | A | 183 max. HB |
| GB 1221-92 | Grade 00Cr12 | --- | --- | t ≤ 75 | --- | 196 | --- | 365 | --- | 22 | A | 183 min. HB |
| JIS G 4303:2012 | Symbol SUS410L | --- | --- | d ≤ 75 | --- | 195 | --- | 360 | --- | 22 | A | 183 max. HBW; 90 max. HRBW; 200 max. HV |

**8.2 Stainless Steels: Bar**

**8.2.2B Mechanical Properties of Ferritic Stainless Steels (Continued)**

| Specification | Designation | UNS No | Steel No | Section Thickness/Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | % min | | |
| EN 10088-3:2014 | X6Cr17 | --- | 1.4016 | 0.05 < d ≤ 0.10 | --- | --- | --- | 950 max. | --- | 10 | A | --- |
| | | | | 0.10 < d ≤ 0.20 | --- | --- | --- | 900 max. | --- | 10 | A | --- |
| | | | | 0.20 < d ≤ 0.50 | --- | --- | --- | 850 max. | --- | 15 | A | --- |
| | | | | 0.50 < d ≤ 1.00 | --- | --- | --- | 850 max. | --- | 15 | A | --- |
| | | | | 1.00 < d ≤ 3.00 | --- | --- | --- | 800 max. | --- | 15 | A | --- |
| | | | | 3.00 < d ≤ 5.00 | --- | --- | --- | 750 max. | --- | 15 | A | --- |
| | | | | t ≤ 10 | --- | 320 | --- | 500-750 | --- | 8 | A | --- |
| | | | | 10 < t ≤ 16 | --- | 300 | --- | 480-750 | --- | 8 | A | --- |
| | | | | 5.00 < d ≤ 16.00 | --- | --- | --- | 700 max. | --- | 20 | A | --- |
| | | | | 16 < t ≤ 40 | --- | 240 | --- | 400-700 | --- | 15 | A | --- |
| | | | | 40 < t ≤ 63 | --- | 240 | --- | 400-700 | --- | 15 | A | --- |
| | | | | t ≤ 100 | --- | 240 | --- | 400-630 | --- | 20 L | A | 200 max. HBW |
| | | | | 63 < t ≤ 100 | --- | 240 | --- | 400-630 | --- | 20 | A | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 500-700 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 600-800 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 700-900 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 800-1000 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 900-1100 | --- | --- | --- | --- |
| EN 10263-5:2001 | X6Cr17 | --- | 1.4016 | 2 < d ≤ 5 | --- | --- | --- | 560 max. L | --- | --- | CD+A | --- |
| | | | | 2 < d ≤ 5 | --- | --- | --- | 620 max. L | --- | --- | CD+A | --- |
| | | | | 5 < d ≤ 10 | --- | --- | --- | 560 max. L | --- | --- | A | --- |
| | | | | 5 < d ≤ 10 | --- | --- | --- | 660 max. L | --- | --- | A | --- |
| | | | | 5 < d ≤ 10 | --- | --- | --- | 560 max. L | --- | --- | CD+A | --- |
| | | | | 5 < d ≤ 10 | --- | --- | --- | 600 max. L | --- | --- | CD+A | --- |
| | | | | 10 < d ≤ 25 | --- | --- | --- | 560 max. L | --- | --- | A | --- |
| | | | | 10 < d ≤ 25 | --- | --- | --- | 640 max. L | --- | --- | A | --- |
| | | | | 10 < d ≤ 25 | --- | --- | --- | 560 max. L | --- | --- | CD+A | --- |
| ISO 4954:1993 | Type X 6 Cr 17 E | --- | --- | 2 ≤ d ≤ 25 | --- | --- | --- | 560 max. | --- | --- | A, CW | --- |
| | | | | 2 ≤ d ≤ 25 | --- | --- | --- | 600 max. | --- | --- | A, CW | --- |
| ISO 4955:2005 | X6Cr17 | --- | --- | 0.5 ≤ t < 3 | --- | 250 | --- | 430-630 | --- | 18 L, 18 T | A | 197 max. HB |
| | | | | 3 ≤ t ≤ 12 | --- | 250 | --- | 430-630 | --- | 20 L, 18 T | A | 197 max. HB |
| | | | | 5 ≤ t ≤ 15 | --- | 250 | --- | 430-630 | --- | 20 | A | 197 max. HB |
| | | | | 1.5 ≤ t ≤ 25 | --- | 250 | --- | 430-630 | --- | 20 | A | 197 max. HB |
| | | | | 5 ≤ t ≤ 25 | --- | 250 | --- | 430-630 | --- | 20 | A | 197 max. HB |

**8.2 Stainless Steels: Bar**

**8.2.2B Mechanical Properties of Ferritic Stainless Steels (Continued)**

| Specification | Designation | UNS No | Steel No | Section Thickness/Diameter mm | Section Thickness/Diameter in. | Yield Strength, min. MPa | Yield Strength, min. ksi | Tensile Strength, min. MPa | Tensile Strength, min. ksi | Elongation % min | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ASME SA-276 | Type 430 | S43000 | --- | --- | --- | 207 | 30 | 415 | 60 | 20 | A and HF or A and CF | --- |
| ASME SA-479/SA-479M | Type 430 | S43000 | --- | --- | --- | 275 | 40 | 485 | 70 | 20 | A | 192 max. HB |
| ASTM A276/A276M-15 | Type 430 | S43000 | --- | --- | --- | 207 | 30 | 415 | 60 | 20 | A+HF or A+CF | --- |
| ASTM A479/A479M-14 | Type 430 | S43000 | --- | --- | --- | 275 | 40 | 485 | 70 | 20 | A | 192 max. HB |
| GB 1220-92 | Grade 1Cr17 | --- | --- | t ≤ 75 | --- | 205 | --- | 450 | --- | 22 | A | 183 max. HB |
| GB 1221-92 | Grade 1Cr17 | --- | --- | t ≤ 75 | --- | 205 | --- | 450 | --- | 22 | A | 183 min. HB |
| JIS G 4303:2012 | Symbol SUS430 | --- | --- | d ≤ 75 | --- | 205 | --- | 450 | --- | 22 | A | 183 max. HBW; 90 max. HRBW; 200 max. HV |
| ASTM A582/A582M-12e1 | Type 430F | S43020 | --- | --- | --- | --- | --- | --- | --- | --- | A | 262 max. HBW |
| EN 10088-3:2014 | X6CrMoS17 | --- | 1.4105 | 0.05 < d ≤ 0.10 | --- | --- | --- | 950 max. | --- | 10 | A | --- |
| | | | | 0.10 < d ≤ 0.20 | --- | --- | --- | 900 max. | --- | 10 | A | --- |
| | | | | 0.20 < d ≤ 0.50 | --- | --- | --- | 850 max. | --- | 15 | A | --- |
| | | | | 0.50 < d ≤ 1.00 | --- | --- | --- | 850 max. | --- | 15 | A | --- |
| | | | | 1.00 < d ≤ 3.00 | --- | --- | --- | 800 max. | --- | 15 | A | --- |
| | | | | 3.00 < d ≤ 5.00 | --- | --- | --- | 750 max. | --- | 15 | A | --- |
| | | | | t ≤ 10 | --- | 330 | --- | 530-780 | --- | 7 | A | --- |
| | | | | 10 < t ≤ 16 | --- | 310 | --- | 500-780 | --- | 7 | A | --- |
| | | | | 5.00 < d ≤ 16.00 | --- | --- | --- | 700 max. | --- | 20 | A | --- |
| | | | | 16 < t ≤ 40 | --- | 250 | --- | 430-730 | --- | 12 | A | --- |
| | | | | 40 < t ≤ 63 | --- | 250 | --- | 430-730 | --- | 12 | A | --- |
| | | | | t ≤ 100 | --- | 250 | --- | 430-630 | --- | 20 L | A | 200 max. HBW |
| | | | | 63 < t ≤ 100 | --- | 250 | --- | 430-630 | --- | 20 | A | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 500-700 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 600-800 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 700-900 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 800-1000 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 900-1100 | --- | --- | --- | --- |
| GB 1220-92 | Grade Y1Cr17 | --- | --- | t ≤ 75 | --- | 205 | --- | 450 | --- | 22 | A | 183 max. HB |
| ISO 16143-2:2004 | X7CrS17 | --- | --- | t ≤ 75 | --- | 250 | --- | 430 | --- | 20 L | A | 262 max. HBW |
| JIS G 4303:2012 | Symbol SUS430F | --- | --- | d ≤ 75 | --- | 205 | --- | 450 | --- | 22 | A | 183 max. HBW; 90 max. HRBW; 200 max. HV |
| ASTM A582/A582M-12e1 | --- | S18235 | --- | --- | --- | --- | --- | --- | --- | --- | A | 207 max. HBW |
| EN 10088-3:2014 | X2CrMoTiS18-2 | --- | 1.4523 | t ≤ 100 | --- | 280 | --- | 430-600 | --- | 15 L | A | 200 max. HBW |

**8.2 Stainless Steels: Bar**

**8.2.2B Mechanical Properties of Ferritic Stainless Steels (Continued)**

| Specification | Designation | UNS No | Steel No | Section Thickness/Diameter mm | Section Thickness/Diameter in. | Yield Strength, min. MPa | Yield Strength, min. ksi | Tensile Strength, min. MPa | Tensile Strength, min. ksi | Elongation % min | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| EN 10088-3:2014 | X6CrMo17-1 | --- | 1.4113 | 0.05 < d ≤ 0.10 | --- | --- | --- | 950 max. | --- | 10 | A | --- |
| | | | | 0.10 < d ≤ 0.20 | --- | --- | --- | 900 max. | --- | 10 | A | --- |
| | | | | 0.20 < d ≤ 0.50 | --- | --- | --- | 850 max. | --- | 15 | A | --- |
| | | | | 0.50 < d ≤ 1.00 | --- | --- | --- | 850 max. | --- | 15 | A | --- |
| | | | | 1.00 < d ≤ 3.00 | --- | --- | --- | 800 max. | --- | 15 | A | --- |
| | | | | 3.00 < d ≤ 5.00 | --- | --- | --- | 750 max. | --- | 15 | A | --- |
| | | | | t ≤ 10 | --- | 340 | --- | 540-700 | --- | 8 | A | --- |
| | | | | 10 < t ≤ 16 | --- | 320 | --- | 500-700 | --- | 12 | A | --- |
| | | | | 5.00 < d ≤ 16.00 | --- | --- | --- | 700 max. | --- | 20 | A | --- |
| | | | | 16 < t ≤ 40 | --- | 280 | --- | 440-700 | --- | 15 | A | --- |
| | | | | 40 < t ≤ 63 | --- | 280 | --- | 440-700 | --- | 15 | A | --- |
| | | | | t ≤ 100 | --- | 280 | --- | 440-660 | --- | 18 L | A | 200 max. HBW |
| | | | | 63 < t ≤ 100 | --- | 280 | --- | 440-660 | --- | 18 | A | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 500-700 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 600-800 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 700-900 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 800-1000 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 900-1100 | --- | --- | --- | --- |
| EN 10263-5:2001 | X6CrMo17-1 | --- | 1.4113 | 2 < d ≤ 5 | --- | --- | --- | 600 max. L | --- | --- | CD+A | --- |
| | | | | 2 < d ≤ 5 | --- | --- | --- | 660 max. L | --- | --- | CD+A | --- |
| | | | | 5 < d ≤ 10 | --- | --- | --- | 600 max. L | --- | --- | A | --- |
| | | | | 5 < d ≤ 10 | --- | --- | --- | 710 max. L | --- | --- | A | --- |
| | | | | 5 < d ≤ 10 | --- | --- | --- | 600 max. L | --- | --- | CD+A | --- |
| | | | | 5 < d ≤ 10 | --- | --- | --- | 640 max. L | --- | --- | CD+A | --- |
| | | | | 10 < d ≤ 25 | --- | --- | --- | 600 max. L | --- | --- | A | --- |
| | | | | 10 < d ≤ 25 | --- | --- | --- | 690 max. L | --- | --- | A | --- |
| | | | | 10 < d ≤ 25 | --- | --- | --- | 600 max. L | --- | --- | CD+A | --- |
| GB 1220-92 | Grade 1Cr17Mo | --- | --- | t ≤ 75 | --- | 205 | --- | 450 | --- | 22 | A | 183 max. HB |
| ISO 4954:1993 | Type X 6 CrMo 17 1 E | --- | --- | 2 ≤ d ≤ 25 | --- | --- | --- | 600 max. | --- | --- | A, CW | --- |
| | | | | 2 ≤ d ≤ 25 | --- | --- | --- | 640 max. | --- | --- | A, CW | --- |
| JIS G 4303:2012 | Symbol SUS434 | --- | --- | d ≤ 75 | --- | 205 | --- | 450 | --- | 22 | A | 183 max. HBW; 90 max. HRBW; 200 max. HV |

**8.2 Stainless Steels: Bar**

**8.2.2B Mechanical Properties of Ferritic Stainless Steels (Continued)**

| Specification | Designation | UNS No | Steel No | Section Thickness/Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation % min | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | | | |
| ASME SA-276 | Type XM-27 | S44627 | --- | --- | --- | 275 | 40 | 450 | 65 | 20 | A and HF | 219 max. HB |
| | | | | --- | --- | 275 | 40 | 450 | 65 | 16 | A and CF | 219 max. HB |
| ASME SA-479/SA-479M | Type XM-27 | S44627 | --- | --- | --- | 275 | 40 | 450 | 65 | --- | A | 217 max. HB |
| ASTM A276/A276M-15 | Type XM-27 | S44627 | --- | --- | --- | 275 | 40 | 450 | 65 | 20 | A+HF | 219 max. HBW |
| | | | | --- | --- | 275 | 40 | 450 | 65 | 16 | A+CF | 219 max. HBW |
| ASTM A479/A479M-14 | Type XM-27 | S44627 | --- | --- | --- | 275 | 40 | 450 | 65 | --- | A | 217 max. HB |
| GB 1220-92 | Grade 00Cr27Mo | --- | --- | t ≤ 75 | --- | 245 | --- | 410 | --- | 20 | A | 219 max. HB |
| JIS G 4303:2012 | Symbol SUSXM27 | --- | --- | d ≤ 75 | --- | 245 | --- | 410 | --- | 20 | A | 219 max. HBW; 96 max. HRBW; 230 max. HV |
| ASME SA-276 | Type 446 | S44600 | --- | --- | --- | 275 | 40 | 450 | 65 | 20 | A and HF | 219 max. HB |
| | | | | --- | --- | 275 | 40 | 450 | 65 | 16 | A and CF | 219 max. HB |
| ASTM A276/A276M-15 | Type 446 | S44600 | --- | --- | --- | 275 | 40 | 450 | 65 | 20 | A+HF | 219 max. HBW |
| | | | | --- | --- | 275 | 40 | 450 | 65 | 16 | A+CF | 219 max. HBW |
| EN 10095:1999 | X18CrN28 | --- | 1.4749 | 0.5 ≤ t < 3 | --- | 280 | --- | 500-700 | --- | 13 L, 13 T | A | 212 max. HB |
| | | | | 3 ≤ t ≤ 12 | --- | 280 | --- | 500-700 | --- | 15 L, 15 T | A | 212 max. HB |
| | | | | t ≤ 25 | --- | 280 | --- | 500-700 L | --- | 15 L | A | 212 max. HB |
| GB 1221-92 | Grade 2Cr25N | --- | --- | t ≤ 75 | --- | 275 | --- | 510 | --- | 20 | A | 201 max. HB |
| JIS G 4311:2011 | Symbol SUH446 | --- | --- | --- | --- | 275 | --- | 510 | --- | 20 | A | 201 max. HBW |
| ASME SA-276 | Type 447 | S44700 | --- | --- | --- | 380 | 55 | 480 | 70 | 20 | A and HF | --- |
| | | | | --- | --- | 415 | 60 | 520 | 75 | 15 | A and CF | --- |
| ASME SA-479/SA-479M | --- | S44700 | --- | --- | --- | 380 | 55 | 485 | 70 | 20 | A | --- |
| ASTM A276/A276M-15 | Type 447 | S44700 | --- | --- | --- | 380 | 55 | 480 | 70 | 20 | A+HF | --- |
| | | | | --- | --- | 415 | 60 | 520 | 75 | 15 | A+CF | --- |
| ASTM A479/A479M-14 | --- | S44700 | --- | --- | --- | 380 | 55 | 485 | 70 | 20 | A | --- |
| GB 1220-92 | Grade 00Cr30Mo2 | --- | --- | t ≤ 75 | --- | 295 | --- | 450 | --- | 20 | A | 228 max. HB |
| JIS G 4303:2012 | Symbol SUS447J1 | --- | --- | d ≤ 75 | --- | 295 | --- | 450 | --- | 20 | A | 228 max. HBW; 98 max. HRBW; 241 max. HV |

**8.2 Stainless Steels: Bar**

**8.2.3A Chemical Composition of Austenitic Stainless Steels**

| Specification | Designation | UNS No | Steel No | Weight, %, max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASME SA-276 | Type 201 | S20100 | --- | 0.15 | 5.50-7.50 | 1.00 | 0.060 | 0.030 | 16.00-18.00 | 3.50-5.50 | --- | N 0.25 |
| ASTM A276/A276M-15 | Type 201 | S20100 | --- | 0.15 | 5.5-7.5 | 1.00 | 0.060 | 0.030 | 16.0-18.0 | 3.5-5.5 | --- | N 0.25 |
| EN 10088-3:2014 | X12CrMnNiN17-7-5 | --- | 1.4372 | 0.15 | 5.5-7.5 | 1.00 | 0.045 | 0.015 | 16.0-18.0 | 3.5-5.5 | --- | N 0.05-0.25 |
| GB 1220-92 | Grade 1Cr17Mn6Ni5N | --- | --- | 0.15 | 5.50-7.50 | 1.00 | 0.060 | 0.030 | 16.00-18.00 | 3.50-5.50 | --- | N 0.25 |
| JIS G 4303:2012 | Symbol SUS201 | --- | --- | 0.15 | 5.50-7.50 | 1.00 | 0.060 | 0.030 | 16.00-18.00 | 3.50-5.50 | --- | N 0.25 |
| ASME SA-276 | Type 202 | S20200 | --- | 0.15 | 7.50-10.00 | 1.00 | 0.060 | 0.030 | 17.00-19.00 | 4.00-6.00 | --- | N 0.25 |
| ASTM A276/A276M-15 | Type 202 | S20200 | --- | 0.15 | 7.5-10.0 | 1.00 | 0.060 | 0.030 | 17.0-19.0 | 4.0-6.0 | --- | N 0.25 |
| GB 1220-92 | Grade 1Cr18Mn8Ni5N | --- | --- | 0.15 | 7.50-10.00 | 1.00 | 0.060 | 0.030 | 17.00-19.00 | 4.00-6.00 | --- | N 0.25 |
| JIS G 4303:2012 | Symbol SUS202 | --- | --- | 0.15 | 7.50-10.00 | 1.00 | 0.060 | 0.030 | 17.00-19.00 | 4.00-6.00 | --- | N 0.25 |
| EN 10088-3:2014 | X10CrNi18-8 | --- | 1.4310 | 0.05-0.15 | 2.00 | 2.00 | 0.045 | 0.015 | 16.0-19.0 | 6.0-9.5 | 0.80 | N 0.10 |
| EN 10263-5:2001 | X10CrNi18-8 | --- | 1.4310 | 0.05-0.15 | 2.00 | 2.00 | 0.045 | 0.015 | 16.00-19.00 | 6.00-9.50 | 0.80 | Cu 1.00; N 0.11 |
| GB 1220-92 | Grade 1Cr17Ni7 | --- | --- | 0.15 | 2.00 | 1.00 | 0.035 | 0.030 | 16.00-18.00 | 6.00-8.00 | --- | --- |
| JIS G 4303:2012 | Symbol SUS301 | --- | --- | 0.15 | 2.00 | 1.00 | 0.045 | 0.030 | 16.00-18.00 | 6.00-8.00 | --- | --- |
| ASME SA-276 | Type 302 | S30200 | --- | 0.15 | 2.00 | 1.00 | 0.045 | 0.030 | 17.00-19.00 | 8.00-10.00 | --- | N 0.10 |
| ASME SA-479/SA-479M | Type 302 | S30200 | --- | 0.15 | 2.00 | 1.00 | 0.045 | 0.030 | 17.0-19.0 | 8.0-10.0 | --- | N 0.10 |
| ASTM A276/A276M-15 | Type 302 | S30200 | --- | 0.15 | 2.00 | 1.00 | 0.045 | 0.030 | 17.0-19.0 | 8.0-10.0 | --- | N 0.10 |
| ASTM A479/A479M-14 | Type 302 | S30200 | --- | 0.15 | 2.00 | 1.00 | 0.045 | 0.030 | 17.0-19.0 | 8.0-10.0 | --- | N 0.10 |
| ISO 4954:1993 | Type X 10 CrNi 18 9 E | --- | --- | 0.12 | 2.00 | 1.00 | 0.045 | 0.030 | 17.0-19.0 | 8.0-10.0 | --- | --- |
| JIS G 4303:2012 | Symbol SUS302 | --- | --- | 0.15 | 2.00 | 1.00 | 0.045 | 0.030 | 17.00-19.00 | 8.00-10.00 | --- | --- |
| JIS G 4318:1998 A1:2007 | Symbol SUS302 | --- | --- | 0.15 | 2.00 | 1.00 | 0.45 | 0.030 | 17.00-19.00 | 8.00-10.00 | --- | --- |
| ASTM A582/A582M-12e1 | Type 303 | S30300 | --- | 0.15 | 2.00 | 1.00 | 0.20 | 0.15 min. | 17.0-19.0 | 8.0-10.0 | --- | --- |
| EN 10088-3:2014 | X8CrNiS18-9 | --- | 1.4305 | 0.10 | 2.00 | 1.00 | 0.045 | 0.15-0.35 | 17.0-19.0 | 8.0-10.0 | --- | Cu 1.00; N 0.10 |
| EN 10294-2:2012 | X8CrNiS18-9 | --- | 1.4305 | 0.10 | 2.00 | 1.00 | 0.040 | 0.15-0.35 | 17.0-19.0 | 8.0-10.0 | --- | Cu 1.00; N 0.10 |
| GB 1220-92 | Grade Y1Cr18Ni9 | --- | --- | 0.15 | 2.00 | 1.00 | 0.20 | 0.15 min. | 17.00-19.00 | 8.00-10.00 | 0.60 | --- |
| GB 4226-84 | Grade Y1Cr18Ni9 | --- | --- | 0.15 | 2.00 | 1.00 | 0.20 | 0.15 min. | 17.00-19.00 | 8.00-10.00 | 0.60 | --- |
| JIS G 4303:2012 | Symbol SUS303 | --- | --- | 0.15 | 2.00 | 1.00 | 0.20 | 0.15 min. | 17.00-19.00 | 8.00-10.00 | 0.60 | --- |
| JIS G 4318:1998 A1:2007 | Symbol SUS303 | --- | --- | 0.15 | 2.00 | 1.00 | 0.20 | 0.15 min. | 17.00-19.00 | 8.00-10.00 | 0.60 | --- |
| ASTM A582/A582M-12e1 | Type 303Se | S30323 | --- | 0.15 | 2.00 | 1.00 | 0.20 | 0.06 | 17.0-19.0 | 8.0-10.0 | --- | Se 0.15 min. |
| GB 1220-92 | Grade Y1Cr18Ni9Se | --- | --- | 0.15 | 2.00 | 1.00 | 0.20 | 0.060 | 17.00-19.00 | 8.00-10.00 | --- | Se 0.15 min. |
| GB 4226-84 | Grade Y1Cr18Ni9Se | --- | --- | 0.15 | 2.00 | 1.00 | 0.20 | 0.060 | 17.00-19.00 | 8.00-10.00 | --- | Se 0.15 min. |
| JIS G 4303:2012 | Symbol SUS303Se | --- | --- | 0.15 | 2.00 | 1.00 | 0.20 | 0.060 | 17.00-19.00 | 8.00-10.00 | --- | Se 0.15 min. |
| JIS G 4318:1998 A1:2007 | Symbol SUS303Se | --- | --- | 0.15 | 2.00 | 1.00 | 0.20 | 0.060 | 17.00-19.00 | 8.00-10.00 | --- | Se 0.15 min. |

**8.2 Stainless Steels: Bar**

**8.2.3A Chemical Composition of Austenitic Stainless Steels (Continued)**

| Specification | Designation | UNS No | Steel No | Weight, %, max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASME SA-276 | Type 304 | S30400 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 18.00-20.00 | 8.00-10.50 | --- | N 0.10 |
| ASME SA-479/SA-479M | Type 304 | S30400 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 18.0-20.0 | 8.0-10.5 | --- | --- |
| ASME SA-666 | Type 304 | S30400 | --- | 0.08 | 2.00 | 0.75 | 0.045 | 0.030 | 18.0-20.0 | 8.0-10.5 | --- | N 0.10 |
| ASTM A276/A276M-15 | Type 304 | S30400 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 18.0-20.0 | 8.0-11.0 | --- | --- |
| ASTM A314-13a | Type 304 | S30400 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 18.00-20.00 | 8.00-10.50 | --- | N 0.10 |
| ASTM A479/A479M-14 | Type 304 | S30400 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 18.0-20.0 | 8.0-10.5 | --- | --- |
| ASTM A666-15 | Type 304 | S30400 | --- | 0.08 | 2.00 | 0.75 | 0.045 | 0.030 | 18.0-20.0 | 8.0-10.5 | --- | N 0.10 |
| ASTM A955/A955M-15 | Grade 60 [420], Type 304 | S30400 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 18.00-20.00 | 8.00-10.50 | --- | N 0.10 |
| | Grade 75 [520], Type 304 | S30400 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 18.00-20.00 | 8.00-10.50 | --- | N 0.10 |
| EN 10088-3:2014 | X5CrNi18-10 | --- | 1.4301 | 0.07 | 2.00 | 1.00 | 0.045 | 0.030 | 17.5-19.5 | 8.0-10.5 | --- | N 0.10 |
| EN 10263-5:2001 | X5CrNi18-10 | --- | 1.4301 | 0.07 | 2.00 | 1.00 | 0.045 | 0.030 | 17.00-19.50 | 8.00-10.50 | --- | Cu 1.00; N 0.11 |
| EN 10294-2:2012 | X5CrNi18-10 | --- | 1.4301 | 0.07 | 2.00 | 1.00 | 0.040 | 0.015-0.030 | 17.5-19.5 | 8.0-10.5 | --- | N 0.10 |
| GB 1220-92 | Grade 0Cr18Ni9 | --- | --- | 0.07 | 2.00 | 1.00 | 0.035 | 0.030 | 17.00-19.00 | 8.00-11.00 | --- | --- |
| GB 1221-92 | Grade 0Cr18Ni9 | --- | --- | 0.07 | 2.00 | 1.00 | 0.035 | 0.030 | 17.00-19.00 | 8.00-11.00 | --- | --- |
| GB 4226-84 | Grade 0Cr19Ni9 | --- | --- | 0.08 | 2.00 | 1.00 | 0.035 | 0.030 | 18.00-20.00 | 8.00-10.50 | --- | --- |
| ISO 4954:1993 | Type X 5 CrNi 18 9 E | --- | --- | 0.07 | 2.00 | 1.00 | 0.045 | 0.030 | 17.0-19.0 | 8.0-11.0 | --- | --- |
| JIS G 4303:2012 | Symbol SUS304 | --- | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 18.00-20.00 | 8.00-10.50 | --- | --- |
| JIS G 4318:1998 A1:2007 | Symbol SUS304 | --- | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 18.00-20.00 | 8.00-10.50 | --- | --- |
| ASME SA-276 | Type 304L | S30403 | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 18.00-20.00 | 8.00-12.00 | --- | N 0.10 |
| ASME SA-479/SA-479M | Type 304L | S30403 | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 18.0-20.0 | 8.0-12.0 | --- | --- |
| ASME SA-666 | Type 304L | S30403 | --- | 0.030 | 2.00 | 0.75 | 0.045 | 0.030 | 18.0-20.0 | 8.0-12.0 | --- | N 0.10 |
| ASTM A276/A276M-15 | Type 304L | S30403 | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 18.0-20.0 | 8.0-12.0 | --- | --- |
| ASTM A314-13a | Type 304L | S30403 | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 18.00-20.00 | 8.00-12.00 | --- | N 0.10 |
| ASTM A479/A479M-14 | Type 304L | S30403 | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 18.0-20.0 | 8.0-12.0 | --- | --- |
| ASTM A666-15 | Type 304L | S30403 | --- | 0.030 | 2.00 | 0.75 | 0.045 | 0.030 | 18.0-20.0 | 8.0-12.0 | --- | N 0.10 |
| EN 10088-3:2014 | X2CrNi18-9 | --- | 1.4307 | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 17.5-19.5 | 8.0-10.5 | --- | N 0.10 |
| EN 10263-5:2001 | X2CrNi18-9 | --- | 1.4307 | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 17.50-19.50 | 8.00-10.00 | --- | Cu 1.00; N 0.11 |
| EN 10294-2:2012 | X2CrNi18-9 | --- | 1.4307 | 0.030 | 2.00 | 1.00 | 0.040 | 0.015-0.030 | 17.5-19.5 | 8.0-10.5 | --- | N 0.10 |
| | X2CrNi19-11 | --- | 1.4306 | 0.030 | 2.00 | 1.00 | 0.040 | 0.015-0.030 | 17.0-19.0 | 10.0-12.0 | --- | N 0.10 |
| GB 1220-92 | Grade 00Cr19Ni10 | --- | --- | 0.030 | 2.00 | 1.00 | 0.035 | 0.030 | 18.00-20.00 | 8.00-12.00 | --- | --- |
| GB 4226-84 | Grade 00Cr19Ni11 | --- | --- | 0.030 | 2.00 | 1.00 | 0.035 | 0.030 | 18.00-20.00 | 9.00-13.00 | --- | --- |
| ISO 4954:1993 | Type X 2 CrNi 18 10 E | --- | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 17.0-19.0 | 9.0-12.0 | --- | --- |
| JIS G 4303:2012 | Symbol SUS304L | --- | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 18.00-20.00 | 9.00-13.00 | --- | --- |
| JIS G 4318:1998 A1:2007 | Symbol SUS304L | --- | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 18.00-20.00 | 9.00-13.00 | --- | --- |

**8.2 Stainless Steels: Bar**

**8.2.3A Chemical Composition of Austenitic Stainless Steels (Continued)**

| Specification | Designation | UNS No | Steel No | Weight, %, max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASME SA-276 | Type 304N | S30451 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 18.00-20.00 | 8.00-10.50 | --- | N 0.10-0.16 |
| ASME SA-479/SA-479M | Type 304N | S30451 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 18.0-20.0 | 8.0-12.0 | --- | N 0.10-0.16 |
| ASME SA-666 | Type 304N | S30451 | --- | 0.08 | 2.00 | 0.75 | 0.045 | 0.030 | 18.0-20.0 | 8.0-10.5 | --- | N 0.10-0.16 |
| ASTM A276/A276M-15 | Type 304N | S30451 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 18.0-20.0 | 8.0-11.0 | --- | N 0.10-0.16 |
| ASTM A479/A479M-14 | Type 304N | S30451 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 18.0-20.0 | 8.0-12.0 | --- | N 0.10-0.16 |
| ASTM A666-15 | Type 304N | S30451 | --- | 0.08 | 2.00 | 0.75 | 0.045 | 0.030 | 18.0-20.0 | 8.0-10.5 | --- | N 0.10-0.16 |
| GB 1220-92 | Grade 0Cr19Ni9N | --- | --- | 0.08 | 2.00 | 1.00 | 0.035 | 0.030 | 18.00-20.00 | 7.00-10.50 | --- | N 0.10-0.25 |
| JIS G 4303:2012 | Symbol SUS304N1 | --- | --- | 0.08 | 2.50 | 1.00 | 0.045 | 0.030 | 18.00-20.00 | 7.00-10.50 | --- | N 0.10-0.25 |
| EN 10088-3:2014 | X5CrNiN19-9 | --- | 1.4315 | 0.06 | 2.00 | 1.00 | 0.045 | 0.015 | 18.0-20.0 | 8.0-11.0 | --- | N 0.12-0.22 |
| ASME SA-276 | Type 304LN | S30453 | --- | 0.03 | 2.00 | 1.00 | 0.045 | 0.030 | 18.00-20.00 | 8.00-12.00 | --- | N 0.10-0.16 |
| ASME SA-479/SA-479M | Type 304LN | S30453 | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 18.0-20.0 | 8.0-11.0 | --- | N 0.10-0.16 |
| ASME SA-666 | Type 304LN | S30453 | --- | 0.030 | 2.00 | 0.75 | 0.045 | 0.030 | 18.0-20.0 | 8.0-12.0 | --- | N 0.10-0.16 |
| ASTM A276/A276M-15 | Type 304LN | S30453 | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 18.0-20.0 | 8.0-11.0 | --- | N 0.10-0.16 |
| ASTM A479/A479M-14 | Type 304LN | S30453 | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 18.0-20.0 | 8.0-11.0 | --- | N 0.10-0.16 |
| ASTM A666-15 | Type 304LN | S30453 | --- | 0.030 | 2.00 | 0.75 | 0.045 | 0.030 | 18.0-20.0 | 8.0-12.0 | --- | N 0.10-0.16 |
| EN 10088-3:2014 | X2CrNiN18-10 | --- | 1.4311 | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 17.5-19.5 | 8.5-11.5 | --- | N 0.12-0.22 |
| GB 1220-92 | Grade 00Cr18Ni10N | --- | --- | 0.030 | 2.00 | 1.00 | 0.035 | 0.030 | 17.00-19.00 | 8.50-11.50 | --- | N 0.12-0.22 |
| JIS G 4303:2012 | Symbol SUS304LN | --- | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 17.00-19.00 | 8.50-11.50 | --- | N 0.12-0.22 |
| ASME SA-479/SA-479M | Type 304H | S30409 | --- | 0.04-0.10 | 2.00 | 1.00 | 0.045 | 0.030 | 18.0-20.0 | 8.0-10.5 | --- | --- |
| ASTM A479/A479M-14 | Type 304H | S30409 | --- | 0.04-0.10 | 2.00 | 1.00 | 0.045 | 0.030 | 18.0-20.0 | 8.0-10.5 | --- | --- |
| EN 10088-3:2014 | X9CrNi18-9 | --- | 1.4325 | 0.03-0.15 | 2.00 | 1.00 | 0.045 | 0.030 | 17.0-19.0 | 8.0-10.0 | --- | --- |
| ISO 4955:2005 | X7CrNi18-9 | --- | --- | 0.04-0.10 | 2.00 | 1.00 | 0.045 | 0.030 | 17.0-19.0 | 8.0-11.0 | --- | --- |
| ASME SA-276 | Type XM-21 | S30452 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 18.00-20.00 | 8.00-10.50 | --- | N 0.16-0.30 |
| ASTM A276/A276M-15 | Type XM-21 | S30452 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 18.0-20.0 | 8.0-10.0 | --- | N 0.16-0.30 |
| GB 1220-92 | Grade 0Cr19Ni10NbN | --- | --- | 0.08 | 2.00 | 1.00 | 0.035 | 0.030 | 18.00-20.00 | 7.50-10.50 | --- | Nb 0.15; N 0.15-0.30 |
| JIS G 4303:2012 | Symbol SUS304N2 | --- | --- | 0.08 | 2.50 | 1.00 | 0.045 | 0.030 | 18.00-20.00 | 7.50-10.50 | --- | Nb 0.15; N 0.15-0.30 |
| ASME SA-276 | Type 305 | S30500 | --- | 0.12 | 2.00 | 1.00 | 0.045 | 0.030 | 17.00-19.00 | 10.50-13.00 | --- | --- |
| ASTM A276/A276M-15 | Type 305 | S30500 | --- | 0.12 | 2.00 | 1.00 | 0.045 | 0.030 | 17.0-19.0 | 11.0-13.0 | --- | --- |
| GB 1220-92 | Grade 1Cr18Ni12 | --- | --- | 0.12 | 2.00 | 1.00 | 0.035 | 0.030 | 17.00-19.00 | 10.50-13.00 | --- | --- |
| GB 4226-84 | Grade 1Cr18Ni12 | --- | --- | 0.12 | 2.00 | 1.00 | 0.035 | 0.030 | 17.00-19.00 | 10.50-13.00 | --- | --- |
| JIS G 4303:2012 | Symbol SUS305 | --- | --- | 0.12 | 2.00 | 1.00 | 0.045 | 0.030 | 17.00-19.00 | 10.50-13.00 | --- | --- |
| JIS G 4318:1998 A1:2007 | Symbol SUS305 | --- | --- | 0.12 | 2.00 | 1.00 | 0.045 | 0.030 | 17.00-19.00 | 10.50-13.00 | --- | --- |
| EN 10088-3:2014 | X4CrNi18-12 | --- | 1.4303 | 0.06 | 2.00 | 1.00 | 0.045 | 0.030 | 17.0-19.0 | 11.0-13.0 | --- | N 0.10 |
| EN 10263-5:2001 | X4CrNi18-12 | --- | 1.4303 | 0.06 | 2.00 | 1.00 | 0.045 | 0.030 | 17.00-19.00 | 11.00-13.00 | --- | N 0.11 |
| EN 10269:2013 | X4CrNi18-12 | --- | 1.4303 | 0.06 | 2.00 | 1.00 | 0.045 | 0.015 | 17.0-19.0 | 11.0-13.0 | --- | N 0.10 |
| GB 4226-84 | Grade 0Cr18Ni12 | --- | --- | 0.08 | 2.00 | 1.00 | 0.035 | 0.030 | 16.50-19.00 | 11.00-13.50 | --- | --- |
| ISO 4954:1993 | Type X 5 CrNi 18 12 E | --- | --- | 0.07 | 2.00 | 1.00 | 0.045 | 0.030 | 17.0-19.0 | 11.0-13.0 | --- | --- |
| JIS G 4318:1998 A1:2007 | Symbol SUS305J1 | --- | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 16.50-19.00 | 11.00-13.50 | --- | --- |

**8.2 Stainless Steels: Bar**

**8.2.3A Chemical Composition of Austenitic Stainless Steels (Continued)**

| Specification | Designation | UNS No | Steel No | Weight, %, max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASME SA-276 | Type 309 | S30900 | --- | 0.20 | 2.00 | 1.00 | 0.045 | 0.030 | 22.00-24.00 | 12.00-15.00 | --- | --- |
| ASTM A276/A276M-15 | Type 309 | S30900 | --- | 0.20 | 2.00 | 1.00 | 0.045 | 0.030 | 22.0-24.0 | 12.0-15.0 | --- | --- |
| GB 1221-92 | Grade 2Cr23Ni13 | --- | --- | 0.20 | 2.00 | 1.00 | 0.035 | 0.030 | 22.00-24.00 | 12.00-15.00 | --- | --- |
| JIS G 4311:2011 | Symbol SUH309 | --- | --- | 0.20 | 2.00 | 1.00 | 0.040 | 0.030 | 22.00-24.00 | 12.00-15.00 | --- | --- |
| ASME SA-276 | Type 309S | S30908 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 22.00-24.00 | 12.00-15.00 | --- | --- |
| ASME SA-479/SA-479M | Type 309S | S30908 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 22.0-24.0 | 12.0-15.0 | --- | --- |
| ASTM A276/A276M-15 | Type 309S | S30908 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 22.0-24.0 | 12.0-15.0 | --- | --- |
| ASTM A479/A479M-14 | Type 309S | S30908 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 22.0-24.0 | 12.0-15.0 | --- | --- |
| GB 1220-92 | Grade 0Cr23Ni13 | --- | --- | 0.08 | 2.00 | 1.00 | 0.035 | 0.030 | 22.00-24.00 | 12.00-15.00 | --- | --- |
| GB 1221-92 | Grade 0Cr23Ni13 | --- | --- | 0.08 | 2.00 | 1.00 | 0.035 | 0.030 | 22.00-24.00 | 12.00-15.00 | --- | --- |
| GB 4226-84 | Grade 0Cr23Ni13 | --- | --- | 0.08 | 2.00 | 1.00 | 0.035 | 0.030 | 22.00-24.00 | 12.00-15.00 | --- | --- |
| JIS G 4303:2012 | Symbol SUS309S | --- | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 22.00-24.00 | 12.00-15.00 | --- | --- |
| JIS G 4318:1998 A1:2007 | Symbol SUS309S | --- | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 22.00-24.00 | 12.00-15.00 | --- | --- |
| ASME SA-276 | Type 310 | S31000 | --- | 0.25 | 2.00 | 1.50 | 0.045 | 0.030 | 24.00-26.00 | 19.00-22.00 | --- | --- |
| ASTM A276/A276M-15 | Type 310 | S31000 | --- | 0.25 | 2.00 | 1.50 | 0.045 | 0.030 | 24.0-26.0 | 19.0-22.0 | --- | --- |
| GB 1221-92 | Grade 2Cr25Ni20 | --- | --- | 0.25 | 2.00 | 1.50 | 0.035 | 0.030 | 24.00-26.00 | 19.00-22.00 | --- | --- |
| JIS G 4311:2011 | Symbol SUH310 | --- | --- | 0.25 | 2.00 | 1.50 | 0.040 | 0.030 | 24.00-26.00 | 19.00-22.00 | --- | --- |
| ASME SA-276 | Type 310S | S31008 | --- | 0.08 | 2.00 | 1.50 | 0.045 | 0.030 | 24.00-26.00 | 19.00-22.00 | --- | --- |
| ASME SA-479/SA-479M | Type 310S | S31008 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 24.0-26.0 | 19.0-22.0 | --- | --- |
| ASTM A276/A276M-15 | Type 310S | S31008 | --- | 0.08 | 2.00 | 1.50 | 0.045 | 0.030 | 24.0-26.0 | 19.0-22.0 | --- | --- |
| ASTM A479/A479M-14 | Type 310S | S31008 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 24.0-26.0 | 19.0-22.0 | --- | --- |
| GB 1220-92 | Grade 0Cr25Ni20 | --- | --- | 0.08 | 2.00 | 1.00 | 0.035 | 0.030 | 24.00-26.00 | 19.00-22.00 | --- | --- |
| GB 1221-92 | Grade 0Cr25Ni20 | --- | --- | 0.08 | 2.00 | 1.50 | 0.035 | 0.030 | 24.00-26.00 | 19.00-22.00 | --- | --- |
| GB 4226-84 | Grade 0Cr25Ni20 | --- | --- | 0.08 | 2.00 | 1.00 | 0.035 | 0.030 | 24.00-26.00 | 19.00-22.00 | --- | --- |
| JIS G 4303:2012 | Symbol SUS310S | --- | --- | 0.08 | 2.00 | 1.50 | 0.045 | 0.030 | 24.00-26.00 | 19.00-22.00 | --- | --- |
| JIS G 4318:1998 A1:2007 | Symbol SUS310S | --- | --- | 0.08 | 2.00 | 1.50 | 0.045 | 0.030 | 24.00-26.00 | 19.00-22.00 | --- | --- |

**8.2 Stainless Steels: Bar**

**8.2.3A Chemical Composition of Austenitic Stainless Steels (Continued)**

| Specification | Designation | UNS No | Steel No | Weight, %, max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASME SA-276 | --- | S31254 | --- | 0.020 | 1.00 | 0.80 | 0.030 | 0.010 | 19.50-20.50 | 17.50-18.50 | 6.00-6.50 | Cu 0.50-1.00; N 0.18-0.22 |
| ASME SA-479/SA-479M | --- | S31254 | --- | 0.020 | 1.00 | 0.80 | 0.030 | 0.010 | 19.5-20.5 | 17.5-18.5 | 6.0-6.5 | Cu 0.50-1.00; N 0.18-0.22 |
| ASTM A276/A276M-15 | --- | S31254 | --- | 0.020 | 1.00 | 0.80 | 0.030 | 0.010 | 19.5-20.5 | 17.5-18.5 | 6.0-6.5 | Cu 0.50-1.00; N 0.18-0.25 |
| ASTM A479/A479M-14 | --- | S31254 | --- | 0.020 | 1.00 | 0.80 | 0.030 | 0.010 | 19.5-20.5 | 17.5-18.5 | 6.0-6.5 | Cu 0.50-1.00; N 0.18-0.25 |
| EN 10088-3:2014 | X1CrNiMoCuN20-18-7 | --- | 1.4547 | 0.020 | 1.00 | 0.70 | 0.030 | 0.010 | 19.5-20.5 | 17.5-18.5 | 6.0-7.0 | Cu 0.50-1.00; N 0.18-0.25 |
| JIS G 4303:2012 | Symbol SUS312L | --- | --- | 0.020 | 1.00 | 0.80 | 0.030 | 0.015 | 19.00-21.00 | 17.50-19.50 | 6.00-7.00 | Cu 0.50-1.00; N 0.16-0.25 |
| EN 10088-3:2014 | X1CrNiMoCuNW24-22-6 | --- | 1.4659 | 0.020 | 2.00-4.0 | 0.70 | 0.030 | 0.010 | 23.0-25.0 | 21.0-23.0 | 5.5-6.5 | Cu 1.00-2.00; W 1.50-2.50; N 0.35-0.50 |
| ISO 16143-2:2004 | X1CrNiMoCuNW24-22-6 | --- | --- | 0.020 | 2.00-4.00 | 0.70 | 0.030 | 0.010 | 23.0-25.0 | 21.0-23.0 | 5.5-6.5 | Cu 1.00-2.00; W 1.50-2.50; N 0.35-0.5 |
| ASTM A276/A276M-15 | --- | S32654 | --- | 0.020 | 2.0-4.0 | 0.50 | 0.030 | 0.005 | 24.0-25.0 | 21.0-23.0 | 7.0-8.0 | Cu 0.30-0.60; N 0.45-0.55 |
| ASTM A479/A479M-14 | --- | S32654 | --- | 0.020 | 2.0-4.0 | 0.50 | 0.030 | 0.005 | 24.0-25.0 | 21.0-23.0 | 7.0-8.0 | Cu 0.30-0.60; N 0.45-0.55 |
| EN 10088-3:2014 | X1CrNiMoCuN24-22-8 | --- | 1.4652 | 0.020 | 2.00-4.0 | 0.50 | 0.030 | 0.005 | 23.0-25.0 | 21.0-23.0 | 7.0-8.0 | Cu 0.30-0.60; N 0.45-0.55 |
| ISO 16143-2:2004 | X1CrNiMoCuN24-22-8 | --- | --- | 0.020 | 2.00-4.00 | 0.50 | 0.030 | 0.005 | 23.0-25.0 | 21.0-23.0 | 7.0-8.0 | Cu 0.30-0.60; N 0.45-0.55 |
| ASME SA-276 | Type 314 | S31400 | --- | 0.25 | 2.00 | 1.50-3.00 | 0.045 | 0.030 | 23.00-26.00 | 19.00-22.00 | --- | --- |
| ASTM A276/A276M-15 | Type 314 | S31400 | --- | 0.25 | 2.00 | 1.50-3.00 | 0.045 | 0.030 | 23.0-26.0 | 19.0-22.0 | --- | --- |
| GB 1221-92 | Grade 1Cr25Ni20Si2 | --- | --- | 0.20 | 1.50 | 1.50-2.50 | 0.035 | 0.030 | 24.00-27.00 | 18.00-21.00 | --- | --- |
| EN 10095:1999 | X15CrNiSi25-21 | --- | 1.4841 | 0.20 | 2.00 | 1.50-2.50 | 0.045 | 0.015 | 24.00-26.00 | 19.00-22.00 | --- | N 0.11 |
| ASME SA-276 | Type 316 | S31600 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 16.00-18.00 | 10.00-14.00 | 2.00-3.00 | N 0.10 |
| ASME SA-479/SA-479M | Type 316 | S31600 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 16.0-18.0 | 10.0-14.0 | 2.00-3.00 | --- |
| ASME SA-666 | Type 316 | S31600 | --- | 0.08 | 2.00 | 0.75 | 0.045 | 0.030 | 16.0-18.0 | 10.0-14.0 | 2.00-3.00 | --- |
| ASTM A276/A276M-15 | Type 316 | S31600 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 16.0-18.0 | 10.0-14.0 | 2.00-3.00 | --- |
| ASTM A479/A479M-14 | Type 316 | S31600 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 16.0-18.0 | 10.0-14.0 | 2.00-3.00 | --- |
| ASTM A666-15 | Type 316 | S31600 | --- | 0.08 | 2.00 | 0.75 | 0.045 | 0.030 | 16.0-18.0 | 10.0-14.0 | 2.00-3.00 | --- |
| EN 10088-3:2014 | X5CrNiMo17-12-2 | --- | 1.4401 | 0.07 | 2.00 | 1.00 | 0.045 | 0.030 | 16.5-18.5 | 10.0-13.0 | 2.00-2.50 | N 0.10 |
| | X3CrNiMo17-13-3 | --- | 1.4436 | 0.05 | 2.00 | 1.00 | 0.045 | 0.030 | 16.5-18.5 | 10.5-13.0 | 2.50-3.00 | N 0.10 |
| EN 10263-5:2001 | X5CrNiMo17-12-2 | --- | 1.4401 | 0.07 | 2.00 | 1.00 | 0.045 | 0.030 | 16.50-18.50 | 10.00-13.00 | 2.00-2.50 | Cu 1.00; N 0.11 |
| | X3CrNiMo17-13-3 | --- | 1.4436 | 0.05 | 2.00 | 1.00 | 0.045 | 0.015 | 16.50-18.50 | 10.50-13.00 | 2.50-3.00 | N 0.11 |
| EN 10294-2:2012 | X5CrNiMo17-12-2 | --- | 1.4401 | 0.07 | 2.00 | 1.00 | 0.040 | 0.015-0.030 | 16.5-18.5 | 10.0-13.0 | 2.00-2.50 | --- |
| GB 1220-92 | Grade 0Cr17Ni12Mo2 | --- | --- | 0.08 | 2.00 | 1.00 | 0.035 | 0.030 | 16.00-18.50 | 10.00-14.00 | 2.00-3.00 | --- |
| GB 1221-92 | Grade 0Cr17Ni12Mo2 | --- | --- | 0.08 | 2.00 | 1.00 | 0.035 | 0.030 | 16.00-18.00 | 10.00-14.00 | 2.00-3.00 | --- |
| GB 4226-84 | Grade 0Cr17Ni12Mo2 | --- | --- | 0.08 | 2.00 | 1.00 | 0.035 | 0.030 | 16.00-18.00 | 10.00-14.00 | 2.00-3.00 | --- |
| ISO 4954:1993 | Type X 5 CrNiMo 17 12 2 E | --- | --- | 0.07 | 2.00 | 1.00 | 0.045 | 0.030 | 16.5-18.5 | 10.5-13.5 | 2.0-2.5 | --- |
| JIS G 4303:2012 | Symbol SUS316 | --- | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 16.00-18.00 | 10.00-14.00 | 2.00-3.00 | --- |
| JIS G 4318:1998 A1:2007 | Symbol SUS316 | --- | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 16.00-18.00 | 10.00-14.00 | 2.00-3.00 | --- |

**8.2 Stainless Steels: Bar**

**8.2.3A Chemical Composition of Austenitic Stainless Steels (Continued)**

| Specification | Designation | UNS No | Steel No | Weight, %, max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASME SA-276 | Type 316L | S31603 | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 16.00-18.00 | 10.00-14.00 | 2.00-3.00 | N 0.10 |
| ASME SA-479/SA-479M | Type 316L | S31603 | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 16.0-18.0 | 10.0-14.0 | 2.00-3.00 | --- |
| ASME SA-666 | Type 316L | S31603 | --- | 0.030 | 2.00 | 0.75 | 0.045 | 0.030 | 16.0-18.0 | 10.0-14.0 | 2.00-3.00 | --- |
| ASTM A276/A276M-15 | Type 316L | S31603 | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 16.0-18.0 | 10.0-14.0 | 2.00-3.00 | --- |
| ASTM A479/A479M-14 | Type 316L | S31603 | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 16.0-18.0 | 10.0-14.0 | 2.00-3.00 | --- |
| ASTM A666-15 | Type 316L | S31603 | --- | 0.030 | 2.00 | 0.75 | 0.045 | 0.030 | 16.0-18.0 | 10.0-14.0 | 2.00-3.00 | --- |
| ASTM A955/A955M-15 | Grade 60 [420], Type 316L | S31603 | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 16.00-18.00 | 10.00-14.00 | 2.00-3.00 | N 0.10 |
| | Grade 75 [520], Type 316L | S31603 | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 16.00-18.00 | 10.00-14.00 | 2.00-3.00 | N 0.10 |
| EN 10088-3:2014 | X2CrNiMo17-12-2 | --- | 1.4404 | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 16.5-18.5 | 10.0-13.0 | 2.00-2.50 | N 0.10 |
| | X2CrNiMo17-12-3 | --- | 1.4432 | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 16.5-18.5 | 10.5-13.0 | 2.50-3.00 | N 0.10 |
| | X2CrNiMo18-14-3 | --- | 1.4435 | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 17.0-19.0 | 12.5-15.0 | 2.50-3.00 | N 0.10 |
| EN 10263-5:2001 | X2CrNiMo17-12-2 | --- | 1.4404 | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 16.50-18.50 | 10.00-13.00 | 2.00-2.50 | Cu 1.00; N 0.11 |
| | X2CrNiMo17-12-3 | --- | 1.4432 | 0.030 | 2.00 | 1.00 | 0.045 | 0.015 | 16.50-18.50 | 10.50-13.00 | 2.50-3.00 | Cu 1.00; N 0.11 |
| EN 10294-2:2012 | X2CrNiMo17-12-2 | --- | 1.4404 | 0.030 | 2.00 | 1.00 | 0.040 | 0.015-0.030 | 16.5-18.5 | 10.0-13.0 | 2.00-2.50 | N 0.10 |
| | X2CrNiMo18-14-3 | --- | 1.4435 | 0.030 | 2.00 | 1.00 | 0.040 | 0.015-0.030 | 17.0-19.0 | 12.5-15.0 | 2.50-3.00 | N 0.10 |
| ISO 4954:1993 | Type X 2 CrNiMo 17 13 3 E | --- | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 16.5-18.5 | 11.5-14.5 | 2.5-3.0 | --- |
| ASME SA-276 | Type 316Ti | S31635 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 16.00-18.00 | 10.00-14.00 | 2.00-3.00 | Ti 5x(C+N) to 0.70; N 0.10 |
| ASME SA-479/SA-479M | Type 316Ti | S31635 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 16.0-18.0 | 10.0-14.0 | 2.00-3.00 | Ti 5x(C+N) to 0.70; N 0.10 |
| ASTM A276/A276M-15 | Type 316Ti | S31635 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 16.0-18.0 | 10.0-14.0 | 2.00-3.00 | Ti 5x(C+N) to 0.70; N 0.10 |
| ASTM A314-13a | Type 316Ti | S31635 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 16.00-18.00 | 10.00-14.00 | 2.00-3.00 | Ti 5x(C+N) to 0.70 |
| ASTM A479/A479M-14 | Type 316Ti | S31635 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 16.0-18.0 | 10.0-14.0 | 2.00-3.00 | Ti 5x(C+N) to 0.70; N 0.10 |
| EN 10088-3:2014 | X6CrNiMoTi17-12-2 | --- | 1.4571 | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 16.5-18.5 | 10.5-13.5 | 2.00-2.50 | Ti 5xC to 0.70 |
| EN 10263-5:2001 | X6CrNiMoTi17-12-2 | --- | 1.4571 | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 16.50-18.50 | 10.50-13.50 | 2.00-2.50 | Ti 5xC to 0.70; Cu 1.00 |
| EN 10294-2:2012 | X6CrNiMoTi17-12-2 | --- | 1.4571 | 0.08 | 2.00 | 1.00 | 0.040 | 0.015-0.030 | 16.5-18.5 | 10.5-13.5 | 2.00-2.50 | Ti 5xC to 0.70 |
| ISO 16143-2:2004 | X6CrNiMoTi17-12-2 | --- | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 16.5-18.5 | 10.5-13.5 | 2.00-2.50 | Ti 5xC to 0.70 |
| ISO 4954:1993 | Type X 6 CrNiMoTi 17 12 2 E | --- | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 16.5-18.5 | 11.0-14.0 | 2.0-2.5 | Ti 5xC to 0.80 |
| JIS G 4303:2012 | Symbol SUS316Ti | --- | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 16.00-18.00 | 10.00-14.00 | 2.00-3.00 | Ti 5xC min. |
| ASME SA-276 | Type 316Cb | S31640 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 16.00-18.00 | 10.00-14.00 | 2.00-3.00 | (Cb+Ta) 10xC to 1.10; N 0.10 |
| ASME SA-479/SA-479M | Type 316Cb | S31640 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 16.0-18.0 | 10.0-14.0 | 2.00-3.00 | Cb 10xC to 1.10; N 0.10 |
| ASTM A276/A276M-15 | Type 316Cb | S31640 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 16.0-18.0 | 10.0-14.0 | 2.00-3.00 | Cb 10xC to 1.10; N 0.10 |
| ASTM A479/A479M-14 | Type 316Cb | S31640 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 16.0-18.0 | 10.0-14.0 | 2.00-3.00 | Cb 10xC to 1.10; N 0.10 |
| EN 10088-3:2014 | X6CrNiMoNb17-12-2 | --- | 1.4580 | 0.08 | 2.00 | 1.00 | 0.045 | 0.015 | 16.5-18.5 | 10.5-13.5 | 2.00-2.50 | Nb 10xC to 1.00 |
| GB 1220-92 | Grade 0Cr18Ni12Mo2Cu2 | --- | --- | 0.08 | 2.00 | 1.00 | 0.035 | 0.030 | 17.00-19.00 | 10.00-14.50 | 1.20-2.75 | Cu 1.00-2.50 |
| JIS G 4303:2012 | Symbol SUS316J1 | --- | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 17.00-19.00 | 10.00-14.00 | 1.20-2.75 | Cu 1.00-2.50 |

**8.2 Stainless Steels: Bar**

**8.2.3A Chemical Composition of Austenitic Stainless Steels (Continued)**

| Specification | Designation | UNS No | Steel No | Weight, %, max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| GB 1220-92 | Grade 00Cr17Ni14Mo2 | --- | --- | 0.030 | 2.00 | 1.00 | 0.035 | 0.030 | 16.00-18.00 | 12.00-15.00 | 2.00-3.00 | --- |
| GB 4226-84 | Grade 00Cr17Ni14Mo2 | --- | --- | 0.030 | 2.00 | 1.00 | 0.035 | 0.030 | 16.00-18.00 | 12.00-15.00 | 2.00-3.00 | --- |
| JIS G 4303:2012 | Symbol SUS316L | --- | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 16.00-18.00 | 12.00-15.00 | 2.00-3.00 | --- |
| JIS G 4318:1998 A1:2007 | Symbol SUS316L | --- | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 16.00-18.00 | 12.00-15.00 | 2.00-3.00 | --- |
| GB 1220-92 | Grade 00Cr18Ni14Mo2Cu2 | --- | --- | 0.030 | 2.00 | 1.00 | 0.035 | 0.030 | 17.00-19.00 | 12.00-16.00 | 1.20-2.75 | Cu 1.00-2.50 |
| JIS G 4303:2012 | Symbol SUS316J1L | --- | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 17.00-19.00 | 12.00-16.00 | 1.20-2.75 | Cu 1.00-2.50 |
| ASME SA-479/SA-479M | --- | S34565 | --- | 0.030 | 5.0-7.0 | 1.00 | 0.030 | 0.010 | 23.0-25.0 | 16.0-18.0 | 4.0-5.0 | Cb 0.10; N 0.40-0.60 |
| ASTM A276/A276M-15 | --- | S34565 | --- | 0.030 | 5.0-7.0 | 1.00 | 0.030 | 0.010 | 23.0-25.0 | 16.0-18.0 | 4.0-5.0 | Cb 0.10; N 0.40-0.60 |
| ASTM A479/A479M-14 | --- | S34565 | --- | 0.030 | 5.0-7.0 | 1.00 | 0.030 | 0.010 | 23.0-25.0 | 16.0-18.0 | 4.0-5.0 | Cb 0.10; N 0.40-0.60 |
| EN 10088-3:2014 | X2CrNiMnMoN25-18-6-5 | --- | 1.4565 | 0.030 | 5.0-7.0 | 1.00 | 0.030 | 0.015 | 24.0-26.0 | 16.0-19.0 | 4.0-5.0 | Nb 0.15; N 0.30-0.60 |
| ISO 16143-2:2004 | X2CrNiMnMoN25-18-6-5 | --- | --- | 0.030 | 5.00-7.00 | 1.00 | 0.030 | 0.015 | 24.0-26.0 | 16.0-19.0 | 4.0-5.0 | Nb 0.15; N 0.30-0.6 |
| ASME SA-276 | Type 316N | S31651 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 16.00-18.00 | 10.00-14.00 | 2.00-3.00 | N 0.10-0.16 |
| ASME SA-479/SA-479M | Type 316N | S31651 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 16.0-18.0 | 10.0-14.0 | 2.00-3.00 | N 0.10-0.16 |
| ASME SA-666 | Type 316N | S31651 | --- | 0.08 | 2.00 | 0.75 | 0.045 | 0.030 | 16.0-18.0 | 10.0-14.0 | 2.00-3.00 | N 0.10-0.16 |
| ASTM A276/A276M-15 | Type 316N | S31651 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 16.0-18.0 | 10.0-14.0 | 2.00-3.00 | N 0.10-0.16 |
| ASTM A479/A479M-14 | Type 316N | S31651 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 16.0-18.0 | 10.0-14.0 | 2.00-3.00 | N 0.10-0.16 |
| ASTM A666-15 | Type 316N | S31651 | --- | 0.08 | 2.00 | 0.75 | 0.045 | 0.030 | 16.0-18.0 | 10.0-14.0 | 2.00-3.00 | N 0.10-0.16 |
| GB 1220-92 | Grade 0Cr17Ni12Mo2N | --- | --- | 0.08 | 2.00 | 1.00 | 0.035 | 0.030 | 16.00-18.00 | 10.00-14.00 | 2.00-3.00 | N 0.10-0.22 |
| JIS G 4303:2012 | Symbol SUS316N | --- | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 16.00-18.00 | 10.00-14.00 | 2.00-3.00 | N 0.10-0.22 |
| ASME SA-276 | Type 316LN | S31653 | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 16.00-18.00 | 10.00-14.00 | 2.00-3.00 | Cu 0.16-0.30; N 0.10-0.16 |
| ASME SA-479/SA-479M | Type 316LN | S31653 | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 16.0-18.0 | 10.0-14.0 | 2.00-3.00 | N 0.10-0.16 |
| ASTM A276/A276M-15 | Type 316LN | S31653 | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 16.0-18.0 | 10.0-13.0 | 2.00-3.00 | N 0.10-0.16 |
| ASTM A479/A479M-14 | Type 316LN | S31653 | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 16.0-18.0 | 10.0-14.0 | 2.00-3.00 | N 0.10-0.16 |
| EN 10088-3:2014 | X2CrNiMoN17-11-2 | --- | 1.4406 | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 16.5-18.5 | 10.0-12.5 | 2.00-2.50 | N 0.12-0.22 |
| | X2CrNiMoN17-13-3 | --- | 1.4429 | 0.030 | 2.00 | 1.00 | 0.045 | 0.015 | 16.5-18.5 | 11.0-14.0 | 2.50-3.00 | N 0.12-0.22 |
| EN 10263-5:2001 | X2CrNiMoN17-13-3 | --- | 1.4429 | 0.030 | 2.00 | 1.00 | 0.045 | 0.015 | 16.50-18.50 | 11.00-14.00 | 2.50-3.00 | Cu 1.00; N 0.12-0.22 |
| GB 1220-92 | Grade 00Cr17Ni13Mo2N | --- | --- | 0.030 | 2.00 | 1.00 | 0.035 | 0.030 | 16.00-18.50 | 10.50-14.50 | 2.00-3.00 | N 0.12-0.22 |
| ISO 4954:1993 | Type X 2 CrNiMoN 17 13 3 E | --- | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 16.5-18.5 | 11.5-14.5 | 2.5-3.0 | N 0.12-0.22 |
| JIS G 4303:2012 | Symbol SUS316LN | --- | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 16.50-18.50 | 10.50-14.50 | 2.00-3.00 | N 0.12-0.22 |

**8.2 Stainless Steels: Bar**

**8.2.3A Chemical Composition of Austenitic Stainless Steels (Continued)**

| Specification | Designation | UNS No | Steel No | Weight, %, max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASME SA-276 | Type 317 | S31700 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 18.00-20.00 | 11.00-15.00 | 3.00-4.00 | N 0.10 |
| ASME SA-479/SA-479M | Type 317 | S31700 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 18.0-20.0 | 11.0-15.0 | 3.0-4.0 | --- |
| ASTM A276/A276M-15 | Type 317 | S31700 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 18.0-20.0 | 11.0-15.0 | 3.0-4.0 | N 0.10 |
| ASTM A479/A479M-14 | Type 317 | S31700 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 18.0-20.0 | 11.0-15.0 | 3.0-4.0 | --- |
| GB 1220-92 | Grade 0Cr19Ni13Mo3 | --- | --- | 0.08 | 2.00 | 1.00 | 0.035 | 0.030 | 18.00-20.00 | 11.00-15.00 | 3.00-4.00 | --- |
| GB 1221-92 | Grade 0Cr19Ni13Mo3 | --- | --- | 0.08 | 2.00 | 1.00 | 0.035 | 0.030 | 18.00-20.00 | 11.00-15.00 | 3.00-4.00 | --- |
| JIS G 4303:2012 | Symbol SUS317 | --- | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 18.00-20.00 | 11.00-15.00 | 3.00-4.00 | --- |
| EN 10088-3:2014 | X2CrNiMo18-15-4 | --- | 1.4438 | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 17.5-19.5 | 13.0-16.0 | 3.0-4.0 | N 0.10 |
| GB 1220-92 | Grade 00Cr19Ni13Mo3 | --- | --- | 0.030 | 2.00 | 1.00 | 0.035 | 0.030 | 18.00-20.00 | 11.00-15.00 | 3.00-4.00 | --- |
| JIS G 4303:2012 | Symbol SUS317L | --- | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 18.00-20.00 | 11.00-15.00 | 3.00-4.00 | --- |
| EN 10088-3:2014 | X2CrNiMoN17-13-5 | --- | 1.4439 | 0.030 | 2.00 | 1.00 | 0.045 | 0.015 | 16.5-18.5 | 12.5-14.5 | 4.0-5.0 | N 0.12-0.22 |
| GB 1220-92 | Grade 0Cr18Ni16Mo5 | --- | --- | 0.040 | 2.00 | 1.00 | 0.035 | 0.030 | 16.00-19.00 | 15.00-17.00 | 4.00-6.00 | --- |
| JIS G 4303:2012 | Symbol SUS317J1 | --- | --- | 0.040 | 2.50 | 1.00 | 0.045 | 0.030 | 16.00-19.00 | 15.00-17.00 | 4.00-6.00 | --- |
| ASME SA-276 | Type 321 | S32100 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 17.00-19.00 | 9.00-12.00 | --- | Ti 5x(C+N) to 0.70 |
| ASME SA-479/SA-479M | Type 321 | S32100 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 17.0-19.0 | 9.0-12.0 | --- | Ti 5x(C+N) to 0.70 |
| | Type 321H | S32109 | --- | 0.04-0.10 | 2.00 | 1.00 | 0.045 | 0.030 | 17.0-19.0 | 9.0-12.0 | --- | Ti 4x(C+N) to 0.70 |
| ASTM A276/A276M-15 | Type 321 | S32100 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 17.0-19.0 | 9.0-12.0 | --- | Ti 5x(C+N) to 0.70 |
| ASTM A479/A479M-14 | Type 321 | S32100 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 17.0-19.0 | 9.0-12.0 | --- | Ti 5x(C+N) to 0.70 |
| | Type 321H | S32109 | --- | 0.04-0.10 | 2.00 | 1.00 | 0.045 | 0.030 | 17.0-19.0 | 9.0-12.0 | --- | Ti 4x(C+N) to 0.70 |
| EN 10088-3:2014 | X6CrNiTi18-10 | --- | 1.4541 | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 17.0-19.0 | 9.0-12.0 | --- | Ti 5xC to 0.70 |
| EN 10263-5:2001 | X6CrNiTi18-10 | --- | 1.4541 | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 17.00-19.00 | 9.00-12.00 | --- | Ti 5xC to 0.70; Cu 1.00 |
| GB 1220-92 | Grade 0Cr18Ni10Ti | --- | --- | 0.08 | 2.00 | 1.00 | 0.035 | 0.030 | 17.00-19.00 | 9.00-12.00 | --- | Ti 5xC min. |
| | Grade 1Cr18Ni9 | --- | --- | 0.15 | 2.00 | 1.00 | 0.035 | 0.030 | 17.00-19.00 | 8.00-10.00 | --- | Ti 5x(C-0.02) to 0.80 |
| GB 1221-92 | Grade 0Cr18Ni10Ti | --- | --- | 0.08 | 2.00 | 1.00 | 0.035 | 0.030 | 17.00-19.00 | 9.00-12.00 | --- | Ti 5xC min. |
| GB 4226-84 | Grade 0Cr18Ni11Ti | --- | --- | 0.08 | 2.00 | 1.00 | 0.035 | 0.030 | 17.00-19.00 | 9.00-13.00 | --- | Ti 5xC min. |
| | Grade 1Cr18Ni9 | --- | --- | 0.15 | 2.00 | 1.00 | 0.035 | 0.030 | 17.00-19.00 | 8.00-10.00 | --- | Ti 5x(C-0.02) to 0.80 |
| ISO 4954:1993 | Type X 6 CrNiTi 18 10 E | --- | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 17.0-19.0 | 9.0-12.0 | --- | Ti 5xC to 0.80 |
| JIS G 4303:2012 | Symbol SUS321 | --- | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 17.00-19.00 | 9.00-13.00 | --- | Ti 5xC min. |
| JIS G 4318:1998 A1:2007 | Symbol SUS321 | --- | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 17.00-19.00 | 9.00-13.00 | --- | Ti 5xC min |

**8.2 Stainless Steels: Bar**

**8.2.3A Chemical Composition of Austenitic Stainless Steels (Continued)**

| Specification | Designation | UNS No | Steel No | Weight, %, max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| EN 10088-3:2014 | X8CrMnNiN18-9-5 | --- | 1.4374 | 0.05-0.10 | 9.0-10.0 | 0.30-0.60 | 0.035 | 0.030 | 17.5-18.5 | 5.0-6.0 | 0.50 | Cu 0.40; N 0.25-0.32 |
| ISO 16143-2:2004 | X8CrMnNiN18-9-5 | --- | --- | 0.05-0.10 | 9.00-10.00 | 0.30-0.60 | 0.035 | 0.030 | 17.5-18.5 | 5.0-6.0 | 0.50 | Cu 0.40; N 0.25-0.32 |
| EN 10088-3:2014 | X11CrNiMnN19-8-6 | --- | 1.4369 | 0.07-0.15 | 5.0-7.5 | 0.50-1.00 | 0.030 | 0.015 | 17.5-19.5 | 6.5-8.5 | --- | N 0.20-0.30 |
| ISO 16143-2:2004 | X11CrNiMnN19-8-6 | --- | --- | 0.07-0.15 | 5.00-7.50 | 0.50-1.00 | 0.030 | 0.015 | 17.5-19.5 | 6.5-8.5 | --- | N 0.20-0.3 |
| ASME SA-276 | Type 347 | S34700 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 17.00-19.00 | 9.00-13.00 | --- | (Cb+Ta) 10xC min. |
| | Type 348 | S34800 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 17.00-19.00 | 9.00-13.00 | --- | (Cb+Ta) 10xC min.; Ta 0.10; Co 0.20 |
| ASME SA-479/SA-479M | Type 347 | S34700 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 17.0-19.0 | 9.0-12.0 | --- | Cb 10xC to 1.10 |
| | Type 347H | S34709 | --- | 0.04-0.10 | 2.00 | 1.00 | 0.045 | 0.030 | 17.0-19.0 | 9.0-12.0 | --- | Cb 8xC to 1.10 |
| ASTM A276/A276M-15 | Type 347 | S34700 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 17.0-19.0 | 9.0-12.0 | --- | Cb 10xC to 1.10 |
| | Type 348 | S34800 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 17.0-19.0 | 9.0-12.0 | --- | Cb 10xC to 1.10; Ta 0.10; Co 0.20 |
| ASTM A479/A479M-14 | Type 347 | S34700 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 17.0-19.0 | 9.0-12.0 | --- | Cb 10xC to 1.10 |
| | Type 347H | S34709 | --- | 0.04-0.10 | 2.00 | 1.00 | 0.045 | 0.030 | 17.0-19.0 | 9.0-12.0 | --- | Cb 8xC to 1.10 |
| EN 10088-3:2014 | X6CrNiNb18-10 | --- | 1.4550 | 0.08 | 2.00 | 1.00 | 0.045 | 0.015 | 17.0-19.0 | 9.0-12.0 | --- | Nb 10xC to 1.00 |
| GB 1220-92 | Grade 0Cr18Ni11Nb | --- | --- | 0.08 | 2.00 | 1.00 | 0.035 | 0.030 | 17.00-19.00 | 9.00-13.00 | --- | Nb 10xC min. |
| GB 4226-84 | Grade 0Cr18Ni11Nb | --- | --- | 0.08 | 2.00 | 1.00 | 0.035 | 0.030 | 17.00-19.00 | 9.00-13.00 | --- | Nb 10xC min. |
| JIS G 4303:2012 | Symbol SUS347 | --- | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 17.00-19.00 | 9.00-13.00 | --- | Nb 10xC min. |
| JIS G 4318:1998 A1:2007 | Symbol SUS347 | --- | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 17.00-19.00 | 9.00-13.00 | --- | Nb 10xC min. |
| ASME SA-276 | --- | S30815 | --- | 0.10 | 0.80 | 1.40-2.00 | 0.040 | 0.030 | 20.00-22.00 | 10.00-12.00 | --- | N 0.14-0.20; Ce 0.03-0.08 |
| ASME SA-479/SA-479M | --- | S30815 | --- | 0.05-0.10 | 0.80 | 1.40-2.00 | 0.040 | 0.030 | 20.0-22.0 | 10.0-12.0 | --- | N 0.14-0.20; Ce 0.03-0.08 |
| ASTM A276/A276M-15 | --- | S30815 | --- | 0.05-0.10 | 0.80 | 1.40-2.00 | 0.040 | 0.030 | 20.0-22.0 | 10.0-12.0 | --- | N 0.14-0.20; Ce 0.03-0.08 |
| ASTM A479/A479M-14 | --- | S30815 | --- | 0.05-0.10 | 0.80 | 1.40-2.00 | 0.040 | 0.030 | 20.0-22.0 | 10.0-12.0 | --- | N 0.14-0.20; Ce 0.03-0.08 |
| ISO 4955:2005 | X7CrNiSiNCe21-11 | --- | --- | 0.05-0.10 | 0.80 | 1.40-2.00 | 0.045 | 0.030 | 20.0-22.0 | 10.0-12.0 | --- | N 0.14-0.20; Ce 0.03-0.08 |
| EN 10088-3:2014 | X6CrNiCuS18-9-2 | --- | 1.4570 | 0.08 | 2.00 | 1.00 | 0.045 | 0.15-0.35 | 17.0-19.0 | 8.0-10.0 | 0.60 | Cu 1.40-1.80; N 0.10 |
| ISO 16143-2:2004 | X6CrNiCuS18-9-2 | --- | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.15 | 17.0-19.0 | 8.0-10.0 | 0.60 | Cu 1.40-1.80; N 0.11 |
| EN 10090:1998 | X53CrMnNiNbN21-9 | --- | 1.4870 | 0.48-0.58 | 8.00-10.00 | 0.45 | 0.045 | 0.030 | 20.00-22.00 | 3.25-4.50 | --- | (Nb+Ta) 2.00 to 3.00; (C+N) 0.90 min.; N 0.38-0.50 |
| ISO 683-15:1992 | Grade X 53CrMnNiNbN21 9 | --- | --- | 0.48-0.58 | 8.0-10.0 | 0.45 | 0.050 | 0.030 | 20.0-22.0 | 3.25-4.5 | --- | (Nb+Ta) 2.00 to 3.00; (C+N) > 0.90; N 0.38-0.50 |
| GB 1221-92 | Grade 5Cr21Mn9Ni4N | --- | --- | 0.48-0.58 | 8.00-10.00 | 0.35 | 0.040 | 0.030 | 20.00-22.00 | 3.25-4.50 | --- | N 0.35-0.50 |
| JIS G 4311:2011 | Symbol SUH35 | --- | --- | 0.48-0.58 | 8.00-10.00 | 0.35 | 0.040 | 0.030 | 20.00-22.00 | 3.25-4.50 | --- | N 0.35-0.50 |

**8.2 Stainless Steels: Bar**

**8.2.3A Chemical Composition of Austenitic Stainless Steels (Continued)**

| Specification | Designation | UNS No | Steel No | Weight, %, max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASME SA-479/SA-479M | --- | S35315 | --- | 0.04-0.08 | 2.00 | 1.20-2.00 | 0.040 | 0.030 | 24.0-26.0 | 34.0-36.0 | --- | N 0.12-0.18; Ce 0.03-0.08 |
| ASTM A479/A479M-14 | --- | S35315 | --- | 0.04-0.08 | 2.00 | 1.20-2.00 | 0.040 | 0.030 | 24.0-26.0 | 34.0-36.0 | --- | N 0.12-0.18; Ce 0.03-0.08 |
| EN 10095:1999 | X6NiCrSiNCe35-25 | --- | 1.4854 | 0.04-0.08 | 2.00 | 1.20-2.00 | 0.040 | 0.015 | 24.00-26.00 | 34.00-36.00 | --- | N 0.12-0.20; Ce 0.03-0.08 |
| ISO 4955:2005 | X6NiCrSiNCe35-25 | --- | --- | 0.04-0.08 | 2.00 | 1.20-2.00 | 0.040 | 0.015 | 24.0-26.0 | 34.0-36.0 | --- | N 0.12-0.20; Ce 0.03-0.08 |
| EN 10088-3:2014 | X3CrNiCu18-9-4 | --- | 1.4567 | 0.04 | 2.00 | 1.00 | 0.045 | 0.030 | 17.0-19.0 | 8.5-10.5 | --- | Cu 3.0-4.0; N 0.10 |
| EN 10263-5:2001 | X3CrNiCu18-9-4 | --- | 1.4567 | 0.04 | 2.00 | 1.00 | 0.045 | 0.030 | 17.00-19.00 | 8.50-10.50 | --- | Cu 3.00-4.00; N 0.11 |
| EN 10269:2013 | X3CrNiCu18-9-4 | --- | 1.4567 | 0.04 | 2.00 | 1.00 | 0.045 | 0.015 | 17.0-19.0 | 8.5-10.5 | --- | Cu 3.0-4.0; N 0.10 |
| GB 1220-92 | Grade 0Cr18Ni9Cu3 | --- | --- | 0.08 | 2.00 | 1.00 | 0.035 | 0.030 | 17.00-19.00 | 8.50-10.50 | --- | Cu 3.00-4.00 |
| ISO 16143-2:2004 | X3CrNiCu18-9-4 | --- | --- | 0.04 | 2.00 | 1.00 | 0.045 | 0.030 | 17.00-19.00 | 8.50-10.50 | --- | Cu 3.00-4.00; N 0.11 |
| ISO 4954:1993 | Type X 3 CrNiCu 18 9 3 E | --- | --- | 0.04 | 2.00 | 1.00 | 0.045 | 0.030 | 17.0-19.0 | 8.5-10.5 | --- | Cu 3.00-4.00 |
| JIS G 4303:2012 | Symbol SUSXM7 | --- | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 17.00-19.00 | 8.50-10.50 | --- | Cu 3.00-4.00 |
| GB 1220-92 | Grade 0Cr18Ni13Si4 | --- | --- | 0.08 | 2.00 | 3.00-5.00 | 0.035 | 0.030 | 15.00-20.00 | 11.50-15.00 | --- | --- |
| GB 1221-92 | Grade 0Cr18Ni13Si4 | --- | --- | 0.08 | 2.00 | 3.00-5.00 | 0.035 | 0.030 | 15.00-20.00 | 11.50-15.00 | --- | --- |
| JIS G 4303:2012 | Symbol SUSXM15J1 | --- | --- | 0.08 | 2.00 | 3.00-5.00 | 0.045 | 0.030 | 15.00-20.00 | 11.50-15.00 | --- | --- |
| GB 1221-92 | Grade 2Cr21Ni12N | --- | --- | 0.15-0.28 | 1.00-1.60 | 0.75-1.25 | 0.035 | 0.030 | 20.00-22.00 | 10.50-12.50 | --- | N 0.15-0.30 |
| JIS G 4311:2011 | Symbol SUH37 | --- | --- | 0.15-0.25 | 1.00-1.60 | 1.00 | 0.040 | 0.030 | 20.50-22.50 | 10.00-12.00 | --- | N 0.15-0.30 |
| EN 10088-3:2014 | X8CrMnCuN17-8-3 | --- | 1.4597 | 0.10 | 6.5-9.0 | 2.00 | 0.040 | 0.030 | 15.0-18.0 | 3.00 | 1.00 | Cu 2.00-3.5; N 0.10-0.30 |
| ISO 16143-2:2004 | X8CrMnCuN17-8-3 | --- | --- | 0.10 | 6.50-8.50 | 2.00 | 0.040 | 0.030 | 16.0-18.0 | 2.00 | 1.00 | Cu 2.00-3.5; N 0.15-0.3 |
| ASME SA-453/SA-453M | Grade 660, Class A | S66286 | --- | 0.08 | 2.00 | 1.00 | 0.040 | 0030 | 13.5-16.0 | 24.0-27.0 | 1.00-1.50 | V 0.10-0.50; Al 0.35; Ti 1.90-2.35; B 0.001-0.010 |
| ASTM A453/A453M-12 | Grade 660, Class A | S66286 | --- | 0.08 | 2.00 | 1.00 | 0.040 | 0030 | 13.5-16.0 | 24.0-27.0 | 1.00-1.50 | V 0.10-0.50; Al 0.35; Ti 1.90-2.35; B 0.001-0.010 |
| EN 10302:2008 | X6NiCrTiMoVB25-15-2 | --- | 1.4980 | 0.030-0.08 | 1.00-2.00 | 1.00 | 0.025 | 0.015 | 13.5-16.0 | 24.0-27.0 | 1.00-1.50 | V 0.10-0.50; Al 0.35; Ti 1.90-2.30; B 0.0030-0.010 |
| GB 1221-92 | Grade 0Cr15Ni25Ti2MoAlVB | --- | --- | 0.08 | 2.00 | 1.00 | 0.035 | 0.030 | 13.50-16.00 | 24.00-27.00 | 1.00-1.50 | V 0.10-0.50; Al 0.35; Ti 1.90-2.35; B 0.001-0.010 |
| JIS G 4311:2011 | Symbol SUH660 | --- | --- | 0.08 | 2.00 | 1.00 | 0.040 | 0.030 | 13.50-16.00 | 24.00-27.00 | 1.00-1.50 | V 0.10-0.50; Al 0.35; Ti 1.90-2.35; B 0.001-0.010 |
| ASME SA-479/SA-479M | --- | N08367 | --- | 0.030 | 2.00 | 1.00 | 0.040 | 0.030 | 20.0-22.0 | 23.5-25.5 | 6.0-7.0 | Cu 0.75; N 0.18-0.25 |
| ASTM A479/A479M-14 | --- | N08367 | --- | 0.030 | 2.00 | 1.00 | 0.040 | 0.030 | 20.0-22.0 | 23.5-25.5 | 6.0-7.0 | Cu 0.75; N 0.18-0.25 |
| ASTM B691-02 (2013) | --- | N08367 | --- | 0.030 | 2.00 | 1.00 | 0.040 | 0.030 | 20.00-22.00 | 23.50-25.50 | 6.00-7.00 | Cu 0.75; N 0.18-0.25 |
| JIS G 4303:2012 | Symbol SUS836L | --- | --- | 0.030 | 2.00 | 1.00 | 0.045 | 0.030 | 19.00-24.00 | 24.00-26.00 | 5.00-7.00 | N 0.25 |
| EN 10088-3:2014 | X1NiCrMoCu25-20-5 | --- | 1.4539 | 0.020 | 2.00 | 0.70 | 0.030 | 0.010 | 19.0-21.0 | 24.0-26.0 | 4.0-5.0 | Cu 1.20-2.00; N 0.15 |
| JIS G 4303:2012 | Symbol SUS890L | --- | --- | 0.020 | 2.00 | 1.00 | 0.045 | 0.030 | 19.00-23.00 | 23.00-28.00 | 4.00-5.00 | Cu 1.00-2.00 |
| EN 10088-3:2014 | X1NiCrMoCu31-27-4 | --- | 1.4563 | 0.020 | 2.00 | 0.70 | 0.030 | 0.010 | 26.0-28.0 | 30.0-32.0 | 3.0-4.0 | Cu 0.70-1.50; N 0.10 |
| EN 10272:2007 | X1NiCrMoCu31-27-4 | --- | 1.4563 | 0.020 | 2.00 | 0.70 | 0.030 | 0.010 | 26.0-28.0 | 30.0-32.0 | 3.0-4.0 | Cu 0.70-1.50; N 0.10 |
| ISO 16143-2:2004 | X1NiCrMoCu31-27-4 | --- | --- | 0.020 | 2.00 | 0.70 | 0.030 | 0.010 | 26.0-28.0 | 30.0-32.0 | 3.00-4.00 | Cu 0.70-1.50; N 0.11 |

**8.2 Stainless Steels: Bar**

**8.2.3B Mechanical Properties of Austenitic Stainless Steels**

| Specification | Designation | UNS No | Steel No | Section Thickness/Diameter mm | Section Thickness/Diameter in. | Yield Strength, min. MPa | Yield Strength, min. ksi | Tensile Strength, min. MPa | Tensile Strength, min. ksi | Elongation % min | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ASME SA-276 | Type 201 | S20100 | --- | --- | --- | 275 | 40 | 515 | 75 | 40 | A and HF or A and CF | --- |
| ASTM A276/A276M-15 | Type 201 | S20100 | --- | --- | --- | 275 | 40 | 515 | 75 | 40 | A+HF or A+CF | --- |
| EN 10088-3:2014 | X12CrMnNiN17-7-5 | --- | 1.4372 | t ≤ 160 | --- | 230 | --- | 680-880 | --- | 40 L | SA | 260 max. HBW; L: 100 J @ RT |
| | | | | 160 < t ≤ 250 | --- | 230 | --- | 680-880 | --- | 35 T | SA | 260 max. HBW; T: 60 J @ RT |
| GB 1220-92 | Grade 1Cr17Mn6Ni5N | --- | --- | t ≤ 180 | --- | 275 | --- | 520 | --- | 40 | ST | 241 max. HB; 100 max. HRB |
| JIS G 4303:2012 | Symbol SUS201 | --- | --- | d ≤ 180 | --- | 275 | --- | 520 | --- | 40 | ST | 241 max. HBW; 100 max. HRBW; 253 max. HV |
| ASME SA-276 | Type 202 | S20200 | --- | --- | --- | 275 | 40 | 515 | 75 | 40 | A and HF or A and CF | --- |
| | | | | t ≤ 19.05 | t ≤ 0.75 | 690 | 100 | 860 | 125 | 12 | CW and CF | --- |
| | | | | 19.05 < t ≤ 25.40 | 0.75 < t ≤ 1 | 550 | 80 | 795 | 115 | 15 | CW and CF | --- |
| | | | | 25.40 < t ≤ 31.75 | 1 < t ≤ 1.25 | 450 | 65 | 725 | 105 | 20 | CW and CF | --- |
| | | | | 31.75 < t ≤ 38.10 | 1.25 < t ≤ 1.5 | 345 | 50 | 690 | 100 | 24 | CW and CF | --- |
| | | | | 38.10 < t ≤ 44.45 | 1.5 < t ≤ 1.75 | 310 | 45 | 655 | 95 | 28 | CW and CF | --- |
| ASTM A276/A276M-15 | Type 202 | S20200 | --- | --- | --- | 275 | 40 | 515 | 75 | 40 | A+HF or A+CF | --- |
| | | | | t ≤ 19.05 | t ≤ 0.75 | 690 | 100 | 860 | 125 | 12 | CW+CF | --- |
| | | | | 19.05 < t ≤ 25.40 | 0.75 < t ≤ 1 | 550 | 80 | 795 | 115 | 15 | CW+CF | --- |
| | | | | 25.40 < t ≤ 31.75 | 1 < t ≤ 1.25 | 450 | 65 | 725 | 105 | 20 | CW+CF | --- |
| | | | | 31.75 < t ≤ 38.10 | 1.25 < t ≤ 1.5 | 345 | 50 | 690 | 100 | 24 | CW+CF | --- |
| | | | | 38.10 < t ≤ 44.45 | 1.5 < t ≤ 1.75 | 310 | 45 | 655 | 95 | 28 | CW+CF | --- |
| GB 1220-92 | Grade 1Cr18Mn8Ni5N | --- | --- | t ≤ 180 | --- | 275 | --- | 520 | --- | 40 | ST | 207 max. HB; 95 max. HRB |
| JIS G 4303:2012 | Symbol SUS202 | --- | --- | d ≤ 180 | --- | 275 | --- | 520 | --- | 40 | ST | 207 max. HBW; 95 max. HRBW; 218 max. HV |

**8.2 Stainless Steels: Bar**

**8.2.3B Mechanical Properties of Austenitic Stainless Steels (Continued)**

| Specification | Designation | UNS No | Steel No | Section Thickness/Diameter mm | Section Thickness/Diameter in. | Yield Strength, min. MPa | Yield Strength, min. ksi | Tensile Strength, min. MPa | Tensile Strength, min. ksi | Elongation % min | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| EN 10088-3:2014 | X10CrNi18-8 | --- | 1.4310 | --- | --- | 500 | --- | 800-1000 | --- | 12 | CW | --- |
| | | | | 0.05 < d ≤ 0.10 | --- | --- | --- | 1100 max. | --- | 20 | SA | --- |
| | | | | 0.10 < d ≤ 0.20 | --- | --- | --- | 1050 max. | --- | 20 | SA | --- |
| | | | | 0.20 < d ≤ 0.50 | --- | --- | --- | 1000 max. | --- | 30 | SA | --- |
| | | | | 0.50 < d ≤ 1.00 | --- | --- | --- | 950 max. | --- | 30 | SA | --- |
| | | | | 1.00 < d ≤ 3.00 | --- | --- | --- | 900 max. | --- | 30 | SA | --- |
| | | | | 3.00 < d ≤ 5.00 | --- | --- | --- | 850 max. | --- | 35 | SA | --- |
| | | | | 5.00 < d ≤ 16.00 | --- | --- | --- | 800 max. | --- | 35 | SA | --- |
| | | | | t ≤ 40 | --- | 195 | --- | 500-750 | --- | 40 L | SA | 230 max. HBW |
| | | | | d ≥ 0.05 | --- | --- | --- | 500-700 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 600-800 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 700-900 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 800-1000 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 900-1100 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1000-1250 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1100-1350 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1200-1450 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1400-1700 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1600-1900 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1800-2100 | --- | --- | --- | --- |
| EN 10263-5:2001 | X10CrNi18-8 | --- | 1.4310 | 2 < d ≤ 5 | --- | --- | --- | 720 max. L | --- | --- | CD+SA | --- |
| | | | | 2 < d ≤ 5 | --- | --- | --- | 760 max. L | --- | --- | CD+SA | --- |
| | | | | 5 < d ≤ 10 | --- | --- | --- | 660 max. L | --- | --- | SA | --- |
| | | | | 5 < d ≤ 10 | --- | --- | --- | 890 max. L | --- | --- | CD+SA | --- |
| | | | | 5 < d ≤ 10 | --- | --- | --- | 680 max. L | --- | --- | CD+SA | --- |
| | | | | 5 < d ≤ 10 | --- | --- | --- | 730 max. L | --- | --- | CD+SA | --- |
| | | | | 10 < d ≤ 25 | --- | --- | --- | 660 max. L | --- | --- | SA | --- |
| | | | | 10 < d ≤ 25 | --- | --- | --- | 850 max. L | --- | --- | CD+SA | --- |
| | | | | 10 < d ≤ 25 | --- | --- | --- | 660 max. L | --- | --- | CD+SA | --- |
| | | | | 25 < d ≤ 50 | --- | --- | --- | 660 max. L | --- | --- | SA | --- |
| GB 1220-92 | Grade 1Cr17Ni7 | --- | --- | t ≤ 180 | --- | 205 | --- | 520 | --- | 40 | ST | 187 max. HB; 90 max. HRB |
| JIS G 4303:2012 | Symbol SUS301 | --- | --- | d ≤ 180 | --- | 205 | --- | 520 | --- | 40 | ST | 207 max. HBW; 95 max. HRBW; 218 max. HV |

**8.2 Stainless Steels: Bar**

**8.2.3B Mechanical Properties of Austenitic Stainless Steels (Continued)**

| Specification | Designation | UNS No | Steel No | Section Thickness/Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation % min | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | | | |
| ASME SA-276 | Type 302 | S30200 | --- | t ≤ 12.5 | t ≤ 0.5 | 205 | 30 | 515 | 75 | 30 | A and HF | --- |
| | | | | t ≤ 12.70 | t ≤ 0.5 | 310 | 45 | 620 | 90 | 30 | A and CF | --- |
| | | | | t ≤ 19.05 | t ≤ 0.75 | 690 | 100 | 860 | 125 | 12 | CW and CF | --- |
| | | | | 19.05 < t ≤ 25.40 | 0.75 < t ≤ 1 | 550 | 80 | 795 | 115 | 15 | CW and CF | --- |
| | | | | 25.40 < t ≤ 31.75 | 1 < t ≤ 1.25 | 450 | 65 | 725 | 105 | 20 | CW and CF | --- |
| | | | | 31.75 < t ≤ 38.10 | 1.25 < t ≤ 1.5 | 345 | 50 | 690 | 100 | 24 | CW and CF | --- |
| | | | | 38.10 < t ≤ 44.45 | 1.5 < t ≤ 1.75 | 310 | 45 | 655 | 95 | 28 | CW and CF | --- |
| | | | | t > 12.5 | t > 0.5 | 205 | 30 | 515 | 75 | 40 | A and HF | --- |
| | | | | t > 12.70 | t > 0.5 | 205 | 30 | 515 | 75 | 30 | A and CF | --- |
| ASME SA-479/SA-479M | Type 302 | S30200 | --- | --- | --- | 205 | 30 | 515 | 75 | 30 | A | --- |
| ASTM A276/A276M-15 | Type 302 | S30200 | --- | t ≤ 12.5 | t ≤ 0.5 | 205 | 30 | 515 | 75 | 30 | A+HF | --- |
| | | | | t ≤ 12.70 | t ≤ 0.5 | 310 | 45 | 620 | 90 | 30 | A+CF | --- |
| | | | | t ≤ 19.05 | t ≤ 0.75 | 690 | 100 | 860 | 125 | 12 | CW+CF | --- |
| | | | | 19.05 < t ≤ 25.40 | 0.75 < t ≤ 1 | 550 | 80 | 795 | 115 | 15 | CW+CF | --- |
| | | | | 25.40 < t ≤ 31.75 | 1 < t ≤ 1.25 | 450 | 65 | 725 | 105 | 20 | CW+CF | --- |
| | | | | 31.75 < t ≤ 38.10 | 1.25 < t ≤ 1.5 | 345 | 50 | 690 | 100 | 24 | CW+CF | --- |
| | | | | 38.10 < t ≤ 44.45 | 1.5 < t ≤ 1.75 | 310 | 45 | 655 | 95 | 28 | CW+CF | --- |
| | | | | t > 12.5 | t > 0.5 | 205 | 30 | 515 | 75 | 40 | A+HF | --- |
| | | | | t > 12.70 | t > 0.5 | 205 | 30 | 515 | 75 | 30 | A+CF | --- |
| ASTM A479/A479M-14 | Type 302 | S30200 | --- | --- | --- | 205 | 30 | 515 | 75 | 30 | SA | --- |
| ISO 4954:1993 | Type X 10 CrNi 18 9 E | --- | --- | 2 ≤ d ≤ 50 | --- | --- | --- | 660 max. | --- | --- | Q, CD | --- |
| | | | | 2 ≤ d ≤ 50 | --- | --- | --- | 720 max. | --- | --- | see standard | --- |
| JIS G 4303:2012 | Symbol SUS302 | --- | --- | d ≤ 180 | --- | 205 | --- | 520 | --- | 40 | ST | 187 max. HBW; 90 max. HRBW; 200 max. HV |

**8.2 Stainless Steels: Bar**

**8.2.3B Mechanical Properties of Austenitic Stainless Steels (Continued)**

| Specification | Designation | UNS No | Steel No | Section Thickness/Diameter mm | Section Thickness/Diameter in. | Yield Strength, min. MPa | Yield Strength, min. ksi | Tensile Strength, min. MPa | Tensile Strength, min. ksi | Elongation % min | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ASTM A582/A582M-12e1 | Type 303 | S30300 | --- | --- | --- | --- | --- | --- | --- | --- | A | 262 max. HBW |
| EN 10088-3:2014 | X8CrNiS18-9 | --- | 1.4305 | --- | --- | 350 | --- | 700-850 | --- | 20 | CW | --- |
| | | | | --- | --- | 500 | --- | 800-1000 | --- | 12 | CW | --- |
| | | | | 0.05 < d ≤ 0.10 | --- | --- | --- | 1100 max. | --- | 20 | SA | --- |
| | | | | 0.10 < d ≤ 0.20 | --- | --- | --- | 1050 max. | --- | 20 | SA | --- |
| | | | | 0.20 < d ≤ 0.50 | --- | --- | --- | 1000 max. | --- | 30 | SA | --- |
| | | | | 0.50 < d ≤ 1.00 | --- | --- | --- | 950 max. | --- | 30 | SA | --- |
| | | | | 1.00 < d ≤ 3.00 | --- | --- | --- | 900 max. | --- | 30 | SA | --- |
| | | | | 3.00 < d ≤ 5.00 | --- | --- | --- | 850 max. | --- | 35 | SA | --- |
| | | | | t ≤ 10 | --- | 400 | --- | 600-950 | --- | 15 L | SA | --- |
| | | | | 10 < t ≤ 16 | --- | 400 | --- | 600-950 | --- | 15 L | SA | --- |
| | | | | 5.00 < d ≤ 16.00 | --- | --- | --- | 800 max. | --- | 35 | SA | --- |
| | | | | 16 < t ≤ 40 | --- | 190 | --- | 500-850 | --- | 20 L | SA | --- |
| | | | | 40 < t ≤ 63 | --- | 190 | --- | 500-850 | --- | 20 L | SA | --- |
| | | | | t ≤ 160 | --- | 190 | --- | 500-750 | --- | 35 L | SA | 230 max. HBW |
| | | | | 63 < t ≤ 160 | --- | 190 | --- | 500-750 | --- | 35 L | SA | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 500-700 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 600-800 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 700-900 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 800-1000 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 900-1100 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1000-1250 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1100-1350 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1200-1450 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1400-1700 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1600-1900 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1800-2100 | --- | --- | --- | --- |
| EN 10294-2:2012 | X8CrNiS18-9 | --- | 1.4305 | --- | --- | 190 | --- | 500-700 | --- | 35 L; 30 T | SA | --- |
| GB 1220-92 | Grade Y1Cr18Ni9 | --- | --- | t ≤ 180 | --- | 205 | --- | 520 | --- | 40 | ST | 187 max. HB; 90 max. HRB |
| JIS G 4303:2012 | Symbol SUS303 | --- | --- | d ≤ 180 | --- | 205 | --- | 520 | --- | 40 | ST | 187 max. HBW; 90 max. HRBW; 200 max. HV |
| ASTM A582/A582M-12e1 | Type 303Se | S30323 | --- | --- | --- | --- | --- | --- | --- | --- | A | 262 max. HBW |
| GB 1220-92 | Grade Y1Cr18Ni9Se | --- | --- | t ≤ 180 | --- | 205 | --- | 520 | --- | 40 | ST | 187 max. HB; 90 max. HRB |
| JIS G 4303:2012 | Symbol SUS303Se | --- | --- | d ≤ 180 | --- | 205 | --- | 520 | --- | 40 | ST | 187 max. HBW; 90 max. HRBW; 200 max. HV |

**8.2 Stainless Steels: Bar**

**8.2.3B Mechanical Properties of Austenitic Stainless Steels (Continued)**

| Specification | Designation | UNS No | Steel No | Section Thickness/Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation % min | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | | | |
| ASME SA-276 | Type 304 | S30400 | --- | t ≤ 12.5 | t ≤ 0.5 | 205 | 30 | 515 | 75 | 30 | A and HF | --- |
| | | | | t ≤ 12.70 | t ≤ 0.5 | 310 | 45 | 620 | 90 | 30 | A and CF | --- |
| | | | | t ≤ 19.05 | t ≤ 0.75 | 690 | 100 | 860 | 125 | 12 | CW and CF | --- |
| | | | | 19.05 < t ≤ 25.40 | 0.75 < t ≤ 1 | 550 | 80 | 795 | 115 | 15 | CW and CF | --- |
| | | | | 25.40 < t ≤ 31.75 | 1 < t ≤ 1.25 | 450 | 65 | 725 | 105 | 20 | CW and CF | --- |
| | | | | 31.75 < t ≤ 38.10 | 1.25 < t ≤ 1.5 | 345 | 50 | 690 | 100 | 24 | CW and CF | --- |
| | | | | 38.10 < t ≤ 44.45 | 1.5 < t ≤ 1.75 | 310 | 45 | 655 | 95 | 28 | CW and CF | --- |
| | | | | t ≤ 50.8 | t ≤ 2 | 515 | 75 | 650 | 95 | 25 | H+CW+CF | --- |
| | | | | 50.8 < t ≤ 63.5 | 2 < t ≤ 2.5 | 450 | 65 | 620 | 90 | 30 | H+CW+CF | --- |
| | | | | 63.5 < t ≤ 76.2 | 2.5 < t ≤ 3 | 380 | 55 | 550 | 80 | 30 | H+CW+CF | --- |
| | | | | t > 12.5 | t > 0.5 | 205 | 30 | 515 | 75 | 40 | A and HF | --- |
| | | | | t > 12.70 | t > 0.5 | 205 | 30 | 515 | 75 | 30 | A and CF | --- |
| ASME SA-479/SA-479M | Type 304 | S30400 | --- | --- | --- | 205 | 30 | 515 | 75 | 30 | A | --- |
| | | | | --- | --- | 450 | 65 | 585 | 85 | 30 | H | --- |
| | | | | t ≤ 50.8 | t ≤ 2 | 515 | 75 | 655 | 95 | 25 | H | --- |
| | | | | 50.8 < t ≤ 63.5 | 2 < t ≤ 2.5 | 450 | 65 | 620 | 90 | 30 | H | --- |
| | | | | 63.5 < t ≤ 76.2 | 2.5 < t ≤ 3 | 380 | 55 | 550 | 80 | 30 | H | --- |
| ASME SA-666 | Type 304 | S30400 | --- | --- | --- | 205 | 30 | 515 | 75 | 40 | A | 201 max. HB; 92 max. HRB |
| ASTM A276/A276M-15 | Type 304 | S30400 | --- | t ≤ 12.5 | t ≤ 0.5 | 205 | 30 | 515 | 75 | 30 | A+HF | --- |
| | | | | t ≤ 12.70 | t ≤ 0.5 | 310 | 45 | 620 | 90 | 30 | A+CF | --- |
| | | | | t ≤ 19.05 | t ≤ 0.75 | 690 | 100 | 860 | 125 | 12 | CW+CF | --- |
| | | | | 19.05 < t ≤ 25.40 | 0.75 < t ≤ 1 | 550 | 80 | 795 | 115 | 15 | CW+CF | --- |
| | | | | 25.40 < t ≤ 31.75 | 1 < t ≤ 1.25 | 450 | 65 | 725 | 105 | 20 | CW+CF | --- |
| | | | | 31.75 < t ≤ 38.10 | 1.25 < t ≤ 1.5 | 345 | 50 | 690 | 100 | 24 | CW+CF | --- |
| | | | | 38.10 < t ≤ 44.45 | 1.5 < t ≤ 1.75 | 310 | 45 | 655 | 95 | 28 | CW+CF | --- |
| | | | | t ≤ 50.8 | t ≤ 2 | 515 | 75 | 650 | 95 | 25 | H+CF | --- |
| | | | | 50.8 < t ≤ 63.5 | 2 < t ≤ 2.5 | 450 | 65 | 620 | 90 | 30 | H+CF | --- |
| | | | | 63.5 < t ≤ 76.2 | 2.5 < t ≤ 3 | 380 | 55 | 550 | 80 | 30 | H+CF | --- |
| | | | | t > 12.5 | t > 0.5 | 205 | 30 | 515 | 75 | 40 | A+HF | --- |
| | | | | t > 12.70 | t > 0.5 | 205 | 30 | 515 | 75 | 30 | A+CF | --- |
| ASTM A479/A479M-14 | Type 304 | S30400 | --- | --- | --- | 205 | 30 | 515 | 75 | 30 | SA | --- |
| | | | | --- | --- | 450 | 65 | 585 | 85 | 30 | H | --- |
| | | | | t ≤ 50.8 | t ≤ 2 | 515 | 75 | 655 | 95 | 25 | H | --- |
| | | | | 50.8 < t ≤ 63.5 | 2 < t ≤ 2.5 | 450 | 65 | 620 | 90 | 30 | H | --- |
| | | | | 63.5 < t ≤ 76.2 | 2.5 < t ≤ 3 | 380 | 55 | 550 | 80 | 30 | H | --- |
| ASTM A666-15 | Type 304 | S30400 | --- | --- | --- | 205 | 30 | 515 | 75 | 40 | A | 201 max. HB; 92 max. HRB |

Note: This section continued on next page

**8.2 Stainless Steels: Bar**

**8.2.3B Mechanical Properties of Austenitic Stainless Steels (Continued)**

| Specification | Designation | UNS No | Steel No | Section Thickness/Diameter mm | Section Thickness/Diameter in. | Yield Strength, min. MPa | Yield Strength, min. ksi | Tensile Strength, min. MPa | Tensile Strength, min. ksi | Elongation % min | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ASTM A955/A955M-15 | Grade 60 [420], Type 304 | S30400 | --- | --- | --- | 420 | 60 | 620 | 90 | 20 | A, HR or SH | --- |
| | Grade 75 [520], Type 304 | S30400 | --- | --- | --- | 520 | 75 | 690 | 100 | 20 | A, HR or SH | --- |
| EN 10088-3:2014 | X5CrNi18-10 | --- | 1.4301 | --- | --- | 350 | --- | 700-850 | --- | 20 | CW | --- |
| | | | | --- | --- | 500 | --- | 800-1000 | --- | 12 | CW | --- |
| | | | | 0.05 < d ≤ 0.10 | --- | --- | --- | 1100 max. | --- | 20 | SA | --- |
| | | | | 0.10 < d ≤ 0.20 | --- | --- | --- | 1050 max. | --- | 20 | SA | --- |
| | | | | 0.20 < d ≤ 0.50 | --- | --- | --- | 1000 max. | --- | 30 | SA | --- |
| | | | | 0.50 < d ≤ 1.00 | --- | --- | --- | 950 max. | --- | 30 | SA | --- |
| | | | | 1.00 < d ≤ 3.00 | --- | --- | --- | 900 max. | --- | 30 | SA | --- |
| | | | | 3.00 < d ≤ 5.00 | --- | --- | --- | 850 max. | --- | 35 | SA | --- |
| | | | | t ≤ 10 | --- | 400 | --- | 600-950 | --- | 25 L | SA | --- |
| | | | | 10 < t ≤ 16 | --- | 400 | --- | 600-950 | --- | 25 L | SA | --- |
| | | | | 5.00 < d ≤ 16.00 | --- | --- | --- | 800 max. | --- | 35 | SA | --- |
| | | | | 16 < t ≤ 40 | --- | 190 | --- | 600-850 | --- | 30 L | SA | L: 100 J @ RT |
| | | | | 40 < t ≤ 63 | --- | 190 | --- | 580-850 | --- | 30 L | SA | L: 100 J @ RT |
| | | | | t ≤ 160 | --- | 190 | --- | 500-700 | --- | 45 L | SA | 215 max. HBW; L: 100 J @ RT |
| | | | | 63 < t ≤ 160 | --- | 190 | --- | 500-700 | --- | 45 L | SA | L: 100 J @ RT |
| | | | | 160 < t ≤ 250 | --- | 190 | --- | 500-700 | --- | 35 T | SA | 215 max. HBW; T: 60 J @ RT |
| | | | | 160 < t ≤ 250 | --- | 190 | --- | 500-700 | --- | 35 T | SA | T: 60 J @ RT |
| | | | | d ≥ 0.05 | --- | --- | --- | 500-700 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 600-800 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 700-900 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 800-1000 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 900-1100 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1000-1250 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1100-1350 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1200-1450 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1400-1700 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1600-1900 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1800-2100 | --- | --- | --- | --- |

Note: This section continued on next page

**8.2 Stainless Steels: Bar**

**8.2.3B Mechanical Properties of Austenitic Stainless Steels (Continued)**

| Specification | Designation | UNS No | Steel No | Section Thickness/Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation % min | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | | | |
| EN 10263-5:2001 | X5CrNi18-10 | --- | 1.4301 | 2 < d ≤ 5 | --- | --- | --- | 700 max. L | --- | --- | CD+SA | --- |
| | | | | 2 < d ≤ 5 | --- | --- | --- | 750 max. L | --- | --- | CD+SA | --- |
| | | | | 5 < d ≤ 10 | --- | --- | --- | 650 max. L | --- | --- | SA | --- |
| | | | | 5 < d ≤ 10 | --- | --- | --- | 820 max. L | --- | --- | CD+SA | --- |
| | | | | 5 < d ≤ 10 | --- | --- | --- | 650 max. L | --- | --- | CD+SA | --- |
| | | | | 5 < d ≤ 10 | --- | --- | --- | 700 max. L | --- | --- | CD+SA | --- |
| | | | | 10 < d ≤ 25 | --- | --- | --- | 650 max. L | --- | --- | SA | --- |
| | | | | 10 < d ≤ 25 | --- | --- | --- | 780 max. L | --- | --- | CD+SA | --- |
| | | | | 10 < d ≤ 25 | --- | --- | --- | 650 max. L | --- | --- | CD+SA | --- |
| | | | | 25 < d ≤ 50 | --- | --- | --- | 650 max. L | --- | --- | SA | --- |
| EN 10294-2:2012 | X5CrNi18-10 | --- | 1.4301 | --- | --- | 195 | --- | 500-700 | --- | 40 L; 35 T | SA | --- |
| GB 1220-92 | Grade 0Cr18Ni9 | --- | --- | t ≤ 180 | --- | 205 | --- | 520 | --- | 40 | ST | 187 max. HB; 90 max. HRB |
| GB 1221-92 | Grade 0Cr18Ni9 | --- | --- | t ≤ 180 | --- | 205 | --- | 520 | --- | 40 | ST | 187 max. HB |
| ISO 4954:1993 | Type X 5 CrNi 18 9 E | --- | --- | 2 ≤ d ≤ 50 | --- | --- | --- | 650 max. | --- | --- | Q, CD | --- |
| | | | | 2 ≤ d ≤ 50 | --- | --- | --- | 710 max. | --- | --- | see standard | --- |
| JIS G 4303:2012 | Symbol SUS304 | --- | --- | d ≤ 180 | --- | 205 | --- | 520 | --- | 40 | ST | 187 max. HBW; 90 max. HRBW; 200 max. HV |

**8.2 Stainless Steels: Bar**

**8.2.3B Mechanical Properties of Austenitic Stainless Steels (Continued)**

| Specification | Designation | UNS No | Steel No | Section Thickness/Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation % min | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | | | |
| ASME SA-276 | Type 304L | S30403 | --- | t ≤ 12.5 | t ≤ 0.5 | 170 | 25 | 485 | 70 | 30 | A and HF | --- |
| | | | | t ≤ 12.70 | t ≤ 0.5 | 310 | 45 | 620 | 90 | 30 | A and CF | --- |
| | | | | t > 12.5 | t > 0.5 | 170 | 25 | 485 | 70 | 40 | A and HF | --- |
| | | | | t > 12.70 | t > 0.5 | 170 | 25 | 485 | 70 | 30 | A and CF | --- |
| ASME SA-479/SA-479M | Type 304L | S30403 | --- | --- | --- | 170 | 25 | 485 | 70 | 30 | SA | --- |
| | | | | --- | --- | 450 | 65 | 585 | 85 | 30 | H | --- |
| | | | | t ≤ 50.8 | t ≤ 2 | 515 | 75 | 655 | 95 | 25 | H | --- |
| | | | | 50.8 < t ≤ 63.5 | 2 < t ≤ 2.5 | 450 | 65 | 620 | 90 | 30 | H | --- |
| | | | | 63.5 < t ≤ 76.2 | 2.5 < t ≤ 3 | 380 | 55 | 550 | 80 | 30 | H | --- |
| ASME SA-666 | Type 304L | S30403 | --- | --- | --- | 170 | 25 | 485 | 70 | 40 | A | 201 max. HB; 92 max. HRB |
| ASTM A276/A276M-15 | Type 304L | S30403 | --- | t ≤ 12.5 | t ≤ 0.5 | 170 | 25 | 485 | 70 | 30 | A+HF | --- |
| | | | | t ≤ 12.70 | t ≤ 0.5 | 310 | 45 | 620 | 90 | 30 | A+CF | --- |
| | | | | t ≤ 19.05 | t ≤ 0.75 | 690 | 100 | 860 | 125 | 12 | CW+CF | --- |
| | | | | 19.05 < t ≤ 25.40 | 0.75 < t ≤ 1 | 550 | 80 | 795 | 115 | 15 | CW+CF | --- |
| | | | | 25.40 < t ≤ 31.75 | 1 < t ≤ 1.25 | 450 | 65 | 725 | 105 | 20 | CW+CF | --- |
| | | | | 31.75 < t ≤ 38.10 | 1.25 < t ≤ 1.5 | 345 | 50 | 690 | 100 | 24 | CW+CF | --- |
| | | | | 38.10 < t ≤ 44.45 | 1.5 < t ≤ 1.75 | 310 | 45 | 655 | 95 | 28 | CW+CF | --- |
| | | | | t ≤ 50.8 | t ≤ 2 | 515 | 75 | 650 | 95 | 25 | H+CF | --- |
| | | | | 50.8 < t ≤ 63.5 | 2 < t ≤ 2.5 | 450 | 65 | 620 | 90 | 30 | H+CF | --- |
| | | | | 63.5 < t ≤ 76.2 | 2.5 < t ≤ 3 | 380 | 55 | 550 | 80 | 30 | H+CF | --- |
| | | | | t > 12.5 | t > 0.5 | 170 | 25 | 485 | 70 | 40 | A+HF | --- |
| | | | | t > 12.70 | t > 0.5 | 170 | 25 | 485 | 70 | 30 | A+CF | --- |
| ASTM A479/A479M-14 | Type 304L | S30403 | --- | --- | --- | 170 | 25 | 485 | 70 | 30 | SA | --- |
| | | | | --- | --- | 450 | 65 | 585 | 85 | 30 | H | --- |
| | | | | t ≤ 50.8 | t ≤ 2 | 515 | 75 | 655 | 95 | 25 | H | --- |
| | | | | 50.8 < t ≤ 63.5 | 2 < t ≤ 2.5 | 450 | 65 | 620 | 90 | 30 | H | --- |
| | | | | 63.5 < t ≤ 76.2 | 2.5 < t ≤ 3 | 380 | 55 | 550 | 80 | 30 | H | --- |
| ASTM A666-15 | Type 304L | S30403 | --- | --- | --- | 170 | 25 | 485 | 70 | 40 | A | 201 max. HB; 92 max. HRB |

Note This section continued on next page

**8.2 Stainless Steels: Bar**

**8.2.3B Mechanical Properties of Austenitic Stainless Steels (Continued)**

| Specification | Designation | UNS No | Steel No | Section Thickness/Diameter mm | Section Thickness/Diameter in. | Yield Strength, min. MPa | Yield Strength, min. ksi | Tensile Strength, min. MPa | Tensile Strength, min. ksi | Elongation % min | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| EN 10088-3:2014 | X2CrNi18-9 | --- | 1.4307 | --- | --- | 350 | --- | 700-850 | --- | 20 | CW | --- |
| | | | | --- | --- | 500 | --- | 800-1000 | --- | 12 | CW | --- |
| | | | | 0.05 < d ≤ 0.10 | --- | --- | --- | 1100 max. | --- | 20 | SA | --- |
| | | | | 0.10 < d ≤ 0.20 | --- | --- | --- | 1050 max. | --- | 20 | SA | --- |
| | | | | 0.20 < d ≤ 0.50 | --- | --- | --- | 1000 max. | --- | 30 | SA | --- |
| | | | | 0.50 < d ≤ 1.00 | --- | --- | --- | 950 max. | --- | 30 | SA | --- |
| | | | | 1.00 < d ≤ 3.00 | --- | --- | --- | 900 max. | --- | 30 | SA | --- |
| | | | | 3.00 < d ≤ 5.00 | --- | --- | --- | 850 max. | --- | 35 | SA | --- |
| | | | | t ≤ 10 | --- | 400 | --- | 600-930 | --- | 25 L | SA | --- |
| | | | | 10 < t ≤ 16 | --- | 380 | --- | 600-930 | --- | 25 L | SA | --- |
| | | | | 5.00 < d ≤ 16.00 | --- | --- | --- | 800 max. | --- | 35 | SA | --- |
| | | | | 16 < t ≤ 40 | --- | 175 | --- | 500-830 | --- | 30 L | SA | L: 100 J @ RT |
| | | | | 40 < t ≤ 63 | --- | 175 | --- | 500-830 | --- | 30 L | SA | L: 100 J @ RT |
| | | | | t ≤ 160 | --- | 175 | --- | 500-700 | --- | 45 L | SA | 215 max. HBW; L: 100 J @ RT |
| | | | | 63 < t ≤ 160 | --- | 175 | --- | 500-700 | --- | 45 L | SA | L: 100 J @ RT |
| | | | | 160 < t ≤ 250 | --- | 175 | --- | 500-700 | --- | 35 T | SA | 215 max. HBW; T: 60 J @ RT |
| | | | | 160 < t ≤ 250 | --- | 175 | --- | 500-700 | --- | 35 T | SA | T: 60 J @ RT |
| | | | | d ≥ 0.05 | --- | --- | --- | 500-700 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 600-800 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 700-900 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 800-1000 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 900-1100 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1000-1250 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1100-1350 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1200-1450 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1400-1700 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1600-1900 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1800-2100 | --- | --- | --- | --- |

Note: This section continued on next page

**8.2 Stainless Steels: Bar**

**8.2.3B Mechanical Properties of Austenitic Stainless Steels (Continued)**

| Specification | Designation | UNS No | Steel No | Section Thickness/Diameter mm | Section Thickness/Diameter in. | Yield Strength, min. MPa | Yield Strength, min. ksi | Tensile Strength, min. MPa | Tensile Strength, min. ksi | Elongation % min | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| EN 10263-5:2001 | X2CrNi18-9 | --- | 1.4307 | 2 < d ≤ 5 | --- | --- | --- | 680 max. L | --- | --- | CD+SA | --- |
| | | | | 2 < d ≤ 5 | --- | --- | --- | 730 max. L | --- | --- | CD+SA | --- |
| | | | | 5 < d ≤ 10 | --- | --- | --- | 630 max. L | --- | --- | SA | --- |
| | | | | 5 < d ≤ 10 | --- | --- | --- | 800 max. L | --- | --- | CD+SA | --- |
| | | | | 5 < d ≤ 10 | --- | --- | --- | 630 max. L | --- | --- | CD+SA | --- |
| | | | | 5 < d ≤ 10 | --- | --- | --- | 680 max. L | --- | --- | CD+SA | --- |
| | | | | 10 < d ≤ 25 | --- | --- | --- | 630 max. L | --- | --- | SA | --- |
| | | | | 10 < d ≤ 25 | --- | --- | --- | 760 max. L | --- | --- | CD+SA | --- |
| | | | | 10 < d ≤ 25 | --- | --- | --- | 630 max. L | --- | --- | CD+SA | --- |
| | | | | 25 < d ≤ 50 | --- | --- | --- | 630 max. L | --- | --- | SA | --- |
| | | | | 25 < d ≤ 50 | --- | --- | --- | 740 max. L | --- | --- | CD+SA | --- |
| | | | | 25 < d ≤ 50 | --- | --- | --- | 630 max. L | --- | --- | CD+SA | --- |
| EN 10294-2:2012 | X2CrNi18-9 | --- | 1.4307 | --- | --- | 180 | --- | 460-680 | --- | 40 L; 35 T | SA | --- |
| | X2CrNi19-11 | --- | 1.4306 | --- | --- | 180 | --- | 460-680 | --- | 40 L; 35 T | SA | --- |
| GB 1220-92 | Grade 00Cr19Ni10 | --- | --- | t ≤ 180 | --- | 177 | --- | 480 | --- | 40 | ST | 187 max. HB; 90 max. HRB |
| ISO 4954:1993 | Type X 2 CrNi 18 10 E | --- | --- | 2 ≤ d ≤ 50 | --- | --- | --- | 630 max. | --- | --- | Q, CD | --- |
| | | | | 2 ≤ d ≤ 50 | --- | --- | --- | 680 max. | --- | --- | see standard | --- |
| JIS G 4303:2012 | Symbol SUS304L | --- | --- | d ≤ 180 | --- | 175 | --- | 480 | --- | 40 | ST | 187 max. HBW; 90 max. HRBW; 200 max. HV |
| ASME SA-276 | Type 304N | S30451 | --- | --- | --- | 240 | 35 | 550 | 80 | 30 | A and HF or A and CF | --- |
| | | | | t ≤ 19.05 | t ≤ 0.75 | 690 | 100 | 860 | 125 | 12 | CW and CF | --- |
| | | | | 19.05 < t ≤ 25.40 | 0.75 < t ≤ 1 | 550 | 80 | 795 | 115 | 15 | CW and CF | --- |
| | | | | 25.40 < t ≤ 31.75 | 1 < t ≤ 1.25 | 450 | 65 | 725 | 105 | 20 | CW and CF | --- |
| | | | | 31.75 < t ≤ 38.10 | 1.25 < t ≤ 1.5 | 345 | 50 | 690 | 100 | 24 | CW and CF | --- |
| | | | | 38.10 < t ≤ 44.45 | 1.5 < t ≤ 1.75 | 310 | 45 | 655 | 95 | 28 | CW and CF | --- |
| | | | | t ≤ 50.8 | t ≤ 2 | 515 | 75 | 650 | 95 | 25 | H+CW+CF | --- |
| | | | | 50.8 < t ≤ 63.5 | 2 < t ≤ 2.5 | 450 | 65 | 620 | 90 | 30 | H+CW+CF | --- |
| | | | | 63.5 < t ≤ 76.2 | 2.5 < t ≤ 3 | 380 | 55 | 550 | 80 | 30 | H+CW+CF | --- |
| ASME SA-479/SA-479M | Type 304N | S30451 | --- | --- | --- | 240 | 35 | 550 | 80 | 30 | A | --- |
| ASME SA-666 | Type 304N | S30451 | --- | --- | --- | 240 | 35 | 550 | 80 | 30 | A | 217 max. HB; 95 max. HRB |

Note: This section continued on next page

**8.2 Stainless Steels: Bar**

**8.2.3B Mechanical Properties of Austenitic Stainless Steels (Continued)**

| Specification | Designation | UNS No | Steel No | Section Thickness/Diameter mm | Section Thickness/Diameter in. | Yield Strength, min. MPa | Yield Strength, min. ksi | Tensile Strength, min. MPa | Tensile Strength, min. ksi | Elongation % min | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ASTM A276/A276M-15 | Type 304N | S30451 | --- | --- | --- | 240 | 35 | 550 | 80 | 30 | A+HF or A+CF | --- |
| | | | | t ≤ 19.05 | t ≤ 0.75 | 690 | 100 | 860 | 125 | 12 | CW+CF | --- |
| | | | | 19.05 < t ≤ 25.40 | 0.75 < t ≤ 1 | 550 | 80 | 795 | 115 | 15 | CW+CF | --- |
| | | | | 25.40 < t ≤ 31.75 | 1 < t ≤ 1.25 | 450 | 65 | 725 | 105 | 20 | CW+CF | --- |
| | | | | 31.75 < t ≤ 38.10 | 1.25 < t ≤ 1.5 | 345 | 50 | 690 | 100 | 24 | CW+CF | --- |
| | | | | 38.10 < t ≤ 44.45 | 1.5 < t ≤ 1.75 | 310 | 45 | 655 | 95 | 28 | CW+CF | --- |
| | | | | t ≤ 50.8 | t ≤ 2 | 515 | 75 | 650 | 95 | 25 | H+CF | --- |
| | | | | 50.8 < t ≤ 63.5 | 2 < t ≤ 2.5 | 450 | 65 | 620 | 90 | 30 | H+CF | --- |
| | | | | 63.5 < t ≤ 76.2 | 2.5 < t ≤ 3 | 380 | 55 | 550 | 80 | 30 | H+CF | --- |
| ASTM A479/A479M-14 | Type 304N | S30451 | --- | --- | --- | 240 | 35 | 550 | 80 | 30 | SA | --- |
| ASTM A666-15 | Type 304N | S30451 | --- | --- | --- | 240 | 35 | 550 | 80 | 30 | A | 217 max. HB; 95 max. HRB |
| GB 1220-92 | Grade 0Cr19Ni9N | --- | --- | t ≤ 180 | --- | 275 | --- | 550 | --- | 35 | ST | 217 max. HB; 95 max. HRB |
| JIS G 4303:2012 | Symbol SUS304N1 | --- | --- | d ≤ 180 | --- | 275 | --- | 550 | --- | 35 | ST | 217 max. HBW; 95 max. HRBW; 220 max. HV |
| EN 10088-3:2014 | X5CrNiN19-9 | --- | 1.4315 | t ≤ 40 | --- | 270 | --- | 550-750 | --- | 40 L | SA | 215 max. HBW; L: 100 J @ RT |
| ASME SA-276 | Type 304LN | S30453 | --- | t ≤ 12.5 | t ≤ 0.5 | 205 | 30 | 515 | 75 | 30 | A and HF | --- |
| | | | | t ≤ 12.70 | t ≤ 0.5 | 310 | 45 | 620 | 90 | 30 | A and CF | --- |
| | | | | t > 12.5 | t > 0.5 | 205 | 30 | 515 | 75 | 40 | A and HF | --- |
| | | | | t > 12.70 | t > 0.5 | 205 | 30 | 515 | 75 | 30 | A and CF | --- |
| ASME SA-479/SA-479M | Type 304LN | S30453 | --- | --- | --- | 205 | 30 | 515 | 75 | 30 | A | --- |
| ASME SA-666 | Type 304LN | S30453 | --- | --- | --- | 205 | 30 | 515 | 75 | 40 | A | 217 max. HB; 95 max. HRB |
| ASTM A276/A276M-15 | Type 304LN | S30453 | --- | t ≤ 12.5 | t ≤ 0.5 | 205 | 30 | 515 | 75 | 30 | A+HF | --- |
| | | | | t ≤ 12.70 | t ≤ 0.5 | 310 | 45 | 620 | 90 | 30 | A+CF | --- |
| | | | | t > 12.5 | t > 0.5 | 205 | 30 | 515 | 75 | 40 | A+HF | --- |
| | | | | t > 12.70 | t > 0.5 | 205 | 30 | 515 | 75 | 30 | A+CF | --- |
| ASTM A479/A479M-14 | Type 304LN | S30453 | --- | --- | --- | 205 | 30 | 515 | 75 | 30 | SA | --- |
| ASTM A666-15 | Type 304LN | S30453 | --- | --- | --- | 205 | 30 | 515 | 75 | 40 | A | 217 max. HB; 95 max. HRB |
| EN 10088-3:2014 | X2CrNiN18-10 | --- | 1.4311 | t ≤ 160 | --- | 270 | --- | 550-760 | --- | 40 L | SA | 230 max. HBW; L: 100 J @ RT |
| | | | | 160 < t ≤ 250 | --- | 270 | --- | 550-760 | --- | 30 T | SA | 230 max. HBW; T: 60 J @ RT |
| GB 1220-92 | Grade 00Cr18Ni10N | --- | --- | t ≤ 180 | --- | 245 | --- | 550 | --- | 40 | ST | 217 max. HB; 95 max. HRB |

Note: This section continued on the next page

**8.2 Stainless Steels: Bar**

**8.2.3B Mechanical Properties of Austenitic Stainless Steels (Continued)**

| Specification | Designation | UNS No | Steel No | Section Thickness/Diameter mm | Section Thickness/Diameter in. | Yield Strength, min. MPa | Yield Strength, min. ksi | Tensile Strength, min. MPa | Tensile Strength, min. ksi | Elongation % min | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| JIS G 4303:2012 | Symbol SUS304LN | --- | --- | d ≤ 180 | --- | 245 | --- | 550 | --- | 40 | ST | 217 max. HBW; 95 max. HRBW; 220 max. HV |
| ASME SA-479/SA-479M | Type 304H | S30409 | --- | --- | --- | 205 | 30 | 515 | 75 | 30 | A | --- |
| ASTM A479/A479M-14 | Type 304H | S30409 | --- | --- | --- | 205 | 30 | 515 | 75 | 30 | SA | --- |
| EN 10088-3:2014 | X9CrNi18-9 | --- | 1.4325 | t ≤ 40 | --- | 190 | --- | 550-750 | --- | 40 L | SA | 215 max. HB |
| ISO 4955:2005 | X7CrNi18-9 | --- | --- | 0.5 ≤ t < 3 | --- | 195 | --- | 500-700 | --- | 37 L, 37 T | SA | 192 max. HB |
| | | | | 1.5 ≤ t ≤ 25 | --- | 195 | --- | 500-700 | --- | 40 | SA | 192 max. HB |
| | | | | 3 ≤ t ≤ 75 | --- | 195 | --- | 500-700 | --- | 40 L, 40 T | SA | 192 max. HB |
| | | | | t ≤ 100 | --- | 195 | --- | 500-700 | --- | 40 | SA | 192 max. HB |
| | | | | 5 ≤ t ≤ 160 | --- | 195 | --- | 500-700 | --- | 40 | SA | 192 max. HB |
| ASME SA-276 | Type XM-21 | S30452 | --- | --- | --- | 345 | 50 | 620 | 90 | 30 | A and HF or A and CF | --- |
| | | | | t ≤ 25.40 | t ≤ 1 | 860 | 125 | 1000 | 145 | 15 | CW and CF | --- |
| | | | | 25.40 < t ≤ 31.75 | 1 < t ≤ 1.25 | 795 | 115 | 930 | 135 | 16 | CW and CF | --- |
| | | | | 31.75 < t ≤ 38.10 | 1.25 < t ≤ 1.5 | 725 | 105 | 895 | 135 | 17 | CW and CF | --- |
| | | | | 38.10 < t ≤ 44.45 | 1.5 < t ≤ 1.75 | 690 | 100 | 860 | 125 | 18 | CW and CF | --- |
| ASTM A276/A276M-15 | Type XM-21 | S30452 | --- | --- | --- | 345 | 50 | 620 | 90 | 30 | A+HF or A+CF | --- |
| | | | | t ≤ 25.40 | t ≤ 1 | 860 | 125 | 1000 | 145 | 15 | CW+CF | --- |
| | | | | 25.40 < t ≤ 31.75 | 1 < t ≤ 1.25 | 795 | 115 | 930 | 135 | 16 | CW+CF | --- |
| | | | | 31.75 < t ≤ 38.10 | 1.25 < t ≤ 1.5 | 725 | 105 | 895 | 135 | 17 | CW+CF | --- |
| | | | | 38.10 < t ≤ 44.45 | 1.5 < t ≤ 1.75 | 690 | 100 | 860 | 125 | 18 | CW+CF | --- |
| GB 1220-92 | Grade 0Cr19Ni10NbN | --- | --- | t ≤ 180 | --- | 345 | --- | 685 | --- | 35 | ST | 250 max. HB; 100 max. HRB |
| JIS G 4303:2012 | Symbol SUS304N2 | --- | --- | d ≤ 180 | --- | 345 | --- | 690 | --- | 35 | ST | 250 max. HBW; 100 max. HRBW; 260 max. HV |
| ASME SA-276 | Type 305 | S30500 | --- | t ≤ 12.5 | t ≤ 0.5 | 205 | 30 | 515 | 75 | 30 | A and HF | --- |
| | | | | t ≤ 12.70 | t ≤ 0.5 | 310 | 45 | 620 | 90 | 30 | A and CF | --- |
| | | | | t > 12.5 | t > 0.5 | 205 | 30 | 515 | 75 | 40 | A and HF | --- |
| | | | | t > 12.70 | t > 0.5 | 205 | 30 | 515 | 75 | 30 | A and CF | --- |
| ASTM A276/A276M-15 | Type 305 | S30500 | --- | t ≤ 12.5 | t ≤ 0.5 | 205 | 30 | 515 | 75 | 30 | A+HF | --- |
| | | | | t ≤ 12.70 | t ≤ 0.5 | 310 | 45 | 620 | 90 | 30 | A+CF | --- |
| | | | | t > 12.5 | t > 0.5 | 205 | 30 | 515 | 75 | 40 | A+HF | --- |
| | | | | t > 12.70 | t > 0.5 | 205 | 30 | 515 | 75 | 30 | A+CF | --- |
| GB 1220-92 | Grade 1Cr18Ni12 | --- | --- | t ≤ 180 | --- | 177 | --- | 480 | --- | 40 | ST | 187 max. HB; 90 max. HRB |
| JIS G 4303:2012 | Symbol SUS305 | --- | --- | d ≤ 180 | --- | 175 | --- | 480 | --- | 40 | ST | 187 max. HBW; 90 max. HRBW; 200 max. HV |

**8.2 Stainless Steels: Bar**

**8.2.3B Mechanical Properties of Austenitic Stainless Steels (Continued)**

| Specification | Designation | UNS No | Steel No | Section Thickness/Diameter mm | Section Thickness/Diameter in. | Yield Strength, min. MPa | Yield Strength, min. ksi | Tensile Strength, min. MPa | Tensile Strength, min. ksi | Elongation % min | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| EN 10088-3:2014 | X4CrNi18-12 | --- | 1.4303 | 0.05 < d ≤ 0.10 | --- | --- | --- | 1100 max. | --- | 20 | SA | --- |
| | | | | 0.10 < d ≤ 0.20 | --- | --- | --- | 1050 max. | --- | 20 | SA | --- |
| | | | | 0.20 < d ≤ 0.50 | --- | --- | --- | 1000 max. | --- | 30 | SA | --- |
| | | | | 0.50 < d ≤ 1.00 | --- | --- | --- | 950 max. | --- | 30 | SA | --- |
| | | | | 1.00 < d ≤ 3.00 | --- | --- | --- | 900 max. | --- | 30 | SA | --- |
| | | | | 3.00 < d ≤ 5.00 | --- | --- | --- | 850 max. | --- | 35 | SA | --- |
| | | | | 5.00 < d ≤ 16.00 | --- | --- | --- | 800 max. | --- | 35 | SA | --- |
| | | | | t ≤ 160 | --- | 190 | --- | 500-700 | --- | 45 L | SA | 215 max. HBW; L: 100 J @ RT |
| | | | | 160 < t ≤ 250 | --- | 190 | --- | 500-700 | --- | 35 T | SA | 215 max. HBW; T: 60 J @ RT |
| | | | | d ≥ 0.05 | --- | --- | --- | 500-700 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 600-800 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 700-900 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 800-1000 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 900-1100 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1000-1250 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1100-1350 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1200-1450 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1400-1700 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1600-1900 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1800-2100 | --- | --- | --- | --- |
| EN 10263-5:2001 | X4CrNi18-12 | --- | 1.4303 | 2 < d ≤ 5 | --- | --- | --- | 670 max. L | --- | --- | CD+SA | --- |
| | | | | 2 < d ≤ 5 | --- | --- | --- | 720 max. L | --- | --- | CD+SA | --- |
| | | | | 5 < d ≤ 10 | --- | --- | --- | 650 max. L | --- | --- | SA | --- |
| | | | | 5 < d ≤ 10 | --- | --- | --- | 800 max. L | --- | --- | CD+SA | --- |
| | | | | 5 < d ≤ 10 | --- | --- | --- | 650 max. L | --- | --- | CD+SA | --- |
| | | | | 5 < d ≤ 10 | --- | --- | --- | 700 max. L | --- | --- | CD+SA | --- |
| | | | | 10 < d ≤ 25 | --- | --- | --- | 650 max. L | --- | --- | SA | --- |
| | | | | 10 < d ≤ 25 | --- | --- | --- | 770 max. L | --- | --- | CD+SA | --- |
| | | | | 10 < d ≤ 25 | --- | --- | --- | 650 max. L | --- | --- | CD+SA | --- |
| | | | | 25 < d ≤ 50 | --- | --- | --- | 650 max. L | --- | --- | SA | --- |
| EN 10269:2013 | X4CrNi18-12 | --- | 1.4303 | d ≤ 25 | --- | 500 | --- | 800-1000 L | --- | 12 L | CW | L: 80 J @ 20°C |
| | | | | d ≤ 35 | --- | 350 | --- | 700-850 L | --- | 20 L | CW | L: 80 J @ 20°C |
| | | | | d ≤ 160 | --- | 190 | --- | 500-700 L | --- | 45 L | SA | L: 100 J @ 20°C |
| ISO 4954:1993 | Type X 5 CrNi 18 12 E | --- | --- | 2 ≤ d ≤ 50 | --- | --- | --- | 650 max. | --- | --- | Q, CD | --- |
| | | | | 2 ≤ d ≤ 50 | --- | --- | --- | 700 max. | --- | --- | see standard | --- |

**8.2 Stainless Steels: Bar**

**8.2.3B Mechanical Properties of Austenitic Stainless Steels (Continued)**

| Specification | Designation | UNS No | Steel No | Section Thickness/Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation % min | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | | | |
| ASME SA-276 | Type 309 | S30900 | --- | t ≤ 12.5 | t ≤ 0.5 | 205 | 30 | 515 | 75 | 30 | A and HF | --- |
| | | | | t ≤ 12.70 | t ≤ 0.5 | 310 | 45 | 620 | 90 | 30 | A and CF | --- |
| | | | | t > 12.5 | t > 0.5 | 205 | 30 | 515 | 75 | 40 | A and HF | --- |
| | | | | t > 12.70 | t > 0.5 | 205 | 30 | 515 | 75 | 30 | A and CF | --- |
| ASTM A276/A276M-15 | Type 309 | S30900 | --- | t ≤ 12.5 | t ≤ 0.5 | 205 | 30 | 515 | 75 | 30 | A+HF | --- |
| | | | | t ≤ 12.70 | t ≤ 0.5 | 310 | 45 | 620 | 90 | 30 | A+CF | --- |
| | | | | t > 12.5 | t > 0.5 | 205 | 30 | 515 | 75 | 40 | A+HF | --- |
| | | | | t > 12.70 | t > 0.5 | 205 | 30 | 515 | 75 | 30 | A+CF | --- |
| GB 1221-92 | Grade 2Cr23Ni13 | --- | --- | t ≤ 180 | --- | 205 | --- | 560 | --- | 45 | ST | 201 max. HB |
| JIS G 4311:2011 | Symbol SUH309 | --- | --- | t ≤ 180 | --- | 205 | --- | 560 | --- | 45 | ST | 201 max. HBW |
| ASME SA-276 | Type 309S | S30908 | --- | t ≤ 12.5 | t ≤ 0.5 | 205 | 30 | 515 | 75 | 30 | A and HF | --- |
| | | | | t ≤ 12.70 | t ≤ 0.5 | 310 | 45 | 620 | 90 | 30 | A and CF | --- |
| | | | | t > 12.5 | t > 0.5 | 205 | 30 | 515 | 75 | 40 | A and HF | --- |
| | | | | t > 12.70 | t > 0.5 | 205 | 30 | 515 | 75 | 30 | A and CF | --- |
| ASME SA-479/SA-479M | Type 309S | S30908 | --- | --- | --- | 205 | 30 | 515 | 75 | 30 | A | --- |
| ASTM A276/A276M-15 | Type 309S | S30908 | --- | t ≤ 12.5 | t ≤ 0.5 | 205 | 30 | 515 | 75 | 30 | A+HF | --- |
| | | | | t ≤ 12.70 | t ≤ 0.5 | 310 | 45 | 620 | 90 | 30 | A+CF | --- |
| | | | | t > 12.5 | t > 0.5 | 205 | 30 | 515 | 75 | 40 | A+HF | --- |
| | | | | t > 12.70 | t > 0.5 | 205 | 30 | 515 | 75 | 30 | A+CF | --- |
| ASTM A479/A479M-14 | Type 309S | S30908 | --- | --- | --- | 205 | 30 | 515 | 75 | 30 | SA | --- |
| GB 1220-92 | Grade 0Cr23Ni13 | --- | --- | t ≤ 180 | --- | 205 | --- | 520 | --- | 40 | ST | 187 max. HB; 90 max. HRB |
| GB 1221-92 | Grade 0Cr23Ni13 | --- | --- | t ≤ 180 | --- | 205 | --- | 520 | --- | 40 | ST | 187 max. HB |
| JIS G 4303:2012 | Symbol SUS309S | --- | --- | d ≤ 180 | --- | 205 | --- | 520 | --- | 40 | ST | 187 max. HBW; 90 max. HRBW; 200 max. HV |
| ASME SA-276 | Type 310 | S31000 | --- | t ≤ 12.5 | t ≤ 0.5 | 205 | 30 | 515 | 75 | 30 | A and HF | --- |
| | | | | t ≤ 12.70 | t ≤ 0.5 | 310 | 45 | 620 | 90 | 30 | A and CF | --- |
| | | | | t > 12.5 | t > 0.5 | 205 | 30 | 515 | 75 | 40 | A and HF | --- |
| | | | | t > 12.70 | t > 0.5 | 205 | 30 | 515 | 75 | 30 | A and CF | --- |
| ASTM A276/A276M-15 | Type 310 | S31000 | --- | t ≤ 12.5 | t ≤ 0.5 | 205 | 30 | 515 | 75 | 30 | A+HF | --- |
| | | | | t ≤ 12.70 | t ≤ 0.5 | 310 | 45 | 620 | 90 | 30 | A+CF | --- |
| | | | | t > 12.5 | t > 0.5 | 205 | 30 | 515 | 75 | 40 | A+HF | --- |
| | | | | t > 12.70 | t > 0.5 | 205 | 30 | 515 | 75 | 30 | A+CF | --- |
| GB 1221-92 | Grade 2Cr25Ni20 | --- | --- | t ≤ 180 | --- | 205 | --- | 590 | --- | 40 | ST | 201 max. HB |
| JIS G 4311:2011 | Symbol SUH310 | --- | --- | t ≤ 180 | --- | 205 | --- | 590 | --- | 40 | ST | 201 max. HBW |

**8.2 Stainless Steels: Bar**

**8.2.3B Mechanical Properties of Austenitic Stainless Steels (Continued)**

| Specification | Designation | UNS No | Steel No | Section Thickness/Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation % min | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | | | |
| ASME SA-276 | Type 310S | S31008 | --- | t ≤ 12.5 | t ≤ 0.5 | 205 | 30 | 515 | 75 | 30 | A and HF | --- |
| | | | | t ≤ 12.70 | t ≤ 0.5 | 310 | 45 | 620 | 90 | 30 | A and CF | --- |
| | | | | t > 12.5 | t > 0.5 | 205 | 30 | 515 | 75 | 40 | A and HF | --- |
| | | | | t > 12.70 | t > 0.5 | 205 | 30 | 515 | 75 | 30 | A and CF | --- |
| ASME SA-479/SA-479M | Type 310S | S31008 | --- | --- | --- | 205 | 30 | 515 | 75 | 30 | A | --- |
| ASTM A276/A276M-15 | Type 310S | S31008 | --- | t ≤ 12.5 | t ≤ 0.5 | 205 | 30 | 515 | 75 | 30 | A+HF | --- |
| | | | | t ≤ 12.70 | t ≤ 0.5 | 310 | 45 | 620 | 90 | 30 | A+CF | --- |
| | | | | t > 12.5 | t > 0.5 | 205 | 30 | 515 | 75 | 40 | A+HF | --- |
| | | | | t > 12.70 | t > 0.5 | 205 | 30 | 515 | 75 | 30 | A+CF | --- |
| ASTM A479/A479M-14 | Type 310S | S31008 | --- | --- | --- | 205 | 30 | 515 | 75 | 30 | SA | --- |
| GB 1220-92 | Grade 0Cr25Ni20 | --- | --- | t ≤ 180 | --- | 205 | --- | 520 | --- | 40 | ST | 187 max. HB; 90 max. HRB |
| GB 1221-92 | Grade 0Cr25Ni20 | --- | --- | t ≤ 180 | --- | 205 | --- | 520 | --- | 40 | ST | 187 max. HB |
| JIS G 4303:2012 | Symbol SUS310S | --- | --- | d ≤ 180 | --- | 205 | --- | 520 | --- | 40 | ST | 187 max. HBW; 90 max. HRBW; 200 max. HV |

**8.2 Stainless Steels: Bar**

**8.2.3B Mechanical Properties of Austenitic Stainless Steels (Continued)**

| Specification | Designation | UNS No | Steel No | Section Thickness/Diameter mm | Section Thickness/Diameter in. | Yield Strength, min. MPa | Yield Strength, min. ksi | Tensile Strength, min. MPa | Tensile Strength, min. ksi | Elongation % min | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ASME SA-276 | --- | S31254 | --- | --- | --- | 300 | 44 | 650 | 95 | 35 | A and HF or A and CF | --- |
| ASME SA-479/SA-479M | --- | S31254 | --- | --- | --- | 305 | 44 | 655 | 95 | 35 | A | --- |
| ASTM A276/A276M-15 | --- | S31254 | --- | --- | --- | 300 | 44 | 650 | 95 | 35 | A+HF or A+CF | --- |
| ASTM A479/A479M-14 | --- | S31254 | --- | --- | --- | 305 | 44 | 655 | 95 | 35 | SA | --- |
| EN 10088-3:2014 | X1CrNiMoCuN20-18-7 | --- | 1.4547 | 0.05 < d ≤ 0.10 | --- | --- | --- | 1100 max. | --- | 20 | SA | --- |
| | | | | 0.10 < d ≤ 0.20 | --- | --- | --- | 1050 max. | --- | 20 | SA | --- |
| | | | | 0.20 < d ≤ 0.50 | --- | --- | --- | 1000 max. | --- | 30 | SA | --- |
| | | | | 0.50 < d ≤ 1.00 | --- | --- | --- | 950 max. | --- | 30 | SA | --- |
| | | | | 1.00 < d ≤ 3.00 | --- | --- | --- | 900 max. | --- | 30 | SA | --- |
| | | | | 3.00 < d ≤ 5.00 | --- | --- | --- | 850 max. | --- | 35 | SA | --- |
| | | | | 5.00 < d ≤ 16.00 | --- | --- | --- | 800 max. | --- | 35 | SA | --- |
| | | | | t ≤ 160 | --- | 300 | --- | 650-850 | --- | 35 L | SA | 260 max. HBW; L: 100 J @ RT |
| | | | | 160 < t ≤ 250 | --- | 300 | --- | 650-850 | --- | 30 T | SA | 260 max. HBW; T: 60 J @ RT |
| | | | | d ≥ 0.05 | --- | --- | --- | 500-700 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 600-800 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 700-900 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 800-1000 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 900-1100 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1000-1250 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1100-1350 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1200-1450 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1400-1700 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1600-1900 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1800-2100 | --- | --- | --- | --- |
| JIS G 4303:2012 | Symbol SUS312L | --- | --- | d ≤ 180 | --- | 300 | --- | 650 | --- | 35 | ST | 223 max. HBW; 96 max. HRBW; 230 max. HV |
| EN 10088-3:2014 | X1CrNiMoCuNW24-22-6 | --- | 1.4659 | t ≤ 160 | --- | 420 | --- | 800-1000 | --- | 50 L | SA | 290 max. HBW; L: 90 J @ RT |
| ISO 16143-2:2004 | X1CrNiMoCuNW24-22-6 | --- | --- | t ≤ 160 | --- | 420 | --- | 800-1000 | --- | 50 L | SA | --- |
| ASTM A276/A276M-15 | --- | S32654 | --- | --- | --- | 430 | 62 | 750 | 109 | 40 | A+HF or A+CF | 250 max. HBW |
| ASTM A479/A479M-14 | --- | S32654 | --- | --- | --- | 430 | 62 | 750 | 109 | 40 | SA | 250 max. HB |
| EN 10088-3:2014 | X1CrNiMoCuN24-22-8 | --- | 1.4652 | t ≤ 50 | --- | 430 | --- | 750-1000 | --- | 40 L | SA | 310 max. HBW; L: 100 J @ RT |
| ISO 16143-2:2004 | X1CrNiMoCuN24-22-8 | --- | --- | t ≤ 50 | --- | 430 | --- | 750-1000 | --- | 40 L | SA | --- |

**8.2 Stainless Steels: Bar**

**8.2.3B Mechanical Properties of Austenitic Stainless Steels (Continued)**

| Specification | Designation | UNS No | Steel No | Section Thickness/Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation % min | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | | | |
| ASME SA-276 | Type 314 | S31400 | --- | t ≤ 12.5 | t ≤ 0.5 | 205 | 30 | 515 | 75 | 30 | A and HF | --- |
| | | | | t ≤ 12.70 | t ≤ 0.5 | 310 | 45 | 620 | 90 | 30 | A and CF | --- |
| | | | | t > 12.5 | t > 0.5 | 205 | 30 | 515 | 75 | 40 | A and HF | --- |
| | | | | t > 12.70 | t > 0.5 | 205 | 30 | 515 | 75 | 30 | A and CF | --- |
| ASTM A276/A276M-15 | Type 314 | S31400 | --- | t ≤ 12.5 | t ≤ 0.5 | 205 | 30 | 515 | 75 | 30 | A+HF | --- |
| | | | | t ≤ 12.70 | t ≤ 0.5 | 310 | 45 | 620 | 90 | 30 | A+CF | --- |
| | | | | t > 12.5 | t > 0.5 | 205 | 30 | 515 | 75 | 40 | A+HF | --- |
| | | | | t > 12.70 | t > 0.5 | 205 | 30 | 515 | 75 | 30 | A+CF | --- |
| GB 1221-92 | Grade 1Cr25Ni20Si2 | --- | --- | t ≤ 180 | --- | 295 | --- | 590 | --- | 35 | ST | 187 max. HB |
| EN 10095:1999 | X15CrNiSi25-21 | --- | 1.4841 | 0.5 ≤ t < 3 | --- | 230 | --- | 550-750 | --- | 28 L, 28 T | SA | 223 max. HB |
| | | | | t ≤ 25 | --- | 230 | --- | 550-750 L | --- | 30 L | SA | 223 max. HB |
| | | | | 3 ≤ t ≤ 75 | --- | 230 | --- | 550-750 | --- | 30 L, 30 T | SA | 223 max. HB |
| | | | | t ≤ 160 | --- | 230 | --- | 550-750 L | --- | 30 L | SA | 223 max. HB |

**8.2 Stainless Steels: Bar**

**8.2.3B Mechanical Properties of Austenitic Stainless Steels (Continued)**

| Specification | Designation | UNS No | Steel No | Section Thickness/Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation % min | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | | | |
| ASME SA-276 | Type 316 | S31600 | --- | t ≤ 12.5 | t ≤ 0.5 | 205 | 30 | 515 | 75 | 30 | A and HF | --- |
| | | | | t ≤ 12.70 | t ≤ 0.5 | 310 | 45 | 620 | 90 | 30 | A and CF | --- |
| | | | | t ≤ 19.05 | t ≤ 0.75 | 690 | 100 | 860 | 125 | 12 | CW and CF | --- |
| | | | | 19.05 < t ≤ 25.40 | 0.75 < t ≤ 1 | 550 | 80 | 795 | 115 | 15 | CW and CF | --- |
| | | | | 25.40 < t ≤ 31.75 | 1 < t ≤ 1.25 | 450 | 65 | 725 | 105 | 20 | CW and CF | --- |
| | | | | 31.75 < t ≤ 38.10 | 1.25 < t ≤ 1.5 | 345 | 50 | 690 | 100 | 24 | CW and CF | --- |
| | | | | 38.10 < t ≤ 44.45 | 1.5 < t ≤ 1.75 | 310 | 45 | 655 | 95 | 28 | CW and CF | --- |
| | | | | t ≤ 50.8 | t ≤ 2 | 515 | 75 | 650 | 95 | 25 | H+CW+CF | --- |
| | | | | 50.8 < t ≤ 63.5 | 2 < t ≤ 2.5 | 450 | 65 | 620 | 90 | 30 | H+CW+CF | --- |
| | | | | 63.5 < t ≤ 76.2 | 2.5 < t ≤ 3 | 380 | 55 | 550 | 80 | 30 | H+CW+CF | --- |
| | | | | t > 12.5 | t > 0.5 | 205 | 30 | 515 | 75 | 40 | A and HF | --- |
| | | | | t > 12.70 | t > 0.5 | 205 | 30 | 515 | 75 | 30 | A and CF | --- |
| ASME SA-479/SA-479M | Type 316 | S31600 | --- | --- | --- | 205 | 30 | 515 | 75 | 30 | A | --- |
| | | | | --- | --- | 450 | 65 | 585 | 85 | 30 | H | --- |
| | | | | t ≤ 50.8 | t ≤ 2 | 515 | 75 | 655 | 95 | 30 | H | --- |
| | | | | 50.8 < t ≤ 63.5 | 2 < t ≤ 2.5 | 450 | 65 | 620 | 90 | 30 | H | --- |
| | | | | 63.5 < t ≤ 76.2 | 2.5 < t ≤ 3 | 380 | 55 | 550 | 80 | 30 | H | --- |
| ASME SA-666 | Type 316 | S31600 | --- | --- | --- | 205 | 30 | 515 | 75 | 40 | A | 217 max. HB; 95 max. HRB |
| ASTM A276/A276M-15 | Type 316 | S31600 | --- | t ≤ 12.5 | t ≤ 0.5 | 205 | 30 | 515 | 75 | 30 | A+HF | --- |
| | | | | t ≤ 12.70 | t ≤ 0.5 | 310 | 45 | 620 | 90 | 30 | A+CF | --- |
| | | | | t ≤ 19.05 | t ≤ 0.75 | 690 | 100 | 860 | 125 | 12 | CW+CF | --- |
| | | | | 19.05 < t ≤ 25.40 | 0.75 < t ≤ 1 | 550 | 80 | 795 | 115 | 15 | CW+CF | --- |
| | | | | 25.40 < t ≤ 31.75 | 1 < t ≤ 1.25 | 450 | 65 | 725 | 105 | 20 | CW+CF | --- |
| | | | | 31.75 < t ≤ 38.10 | 1.25 < t ≤ 1.5 | 345 | 50 | 690 | 100 | 24 | CW+CF | --- |
| | | | | 38.10 < t ≤ 44.45 | 1.5 < t ≤ 1.75 | 310 | 45 | 655 | 95 | 28 | CW+CF | --- |
| | | | | t ≤ 50.8 | t ≤ 2 | 515 | 75 | 650 | 95 | 25 | H+CF | --- |
| | | | | 50.8 < t ≤ 63.5 | 2 < t ≤ 2.5 | 450 | 65 | 620 | 90 | 30 | H+CF | --- |
| | | | | 63.5 < t ≤ 76.2 | 2.5 < t ≤ 3 | 380 | 55 | 550 | 80 | 30 | H+CF | --- |
| | | | | t > 12.5 | t > 0.5 | 205 | 30 | 515 | 75 | 40 | A+HF | --- |
| | | | | t > 12.70 | t > 0.5 | 205 | 30 | 515 | 75 | 30 | A+CF | --- |
| ASTM A479/A479M-14 | Type 316 | S31600 | --- | --- | --- | 205 | 30 | 515 | 75 | 30 | SA | --- |
| | | | | --- | --- | 450 | 65 | 585 | 85 | 30 | H | --- |
| | | | | t ≤ 50.8 | t ≤ 2 | 515 | 75 | 655 | 95 | 25 | H | --- |
| | | | | 50.8 < t ≤ 63.5 | 2 < t ≤ 2.5 | 450 | 65 | 620 | 90 | 30 | H | --- |
| | | | | 63.5 < t ≤ 76.2 | 2.5 < t ≤ 3 | 380 | 55 | 550 | 80 | 30 | H | --- |
| ASTM A666-15 | Type 316 | S31600 | --- | --- | --- | 205 | 30 | 515 | 75 | 40 | A | 217 max. HB; 95 max. HRB |

Note: This section continued on next page

**8.2 Stainless Steels: Bar**

**8.2.3B Mechanical Properties of Austenitic Stainless Steels (Continued)**

| Specification | Designation | UNS No | Steel No | Section Thickness/Diameter mm | Section Thickness/Diameter in. | Yield Strength, min. MPa | Yield Strength, min. ksi | Tensile Strength, min. MPa | Tensile Strength, min. ksi | Elongation % min | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| EN 10088-3:2014 | X5CrNiMo17-12-2 | --- | 1.4401 | --- | --- | 350 | --- | 700-850 | --- | 20 | CW | --- |
| | | | | --- | --- | 500 | --- | 800-1000 | --- | 12 | CW | --- |
| | | | | 0.05 < d ≤ 0.10 | --- | --- | --- | 1100 max. | --- | 20 | SA | --- |
| | | | | 0.10 < d ≤ 0.20 | --- | --- | --- | 1050 max. | --- | 20 | SA | --- |
| | | | | 0.20 < d ≤ 0.50 | --- | --- | --- | 1000 max. | --- | 30 | SA | --- |
| | | | | 0.50 < d ≤ 1.00 | --- | --- | --- | 950 max. | --- | 30 | SA | --- |
| | | | | 1.00 < d ≤ 3.00 | --- | --- | --- | 900 max. | --- | 30 | SA | --- |
| | | | | 3.00 < d ≤ 5.00 | --- | --- | --- | 850 max. | --- | 35 | SA | --- |
| | | | | t ≤ 10 | --- | 400 | --- | 600-950 | --- | 25 L | SA | --- |
| | | | | 10 < t ≤ 16 | --- | 380 | --- | 580-950 | --- | 25 L | SA | --- |
| | | | | 5.00 < d ≤ 16.00 | --- | --- | --- | 800 max. | --- | 35 | SA | --- |
| | | | | 16 < t ≤ 40 | --- | 200 | --- | 500-850 | --- | 30 L | SA | L: 100 J @ RT |
| | | | | 40 < t ≤ 63 | --- | 200 | --- | 500-850 | --- | 30 L | SA | L: 100 J @ RT |
| | | | | t ≤ 160 | --- | 200 | --- | 500-700 | --- | 40 L | SA | 215 max. HBW; L: 100 J @ RT |
| | | | | 63 < t ≤ 160 | --- | 200 | --- | 500-700 | --- | 40 L | SA | L: 100 J @ RT |
| | | | | 160 < t ≤ 250 | --- | 200 | --- | 500-700 | --- | 30 T | SA | 215 max. HBW; T: 60 J @ RT |
| | | | | 160 < t ≤ 250 | --- | 200 | --- | 500-700 | --- | 30 T | SA | T: 60 J @ RT |
| | | | | d ≥ 0.05 | --- | --- | --- | 500-700 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 600-800 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 700-900 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 800-1000 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 900-1100 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1000-1250 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1100-1350 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1200-1450 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1400-1700 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1600-1900 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1800-2100 | --- | --- | --- | --- |

Note: This section continued on next page

**8.2 Stainless Steels: Bar**

**8.2.3B Mechanical Properties of Austenitic Stainless Steels (Continued)**

| Specification | Designation | UNS No | Steel No | Section Thickness/Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | % min | | |
| EN 10088-3:2014 | X3NiCrMo17-13-3 | --- | 1.4436 | 0.05 < d ≤ 0.10 | --- | --- | --- | 1100 max. | --- | 20 | SA | --- |
| | | | | 0.10 < d ≤ 0.20 | --- | --- | --- | 1050 max. | --- | 20 | SA | --- |
| | | | | 0.20 < d ≤ 0.50 | --- | --- | --- | 1000 max. | --- | 30 | SA | --- |
| | | | | 0.50 < d ≤ 1.00 | --- | --- | --- | 950 max. | --- | 30 | SA | --- |
| | | | | 1.00 < d ≤ 3.00 | --- | --- | --- | 900 max. | --- | 30 | SA | --- |
| | | | | 3.00 < d ≤ 5.00 | --- | --- | --- | 850 max. | --- | 35 | SA | --- |
| | | | | t ≤ 10 | --- | 400 | --- | 600-950 | --- | 25 L | SA | --- |
| | | | | 10 < t ≤ 16 | --- | 400 | --- | 600-950 | --- | 25 L | SA | --- |
| | | | | 5.00 < d ≤ 16.00 | --- | --- | --- | 800 max. | --- | 35 | SA | --- |
| | | | | 16 < t ≤ 40 | --- | 200 | --- | 500-850 | --- | 30 L | SA | L: 100 J @ RT |
| | | | | 40 < t ≤ 63 | --- | 190 | --- | 500-850 | --- | 30 L | SA | L: 100 J @ RT |
| | | | | t ≤ 160 | --- | 200 | --- | 500-700 | --- | 40 L | SA | 215 max. HBW; L: 100 J @ RT |
| | | | | 63 < t ≤ 160 | --- | 200 | --- | 500-700 | --- | 40 L | SA | L: 100 J @ RT |
| | | | | 160 < t ≤ 250 | --- | 200 | --- | 500-700 | --- | 30 T | SA | 215 max. HBW; T: 60 J @ RT |
| | | | | 160 < t ≤ 250 | --- | 200 | --- | 500-700 | --- | 30 T | SA | T: 60 J @ RT |
| | | | | d ≥ 0.05 | --- | --- | --- | 500-700 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 600-800 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 700-900 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 800-1000 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 900-1100 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1000-1250 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1100-1350 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1200-1450 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1400-1700 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1600-1900 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1800-2100 | --- | --- | --- | --- |

Note: This section continued on next page

**8.2 Stainless Steels: Bar**

**8.2.3B Mechanical Properties of Austenitic Stainless Steels (Continued)**

| Specification | Designation | UNS No | Steel No | Section Thickness/Diameter mm | Section Thickness/Diameter in. | Yield Strength, min. MPa | Yield Strength, min. ksi | Tensile Strength, min. MPa | Tensile Strength, min. ksi | Elongation % min | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| EN 10263-5:2001 | X5CrNiMo17-12-2 | --- | 1.4401 | 2 < d ≤ 5 | --- | --- | --- | 690 max. L | --- | --- | CD+SA | --- |
| | | | | 2 < d ≤ 5 | --- | --- | --- | 740 max. L | --- | --- | CD+SA | --- |
| | | | | 5 < d ≤ 10 | --- | --- | --- | 660 max. L | --- | --- | SA | --- |
| | | | | 5 < d ≤ 10 | --- | --- | --- | 830 max. L | --- | --- | CD+SA | --- |
| | | | | 5 < d ≤ 10 | --- | --- | --- | 670 max. L | --- | --- | CD+SA | --- |
| | | | | 5 < d ≤ 10 | --- | --- | --- | 720 max. L | --- | --- | CD+SA | --- |
| | | | | 10 < d ≤ 25 | --- | --- | --- | 660 max. L | --- | --- | SA | --- |
| | | | | 10 < d ≤ 25 | --- | --- | --- | 790 max. L | --- | --- | CD+SA | --- |
| | | | | 10 < d ≤ 25 | --- | --- | --- | 660 max. L | --- | --- | CD+SA | --- |
| | | | | 25 < d ≤ 50 | --- | --- | --- | 660 max. L | --- | --- | SA | --- |
| | X3CrNiMo17-13-3 | --- | 1.4436 | 2 < d ≤ 5 | --- | --- | --- | 690 max. L | --- | --- | CD+SA | --- |
| | | | | 2 < d ≤ 5 | --- | --- | --- | 740 max. L | --- | --- | CD+SA | --- |
| | | | | 5 < d ≤ 10 | --- | --- | --- | 660 max. L | --- | --- | SA | --- |
| | | | | 5 < d ≤ 10 | --- | --- | --- | 830 max. L | --- | --- | CD+SA | --- |
| | | | | 5 < d ≤ 10 | --- | --- | --- | 670 max. L | --- | --- | CD+SA | --- |
| | | | | 5 < d ≤ 10 | --- | --- | --- | 720 max. L | --- | --- | CD+SA | --- |
| | | | | 10 < d ≤ 25 | --- | --- | --- | 660 max. L | --- | --- | SA | --- |
| | | | | 10 < d ≤ 25 | --- | --- | --- | 790 max. L | --- | --- | CD+SA | --- |
| | | | | 10 < d ≤ 25 | --- | --- | --- | 660 max. L | --- | --- | CD+SA | --- |
| | | | | 25 < d ≤ 50 | --- | --- | --- | 660 max. L | --- | --- | SA | --- |
| EN 10294-2:2012 | X5CrNiMo17-12-2 | --- | 1.4401 | --- | --- | 200 | --- | 500-700 | --- | 40 L; 30 T | SA | --- |
| GB 1220-92 | Grade 0Cr17Ni12Mo2 | --- | --- | t ≤ 180 | --- | 205 | --- | 520 | --- | 40 | ST | 187 max. HB; 90 max. HRB |
| GB 1221-92 | Grade 0Cr17Ni12Mo2 | --- | --- | t ≤ 180 | --- | 205 | --- | 520 | --- | 40 | ST | 187 max. HB |
| ISO 4954:1993 | Type X 5 CrNiMo 17 12 2 E | --- | --- | 2 ≤ d ≤ 50 | --- | --- | --- | 660 max. | --- | --- | Q, CD | --- |
| | | | | 2 ≤ d ≤ 50 | --- | --- | --- | 710 max. | --- | --- | see standard | --- |
| JIS G 4303:2012 | Symbol SUS316 | --- | --- | d ≤ 180 | --- | 205 | --- | 520 | --- | 40 | ST | 187 max. HBW; 90 max. HRBW; 200 max. HV |

**8.2 Stainless Steels: Bar**

**8.2.3B Mechanical Properties of Austenitic Stainless Steels (Continued)**

| Specification | Designation | UNS No | Steel No | Section Thickness/Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation % min | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | | | |
| ASME SA-276 | Type 316L | S31603 | --- | t ≤ 12.5 | t ≤ 0.5 | 170 | 25 | 485 | 70 | 30 | A and HF | --- |
| | | | | t ≤ 12.70 | t ≤ 0.5 | 310 | 45 | 620 | 90 | 30 | A and CF | --- |
| | | | | t > 12.5 | t > 0.5 | 170 | 25 | 485 | 70 | 40 | A and HF | --- |
| | | | | t > 12.70 | t > 0.5 | 170 | 25 | 485 | 70 | 30 | A and CF | --- |
| ASME SA-479/SA-479M | Type 316L | S31603 | --- | --- | --- | 170 | 25 | 485 | 70 | 30 | A | --- |
| | | | | --- | --- | 450 | 65 | 585 | 85 | 30 | H | --- |
| | | | | t ≤ 50.8 | t ≤ 2 | 515 | 75 | 655 | 95 | 25 | H | --- |
| | | | | 50.8 < t ≤ 63.5 | 2 < t ≤ 2.5 | 450 | 65 | 620 | 90 | 30 | H | --- |
| | | | | 63.5 < t ≤ 76.2 | 2.5 < t ≤ 3 | 380 | 55 | 550 | 80 | 30 | H | --- |
| ASME SA-666 | Type 316L | S31603 | --- | --- | --- | 170 | 25 | 485 | 70 | 40 | A | 217 max. HB; 95 max. HRB |
| ASTM A276/A276M-15 | Type 316L | S31603 | --- | t ≤ 12.5 | t ≤ 0.5 | 170 | 25 | 485 | 70 | 30 | A+HF | --- |
| | | | | t ≤ 12.70 | t ≤ 0.5 | 310 | 45 | 620 | 90 | 30 | A+CF | --- |
| | | | | t ≤ 19.05 | t ≤ 0.75 | 690 | 100 | 860 | 125 | 12 | CW+CF | --- |
| | | | | 19.05 < t ≤ 25.40 | 0.75 < t ≤ 1 | 550 | 80 | 795 | 115 | 15 | CW+CF | --- |
| | | | | 25.40 < t ≤ 31.75 | 1 < t ≤ 1.25 | 450 | 65 | 725 | 105 | 20 | CW+CF | --- |
| | | | | 31.75 < t ≤ 38.10 | 1.25 < t ≤ 1.5 | 345 | 50 | 690 | 100 | 24 | CW+CF | --- |
| | | | | 38.10 < t ≤ 44.45 | 1.5 < t ≤ 1.75 | 310 | 45 | 655 | 95 | 28 | CW+CF | --- |
| | | | | t ≤ 50.8 | t ≤ 2 | 515 | 75 | 650 | 95 | 25 | H+CF | --- |
| | | | | 50.8 < t ≤ 63.5 | 2 < t ≤ 2.5 | 450 | 65 | 620 | 90 | 30 | H+CF | --- |
| | | | | 63.5 < t ≤ 76.2 | 2.5 < t ≤ 3 | 380 | 55 | 550 | 80 | 30 | H+CF | --- |
| | | | | t > 12.5 | t > 0.5 | 170 | 25 | 485 | 70 | 40 | A+HF | --- |
| | | | | t > 12.70 | t > 0.5 | 170 | 25 | 485 | 70 | 30 | A+CF | --- |
| ASTM A479/A479M-14 | Type 316L | S31603 | --- | --- | --- | 170 | 25 | 485 | 70 | 30 | SA | --- |
| | | | | --- | --- | 450 | 65 | 585 | 85 | 30 | H | --- |
| | | | | t ≤ 50.8 | t ≤ 2 | 515 | 75 | 655 | 95 | 25 | H | --- |
| | | | | 50.8 < t ≤ 63.5 | 2 < t ≤ 2.5 | 450 | 65 | 620 | 90 | 30 | H | --- |
| | | | | 63.5 < t ≤ 76.2 | 2.5 < t ≤ 3 | 380 | 55 | 550 | 80 | 30 | H | --- |
| ASTM A666-15 | Type 316L | S31603 | --- | --- | --- | 170 | 25 | 485 | 70 | 40 | A | 217 max. HB; 95 max. HRB |
| ASTM A955/A955M-15 | Grade 60 [420], Type 316L | S31603 | --- | --- | --- | 420 | 60 | 620 | 90 | 20 | A, HR or SH | --- |
| | Grade 75 [520], Type 316L | S31603 | --- | --- | --- | 520 | 75 | 690 | 100 | 20 | A, HR or SH | --- |

Note: This section continued on next page

**8.2 Stainless Steels: Bar**

**8.2.3B Mechanical Properties of Austenitic Stainless Steels (Continued)**

| Specification | Designation | UNS No | Steel No | Section Thickness/Diameter mm | Section Thickness/Diameter in. | Yield Strength, min. MPa | Yield Strength, min. ksi | Tensile Strength, min. MPa | Tensile Strength, min. ksi | Elongation % min | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| EN 10088-3:2014 | X2CrNiMo17-12-2 | --- | 1.4404 | --- | --- | 350 | --- | 700-850 | --- | 20 | CW | --- |
| | | | | --- | --- | 500 | --- | 800-1000 | --- | 12 | CW | --- |
| | | | | 0.05 < d ≤ 0.10 | --- | --- | --- | 1100 max. | --- | 20 | SA | --- |
| | | | | 0.10 < d ≤ 0.20 | --- | --- | --- | 1050 max. | --- | 20 | SA | --- |
| | | | | 0.20 < d ≤ 0.50 | --- | --- | --- | 1000 max. | --- | 30 | SA | --- |
| | | | | 0.50 < d ≤ 1.00 | --- | --- | --- | 950 max. | --- | 30 | SA | --- |
| | | | | 1.00 < d ≤ 3.00 | --- | --- | --- | 900 max. | --- | 30 | SA | --- |
| | | | | 3.00 < d ≤ 5.00 | --- | --- | --- | 850 max. | --- | 35 | SA | --- |
| | | | | t ≤ 10 | --- | 400 | --- | 600-930 | --- | 25 L | SA | --- |
| | | | | 10 < t ≤ 16 | --- | 380 | --- | 580-930 | --- | 25 L | SA | --- |
| | | | | 5.00 < d ≤ 16.00 | --- | --- | --- | 800 max. | --- | 35 | SA | --- |
| | | | | 16 < t ≤ 40 | --- | 200 | --- | 500-830 | --- | 30 L | SA | L: 100 J @ RT |
| | | | | 40 < t ≤ 63 | --- | 200 | --- | 500-830 | --- | 30 L | SA | L: 100 J @ RT |
| | | | | t ≤ 160 | --- | 200 | --- | 500-700 | --- | 40 L | SA | 215 max. HBW; L: 100 J @ RT |
| | | | | 63 < t ≤ 160 | --- | 200 | --- | 500-700 | --- | 40 L | SA | L: 100 J @ RT |
| | | | | 160 < t ≤ 250 | --- | 200 | --- | 500-700 | --- | 30 T | SA | 215 max. HBW; T: 60 J @ RT |
| | | | | 160 < t ≤ 250 | --- | 200 | --- | 500-700 | --- | 30 T | SA | T: 60 J @ RT |
| | | | | d ≥ 0.05 | --- | --- | --- | 500-700 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 600-800 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 700-900 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 800-1000 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 900-1100 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1000-1250 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1100-1350 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1200-1450 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1400-1700 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1600-1900 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1800-2100 | --- | --- | --- | --- |

Note: This section continued on next page

**8.2 Stainless Steels: Bar**

**8.2.3B Mechanical Properties of Austenitic Stainless Steels (Continued)**

| Specification | Designation | UNS No | Steel No | Section Thickness/Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | % min | | |
| EN 10088-3:2014 | X2CrNiMo17-12-3 | --- | 1.4432 | 0.05 < d ≤ 0.10 | --- | --- | --- | 1100 max. | --- | 20 | SA | --- |
| | | | | 0.10 < d ≤ 0.20 | --- | --- | --- | 1050 max. | --- | 20 | SA | --- |
| | | | | 0.20 < d ≤ 0.50 | --- | --- | --- | 1000 max. | --- | 30 | SA | --- |
| | | | | 0.50 < d ≤ 1.00 | --- | --- | --- | 950 max. | --- | 30 | SA | --- |
| | | | | 1.00 < d ≤ 3.00 | --- | --- | --- | 900 max. | --- | 30 | SA | --- |
| | | | | 3.00 < d ≤ 5.00 | --- | --- | --- | 850 max. | --- | 35 | SA | --- |
| | | | | t ≤ 10 | --- | 400 | --- | 600-930 | --- | 25 L | SA | --- |
| | | | | 10 < t ≤ 16 | --- | 380 | --- | 600-880 | --- | 25 L | SA | --- |
| | | | | 5.00 < d ≤ 16.00 | --- | --- | --- | 800 max. | --- | 35 | SA | --- |
| | | | | 16 < t ≤ 40 | --- | 200 | --- | 500-850 | --- | 30 L | SA | L: 100 J @ RT |
| | | | | 40 < t ≤ 63 | --- | 200 | --- | 500-850 | --- | 30 L | SA | L: 100 J @ RT |
| | | | | t ≤ 160 | --- | 200 | --- | 500-700 | --- | 40 L | SA | 215 max. HBW; L: 100 J @ RT |
| | | | | 63 < t ≤ 160 | --- | 200 | --- | 500-700 | --- | 40 L | SA | L: 100 J @ RT |
| | | | | 160 < t ≤ 250 | --- | 200 | --- | 500-700 | --- | 30 T | SA | 215 max. HBW; T: 60 J @ RT |
| | | | | 160 < t ≤ 250 | --- | 200 | --- | 500-700 | --- | 30 T | SA | T: 60 J @ RT |
| | | | | d ≥ 0.05 | --- | --- | --- | 500-700 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 600-800 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 700-900 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 800-1000 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 900-1100 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1000-1250 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1100-1350 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1200-1450 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1400-1700 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1600-1900 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1800-2100 | --- | --- | --- | --- |

Note: This section continued on next page

**8.2 Stainless Steels: Bar**

**8.2.3B Mechanical Properties of Austenitic Stainless Steels (Continued)**

| Specification | Designation | UNS No | Steel No | Section Thickness/Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | % min | | |
| EN 10088-3:2014 | X2CrNiMo18-14-3 | --- | 1.4435 | 0.05 < d ≤ 0.10 | --- | --- | --- | 1100 max. | --- | 20 | SA | --- |
| | | | | 0.10 < d ≤ 0.20 | --- | --- | --- | 1050 max. | --- | 20 | SA | --- |
| | | | | 0.20 < d ≤ 0.50 | --- | --- | --- | 1000 max. | --- | 30 | SA | --- |
| | | | | 0.50 < d ≤ 1.00 | --- | --- | --- | 950 max. | --- | 30 | SA | --- |
| | | | | 1.00 < d ≤ 3.00 | --- | --- | --- | 900 max. | --- | 30 | SA | --- |
| | | | | 3.00 < d ≤ 5.00 | --- | --- | --- | 850 max. | --- | 35 | SA | --- |
| | | | | t ≤ 10 | --- | 400 | --- | 600-950 | --- | 25 L | SA | --- |
| | | | | 10 < t ≤ 16 | --- | 400 | --- | 600-950 | --- | 25 L | SA | --- |
| | | | | 5.00 < d ≤ 16.00 | --- | --- | --- | 800 max. | --- | 35 | SA | --- |
| | | | | 16 < t ≤ 40 | --- | 235 | --- | 500-850 | --- | 30 L | SA | L: 100 J @ RT |
| | | | | 40 < t ≤ 63 | --- | 235 | --- | 500-850 | --- | 30 L | SA | L: 100 J @ RT |
| | | | | t ≤ 160 | --- | 200 | --- | 500-700 | --- | 40 L | SA | 215 max. HBW; L: 100 J @ RT |
| | | | | 63 < t ≤ 160 | --- | 235 | --- | 500-700 | --- | 40 L | SA | L: 100 J @ RT |
| | | | | 160 < t ≤ 250 | --- | 200 | --- | 500-700 | --- | 30 T | SA | 215 max. HBW; T: 60 J @ RT |
| | | | | 160 < t ≤ 250 | --- | 235 | --- | 500-700 | --- | 30 T | SA | T: 60 J @ RT |
| | | | | d ≥ 0.05 | --- | --- | --- | 500-700 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 600-800 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 700-900 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 800-1000 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 900-1100 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1000-1250 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1100-1350 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1200-1450 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1400-1700 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1600-1900 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1800-2100 | --- | --- | --- | --- |

Note: This section continue on next page

**8.2 Stainless Steels: Bar**

**8.2.3B Mechanical Properties of Austenitic Stainless Steels (Continued)**

| Specification | Designation | UNS No | Steel No | Section Thickness/Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation | Heat | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | % min | Treatment | |
| EN 10263-5:2001 | X2CrNiMo17-12-2 | --- | 1.4404 | 2 < d ≤ 5 | --- | --- | --- | 670 max. L | --- | --- | CD+SA | --- |
| | | | | 2 < d ≤ 5 | --- | --- | --- | 720 max. L | --- | --- | CD+SA | --- |
| | | | | 5 < d ≤ 10 | --- | --- | --- | 650 max. L | --- | --- | SA | --- |
| | | | | 5 < d ≤ 10 | --- | --- | --- | 780 max. L | --- | --- | CD+SA | --- |
| | | | | 5 < d ≤ 10 | --- | --- | --- | 650 max. L | --- | --- | CD+SA | --- |
| | | | | 5 < d ≤ 10 | --- | --- | --- | 700 max. L | --- | --- | CD+SA | --- |
| | | | | 10 < d ≤ 25 | --- | --- | --- | 650 max. L | --- | --- | SA | --- |
| | | | | 10 < d ≤ 25 | --- | --- | --- | 750 max. L | --- | --- | CD+SA | --- |
| | | | | 10 < d ≤ 25 | --- | --- | --- | 650 max. L | --- | --- | CD+SA | --- |
| | | | | 25 < d ≤ 50 | --- | --- | --- | 650 max. L | --- | --- | SA | --- |
| | X2CrNiMo17-12-3 | --- | 1.4432 | 2 < d ≤ 5 | --- | --- | --- | 670 max. L | --- | --- | CD+SA | --- |
| | | | | 2 < d ≤ 5 | --- | --- | --- | 720 max. L | --- | --- | CD+SA | --- |
| | | | | 5 < d ≤ 10 | --- | --- | --- | 650 max. L | --- | --- | SA | --- |
| | | | | 5 < d ≤ 10 | --- | --- | --- | 780 max. L | --- | --- | CD+SA | --- |
| | | | | 5 < d ≤ 10 | --- | --- | --- | 650 max. L | --- | --- | CD+SA | --- |
| | | | | 5 < d ≤ 10 | --- | --- | --- | 700 max. L | --- | --- | CD+SA | --- |
| | | | | 10 < d ≤ 25 | --- | --- | --- | 650 max. L | --- | --- | SA | --- |
| | | | | 10 < d ≤ 25 | --- | --- | --- | 750 max. L | --- | --- | CD+SA | --- |
| | | | | 10 < d ≤ 25 | --- | --- | --- | 650 max. L | --- | --- | CD+SA | --- |
| | | | | 25 < d ≤ 50 | --- | --- | --- | 650 max. L | --- | --- | SA | --- |
| EN 10294-2:2012 | X2CrNiMo17-12-2 | --- | 1.4404 | --- | --- | 190 | --- | 490-690 | --- | 40 L; 30 T | SA | --- |
| | X2CrNiMo18-14-3 | --- | 1.4435 | --- | --- | 190 | --- | 490-690 | --- | 40 L; 30 T | SA | --- |
| ISO 4954:1993 | Type X 2 CrNiMo 17 13 3 E | --- | --- | 2 ≤ d ≤ 50 | --- | --- | --- | 680 max. | --- | --- | Q, CD | --- |
| | | | | 2 ≤ d ≤ 50 | --- | --- | --- | 730 max. | --- | --- | see standard | --- |
| ASME SA-276 | Type 316Ti | S31635 | --- | t ≤ 12.5 | t ≤ 0.5 | 205 | 30 | 515 | 75 | 30 | A and HF | --- |
| | | | | t ≤ 12.70 | t ≤ 0.5 | 310 | 45 | 620 | 90 | 30 | A and CF | --- |
| | | | | t > 12.5 | t > 0.5 | 205 | 30 | 515 | 75 | 40 | A and HF | --- |
| | | | | t > 12.70 | t > 0.5 | 205 | 30 | 515 | 75 | 30 | A and CF | --- |
| ASME SA-479/SA-479M | Type 316Ti | S31635 | --- | --- | --- | 205 | 30 | 515 | 75 | 30 | A | --- |
| ASTM A276/A276M-15 | Type 316Ti | S31635 | --- | t ≤ 12.5 | t ≤ 0.5 | 205 | 30 | 515 | 75 | 30 | A+HF | --- |
| | | | | t ≤ 12.70 | t ≤ 0.5 | 310 | 45 | 620 | 90 | 30 | A+CF | --- |
| | | | | t > 12.5 | t > 0.5 | 205 | 30 | 515 | 75 | 40 | A+HF | --- |
| | | | | t > 12.70 | t > 0.5 | 205 | 30 | 515 | 75 | 30 | A+CF | --- |
| ASTM A479/A479M-14 | Type 316Ti | S31635 | --- | --- | --- | 205 | 30 | 515 | 75 | 30 | SA | --- |

Note: This section continued on next page

**8.2 Stainless Steels: Bar**

**8.2.3B Mechanical Properties of Austenitic Stainless Steels (Continued)**

| Specification | Designation | UNS No | Steel No | Section Thickness/Diameter mm | Section Thickness/Diameter in. | Yield Strength, min. MPa | Yield Strength, min. ksi | Tensile Strength, min. MPa | Tensile Strength, min. ksi | Elongation % min | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| EN 10088-3:2014 | X6CrNiMoTi17-12-2 | --- | 1.4571 | --- | --- | 350 | --- | 700-850 | --- | 20 | CW | --- |
| | | | | --- | --- | 500 | --- | 800-1000 | --- | 12 | CW | --- |
| | | | | 0.05 < d ≤ 0.10 | --- | --- | --- | 1100 max. | --- | 20 | SA | --- |
| | | | | 0.10 < d ≤ 0.20 | --- | --- | --- | 1050 max. | --- | 20 | SA | --- |
| | | | | 0.20 < d ≤ 0.50 | --- | --- | --- | 1000 max. | --- | 30 | SA | --- |
| | | | | 0.50 < d ≤ 1.00 | --- | --- | --- | 950 max. | --- | 30 | SA | --- |
| | | | | 1.00 < d ≤ 3.00 | --- | --- | --- | 900 max. | --- | 30 | SA | --- |
| | | | | 3.00 < d ≤ 5.00 | --- | --- | --- | 850 max. | --- | 35 | SA | --- |
| | | | | t ≤ 10 | --- | 400 | --- | 600-950 | --- | 25 L | SA | --- |
| | | | | 10 < t ≤ 16 | --- | 380 | --- | 580-950 | --- | 25 L | SA | --- |
| | | | | 5.00 < d ≤ 16.00 | --- | --- | --- | 800 max. | --- | 35 | SA | --- |
| | | | | 16 < t ≤ 40 | --- | 200 | --- | 500-850 | --- | 30 L | SA | L: 100 J @ RT |
| | | | | 40 < t ≤ 63 | --- | 200 | --- | 500-850 | --- | 30 L | SA | L: 100 J @ RT |
| | | | | t ≤ 160 | --- | 200 | --- | 500-700 | --- | 40 L | SA | 215 max. HBW; L: 100 J @ RT |
| | | | | 63 < t ≤ 160 | --- | 200 | --- | 500-700 | --- | 40 L | SA | L: 100 J @ RT |
| | | | | 160 < t ≤ 250 | --- | 200 | --- | 500-700 | --- | 30 T | SA | 215 max. HBW; T: 60 J @ RT |
| | | | | 160 < t ≤ 250 | --- | 200 | --- | 500-700 | --- | 30 T | SA | T: 60 J @ RT |
| | | | | d ≥ 0.05 | --- | --- | --- | 500-700 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 600-800 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 700-900 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 800-1000 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 900-1100 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1000-1250 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1100-1350 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1200-1450 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1400-1700 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1600-1900 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1800-2100 | --- | --- | --- | --- |

Note: This section continued on next page

**8.2 Stainless Steels: Bar**

**8.2.3B Mechanical Properties of Austenitic Stainless Steels (Continued)**

| Specification | Designation | UNS No | Steel No | Section Thickness/Diameter mm | Section Thickness/Diameter in. | Yield Strength, min. MPa | Yield Strength, min. ksi | Tensile Strength, min. MPa | Tensile Strength, min. ksi | Elongation % min | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| EN 10263-5:2001 | X6CrNiMoTi17-12-2 | --- | 1.4571 | 2 < d ≤ 5 | --- | --- | --- | 720 max. L | --- | --- | CD+SA | --- |
| | | | | 2 < d ≤ 5 | --- | --- | --- | 770 max. L | --- | --- | CD+SA | --- |
| | | | | 5 < d ≤ 10 | --- | --- | --- | 680 max. L | --- | --- | SA | --- |
| | | | | 5 < d ≤ 10 | --- | --- | --- | 850 max. L | --- | --- | CD+SA | --- |
| | | | | 5 < d ≤ 10 | --- | --- | --- | 680 max. L | --- | --- | CD+SA | --- |
| | | | | 5 < d ≤ 10 | --- | --- | --- | 730 max. L | --- | --- | CD+SA | --- |
| | | | | 10 < d ≤ 25 | --- | --- | --- | 680 max. L | --- | --- | SA | --- |
| | | | | 10 < d ≤ 25 | --- | --- | --- | 810 max. L | --- | --- | CD+SA | --- |
| | | | | 10 < d ≤ 25 | --- | --- | --- | 680 max. L | --- | --- | CD+SA | --- |
| | | | | 25 < d ≤ 50 | --- | --- | --- | 680 max. L | --- | --- | SA | --- |
| EN 10294-2:2012 | X6CrNiMoTi17-12-2 | --- | 1.4571 | --- | --- | 190 | --- | 490-690 | --- | 35 L; 30 T | SA | --- |
| ISO 4954:1993 | Type X 6 CrNiMoTi 17 12 2 E | --- | --- | 2 ≤ d ≤ 50 | --- | --- | --- | 680 max. | --- | --- | Q, CD | --- |
| | | | | 2 ≤ d ≤ 50 | --- | --- | --- | 730 max. | --- | --- | see standard | --- |
| JIS G 4303:2012 | Symbol SUS316Ti | --- | --- | d ≤ 180 | --- | 205 | --- | 520 | --- | 40 | ST | 187 max. HBW; 90 max. HRBW; 200 max. HV |
| ASME SA-276 | Type 316Cb | S31640 | --- | t ≤ 12.5 | t ≤ 0.5 | 205 | 30 | 515 | 75 | 30 | A and HF | --- |
| | | | | t ≤ 12.70 | t ≤ 0.5 | 310 | 45 | 620 | 90 | 30 | A and CF | --- |
| | | | | t > 12.5 | t > 0.5 | 205 | 30 | 515 | 75 | 40 | A and HF | --- |
| | | | | t > 12.70 | t > 0.5 | 205 | 30 | 515 | 75 | 30 | A and CF | --- |
| ASME SA-479/SA-479M | Type 316Cb | S31640 | --- | --- | --- | 205 | 30 | 515 | 75 | 30 | A | --- |
| ASTM A276/A276M-15 | Type 316Cb | S31640 | --- | t ≤ 12.5 | t ≤ 0.5 | 205 | 30 | 515 | 75 | 30 | A+HF | --- |
| | | | | t ≤ 12.70 | t ≤ 0.5 | 310 | 45 | 620 | 90 | 30 | A+CF | --- |
| | | | | t > 12.5 | t > 0.5 | 205 | 30 | 515 | 75 | 40 | A+HF | --- |
| | | | | t > 12.70 | t > 0.5 | 205 | 30 | 515 | 75 | 30 | A+CF | --- |
| ASTM A479/A479M-14 | Type 316Cb | S31640 | --- | --- | --- | 205 | 30 | 515 | 75 | 30 | SA | --- |
| EN 10088-3:2014 | X6CrNiMoNb17-12-2 | --- | 1.4580 | t ≤ 160 | --- | 215 | --- | 510-740 | --- | 35 L | SA | 230 max. HBW; L: 100 J @ RT |
| | | | | 160 < t ≤ 250 | --- | 215 | --- | 510-740 | --- | 30 T | SA | 230 max. HBW; T: 60 J @ RT |
| GB 1220-92 | Grade 0Cr18Ni12Mo2Cu2 | --- | --- | t ≤ 180 | --- | 205 | --- | 520 | --- | 40 | ST | 187 max. HB; 90 max. HRB |
| JIS G 4303:2012 | Symbol SUS316J1 | --- | --- | d ≤ 180 | --- | 205 | --- | 520 | --- | 40 | ST | 187 max. HBW; 90 max. HRBW; 200 max. HV |
| GB 1220-92 | Grade 00Cr17Ni14Mo2 | --- | --- | t ≤ 180 | --- | 177 | --- | 480 | --- | 40 | ST | 187 max. HB; 90 max. HRB |
| JIS G 4303:2012 | Symbol SUS316L | --- | --- | d ≤ 180 | --- | 175 | --- | 480 | --- | 40 | ST | 187 max. HBW; 90 max. HRBW; 200 max. HV |

**8.2 Stainless Steels: Bar**

**8.2.3B Mechanical Properties of Austenitic Stainless Steels (Continued)**

| Specification | Designation | UNS No | Steel No | Section Thickness/Diameter mm | Section Thickness/Diameter in. | Yield Strength, min. MPa | Yield Strength, min. ksi | Tensile Strength, min. MPa | Tensile Strength, min. ksi | Elongation % min | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GB 1220-92 | Grade 00Cr18Ni14Mo2Cu2 | --- | --- | t ≤ 180 | --- | 177 | --- | 400 | --- | 40 | ST | 187 max. HB; 90 max. HRB |
| JIS G 4303:2012 | Symbol SUS316J1L | --- | --- | d ≤ 180 | --- | 175 | --- | 480 | --- | 40 | ST | 187 max. HBW; 90 max. HRBW; 200 max. HV |
| ASME SA-479/SA-479M | --- | S34565 | --- | --- | --- | 415 | 60 | 795 | 115 | 35 | A | 230 max. HB |
| ASTM A276/A276M-15 | --- | S34565 | --- | --- | --- | 415 | 60 | 795 | 115 | 35 | A+HF or A+CF | --- |
| ASTM A479/A479M-14 | --- | S34565 | --- | --- | --- | 415 | 60 | 795 | 115 | 35 | SA | 230 max. HB |
| EN 10088-3:2014 | X2CrNiMnMoN25-18-6-5 | --- | 1.4565 | t ≤ 160 | --- | 420 | --- | 800-950 | --- | 35 L | SA | L: 100 J @ RT |
| ISO 16143-2:2004 | X2CrNiMnMoN25-18-6-5 | --- | --- | t ≤ 160 | --- | 420 | --- | 800-1000 | --- | 35 L | SA | --- |
| ASME SA-276 | Type 316N | S31651 | --- | --- | --- | 240 | 35 | 550 | 80 | 30 | A and HF or A and CF | --- |
| | | | | t ≤ 19.05 | t ≤ 0.75 | 690 | 100 | 860 | 125 | 12 | CW and CF | --- |
| | | | | 19.05 < t ≤ 25.40 | 0.75 < t ≤ 1 | 550 | 80 | 795 | 115 | 15 | CW and CF | --- |
| | | | | 25.40 < t ≤ 31.75 | 1 < t ≤ 1.25 | 450 | 65 | 725 | 105 | 20 | CW and CF | --- |
| | | | | 31.75 < t ≤ 38.10 | 1.25 < t ≤ 1.5 | 345 | 50 | 690 | 100 | 24 | CW and CF | --- |
| | | | | 38.10 < t ≤ 44.45 | 1.5 < t ≤ 1.75 | 310 | 45 | 655 | 95 | 28 | CW and CF | --- |
| | | | | t ≤ 50.8 | t ≤ 2 | 515 | 75 | 650 | 95 | 25 | H+CW+CF | --- |
| | | | | 50.8 < t ≤ 63.5 | 2 < t ≤ 2.5 | 450 | 65 | 620 | 90 | 30 | H+CW+CF | --- |
| | | | | 63.5 < t ≤ 76.2 | 2.5 < t ≤ 3 | 380 | 55 | 550 | 80 | 30 | H+CW+CF | --- |
| ASME SA-479/SA-479M | Type 316N | S31651 | --- | --- | --- | 240 | 35 | 550 | 80 | 30 | A | --- |
| ASME SA-666 | Type 316N | S31651 | --- | --- | --- | 240 | 35 | 550 | 80 | 35 | A | 217 max. HB; 95 max. HRB |
| ASTM A276/A276M-15 | Type 316N | S31651 | --- | --- | --- | 240 | 35 | 550 | 80 | 30 | A+HF or A+CF | --- |
| | | | | t ≤ 19.05 | t ≤ 0.75 | 690 | 100 | 860 | 125 | 12 | CW+CF | --- |
| | | | | 19.05 < t ≤ 25.40 | 0.75 < t ≤ 1 | 550 | 80 | 795 | 115 | 15 | CW+CF | --- |
| | | | | 25.40 < t ≤ 31.75 | 1 < t ≤ 1.25 | 450 | 65 | 725 | 105 | 20 | CW+CF | --- |
| | | | | 31.75 < t ≤ 38.10 | 1.25 < t ≤ 1.5 | 345 | 50 | 690 | 100 | 24 | CW+CF | --- |
| | | | | 38.10 < t ≤ 44.45 | 1.5 < t ≤ 1.75 | 310 | 45 | 655 | 95 | 28 | CW+CF | --- |
| | | | | t ≤ 50.8 | t ≤ 2 | 515 | 75 | 650 | 95 | 25 | H+CF | --- |
| | | | | 50.8 < t ≤ 63.5 | 2 < t ≤ 2.5 | 450 | 65 | 620 | 90 | 30 | H+CF | --- |
| | | | | 63.5 < t ≤ 76.2 | 2.5 < t ≤ 3 | 380 | 55 | 550 | 80 | 30 | H+CF | --- |
| ASTM A479/A479M-14 | Type 316N | S31651 | --- | --- | --- | 240 | 35 | 550 | 80 | 30 | SA | --- |
| ASTM A666-15 | Type 316N | S31651 | --- | --- | --- | 240 | 35 | 550 | 80 | 35 | A | 217 max. HB; 95 max. HRB |
| GB 1220-92 | Grade 0Cr17Ni12Mo2N | --- | --- | t ≤ 180 | --- | 275 | --- | 550 | --- | 35 | ST | 217 max. HB; 95 max. HRB |

Note: This section continued on next page

**8.2 Stainless Steels: Bar**

**8.2.3B Mechanical Properties of Austenitic Stainless Steels (Continued)**

| Specification | Designation | UNS No | Steel No | Section Thickness/Diameter mm | Section Thickness/Diameter in. | Yield Strength, min. MPa | Yield Strength, min. ksi | Tensile Strength, min. MPa | Tensile Strength, min. ksi | Elongation % min | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| JIS G 4303:2012 | Symbol SUS316N | --- | --- | d ≤ 180 | --- | 275 | --- | 550 | --- | 35 | ST | 217 max. HBW; 95 max. HRBW; 220 max. HV |
| ASME SA-276 | Type 316LN | S31653 | --- | t ≤ 12.5 | t ≤ 0.5 | 205 | 30 | 515 | 75 | 30 | A and HF | --- |
| | | | | t ≤ 12.70 | t ≤ 0.5 | 310 | 45 | 620 | 90 | 30 | A and CF | --- |
| | | | | t > 12.5 | t > 0.5 | 205 | 30 | 515 | 75 | 40 | A and HF | --- |
| | | | | t > 12.70 | t > 0.5 | 205 | 30 | 515 | 75 | 30 | A and CF | --- |
| ASME SA-479/SA-479M | Type 316LN | S31653 | --- | --- | --- | 205 | 30 | 515 | 75 | 30 | A | --- |
| ASTM A276/A276M-15 | Type 316LN | S31653 | --- | t ≤ 12.5 | t ≤ 0.5 | 205 | 30 | 515 | 75 | 30 | A+HF | --- |
| | | | | t ≤ 12.70 | t ≤ 0.5 | 310 | 45 | 620 | 90 | 30 | A+CF | --- |
| | | | | t > 12.5 | t > 0.5 | 205 | 30 | 515 | 75 | 40 | A+HF | --- |
| | | | | t > 12.70 | t > 0.5 | 205 | 30 | 515 | 75 | 30 | A+CF | --- |
| ASTM A479/A479M-14 | Type 316LN | S31653 | --- | --- | --- | 205 | 30 | 515 | 75 | 30 | SA | --- |
| EN 10088-3:2014 | X2CrNiMoN17-11-2 | --- | 1.4406 | t ≤ 160 | --- | 280 | --- | 580-800 | --- | 40 L | SA | 250 max. HBW; L: 100 J @ RT |
| | | | | 160 < t ≤ 250 | --- | 280 | --- | 580-800 | --- | 30 T | SA | 250 max. HBW; T: 60 J @ RT |
| | X2CrNiMoN17-13-3 | --- | 1.4429 | t ≤ 160 | --- | 280 | --- | 580-800 | --- | 40 L | SA | 250 max. HBW; L: 100 J @ RT |
| | | | | 160 < t ≤ 250 | --- | 280 | --- | 580-800 | --- | 30 T | SA | 250 max. HBW; T: 60 J @ RT |
| EN 10263-5:2001 | X2CrNiMoN17-13-3 | --- | 1.4429 | 2 < d ≤ 5 | --- | --- | --- | 820 max. L | --- | --- | CD+SA | --- |
| | | | | 2 < d ≤ 5 | --- | --- | --- | 870 max. L | --- | --- | CD+SA | --- |
| | | | | 5 < d ≤ 10 | --- | --- | --- | 780 max. L | --- | --- | SA | --- |
| | | | | 5 < d ≤ 10 | --- | --- | --- | 940 max. L | --- | --- | CD+SA | --- |
| | | | | 5 < d ≤ 10 | --- | --- | --- | 800 max. L | --- | --- | CD+SA | --- |
| | | | | 5 < d ≤ 10 | --- | --- | --- | 850 max. L | --- | --- | CD+SA | --- |
| | | | | 10 < d ≤ 25 | --- | --- | --- | 780 max. L | --- | --- | SA | --- |
| | | | | 10 < d ≤ 25 | --- | --- | --- | 910 max. L | --- | --- | CD+SA | --- |
| | | | | 10 < d ≤ 25 | --- | --- | --- | 780 max. L | --- | --- | CD+SA | --- |
| | | | | 25 < d ≤ 50 | --- | --- | --- | 780 max. L | --- | --- | SA | --- |
| GB 1220-92 | Grade 00Cr17Ni13Mo2N | --- | --- | t ≤ 180 | --- | 245 | --- | 550 | --- | 40 | ST | 217 max. HB; 95 max. HRB |
| ISO 4954:1993 | Type X 2 CrNiMoN 17 13 3 E | --- | --- | 2 ≤ d ≤ 50 | --- | --- | --- | 780 max. | --- | --- | Q, CD | --- |
| | | | | 2 ≤ d ≤ 50 | --- | --- | --- | 840 max. | --- | --- | see standard | --- |
| JIS G 4303:2012 | Symbol SUS316LN | --- | --- | d ≤ 180 | --- | 245 | --- | 550 | --- | 40 | ST | 217 max. HBW; 95 max. HRBW; 220 max. HV |

**8.2 Stainless Steels: Bar**

**8.2.3B Mechanical Properties of Austenitic Stainless Steels (Continued)**

| Specification | Designation | UNS No | Steel No | Section Thickness/Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | % min | | |
| ASME SA-276 | Type 317 | S31700 | --- | t ≤ 12.5 | t ≤ 0.5 | 205 | 30 | 515 | 75 | 30 | A and HF | --- |
| | | | | t ≤ 12.70 | t ≤ 0.5 | 310 | 45 | 620 | 90 | 30 | A and CF | --- |
| | | | | t > 12.5 | t > 0.5 | 205 | 30 | 515 | 75 | 40 | A and HF | --- |
| | | | | t > 12.70 | t > 0.5 | 205 | 30 | 515 | 75 | 30 | A and CF | --- |
| ASME SA-479/SA-479M | Type 317 | S31700 | --- | --- | --- | 205 | 30 | 515 | 75 | 30 | A | --- |
| ASTM A276/A276M-15 | Type 317 | S31700 | --- | t ≤ 12.5 | t ≤ 0.5 | 205 | 30 | 515 | 75 | 30 | A+HF | --- |
| | | | | t ≤ 12.70 | t ≤ 0.5 | 310 | 45 | 620 | 90 | 30 | A+CF | --- |
| | | | | t > 12.5 | t > 0.5 | 205 | 30 | 515 | 75 | 40 | A+HF | --- |
| | | | | t > 12.70 | t > 0.5 | 205 | 30 | 515 | 75 | 30 | A+CF | --- |
| ASTM A479/A479M-14 | Type 317 | S31700 | --- | --- | --- | 205 | 30 | 515 | 75 | 30 | SA | --- |
| GB 1220-92 | Grade 0Cr19Ni13Mo3 | --- | --- | t ≤ 180 | --- | 205 | --- | 520 | --- | 40 | ST | 187 max. HB; 90 max. HRB |
| GB 1221-92 | Grade 0Cr19Ni13Mo3 | --- | --- | t ≤ 180 | --- | 205 | --- | 540 | --- | 40 | ST | 187 max. HB |
| JIS G 4303:2012 | Symbol SUS317 | --- | --- | d ≤ 180 | --- | 205 | --- | 520 | --- | 40 | ST | 187 max. HBW; 90 max. HRBW; 200 max. HV |
| EN 10088-3:2014 | X2CrNiMo18-15-4 | --- | 1.4438 | t ≤ 160 | --- | 200 | --- | 500-700 | --- | 40 L | SA | 215 max. HBW; L: 100 J @ RT |
| | | | | 160 < t ≤ 250 | --- | 200 | --- | 500-700 | --- | 30 T | SA | 215 max. HBW; T: 60 J @ RT |
| GB 1220-92 | Grade 00Cr19Ni13Mo3 | --- | --- | t ≤ 180 | --- | 177 | --- | 480 | --- | 40 | ST | 187 max. HB; 90 max. HRB |
| JIS G 4303:2012 | Symbol SUS317L | --- | --- | d ≤ 180 | --- | 175 | --- | 480 | --- | 40 | ST | 187 max. HBW; 90 max. HRBW; 200 max. HV |
| EN 10088-3:2014 | X2CrNiMoN17-13-5 | --- | 1.4439 | t ≤ 160 | --- | 280 | --- | 580-800 | --- | 35 L | SA | 250 max. HBW; L: 100 J @ RT |
| | | | | 160 < t ≤ 250 | --- | 280 | --- | 580-800 | --- | 30 T | SA | 250 max. HBW; T: 60 J @ RT |
| GB 1220-92 | Grade 0Cr18Ni16Mo5 | --- | --- | t ≤ 180 | --- | 177 | --- | 480 | --- | 40 | ST | 187 max. HB; 90 max. HRB |
| JIS G 4303:2012 | Symbol SUS317J1 | --- | --- | d ≤ 180 | --- | 175 | --- | 480 | --- | 40 | ST | 187 max. HBW; 90 max. HRBW; 200 max. HV |

**8.2 Stainless Steels: Bar**

**8.2.3B Mechanical Properties of Austenitic Stainless Steels (Continued)**

| Specification | Designation | UNS No | Steel No | Section Thickness/Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation % min | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | | | |
| ASME SA-276 | Type 321 | S32100 | --- | t ≤ 12.5 | t ≤ 0.5 | 205 | 30 | 515 | 75 | 30 | A and HF | --- |
| | | | | t ≤ 12.70 | t ≤ 0.5 | 310 | 45 | 620 | 90 | 30 | A and CF | --- |
| | | | | t > 12.5 | t > 0.5 | 205 | 30 | 515 | 75 | 40 | A and HF | --- |
| | | | | t > 12.70 | t > 0.5 | 205 | 30 | 515 | 75 | 30 | A and CF | --- |
| ASME SA-479/SA-479M | Type 321 | S32100 | --- | --- | --- | 205 | 30 | 515 | 75 | 30 | A | --- |
| | Type 321H | S32109 | --- | --- | --- | 205 | 30 | 515 | 75 | 30 | A | --- |
| ASTM A276/A276M-15 | Type 321 | S32100 | --- | t ≤ 12.5 | t ≤ 0.5 | 205 | 30 | 515 | 75 | 30 | A+HF | --- |
| | | | | t ≤ 12.70 | t ≤ 0.5 | 310 | 45 | 620 | 90 | 30 | A+CF | --- |
| | | | | t > 12.5 | t > 0.5 | 205 | 30 | 515 | 75 | 40 | A+HF | --- |
| | | | | t > 12.70 | t > 0.5 | 205 | 30 | 515 | 75 | 30 | A+CF | --- |
| ASTM A479/A479M-14 | Type 321 | S32100 | --- | --- | --- | 205 | 30 | 515 | 75 | 30 | SA | --- |
| | Type 321H | S32109 | --- | --- | --- | 205 | 30 | 515 | 75 | 30 | SA | --- |

Note: This section continued on next page

**8.2 Stainless Steels: Bar**

**8.2.3B Mechanical Properties of Austenitic Stainless Steels (Continued)**

| Specification | Designation | UNS No | Steel No | Section Thickness/Diameter mm | Section Thickness/Diameter in. | Yield Strength, min. MPa | Yield Strength, min. ksi | Tensile Strength, min. MPa | Tensile Strength, min. ksi | Elongation % min | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| EN 10088-3:2014 | X6CrNiTi18-10 | --- | 1.4541 | --- | --- | 350 | --- | 700-850 | --- | 20 | CW | --- |
| | | | | --- | --- | 500 | --- | 800-1000 | --- | 12 | CW | --- |
| | | | | 0.05 < d ≤ 0.10 | --- | --- | --- | 1100 max. | --- | 20 | SA | --- |
| | | | | 0.10 < d ≤ 0.20 | --- | --- | --- | 1050 max. | --- | 20 | SA | --- |
| | | | | 0.20 < d ≤ 0.50 | --- | --- | --- | 1000 max. | --- | 30 | SA | --- |
| | | | | 0.50 < d ≤ 1.00 | --- | --- | --- | 950 max. | --- | 30 | SA | --- |
| | | | | 1.00 < d ≤ 3.00 | --- | --- | --- | 900 max. | --- | 30 | SA | --- |
| | | | | 3.00 < d ≤ 5.00 | --- | --- | --- | 850 max. | --- | 35 | SA | --- |
| | | | | t ≤ 10 | --- | 400 | --- | 600-950 | --- | 25 L | SA | --- |
| | | | | 10 < t ≤ 16 | --- | 380 | --- | 580-950 | --- | 25 L | SA | --- |
| | | | | 5.00 < d ≤ 16.00 | --- | --- | --- | 800 max. | --- | 35 | SA | --- |
| | | | | 16 < t ≤ 40 | --- | 190 | --- | 500-850 | --- | 30 L | SA | L: 100 J @ RT |
| | | | | 40 < t ≤ 63 | --- | 190 | --- | 500-850 | --- | 30 L | SA | L: 100 J @ RT |
| | | | | t ≤ 160 | --- | 190 | --- | 500-700 | --- | 40 L | SA | 215 max. HBW; L: 100 J @ RT |
| | | | | 63 < t ≤ 160 | --- | 190 | --- | 500-700 | --- | 40 L | SA | L: 100 J @ RT |
| | | | | 160 < t ≤ 250 | --- | 190 | --- | 500-700 | --- | 30 T | SA | 215 max. HBW; T: 60 J @ RT |
| | | | | d ≥ 0.05 | --- | --- | --- | 500-700 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 600-800 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 700-900 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 800-1000 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 900-1100 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1000-1250 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1100-1350 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1200-1450 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1400-1700 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1600-1900 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1800-2100 | --- | --- | --- | --- |

Note: This section continued on next page

**8.2 Stainless Steels: Bar**

**8.2.3B Mechanical Properties of Austenitic Stainless Steels (Continued)**

| Specification | Designation | UNS No | Steel No | Section Thickness/Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation % min | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | | | |
| EN 10263-5:2001 | X6CrNiTi18-10 | --- | 1.4541 | 2 < d ≤ 5 | --- | --- | --- | 720 max. L | --- | --- | CD+SA | --- |
| | | | | 2 < d ≤ 5 | --- | --- | --- | 770 max. L | --- | --- | CD+SA | --- |
| | | | | 5 < d ≤ 10 | --- | --- | --- | 680 max. L | --- | --- | SA | --- |
| | | | | 5 < d ≤ 10 | --- | --- | --- | 850 max. L | --- | --- | CD+SA | --- |
| | | | | 5 < d ≤ 10 | --- | --- | --- | 680 max. L | --- | --- | CD+SA | --- |
| | | | | 5 < d ≤ 10 | --- | --- | --- | 730 max. L | --- | --- | CD+SA | --- |
| | | | | 10 < d ≤ 25 | --- | --- | --- | 680 max. L | --- | --- | SA | --- |
| | | | | 10 < d ≤ 25 | --- | --- | --- | 810 max. L | --- | --- | CD+SA | --- |
| | | | | 10 < d ≤ 25 | --- | --- | --- | 680 max. L | --- | --- | CD+SA | --- |
| | | | | 25 < d ≤ 50 | --- | --- | --- | 680 max. L | --- | --- | SA | --- |
| GB 1220-92 | Grade 0Cr18Ni10Ti | --- | --- | t ≤ 180 | --- | 205 | --- | 520 | --- | 40 | ST | 187 max. HB; 90 max. HRB |
| | Grade 1Cr18Ni9 | --- | --- | t ≤ 180 | --- | 205 | --- | 520 | --- | 40 | ST | 187 max. HB; 90 max. HRB |
| GB 1221-92 | Grade 0Cr18Ni10Ti | --- | --- | t ≤ 180 | --- | 205 | --- | 520 | --- | 40 | ST | 187 max. HB |
| ISO 4954:1993 | Type X 6 CrNiTi 18 10 E | --- | --- | 2 ≤ d ≤ 50 | --- | --- | --- | 680 max. | --- | --- | Q, CD | --- |
| | | | | 2 ≤ d ≤ 50 | --- | --- | --- | 730 max. | --- | --- | see standard | --- |
| JIS G 4303:2012 | Symbol SUS321 | --- | --- | d ≤ 180 | --- | 205 | --- | 520 | --- | 40 | ST | 187 max. HBW; 90 max. HRBW; 200 max. HV |

**8.2 Stainless Steels: Bar**

**8.2.3B Mechanical Properties of Austenitic Stainless Steels (Continued)**

| Specification | Designation | UNS No | Steel No | Section Thickness/Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation % min | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | | | |
| EN 10088-3:2014 | X8CrMnNiN18-9-5 | --- | 1.4374 | 0.05 < d ≤ 0.10 | --- | --- | --- | 1100 max. | --- | 20 | SA | --- |
| | | | | 0.10 < d ≤ 0.20 | --- | --- | --- | 1050 max. | --- | 20 | SA | --- |
| | | | | 0.20 < d ≤ 0.50 | --- | --- | --- | 1000 max. | --- | 30 | SA | --- |
| | | | | 0.50 < d ≤ 1.00 | --- | --- | --- | 950 max. | --- | 30 | SA | --- |
| | | | | 1.00 < d ≤ 3.00 | --- | --- | --- | 900 max. | --- | 30 | SA | --- |
| | | | | 3.00 < d ≤ 5.00 | --- | --- | --- | 850 max. | --- | 35 | SA | --- |
| | | | | t ≤ 10 | --- | 350 | --- | 700-900 | --- | 35 L | SA | 260 max. HBW |
| | | | | 5.00 < d ≤ 16.00 | --- | --- | --- | 800 max. | --- | 35 | SA | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 500-700 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 600-800 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 700-900 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 800-1000 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 900-1100 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1000-1250 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1100-1350 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1200-1450 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1400-1700 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1600-1900 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1800-2100 | --- | --- | --- | --- |
| ISO 16143-2:2004 | X8CrMnNiN18-9-5 | --- | --- | t ≤ 10 | --- | 350 | --- | 700-900 | --- | 35 L | SA | --- |
| EN 10088-3:2014 | X11CrNiMnN19-8-6 | --- | 1.4369 | t ≤ 15 | --- | 340 | --- | 750-950 | --- | 35 L, 35 T | SA | 300 max. HBW; L: 100 J @ RT; T: 60 J @ RT |
| ISO 16143-2:2004 | X11CrNiMnN19-8-6 | --- | --- | t < 4 | --- | 340 | --- | 750-950 | --- | 35 T | SA | --- |
| | | | | t < 15 | --- | 340 | --- | 750-950 | --- | 35 L | SA | --- |
| | | | | 0.05 < t ≤ 0.10 | --- | --- | --- | 1100 max. | --- | 20 | SA | --- |
| | | | | 0.10 < t ≤ 0.20 | --- | --- | --- | 1070 max. | --- | 20 | SA | --- |
| | | | | 0.20 < t ≤ 0.50 | --- | --- | --- | 1020 max. | --- | 30 | SA | --- |
| | | | | 0.50 < t ≤ 1.00 | --- | --- | --- | 970 max. | --- | 30 | SA | --- |
| | | | | 1.00 < t ≤ 3.00 | --- | --- | --- | 920 max. | --- | 30 | SA | --- |
| | | | | 3.00 < t ≤ 5.00 | --- | --- | --- | 870 max. | --- | 35 | SA | --- |
| | | | | 5.00 < t ≤ 16.00 | --- | --- | --- | 820 max. | --- | 35 | SA | --- |

**8.2 Stainless Steels: Bar**

**8.2.3B Mechanical Properties of Austenitic Stainless Steels (Continued)**

| Specification | Designation | UNS No | Steel No | Section Thickness/Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation % min | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | | | |
| ASME SA-276 | Type 347 | S34700 | --- | t ≤ 12.5 | t ≤ 0.5 | 205 | 30 | 515 | 75 | 30 | A and HF | --- |
| | | | | t ≤ 12.70 | t ≤ 0.5 | 310 | 45 | 620 | 90 | 30 | A and CF | --- |
| | | | | t > 12.5 | t > 0.5 | 205 | 30 | 515 | 75 | 40 | A and HF | --- |
| | | | | t > 12.70 | t > 0.5 | 205 | 30 | 515 | 75 | 30 | A and CF | --- |
| | Type 348 | S34800 | --- | t ≤ 12.5 | t ≤ 0.5 | 205 | 30 | 515 | 75 | 30 | A and HF | --- |
| | | | | t ≤ 12.70 | t ≤ 0.5 | 310 | 45 | 620 | 90 | 30 | A and CF | --- |
| | | | | t > 12.5 | t > 0.5 | 205 | 30 | 515 | 75 | 40 | A and HF | --- |
| | | | | t > 12.70 | t > 0.5 | 205 | 30 | 515 | 75 | 30 | A and CF | --- |
| ASME SA-479/SA-479M | Type 347 | S34700 | --- | --- | --- | 205 | 30 | 515 | 75 | 30 | A | --- |
| | Type 347H | S34709 | --- | --- | --- | 205 | 30 | 515 | 75 | 30 | A | --- |
| ASTM A276/A276M-15 | Type 347 | S34700 | --- | t ≤ 12.5 | t ≤ 0.5 | 205 | 30 | 515 | 75 | 30 | A+HF | --- |
| | | | | t ≤ 12.70 | t ≤ 0.5 | 310 | 45 | 620 | 90 | 30 | A+CF | --- |
| | | | | t > 12.5 | t > 0.5 | 205 | 30 | 515 | 75 | 40 | A+HF | --- |
| | | | | t > 12.70 | t > 0.5 | 205 | 30 | 515 | 75 | 30 | A+CF | --- |
| | Type 348 | S34800 | --- | t ≤ 12.5 | t ≤ 0.5 | 205 | 30 | 515 | 75 | 30 | A+HF | --- |
| | | | | t ≤ 12.70 | t ≤ 0.5 | 310 | 45 | 620 | 90 | 30 | A+CF | --- |
| | | | | t > 12.5 | t > 0.5 | 205 | 30 | 515 | 75 | 40 | A+HF | --- |
| | | | | t > 12.70 | t > 0.5 | 205 | 30 | 515 | 75 | 30 | A+CF | --- |
| ASTM A479/A479M-14 | Type 347 | S34700 | --- | --- | --- | 205 | 30 | 515 | 75 | 30 | SA | --- |
| | Type 347H | S34709 | --- | --- | --- | 205 | 30 | 515 | 75 | 30 | SA | --- |
| EN 10088-3:2014 | X6CrNiNb18-10 | --- | 1.4550 | t ≤ 160 | --- | 205 | --- | 510-740 | --- | 40 L | SA | 230 max. HBW; L: 100 J @ RT |
| | | | | 160 < t ≤ 250 | --- | 205 | --- | 510-740 | --- | 30 T | SA | 230 max. HBW; T: 60 J @ RT |
| GB 1220-92 | Grade 0Cr18Ni11Nb | --- | --- | t ≤ 180 | --- | 205 | --- | 520 | --- | 40 | ST | 187 max. HB; 90 max. HRB |
| JIS G 4303:2012 | Symbol SUS347 | --- | --- | d ≤ 180 | --- | 205 | --- | 520 | --- | 40 | ST | 187 max. HBW; 90 max. HRBW; 200 max. HV |
| ASME SA-276 | --- | S30815 | --- | --- | --- | 310 | 45 | 600 | 87 | 40 | A and HF or A and CF | --- |
| ASME SA-479/SA-479M | --- | S30815 | --- | --- | --- | 310 | 45 | 600 | 87 | 40 | A | --- |
| ASTM A276/A276M-15 | --- | S30815 | --- | --- | --- | 310 | 45 | 600 | 87 | 40 | A+HF or A+CF | --- |
| ASTM A479/A479M-14 | --- | S30815 | --- | --- | --- | 310 | 45 | 600 | 87 | 40 | SA | --- |
| ISO 4955:2005 | X7CrNiSiNCe21-11 | --- | --- | 0.5 ≤ t < 3 | --- | 310 | --- | 650-850 | --- | 37 L, 37 T | SA | 210 max. HB |
| | | | | 1.5 ≤ t ≤ 25 | --- | 310 | --- | 650-850 | --- | 40 | SA | 210 max. HB |
| | | | | 3 ≤ t ≤ 75 | --- | 310 | --- | 650-850 | --- | 40 L, 40 T | SA | 210 max. HB |
| | | | | t ≤ 100 | --- | 310 | --- | 650-850 | --- | 40 | SA | 210 max. HB |
| | | | | 5 ≤ t ≤ 160 | --- | 310 | --- | 650-850 | --- | 40 | SA | 210 max. HB |

**8.2 Stainless Steels: Bar**

**8.2.3B Mechanical Properties of Austenitic Stainless Steels (Continued)**

| Specification | Designation | UNS No | Steel No | Section Thickness/Diameter mm | Section Thickness/Diameter in. | Yield Strength, min. MPa | Yield Strength, min. ksi | Tensile Strength, min. MPa | Tensile Strength, min. ksi | Elongation % min | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| EN 10088-3:2014 | X6CrNiCuS18-9-2 | --- | 1.4570 | 0.05 < d ≤ 0.10 | --- | --- | --- | 1100 max. | --- | 20 | SA | --- |
| | | | | 0.10 < d ≤ 0.20 | --- | --- | --- | 1050 max. | --- | 20 | SA | --- |
| | | | | 0.20 < d ≤ 0.50 | --- | --- | --- | 1000 max. | --- | 30 | SA | --- |
| | | | | 0.50 < d ≤ 1.00 | --- | --- | --- | 950 max. | --- | 30 | SA | --- |
| | | | | 1.00 < d ≤ 3.00 | --- | --- | --- | 900 max. | --- | 30 | SA | --- |
| | | | | 3.00 < d ≤ 5.00 | --- | --- | --- | 850 max. | --- | 35 | SA | --- |
| | | | | t ≤ 10 | --- | 400 | --- | 600-950 | --- | 15 L | SA | --- |
| | | | | 10 < t ≤ 16 | --- | 400 | --- | 600-950 | --- | 15 L | SA | --- |
| | | | | 5.00 < d ≤ 16.00 | --- | --- | --- | 800 max. | --- | 35 | SA | --- |
| | | | | 16 < t ≤ 40 | --- | 185 | --- | 500-910 | --- | 20 L | SA | --- |
| | | | | 40 < t ≤ 63 | --- | 185 | --- | 500-910 | --- | 20 L | SA | --- |
| | | | | t ≤ 160 | --- | 185 | --- | 500-710 | --- | 35 L | SA | 215 max. HBW |
| | | | | 63 < t ≤ 160 | --- | 185 | --- | 500-710 | --- | 35 L | SA | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 500-700 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 600-800 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 700-900 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 800-1000 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 900-1100 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1000-1250 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1100-1350 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1200-1450 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1400-1700 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1600-1900 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1800-2100 | --- | --- | --- | --- |
| ISO 16143-2:2004 | X6CrNiCuS18-9-2 | --- | --- | t ≤ 160 | --- | 185 | --- | 500-710 | --- | 35 L | SA | --- |
| EN 10090:1998 | X53CrMnNiNbN21-9 | --- | 1.4870 | --- | --- | --- | --- | 1300 approx. | --- | --- | CTC | 385 HB approx. |
| | | | | --- | --- | --- | --- | 1300 max. | --- | --- | Q | 385 max. HB |
| ISO 683-15:1992 | Grade X 53CrMnNiNbN 21 9 | --- | --- | --- | --- | --- | --- | --- | --- | --- | CTC | --- |
| | | | | --- | --- | --- | --- | 1300 max. | --- | --- | Q | 385 max. HB |
| GB 1221-92 | Grade 5Cr21Mn9Ni4N | --- | --- | t ≤ 25 | --- | 560 | --- | 885 | --- | 8 | ST | 302 min. HB |
| JIS G 4311:2011 | Symbol SUH35 | --- | --- | t ≤ 25 | --- | 560 | --- | 880 | --- | 8 | see standard | 302 min. HBW |

**8.2 Stainless Steels: Bar**

**8.2.3B Mechanical Properties of Austenitic Stainless Steels (Continued)**

| Specification | Designation | UNS No | Steel No | Section Thickness/Diameter mm | Section Thickness/Diameter in. | Yield Strength, min. MPa | Yield Strength, min. ksi | Tensile Strength, min. MPa | Tensile Strength, min. ksi | Elongation % min | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ASME SA-479/SA-479M | --- | S35315 | --- | --- | --- | 270 | 39 | 650 | 94 | 40 | A | --- |
| ASTM A479/A479M-14 | --- | S35315 | --- | --- | --- | 270 | 39 | 650 | 94 | 40 | SA | --- |
| EN 10095:1999 | X6NiCrSiNCe35-25 | --- | 1.4854 | 0.5 ≤ t ≤ 3 | --- | 300 | --- | 650-850 | --- | 40 L, 40 T | SA | 210 max. HB |
| | | | | t ≤ 25 | --- | 300 | --- | 650-850 L | --- | 40 L | SA | 210 max. HB |
| | | | | 3 ≤ t ≤ 75 | --- | 300 | --- | 650-850 | --- | 40 L, 40 T | SA | 210 max. HB |
| | | | | t ≤ 160 | --- | 300 | --- | 650-850 L | --- | 40 L | SA | 210 max. HB |
| ISO 4955:2005 | X6NiCrSiNCe35-25 | --- | --- | 1.5 ≤ t ≤ 25 | --- | 300 | --- | --- | --- | 40 | SA | 210 max. HB |
| | | | | 0.5 ≤ t ≤ 75 | --- | 300 | --- | --- | --- | 40 L, 40 T | SA | 210 max. HB |
| | | | | t ≤ 100 | --- | 300 | --- | --- | --- | 40 | SA | 210 max. HB |
| | | | | 5 ≤ t ≤ 160 | --- | 300 | --- | --- | --- | 40 | SA | 210 max. HB |
| EN 10088-3:2014 | X3CrNiCu18-9-4 | --- | 1.4567 | 0.05 < d ≤ 0.10 | --- | --- | --- | 1100 max. | --- | 20 | SA | --- |
| | | | | 0.10 < d ≤ 0.20 | --- | --- | --- | 1050 max. | --- | 20 | SA | --- |
| | | | | 0.20 < d ≤ 0.50 | --- | --- | --- | 1000 max. | --- | 30 | SA | --- |
| | | | | 0.50 < d ≤ 1.00 | --- | --- | --- | 950 max. | --- | 30 | SA | --- |
| | | | | 1.00 < d ≤ 3.00 | --- | --- | --- | 900 max. | --- | 30 | SA | --- |
| | | | | 3.00 < d ≤ 5.00 | --- | --- | --- | 850 max. | --- | 35 | SA | --- |
| | | | | t ≤ 10 | --- | 400 | --- | 600-850 | --- | 25 L | SA | --- |
| | | | | 10 < t ≤ 16 | --- | 340 | --- | 600-850 | --- | 25 L | SA | --- |
| | | | | 5.00 < d ≤ 16.00 | --- | --- | --- | 800 max. | --- | 35 | SA | --- |
| | | | | 16 < t ≤ 40 | --- | 175 | --- | 450-800 | --- | 30 L | SA | L: 100 J @ RT |
| | | | | 40 < t ≤ 63 | --- | 175 | --- | 450-800 | --- | 30 L | SA | L: 100 J @ RT |
| | | | | t ≤ 160 | --- | 175 | --- | 450-650 | --- | 45 L | SA | 215 max. HBW |
| | | | | 63 < t ≤ 160 | --- | 175 | --- | 450-650 | --- | 40 L | SA | L: 100 J @ RT |
| | | | | d ≥ 0.05 | --- | --- | --- | 500-700 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 600-800 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 700-900 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 800-1000 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 900-1100 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1000-1250 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1100-1350 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1200-1450 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1400-1700 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1600-1900 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1800-2100 | --- | --- | --- | --- |

Note: This section continued on next page

**8.2 Stainless Steels: Bar**

**8.2.3B Mechanical Properties of Austenitic Stainless Steels (Continued)**

| Specification | Designation | UNS No | Steel No | Section Thickness/Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation % min | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | | | |
| EN 10263-5:2001 | X3CrNiCu18-9-4 | --- | 1.4567 | 2 < d ≤ 5 | --- | --- | --- | 600 max. L | --- | --- | CD+SA | --- |
| | | | | 2 < d ≤ 5 | --- | --- | --- | 650 max. L | --- | --- | CD+SA | --- |
| | | | | 5 < d ≤ 10 | --- | --- | --- | 590 max. L | --- | --- | SA | --- |
| | | | | 5 < d ≤ 10 | --- | --- | --- | 740 max. L | --- | --- | CD+SA | --- |
| | | | | 5 < d ≤ 10 | --- | --- | --- | 590 max. L | --- | --- | CD+SA | --- |
| | | | | 5 < d ≤ 10 | --- | --- | --- | 640 max. L | --- | --- | CD+SA | --- |
| | | | | 10 < d ≤ 25 | --- | --- | --- | 590 max. L | --- | --- | SA | --- |
| | | | | 10 < d ≤ 25 | --- | --- | --- | 700 max. L | --- | --- | CD+SA | --- |
| | | | | 10 < d ≤ 25 | --- | --- | --- | 590 max. L | --- | --- | CD+SA | --- |
| | | | | 25 < d ≤ 50 | --- | --- | --- | 590 max. L | --- | --- | SA | --- |
| EN 10269:2013 | X3CrNiCu18-9-4 | --- | 1.4567 | d ≤ 35 | --- | 350 | --- | 700-850 L | --- | 20 L | CW | L: 80 J @ 20°C |
| | | | | d ≤ 160 | --- | 175 | --- | 450-650 L | --- | 45 L | SA | L : 100 J @ 20°C |
| GB 1220-92 | Grade 0Cr18Ni9Cu3 | --- | --- | t ≤ 180 | --- | 177 | --- | 480 | --- | 40 | ST | --- |
| ISO 16143-2:2004 | X3CrNiCu18-9-4 | --- | --- | --- | --- | --- | --- | 450-650 | --- | --- | SA | --- |
| ISO 4954:1993 | Type X 3 CrNiCu 18 9 3 E | --- | --- | 2 ≤ d ≤ 50 | --- | --- | --- | 590 max. | --- | --- | Q, CD | --- |
| | | | | 2 ≤ d ≤ 50 | --- | --- | --- | 620 max. | --- | --- | see standard | --- |
| JIS G 4303:2012 | Symbol SUSXM7 | --- | --- | d ≤ 180 | --- | 175 | --- | 480 | --- | 40 | ST | 187 max. HBW; 90 max. HRBW; 200 max. HV |
| GB 1220-92 | Grade 0Cr18Ni13Si4 | --- | --- | t ≤ 180 | --- | 205 | --- | 520 | --- | 40 | ST | 207 max. HB; 95 max. HRB |
| GB 1221-92 | Grade 0Cr18Ni13Si4 | --- | --- | t ≤ 180 | --- | 205 | --- | 520 | --- | 40 | ST | 207 max. HB |
| JIS G 4303:2012 | Symbol SUSXM15J1 | --- | --- | d ≤ 180 | --- | 205 | --- | 520 | --- | 40 | ST | 207 max. HBW; 95 max. HRBW; 218 max. HV |
| GB 1221-92 | Grade 2Cr21Ni12N | --- | --- | t ≤ 25 | --- | 430 | --- | 820 | --- | 26 | ST | 269 max. HB |
| JIS G 4311:2011 | Symbol SUH37 | --- | --- | t ≤ 25 | --- | 390 | --- | 780 | --- | 35 | see standard | 248 max. HBW |

**8.2 Stainless Steels: Bar**

**8.2.3B Mechanical Properties of Austenitic Stainless Steels (Continued)**

| Specification | Designation | UNS No | Steel No | Section Thickness/Diameter mm | Section Thickness/Diameter in. | Yield Strength, min. MPa | Yield Strength, min. ksi | Tensile Strength, min. MPa | Tensile Strength, min. ksi | Elongation % min | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| EN 10088-3:2014 | X8CrMnCuNB17-8-3 | --- | 1.4597 | 0.05 < d ≤ 0.10 | --- | --- | --- | 1100 max. | --- | 20 | SA | --- |
| | | | | 0.10 < d ≤ 0.20 | --- | --- | --- | 1050 max. | --- | 20 | SA | --- |
| | | | | 0.20 < d ≤ 0.50 | --- | --- | --- | 1000 max. | --- | 30 | SA | --- |
| | | | | 0.50 < d ≤ 1.00 | --- | --- | --- | 950 max. | --- | 30 | SA | --- |
| | | | | 1.00 < d ≤ 3.00 | --- | --- | --- | 900 max. | --- | 30 | SA | --- |
| | | | | 3.00 < d ≤ 5.00 | --- | --- | --- | 850 max. | --- | 35 | SA | --- |
| | | | | 5.00 < d ≤ 16.00 | --- | --- | --- | 800 max. | --- | 35 | SA | --- |
| | | | | t ≤ 160 | --- | 270 | --- | 560-780 | --- | 40 L | SA | 245 max. HBW; L: 100 J @ RT |
| | | | | d ≥ 0.05 | --- | --- | --- | 500-700 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 600-800 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 700-900 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 800-1000 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 900-1100 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1000-1250 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1100-1350 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1200-1450 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1400-1700 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1600-1900 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1800-2100 | --- | --- | --- | --- |
| ISO 16143-2:2004 | X8CrMnCuN17-8-3 | --- | --- | t ≤ 160 | --- | 270 | --- | 560-760 | --- | 40 L | SA | --- |
| ASME SA-453/SA-453M | Grade 660, Class A | S66286 | --- | --- | --- | 585 | 85 | 895 | 130 | 15 | S+H | 248-341 HB; 24-37 HRC |
| ASTM A453/A453M-12 | Grade 660, Class A | S66286 | --- | --- | --- | 585 | 85 | 895 | 130 | 15 | S+H | 248-341 HB; 24-37 HRC |
| EN 10302:2008 | X6NiCrTiMoVB25-15-2 | --- | 1.4980 | --- | --- | 600 | --- | 900-1150 | --- | 15 | PH | --- |
| GB 1221-92 | Grade 0Cr15Ni25Ti2MoAlVB | --- | --- | t ≤ 180 | --- | 590 | --- | 900 | --- | 15 | ST | 248 min. HB |
| JIS G 4311:2011 | Symbol SUH660 | --- | --- | t ≤ 180 | --- | 590 | --- | 900 | --- | 15 | see standard | 248 min. HBW |
| ASME SA-479/SA-479M | --- | N08367 | --- | --- | --- | 310 | 45 | 655 | 95 | 30 | A | 241 max. HB |
| ASTM A479/A479M-14 | --- | N08367 | --- | --- | --- | 310 | 45 | 655 | 95 | 30 | SA | 241 max. HB |
| ASTM B691-02 (2013) | --- | N08367 | --- | --- | --- | 310 | 45 | 655 | 95 | 30 | CFA or HFA | --- |
| JIS G 4303:2012 | Symbol SUS836L | --- | --- | d ≤ 180 | --- | 205 | --- | 520 | --- | 35 | ST | 217 max. HBW; 96 max. HRBW; 230 max. HV |

**8.2 Stainless Steels: Bar**

**8.2.3B Mechanical Properties of Austenitic Stainless Steels (Continued)**

| Specification | Designation | UNS No | Steel No | Section Thickness/Diameter mm | Section Thickness/Diameter in. | Yield Strength, min. MPa | Yield Strength, min. ksi | Tensile Strength, min. MPa | Tensile Strength, min. ksi | Elongation % min | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| EN 10088-3:2014 | X1NiCrMoCu25-20-5 | --- | 1.4539 | 0.05 < d ≤ 0.10 | --- | --- | --- | 1100 max. | --- | 20 | SA | --- |
| | | | | 0.10 < d ≤ 0.20 | --- | --- | --- | 1050 max. | --- | 20 | SA | --- |
| | | | | 0.20 < d ≤ 0.50 | --- | --- | --- | 1000 max. | --- | 30 | SA | --- |
| | | | | 0.50 < d ≤ 1.00 | --- | --- | --- | 950 max. | --- | 30 | SA | --- |
| | | | | 1.00 < d ≤ 3.00 | --- | --- | --- | 900 max. | --- | 30 | SA | --- |
| | | | | 3.00 < d ≤ 5.00 | --- | --- | --- | 850 max. | --- | 35 | SA | --- |
| | | | | t ≤ 10 | --- | 400 | --- | 600-930 | --- | 20 L | SA | --- |
| | | | | 10 < t ≤ 16 | --- | 400 | --- | 600-930 | --- | 20 L | SA | --- |
| | | | | 5.00 < d ≤ 16.00 | --- | --- | --- | 800 max. | --- | 35 | SA | --- |
| | | | | 16 < t ≤ 40 | --- | 230 | --- | 530-880 | --- | 25 L | SA | L: 100 J @ RT |
| | | | | 40 < t ≤ 63 | --- | 230 | --- | 530-880 | --- | 25 L | SA | L: 100 J @ RT |
| | | | | t ≤ 160 | --- | 230 | --- | 530-730 | --- | 35 L | SA | 230 max. HBW; L: 100 J @ RT |
| | | | | 63 < t ≤ 160 | --- | 230 | --- | 530-730 | --- | 35 L | SA | L: 100 J @ RT |
| | | | | 160 < t ≤ 250 | --- | 230 | --- | 530-730 | --- | 30 T | SA | 230 max. HBW; T: 60 J @ RT |
| | | | | 160 < t ≤ 250 | --- | 230 | --- | 530-730 | --- | 30 T | SA | T: 60 J @ RT |
| | | | | d ≥ 0.05 | --- | --- | --- | 500-700 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 600-800 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 700-900 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 800-1000 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 900-1100 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1000-1250 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1100-1350 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1200-1450 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1400-1700 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1600-1900 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1800-2100 | --- | --- | --- | --- |
| JIS G 4303:2012 | Symbol SUS890L | --- | --- | d ≤ 180 | --- | 215 | --- | 490 | --- | 35 | ST | 187 max. HBW; 90 max. HRBW; 200 max. HV |

**8.2 Stainless Steels: Bar**

**8.2.3B Mechanical Properties of Austenitic Stainless Steels (Continued)**

| Specification | Designation | UNS No | Steel No | Section Thickness/Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | % min | | |
| EN 10088-3:2014 | X1NiCrMoCu31-27-4 | --- | 1.4563 | 0.05 < d ≤ 0.10 | --- | --- | --- | 1100 max. | --- | 20 | SA | --- |
| | | | | 0.10 < d ≤ 0.20 | --- | --- | --- | 1050 max. | --- | 20 | SA | --- |
| | | | | 0.20 < d ≤ 0.50 | --- | --- | --- | 1000 max. | --- | 30 | SA | --- |
| | | | | 0.50 < d ≤ 1.00 | --- | --- | --- | 950 max. | --- | 30 | SA | --- |
| | | | | 1.00 < d ≤ 3.00 | --- | --- | --- | 900 max. | --- | 30 | SA | --- |
| | | | | 3.00 < d ≤ 5.00 | --- | --- | --- | 850 max. | --- | 35 | SA | --- |
| | | | | 5.00 < d ≤ 16.00 | --- | --- | --- | 800 max. | --- | 35 | SA | --- |
| | | | | t ≤ 160 | --- | 220 | --- | 500-750 | --- | 35 L | SA | 230 max. HBW; L: 100 J @ RT |
| | | | | 160 < t ≤ 250 | --- | 220 | --- | 500-750 | --- | 30 T | SA | 230 max. HBW; T: 60 J @ RT |
| | | | | d ≥ 0.05 | --- | --- | --- | 500-700 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 600-800 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 700-900 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 800-1000 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 900-1100 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1000-1250 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1100-1350 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1200-1450 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1400-1700 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1600-1900 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1800-2100 | --- | --- | --- | --- |
| EN 10272:2007 | X1NiCrMoCu31-27-4 | --- | 1.4563 | t ≤ 160 | --- | 220 | --- | 500-750 L | --- | 35 L | SA | 230 max. HBW; see standard for impact data |
| | | | | 160 < t ≤ 250 | --- | 220 | --- | 500-750 T | --- | 30 T | SA | 230 max. HBW; see standard for impact data |
| ISO 16143-2:2004 | X1NiCrMoCu31-27-4 | --- | --- | --- | --- | --- | --- | 500-750 | --- | --- | SA | --- |

**8.2 Stainless Steels: Bar**

**8.2.4A Chemical Composition of Precipitation-Hardening Stainless Steels**

| Specification | Designation | UNS No | Steel No | Weight, %, max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASME SA-564/SA-564M | Type 630 | S17400 | --- | 0.07 | 1.00 | 1.00 | 0.040 | 0.030 | 15.00-17.50 | 3.00-5.00 | --- | (Cb+Ta) 0.15 to 0.45; Cu 3.00-5.00 |
| ASTM A564/A564M-13 | Type 630 | S17400 | --- | 0.07 | 1.00 | 1.00 | 0.040 | 0.030 | 15.00-17.50 | 3.00-5.00 | --- | (Cb+Ta) 0.15 to 0.45; Cu 3.00-5.00 |
| ASTM A1028-03 (2015) | Grade F, Class 1 | S17400 | --- | 0.07 | 1.0 | 1.0 | 0.040 | 0.030 | 15.0-17.5 | 3.0-5.0 | --- | Cb 0.15-0.45; Cu 3.0-5.0 |
| EN 10088-3:2014 | X5CrNiCuNb16-4 | --- | 1.4542 | 0.07 | 1.50 | 0.70 | 0.040 | 0.030 | 15.0-17.0 | 3.0-5.0 | 0.60 | Nb 5xC to 0.45; Cu 3.0-5.0 |
| GB 1220-92 | Grade 0Cr17Ni4Cu4Nb | --- | --- | 0.07 | 1.00 | 1.00 | 0.035 | 0.030 | 15.50-17.50 | 3.00-5.00 | --- | Cu 3.00-5.00; Nb 0.15-0.45 |
| GB 1221-92 | Grade 0Cr17Ni4Cu4Nb | --- | --- | 0.07 | 1.00 | 1.00 | 0.035 | 0.030 | 15.50-17.50 | 3.00-5.00 | --- | Cu 3.00-5.00; Nb 0.15-0.45 |
| JIS G 4303:2012 | Symbol SUS630 | --- | --- | 0.07 | 1.00 | 1.00 | 0.040 | 0.030 | 15.00-17.50 | 3.00-5.00 | --- | Cu 3.00-5.00; Nb 0.15-0.45 |
| ASME SA-564/SA-564M | Type 631 | S17700 | --- | 0.09 | 1.00 | 1.00 | 0.040 | 0.030 | 16.00-18.00 | 6.50-7.75 | --- | Al 0.75-1.50 |
| ASTM A564/A564M-13 | Type 631 | S17700 | --- | 0.09 | 1.00 | 1.00 | 0.040 | 0.030 | 16.00-18.00 | 6.50-7.75 | --- | Al 0.75-1.50 |
| EN 10088-3:2014 | X7CrNiAl17-7 | --- | 1.4568 | 0.09 | 1.00 | 0.70 | 0.040 | 0.015 | 16.0-18.0 | 6.5-7.8 | --- | Al 0.70-1.50 |
| GB 1220-92 | Grade 0Cr17Ni7Al | --- | --- | 0.09 | 1.00 | 1.00 | 0.035 | 0.030 | 16.00-18.00 | 6.50-7.75 | --- | Al 0.75-1.50; Cu 0.50 |
| GB 1221-92 | Grade 0Cr17Ni7Al | --- | --- | 0.09 | 1.00 | 1.00 | 0.035 | 0.030 | 16.00-18.00 | 6.50-7.75 | --- | Al 0.75-1.50; Cu 0.50 |
| JIS G 4303:2012 | Symbol SUS631 | --- | --- | 0.09 | 1.00 | 1.00 | 0.040 | 0.030 | 16.00-18.00 | 6.50-7.75 | --- | Al 0.75-1.50 |
| ASME SA-564/SA-564M | Type 632 | S15700 | --- | 0.09 | 1.00 | 1.00 | 0.040 | 0.030 | 14.00-16.00 | 6.50-7.75 | 2.00-3.00 | Al 0.75-1.50 |
| ASTM A564/A564M-13 | Type 632 | S15700 | --- | 0.09 | 1.00 | 1.00 | 0.040 | 0.030 | 14.00-16.00 | 6.50-7.75 | 2.00-3.00 | Al 0.75-1.50 |
| GB 1220-92 | Grade 0Cr15Ni7Mo2Al | --- | --- | 0.09 | 1.00 | 1.00 | 0.035 | 0.030 | 14.00-16.00 | 6.50-7.50 | 2.00-3.00 | Al 0.75-1.50 |

**8.2 Stainless Steels: Bar**

**8.2.4B Mechanical Properties of Precipitation-Hardening Stainless Steels**

| Specification | Designation | UNS No | Steel No | Section Thickness/Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation % min | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | | | |
| ASME SA-564/SA-564M | Type 630 | S17400 | --- | --- | --- | --- | --- | --- | --- | --- | SA | 363 max. HB; 38 max. HRC |
| | | | | --- | --- | 520 | 75 | 795 | 115 | 18 | PH (H1150M) | 255 min. HB; 24 min. HRC; 75 J @ RT |
| | | | | --- | --- | 725 | 105 | 860 | 125 | 16 | PH (H1150D) | 255-311 HB; 24-33 HRC; 41 J @ RT |
| | | | | t ≤ 75 | t ≤ 3 | 1170 | 170 | 1310 L | 190 L | 10 L | PH (H900) | 388 min. HB; 40 min. HRC |
| | | | | t ≤ 75 | t ≤ 3 | 1070 | 155 | 1170 L | 170 L | 10 L | PH (H925) | 375 min. HB; 38 min. HRC; L: 6.8 J @ RT |
| | | | | 75 < t ≤ 200 | 3 < t ≤ 8 | 1170 | 170 | 1310 T | 190 T | 10 T | PH (H900) | 388 min. HB; 40 min. HRC |
| | | | | 75 < t ≤ 200 | 3 < t ≤ 8 | 1070 | 155 | 1170 T | 170 T | 10 T | PH (H925) | 375 min. HB; 38 min. HRC; T: 6.8 J @ RT |
| | | | | t ≤ 200 | t ≤ 8 | 1000 | 145 | 1070 L | 155 L | 12 L | PH (H1025) | 331 min. HB; 35 min. HRC; L: 20 J @ RT |
| | | | | t ≤ 200 | t ≤ 8 | 860 | 125 | 1000 L | 145 L | 13 L | PH (H1075) | 311 min. HB; 32 min. HRC; L: 27 J @ RT |
| | | | | t ≤ 200 | t ≤ 8 | 795 | 115 | 965 L | 140 L | 14 L | PH (H1100) | 302 min. HB; 31 min. HRC; L: 34 J @ RT |
| | | | | t ≤ 200 | t ≤ 8 | 725 | 105 | 930 L | 135 L | 16 L | PH (H1150) | 277 min. HB; 28 min. HRC; L: 41 J @ RT |

Note: This section continued on next page

**8.2 Stainless Steels: Bar**

**8.2.4B Mechanical Properties of Precipitation-Hardening Stainless Steels (Continued)**

| Specification | Designation | UNS No | Steel No | Section Thickness/Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation % min | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | | | |
| ASTM A564/A564M-13 | Type 630 | S17400 | --- | --- | --- | --- | --- | --- | --- | --- | SA | 363 max. HB; 38 max. HRC |
| | | | | --- | --- | 520 | 75 | 795 | 115 | 18 | PH (H1150M) | 255 min. HB; 24 min. HRC; 75 J @ RT |
| | | | | --- | --- | 725 | 105 | 860 | 125 | 16 | PH (H1150D) | 255-311 HB; 24-33 HRC; 41 J @ RT |
| | | | | t ≤ 75 | t ≤ 3 | 1170 | 170 | 1310 L | 190 L | 10 L | PH (H900) | 388 min. HB; 40 min. HRC |
| | | | | t ≤ 75 | t ≤ 3 | 1070 | 155 | 1170 L | 170 L | 10 L | PH (H925) | 375 min. HB; 38 min. HRC; L: 6.8 J @ RT |
| | | | | 75 < t ≤ 200 | 3 < t ≤ 8 | 1170 | 170 | 1310 T | 190 T | 10 T | PH (H900) | 388 min. HB; 40 min. HRC |
| | | | | 75 < t ≤ 200 | 3 < t ≤ 8 | 1070 | 155 | 1170 T | 170 T | 10 T | PH (H925) | 375 min. HB; 38 min. HRC; T: 6.8 J @ RT |
| | | | | t ≤ 200 | t ≤ 8 | 1000 | 145 | 1070 L | 155 L | 12 L | PH (H1025) | 331 min. HB; 35 min. HRC; L: 20 J @ RT |
| | | | | t ≤ 200 | t ≤ 8 | 860 | 125 | 1000 L | 145 L | 13 L | PH (H1075) | 311 min. HB; 32 min. HRC; L: 27 J @ RT |
| | | | | t ≤ 200 | t ≤ 8 | 795 | 115 | 965 L | 140 L | 14 L | PH (H1100) | 302 min. HB; 31 min. HRC; L: 34 J @ RT |
| | | | | t ≤ 200 | t ≤ 8 | 725 | 105 | 930 L | 135 L | 16 L | PH (H1150) | 277 min. HB; 28 min. HRC; L: 41 J @ RT |
| ASTM A1028-03 (2015) | Grade F, Class 1 | S17400 | --- | --- | --- | --- | 105 | --- | 135 | 16 | A+Q+G | 341 max. HB; |

Note: This section continued on next page

**8.2 Stainless Steels: Bar**

**8.2.4B Mechanical Properties of Precipitation-Hardening Stainless Steels (Continued)**

| Specification | Designation | UNS No | Steel No | Section Thickness/Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation % min | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | | | |
| EN 10088-3:2014 | X5CrNiCuNb16-4 | --- | 1.4542 | t ≤ 10 | --- | --- | --- | 1200 max. | --- | --- | A | 360 max. HB |
| | | | | t ≤ 10 | --- | 600 | --- | 900-1100 | --- | 10 L | PH (+P800) | --- |
| | | | | 10 < t ≤ 16 | --- | --- | --- | 1200 max. | --- | --- | A | 360 max. HB |
| | | | | 10 < t ≤ 16 | --- | 600 | --- | 900-1100 | --- | 10 L | PH (+P800) | --- |
| | | | | 16 < t ≤ 40 | --- | --- | --- | 1200 max. | --- | --- | A | 360 max. HB |
| | | | | 16 < t ≤ 40 | --- | 520 | --- | 800-1050 | --- | 12 L | PH (+P800) | L: 75 J @ RT |
| | | | | 40 < t ≤ 63 | --- | --- | --- | 1200 max. | --- | --- | A | 360 max. HB |
| | | | | 40 < t ≤ 63 | --- | 520 | --- | 800-1000 | --- | 18 L | PH (+P800) | L: 75 J @ RT |
| | | | | t ≤ 100 | --- | 1000 | --- | 1070-1270 | --- | 10 L | PH (+P1070) | --- |
| | | | | t ≤ 100 | --- | 720 | --- | 930-1100 | --- | 16 L | PH (+P930) | L: 40 J @ RT |
| | | | | t ≤ 100 | --- | 790 | --- | 960-1160 | --- | 12 L | PH (+P960) | --- |
| | | | | t ≤ 100 | --- | --- | --- | 1200 max. | --- | --- | SA | 360 max. HBW |
| | | | | t ≤ 100 | --- | 520 | --- | 800-950 | --- | 18 L | PH (+P800) | L: 75 J @ RT |
| | | | | t ≤ 100 | --- | 720 | --- | 930-1100 | --- | 12 L | PH (+P930) | L: 40 J @ RT |
| | | | | t ≤ 100 | --- | 790 | --- | 960-1160 | --- | 10 L | PH (+P960) | --- |
| | | | | t ≤ 100 | --- | 1000 | --- | 1070-1270 | --- | 10 L | PH(+P1070) | --- |
| | | | | 63 < t ≤ 160 | --- | --- | --- | 1200 max. | --- | --- | A | 360 max. HB |
| | | | | 63 < t ≤ 160 | --- | 520 | --- | 800-950 | --- | 18 L | PH (+P800) | L: 75 J @ RT |
| GB 1220-92 | Grade 0Cr17Ni4Cu4Nb | --- | --- | t ≤ 75 | --- | --- | --- | --- | --- | --- | ST | 363 max. HB |
| | | | | t ≤ 75 | --- | 1180 | --- | 1310 | --- | 10 | ST | 375 min. HB |
| | | | | t ≤ 75 | --- | 1000 | --- | 1060 | --- | 12 | ST | 331 min. HB |
| | | | | t ≤ 75 | --- | 865 | --- | 1000 | --- | 13 | ST | 302 min. HB |
| | | | | t ≤ 75 | --- | 725 | --- | 930 | --- | 16 | ST | 277 min. HB |
| GB 1221-92 | Grade 0Cr17Ni4Cu4Nb | --- | --- | t ≤ 75 | --- | --- | --- | --- | --- | --- | ST | 363 max. HB |
| | | | | t ≤ 75 | --- | 1180 | --- | 1310 | --- | 10 | ST | 375 min. HB |
| | | | | t ≤ 75 | --- | 1000 | --- | 1060 | --- | 12 | ST | 331 min. HB |
| | | | | t ≤ 75 | --- | 865 | --- | 1000 | --- | 13 | ST | 302 min. HB |
| | | | | t ≤ 75 | --- | 725 | --- | 930 | --- | 16 | ST | 277 min. HB |

Note: This section continued on next page

**8.2 Stainless Steels: Bar**

**8.2.4B Mechanical Properties of Precipitation-Hardening Stainless Steels (Continued)**

| Specification | Designation | UNS No | Steel No | Section Thickness/Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation % min | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | | | |
| JIS G 4303:2012 | Symbol SUS630 | --- | --- | d ≤ 75 | --- | --- | --- | --- | --- | --- | PH (S) | 363 max. HBW; 38 max. HRC; 383 max. HV |
| | | | | d ≤ 75 | --- | 1175 | --- | 1310 | --- | 10 | PH (H900) | 375 min. HBW; 40 min. HRC; 396 min. HV |
| | | | | d ≤ 75 | --- | 1000 | --- | 1070 | --- | 12 | PH (H1025) | 331 min. HBW; 35 min. HRC; 350 min. HV |
| | | | | d ≤ 75 | --- | 860 | --- | 1000 | --- | 13 | PH (H1075) | 302 min. HBW; 31 min. HRC; 320 min. HV |
| | | | | d ≤ 75 | --- | 725 | --- | 930 | --- | 16 | PH (H1150) | 277 min. HBW; 28 min. HRC; 292 min. HV |
| ASME SA-564/SA-564M | Type 631 | S17700 | --- | --- | --- | --- | --- | --- | --- | --- | SA | 229 max. HB; 98 max. HRB |
| | | | | t ≤ 100 | t ≤ 4 | 1030 | 150 | 1280 L | 185 L | 6 L | PH (RH950) | 388 min. HB; 41 min. HRC |
| | | | | t ≤ 150 | t ≤ 6 | 965 | 140 | 1170 L | 170 L | 6 L | PH (TH1050) | 352 min. HB; 38 min. HRC |
| ASTM A564/A564M-13 | Type 631 | S17700 | --- | --- | --- | --- | --- | --- | --- | --- | SA | 229 max. HB; 98 max. HRB |
| | | | | t ≤ 100 | t ≤ 4 | 1030 | 150 | 1280 L | 185 L | 6 L | PH (RH95) | 388 min. HB; 41 min. HRC |
| | | | | t ≤ 150 | t ≤ 6 | 965 | 140 | 1170 L | 170 L | 6 L | PH (TH1050) | 352 min. HB; 38 min. HRC |

Note: This section continued on next page

**8.2 Stainless Steels: Bar**

**8.2.4B Mechanical Properties of Precipitation-Hardening Stainless Steels (Continued)**

| Specification | Designation | UNS No | Steel No | Section Thickness/Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | % min | | |
| EN 10088-3:2014 | X7CrNiAl17-7 | --- | 1.4568 | 0.50 < d ≤ 1.00 | --- | --- | --- | 1100 max. | --- | 10 | A+PH | --- |
| | | | | 1.00 < d ≤ 3.00 | --- | --- | --- | 1050 max. | --- | 10 | A+PH | --- |
| | | | | 3.00 < d ≤ 5.00 | --- | --- | --- | 1000 max. | --- | 10 | A+PH | --- |
| | | | | 5.00 < d ≤ 16.00 | --- | --- | --- | 950 max. | --- | 15 | A+PH | --- |
| | | | | t ≤ 30 | --- | --- | --- | 850 max. | --- | --- | SA | 255 max. HBW |
| | | | | d ≥ 0.05 | --- | --- | --- | 500-700 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 600-800 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 700-900 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 800-1000 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 900-1100 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1000-1250 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1100-1350 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1200-1450 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1400-1700 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1600-1900 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1800-2100 | --- | --- | --- | --- |
| GB 1220-92 | Grade 0Cr17Ni7Al | --- | --- | t ≤ 75 | --- | 380 max. | --- | 1030 max. | --- | 20 | ST | 229 max. HB |
| | | | | t ≤ 75 | --- | 960 | --- | 1140 | --- | 5 | ST | 363 min. HB |
| | | | | t ≤ 75 | --- | 1030 | --- | 1230 | --- | 4 | ST | 388 min. HB |
| GB 1221-92 | Grade 0Cr17Ni7Al | --- | --- | t ≤ 75 | --- | 380 | --- | 1030 | --- | 20 | ST | 229 max. HB |
| | | | | t ≤ 75 | --- | 960 | --- | 1140 | --- | 5 | ST | 363 min. HB |
| | | | | t ≤ 75 | --- | 1030 | --- | 1230 | --- | 4 | ST | 388 min. HB |
| JIS G 4303:2012 | Symbol SUS631 | --- | --- | d ≤ 75 | --- | 380 | --- | 1030 | --- | 20 | PH (S) | 229 max. HBW; 98 max. HRBW; 241 max. HV |
| | | | | d ≤ 75 | --- | 1030 | --- | 1230 | --- | 4 | PH (RH950) | 388 min. HBW; 41 min. HRC; 410 min. HV |
| | | | | d ≤ 75 | --- | 960 | --- | 1140 | --- | 5 | PH (TH1050) | 363 min. HBW; 38 min. HRC; 383 min. HV |

**8.2 Stainless Steels: Bar**

**8.2.4B Mechanical Properties of Precipitation-Hardening Stainless Steels (Continued)**

| Specification | Designation | UNS No | Steel No | Section Thickness/Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation % min | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | | | |
| ASME SA-564/SA-564M | Type 632 | S15700 | --- | --- | --- | --- | --- | --- | --- | --- | SA | 269 max. HB; 100 max. HRB |
| | | | | t ≤ 100 | t ≤ 4 | 1210 | 175 | 1380 L | 200 L | 7 L | PH (RH950) | 415 min. HB |
| | | | | t ≤ 150 | t ≤ 6 | 1100 | 160 | 1240 L | 180 L | 8 L | PH (TH1050) | 375 min. HB |
| ASTM A564/A564M-13 | Type 632 | S15700 | --- | --- | --- | --- | --- | --- | --- | --- | SA | 269 max. HB; 100 max. HRB |
| | | | | t ≤ 100 | t ≤ 4 | 1210 | 175 | 1380 L | 200 L | 7 L | PH (RH950) | 415 min. HB |
| | | | | t ≤ 150 | t ≤ 6 | 1100 | 160 | 1240 L | 180 L | 8 L | PH (TH1050) | 375 min. HB |
| GB 1220-92 | Grade 0Cr15Ni7Mo2Al | --- | --- | t ≤ 75 | --- | --- | --- | --- | --- | --- | ST | 269 max. HB |
| | | | | t ≤ 75 | --- | 1100 | --- | 1210 | --- | 7 | ST | 375 min. HB |
| | | | | t ≤ 75 | --- | 1210 | --- | 1320 | --- | 6 | ST | 388 min. HB |

**8.2 Stainless Steels: Bar**

**8.2.5A Chemical Composition of Duplex Stainless Steels**

| Specification | Designation | UNS No | Steel No | Weight, %, max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| EN 10088-3:2014 | X2CrNiMoSi18-5-3 | --- | 1.4424 | 0.030 | 1.20-2.00 | 1.40-2.00 | 0.035 | 0.015 | 18.0-19.0 | 4.5-5.2 | 2.50-3.0 | N 0.05-0.10 |
| GB 1220-92 | Grade 00Cr18Ni5Mo3Si2 | --- | --- | 0.030 | 1.00-2.00 | 1.30-2.00 | 0.035 | 0.030 | 18.00-19.50 | 4.50-5.50 | 2.50-3.00 | --- |
| ASME SA-276 | --- | S32304 | --- | 0.030 | 2.50 | 1.00 | 0.040 | 0.030 | 21.50-24.50 | 3.00-5.50 | 0.05-0.60 | Cu 0.05-0.60; N 0.05-0.20 |
| ASTM A276/A276M-15 | --- | S32304 | --- | 0.030 | 2.50 | 1.00 | 0.040 | 0.030 | 21.5-24.5 | 3.0-5.5 | 0.05-0.60 | Cu 0.05-0.60; N 0.05-0.20 |
| EN 10088-3:2014 | X2CrNiN23-4 | --- | 1.4362 | 0.030 | 2.00 | 1.00 | 0.035 | 0.015 | 22.0-24.5 | 3.5-5.5 | 0.10-0.60 | Cu 0.10-0.60; N 0.05-0.20 |
| ISO 16143-2:2004 | X2CrNiN23-4 | --- | --- | 0.030 | 2.00 | 1.00 | 0.035 | 0.015 | 22.0-24.0 | 3.50-5.50 | 0.1-0.6 | Cu 0.10-0.60; N 0.05-0.20 |
| ASME SA-276 | --- | S31803 | --- | 0.030 | 2.00 | 1.00 | 0.030 | 0.020 | 21.00-23.00 | 4.50-6.50 | 2.50-3.50 | N 0.08-0.20 |
| ASME SA-479/SA-479M | --- | S31803 | --- | 0.030 | 2.00 | 1.00 | 0.030 | 0.020 | 21.0-23.0 | 4.5-6.5 | 2.5-3.5 | N 0.08-0.20 |
| | --- | S32205 | --- | 0.030 | 2.00 | 1.00 | 0.030 | 0.020 | 22.0-23.0 | 4.5-6.5 | 3.0-3.5 | N 0.14-0.20 |
| ASTM A276/A276M-15 | --- | S31803 | --- | 0.030 | 2.00 | 1.00 | 0.030 | 0.020 | 21.0-23.0 | 4.5-6.5 | 2.5-3.5 | N 0.08-0.20 |
| | --- | S32205 | --- | 0.030 | 2.00 | 1.00 | 0.030 | 0.020 | 22.0-23.0 | 4.5-6.5 | 3.0-3.5 | N 0.14-0.20 |
| ASTM A479/A479M-14 | --- | S31803 | --- | 0.030 | 2.00 | 1.00 | 0.030 | 0.020 | 21.0-23.0 | 4.5-6.5 | 2.5-3.5 | N 0.08-0.20 |
| | --- | S32205 | --- | 0.030 | 2.00 | 1.00 | 0.030 | 0.020 | 22.0-23.0 | 4.5-6.5 | 3.0-3.5 | N 0.14-0.20 |
| ASTM A955/A955M-15 | Grade 60 [420] | S31803 | --- | 0.03 | 2.00 | 1.00 | 0.030 | 0.020 | 21.00-23.00 | 4.50-6.50 | 2.50-3.50 | N 0.08-0.20 |
| | Grade 75 [520] | S31803 | --- | 0.03 | 2.00 | 1.00 | 0.030 | 0.020 | 21.00-23.00 | 4.50-6.50 | 2.50-3.50 | N 0.08-0.20 |
| EN 10088-3:2014 | X2CrNiMoN22-5-3 | --- | 1.4462 | 0.030 | 2.00 | 1.00 | 0.035 | 0.015 | 21.0-23.0 | 4.5-6.5 | 2.50-3.5 | N 0.10-0.22 |
| EN 10263-5:2001 | X2CrNiMoN22-5-3 | --- | 1.4462 | 0.030 | 2.00 | 1.00 | 0.035 | 0.015 | 21.00-23.00 | 4.50-6.50 | 2.50-3.50 | N 0.10-0.22 |
| EN 10294-2:2012 | X2CrNiMoN22-5-3 | --- | 1.4462 | 0.030 | 2.00 | 1.00 | 0.035 | 0.015 | 21.0-23.0 | 4.5-6.5 | 2.50-3.5 | N 0.10-0.22 |
| JIS G 4303:2012 | Symbol SUS329J3L | --- | --- | 0.030 | 2.00 | 1.00 | 0.040 | 0.030 | 21.00-24.00 | 4.50-6.50 | 2.50-3.50 | N 0.08-0.20 |
| ASME SA-479/SA-479M | --- | S32506 | --- | 0.030 | 1.00 | 0.90 | 0.040 | 0.015 | 24.0-26.0 | 5.5-7.2 | 3.0-3.5 | W 0.05-0.30; N 0.08-0.20 |
| ASTM A276/A276M-15 | --- | S32506 | --- | 0.030 | 1.00 | 0.90 | 0.040 | 0.015 | 24.0-26.0 | 5.5-7.2 | 3.0-3.5 | W 0.05-0.30; N 0.08-0.20 |
| ASTM A479/A479M-14 | --- | S32506 | --- | 0.030 | 1.00 | 0.90 | 0.040 | 0.015 | 24.0-26.0 | 5.5-7.2 | 3.0-3.5 | W 0.05-0.30; N 0.08-0.20 |
| JIS G 4303:2012 | Symbol SUS329J4L | --- | --- | 0.030 | 1.50 | 1.00 | 0.040 | 0.030 | 24.00-26.00 | 5.50-7.50 | 2.50-3.50 | N 0.08-0.30 |
| ASME SA-479/SA-479M | --- | S32750 | --- | 0.030 | 1.20 | 0.80 | 0.035 | 0.020 | 24.0-26.0 | 6.0-8.0 | 3.0-5.0 | Cu 0.50; N 0.24-0.32 |
| ASTM A479/A479M-14 | --- | S32750 | --- | 0.030 | 1.20 | 0.80 | 0.035 | 0.020 | 24.0-26.0 | 6.0-8.0 | 3.0-5.0 | Cu 0.50; N 0.24-0.32 |
| EN 10088-3:2014 | X2CrNiMoN25-7-4 | --- | 1.4410 | 0.030 | 2.00 | 1.00 | 0.035 | 0.015 | 24.0-26.0 | 6.0-8.0 | 3.0-4.5 | N 0.24-0.35 |
| ISO 16143-2:2004 | X2CrNiMoN25-7-4 | --- | --- | 0.030 | 2.00 | 1.00 | 0.035 | 0.015 | 24.0-26.0 | 6.0-8.0 | 3.0-4.5 | N 0.24-0.35 |
| ASME SA-276 | --- | S32760 | --- | 0.030 | 1.00 | 1.00 | 0.030 | 0.010 | 24.00-26.00 | 6.00-8.00 | 3.00-4.00 | [Cr+(3.3xMo)+(16xN)] 40 min.; Cu 0.50-1.00; W 0.50-1.00; N 0.20-0.30 |
| ASME SA-479/SA-479M | --- | S32760 | --- | 0.030 | 1.00 | 1.00 | 0.030 | 0.010 | 24.0-26.0 | 6.0-8.0 | 3.0-4.0 | [Cr+(3.3xMo)+(16xN)] 40 min.; Cu 0.50-1.00; W 0.50-1.00; N 0.20-0.30 |
| ASTM A276/A276M-15 | --- | S32760 | --- | 0.030 | 1.00 | 1.00 | 0.030 | 0.010 | 24.0-26.0 | 6.0-8.0 | 3.0-4.0 | [Cr+(3.3xMo)+(16xN)] 40 min.; Cu 0.50-1.00; W 0.50-1.00; N 0.20-0.30 |
| ASTM A479/A479M-14 | --- | S32760 | --- | 0.030 | 1.00 | 1.00 | 0.030 | 0.010 | 24.0-26.0 | 6.0-8.0 | 3.0-4.0 | [Cr+(3.3xMo)+(16xN)] 40 min.; Cu 0.50-1.00; W 0.50-1.00; N 0.20-0.30 |
| EN 10088-3:2014 | X2CrNiMoCuWN25-7-4 | --- | 1.4501 | 0.030 | 1.00 | 1.00 | 0.035 | 0.015 | 24.0-26.0 | 6.0-8.0 | 3.0-4.0 | Cu 0.50-1.00; W 0.50-1.00; N 0.20-0.30 |
| ISO 16143-2:2004 | X2CrNiMoCuWN25-7-4 | --- | --- | 0.030 | 1.00 | 1.00 | 0.035 | 0.015 | 24.0-26.0 | 6.0-8.0 | 3.0-4.0 | Cu 0.50-1.00; W 0.50-1.00; N 0.20-0.30 |

**8.2 Stainless Steels: Bar**

**8.2.5A Chemical Composition of Duplex Stainless Steels (Continued)**

| Specification | Designation | UNS No | Steel No | Weight, %, max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASME SA-479/SA-479M | --- | S32550 | --- | 0.04 | 1.50 | 1.00 | 0.040 | 0.030 | 24.0-27.0 | 4.5-6.5 | 2.9-3.9 | Cu 1.50-2.50; N 0.10-0.25 |
| ASTM A276/A276M-15 | --- | S32550 | --- | 0.04 | 1.50 | 1.0 | 0.040 | 0.030 | 24.0-27.0 | 4.5-6.5 | 2.9-3.9 | Cu 1.50-2.50; N 0.10-0.25 |
| ASTM A479/A479M-14 | --- | S32550 | --- | 0.04 | 1.50 | 1.00 | 0.040 | 0.030 | 24.0-27.0 | 4.5-6.5 | 2.9-3.9 | Cu 1.50-2.50; N 0.10-0.25 |
| EN 10088-3:2014 | X2CrNiMoCuN25-6-3 | --- | 1.4507 | 0.030 | 2.00 | 0.70 | 0.035 | 0.015 | 24.0-26.0 | 6.0-8.0 | 3.0-4.0 | Cu 1.00-2.50; N 0.20-0.30 |
| ISO 16143-2:2004 | X2CrNiMoCuN25-6-3 | --- | --- | 0.030 | 2.00 | 0.70 | 0.035 | 0.015 | 24.0-26.0 | 5.0-7.5 | 2.5-4.0 | Cu 1.00-2.50; N 0.15-0.3 |
| EN 10294-2:2012 | X3CrNiMoN27-5-2 | --- | 1.4460 | 0.05 | 2.00 | 1.00 | 0.035 | 0.015 | 25.0-28.0 | 4.5-6.5 | 1.30-2.00 | N 0.05-0.20 |
| GB 1220-92 | Grade 0Cr26Ni5Mo2 | --- | --- | 0.08 | 1.50 | 1.00 | 0.035 | 0.030 | 23.00-28.00 | 3.00-6.00 | 1.00-3.00 | --- |
| GB 4226-84 | Grade 0Cr26Ni5Mo2 | --- | --- | 0.08 | 1.50 | 1.00 | 0.035 | 0.030 | 23.00-28.00 | 3.00-6.00 | 1.00-3.00 | --- |
| JIS G 4303:2012 | Symbol SUS329J1 | --- | --- | 0.08 | 1.50 | 1.00 | 0.040 | 0.030 | 23.00-28.00 | 3.00-6.00 | 1.00-3.00 | --- |
| JIS G 4318:1998 A1:2007 | Symbol SUS329J1 | --- | --- | 0.08 | 1.50 | 1.00 | 0.040 | 0.030 | 23.00-28.00 | 3.00-6.00 | 1.00-3.00 | --- |
| ASME SA-479/SA-479M | --- | S32906 | --- | 0.030 | 0.80-1.50 | 0.50 | 0.030 | 0.030 | 28.0-30.0 | 5.8-7.5 | 1.50-2.60 | Cu 0.80; N 0.30-0.40 |
| ASTM A479/A479M-14 | --- | S32906 | --- | 0.030 | 0.80-1.50 | 0.50 | 0.030 | 0.030 | 28.0-30.0 | 5.8-7.5 | 1.50-2.60 | Cu 0.80; N 0.30-0.40 |
| EN 10088-3:2014 | X2CrNiMoN29-7-2 | --- | 1.4477 | 0.030 | 0.80-1.50 | 0.50 | 0.030 | 0.015 | 28.0-30.0 | 5.8-7.5 | 1.50-2.60 | Cu 0.80; N 0.30-0.40 |

**8.2 Stainless Steels: Bar**

**8.2.5B Mechanical Properties of Duplex Stainless Steels**

| Specification | Designation | UNS No | Steel No | Section Thickness/Diameter mm | Section Thickness/Diameter in. | Yield Strength, min. MPa | Yield Strength, min. ksi | Tensile Strength, min. MPa | Tensile Strength, min. ksi | Elongation % min | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| EN 10088-3:2014 | X2CrNiMoSi18-5-3 | --- | 1.4424 | t ≤ 50 | --- | 450 | --- | 700-900 | --- | 25 L | SA | 260 max. HBW; L: 100 J @ RT |
| | | | | 50 < t ≤ 160 | --- | 400 | --- | 680-900 | --- | 25 L | SA | 260 max. HBW; L: 100 J @ RT |
| GB 1220-92 | Grade 00Cr18Ni5Mo3Si2 | --- | --- | t ≤ 75 | --- | 390 | --- | 590 | --- | 20 | ST | 30 max. HRB |
| ASME SA-276 | --- | S32304 | --- | --- | --- | 400 | 58 | 600 | 87 | 25 | A and HF or A and CF | 290 max. HB |
| ASTM A276/A276M-15 | --- | S32304 | --- | --- | --- | 400 | 58 | 600 | 87 | 25 | A+HF or A+CF | 290 max. HB |
| EN 10088-3:2014 | X2CrNiN23-4 | --- | 1.4362 | 0.5 < d ≤ 1 | --- | --- | --- | 1050 max. | --- | 20 | SA | --- |
| | | | | 1 < d ≤ 3 | --- | --- | --- | 1000 max. | --- | 20 | SA | --- |
| | | | | 3 < d ≤ 5 | --- | --- | --- | 950 max. | --- | 25 | SA | --- |
| | | | | 5 < d ≤ 16 | --- | --- | --- | 900 max. | --- | 25 | SA | --- |
| | | | | t ≤ 160 | --- | 400 | --- | 600-830 | --- | 25 L | SA | 260 max. HBW; L: 100 J @ RT |
| | | | | d ≥ 0.05 | --- | --- | --- | 800-1000 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 900-1100 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1000-1250 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1100-1350 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1200-1450 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1400-1700 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1600-1900 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1800-2100 | --- | --- | --- | --- |
| ISO 16143-2:2004 | X2CrNiN23-4 | --- | --- | t ≤ 160 | --- | 400 | --- | 600 | --- | 25 L, 25 T | SA | 260 max. HBW |
| ASME SA-276 | --- | S31803 | --- | --- | --- | 448 | 65 | 620 | 90 | 25 | A and HF or A and CF | 290 max. HB |
| ASME SA-479/SA-479M | --- | S31803 | --- | --- | --- | 450 | 65 | 620 | 90 | 25 | A | 290 max. HB |
| | | S32205 | --- | --- | --- | 450 | 65 | 655 | 95 | 25 | A | 290 max. HB |
| ASTM A276/A276M-15 | --- | S31803 | --- | --- | --- | 448 | 65 | 620 | 90 | 25 | A+HF or A+CF | 290 max. HB |
| | | S32205 | --- | --- | --- | 450 | 65 | 655 | 95 | 25 | A+HF or A+CF | 290 max. HB |
| ASTM A479/A479M-14 | --- | S31803 | --- | --- | --- | 450 | 65 | 620 | 90 | 25 | SA | 290 max. HB |
| | | S32205 | --- | --- | --- | 450 | 65 | 655 | 95 | 25 | SA | 290 max. HB |
| ASTM A955/A955M-15 | Grade 60 [420] | S31803 | --- | --- | --- | 420 | 60 | 620 | 90 | 20 | A, HR or SH | --- |
| | Grade 75 [520] | S31803 | --- | --- | --- | 520 | 75 | 690 | 100 | 20 | A, HR or SH | --- |

Note: This section continued on next page

**8.2 Stainless Steels: Bar**

**8.2.5B Mechanical Properties of Duplex Stainless Steels (Continued)**

| Specification | Designation | UNS No | Steel No | Section Thickness/Diameter | | Yield Strength, min. | | Tensile Strength, min. | | Elongation | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mm | in. | MPa | ksi | MPa | ksi | % min | | |
| EN 10088-3:2014 | X2CrNiMoN22-5-3 | --- | 1.4462 | 0.50 < d ≤ 1.00 | --- | --- | --- | 1050 max. | --- | 20 | SA | --- |
| | | | | 1.00 < d ≤ 3.00 | --- | --- | --- | 1000 max. | --- | 20 | SA | --- |
| | | | | 3.00 < d ≤ 5.00 | --- | --- | --- | 950 max. | --- | 25 | SA | --- |
| | | | | t ≤ 10 | --- | 650 | --- | 850-1150 | --- | 12 L | SA | --- |
| | | | | 10 < t ≤ 16 | --- | 650 | --- | 850-1100 | --- | 12 L | SA | --- |
| | | | | 5.00 < d ≤ 16.00 | --- | --- | --- | 900 max. | --- | 25 | SA | --- |
| | | | | 16 < t ≤ 40 | --- | 450 | --- | 650-1000 | --- | 15 L | SA | L: 100 J @ RT |
| | | | | 40 < t ≤ 63 | --- | 450 | --- | 650-1000 | --- | 15 L | SA | L: 100 J @ RT |
| | | | | t ≤ 160 | --- | 450 | --- | 650-880 | --- | 25 L | SA | 270 max. HBW; L: 100 J @ RT |
| | | | | 63 < t ≤ 160 | --- | 450 | --- | 650-880 | --- | 25 L | SA | L: 100 J @ RT |
| | | | | d ≥ 0.05 | --- | --- | --- | 800-1000 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 900-1100 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1000-1250 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1100-1350 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1200-1450 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1400-1700 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1600-1900 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1800-2100 | --- | --- | --- | --- |
| EN 10263-5:2001 | X2CrNiMoN22-5-3 | --- | 1.4462 | 2 < d ≤ 5 | --- | --- | --- | 880 max. L | --- | --- | SA | --- |
| | | | | 2 < d ≤ 5 | --- | --- | --- | 950 max. L | --- | --- | CD+SA | --- |
| | | | | 2 < d ≤ 5 | --- | --- | --- | 1010 max. L | --- | --- | CD+SA | --- |
| | | | | 5 < d ≤ 10 | --- | --- | --- | 880 max. L | --- | --- | SA | --- |
| | | | | 5 < d ≤ 10 | --- | --- | --- | 1020 max. L | --- | --- | CD+SA | --- |
| | | | | 5 < d ≤ 10 | --- | --- | --- | 900 max. L | --- | --- | CD+SA | --- |
| | | | | 5 < d ≤ 10 | --- | --- | --- | 970 max. L | --- | --- | CD+SA | --- |
| | | | | 10 < d ≤ 25 | --- | --- | --- | 880 max. L | --- | --- | SA | --- |
| | | | | 10 < d ≤ 25 | --- | --- | --- | 1000 max. L | --- | --- | CD+SA | --- |
| | | | | 10 < d ≤ 25 | --- | --- | --- | 880 max. L | --- | --- | CD+SA | --- |
| EN 10294-2:2012 | X2CrNiMoN22-5-3 | --- | 1.4462 | --- | --- | 450 | --- | 640-880 | --- | 22 L; 22 T | SA | --- |
| JIS G 4303:2012 | Symbol SUS329J3L | --- | --- | d ≤ 75 | --- | 450 | --- | 620 | --- | 18 | ST | 302 max. HBW; 32 max. HRC; 320 max. HV |
| ASME SA-479/SA-479M | --- | S32506 | --- | --- | --- | 450 | 65 | 620 | 90 | 18 | A | 302 max. HB |
| ASTM A276/A276M-15 | --- | S32506 | --- | --- | --- | 450 | 65 | 620 | 90 | 18 | A+HF or A+CF | 302 max. HB |
| ASTM A479/A479M-14 | --- | S32506 | --- | --- | --- | 450 | 65 | 620 | 90 | 18 | SA | 302 max. HB |
| JIS G 4303:2012 | Symbol SUS329J4L | --- | --- | d ≤ 75 | --- | 450 | --- | 620 | --- | 18 | ST | 302 max. HBW; 32 max. HRC; 320 max. HV |

**8.2 Stainless Steels: Bar**

**8.2.5B Mechanical Properties of Duplex Stainless Steels (Continued)**

| Specification | Designation | UNS No | Steel No | Section Thickness/Diameter mm | Section Thickness/Diameter in. | Yield Strength, min. MPa | Yield Strength, min. ksi | Tensile Strength, min. MPa | Tensile Strength, min. ksi | Elongation % min | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ASME SA-479/SA-479M | --- | S32750 | --- | --- | t ≤ 2 | 550 | 80 | 800 | 116 | 15 | A | 310 max. HB |
| | | | | --- | t > 2 | 515 | 75 | 760 | 110 | 15 | A | 310 max. HB |
| ASTM A479/A479M-14 | --- | S32750 | --- | --- | t ≤ 2 | 550 | 80 | 800 | 116 | 15 | SA | 310 max. HB |
| | | | | --- | t > 2 | 515 | 75 | 760 | 110 | 15 | SA | 310 max. HB |
| EN 10088-3:2014 | X2CrNiMo25-7-4 | --- | 1.4410 | 0.50 < d ≤ 1.00 | --- | --- | --- | 1050 max. | --- | 20 | SA | --- |
| | | | | 1.00 < d ≤ 3.00 | --- | --- | --- | 1000 max. | --- | 20 | SA | --- |
| | | | | 3.00 < d ≤ 5.00 | --- | --- | --- | 950 max. | --- | 25 | SA | --- |
| | | | | 5.00 < d ≤ 16.00 | --- | --- | --- | 900 max. | --- | 25 | SA | --- |
| | | | | t ≤ 160 | --- | 530 | --- | 730-930 | --- | 25 L | SA | 290 max. HBW; L: 100 J @ RT |
| | | | | d ≥ 0.05 | --- | --- | --- | 800-1000 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 900-1100 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1000-1250 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1100-1350 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1200-1450 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1400-1700 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1600-1900 | --- | --- | --- | --- |
| | | | | d ≥ 0.05 | --- | --- | --- | 1800-2100 | --- | --- | --- | --- |
| ISO 16143-2:2004 | X2CrNiMoN25-7-4 | --- | --- | t ≤ 160 | --- | 530 | --- | 730 | --- | 25 L, 25 T | SA | 290 max. HB |
| ASME SA-276 | --- | S32760 | --- | --- | --- | 550 | 80 | 750 | 109 | 25 | A and HF or A and CF | 290 max. HB |
| | | | | --- | --- | 720 | 105 | 860 | 125 | 16 | H+CW+CF | 335 max. HB |
| ASME SA-479/SA-479M | --- | S32760 | --- | --- | --- | 550 | 80 | 750 | 109 | 25 | A | 300 max. HB |
| ASTM A276/A276M-15 | --- | S32760 | --- | --- | --- | 550 | 80 | 750 | 109 | 25 | A+HF or A+CF | 290 max. HB |
| | | | | --- | --- | 720 | 105 | 860 | 125 | 16 | H+CF | 335 max. HB |
| ASTM A479/A479M-14 | --- | S32760 | --- | --- | --- | 550 | 80 | 750 | 109 | 25 | SA | 300 max. HB |
| EN 10088-3:2014 | X2CrNiMoCuWN25-7-4 | --- | 1.4501 | t ≤ 160 | --- | 530 | --- | 730-930 | --- | 25 L | SA | 290 max. HBW; L: 100 J @ RT |
| ISO 16143-2:2004 | X2CrNiMoCuWN25-7-4 | --- | --- | t ≤ 160 | --- | 530 | --- | 730 | --- | 25 L, 25 T | SA | 290 max. HBW |

**8.2 Stainless Steels: Bar**

**8.2.5B Mechanical Properties of Duplex Stainless Steels (Continued)**

| Specification | Designation | UNS No | Steel No | Section Thickness/Diameter mm | Section Thickness/Diameter in. | Yield Strength, min. MPa | Yield Strength, min. ksi | Tensile Strength, min. MPa | Tensile Strength, min. ksi | Elongation % min | Heat Treatment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ASME SA-479/SA-479M | --- | S32550 | --- | --- | --- | 550 | 80 | 760 | 110 | 15 | A | 297 max. HB |
| ASTM A276/A276M-15 | --- | S32550 | --- | --- | --- | 550 | 80 | 750 | 109 | 25 | A+HF or A+CF | 290 max. HB |
| | | | | --- | --- | 720 | 105 | 860 | 125 | 16 | H+CF | 335 max. HB |
| ASTM A479/A479M-14 | --- | S32550 | --- | --- | --- | 550 | 80 | 760 | 110 | 15 | SA | 297 max. HB |
| EN 10088-3:2014 | X2CrNiMoCuN25-6-3 | --- | 1.4507 | t ≤ 16 | --- | --- | --- | --- | --- | --- | SA | --- |
| | | | | 16 < t ≤ 40 | --- | 500 | --- | 700-900 | --- | 25 L | SA | L: 100 J @ RT |
| | | | | 40 < t ≤ 63 | --- | 500 | --- | 700-900 | --- | 25 L | SA | L: 100 J @ RT |
| | | | | t ≤ 160 | --- | 500 | --- | 700-900 | --- | 25 L | SA | 270 max. HBW; L: 100 J @ RT |
| | | | | 63 < t ≤ 160 | --- | 500 | --- | 700-900 | --- | 25 L | SA | L: 100 J @ RT |
| ISO 16143-2:2004 | X2CrNiMoCuN25-6-3 | --- | --- | t ≤ 160 | --- | 500 | --- | 700 | --- | 25 L, 25 T | SA | 270 max. HB |
| EN 10294-2:2012 | X3CrNiMoN27-5-2 | --- | 1.4460 | --- | --- | 460 | --- | 620-880 | --- | 20 L; 20 T | SA | --- |
| GB 1220-92 | Grade 0Cr26Ni5Mo2 | --- | --- | t ≤ 75 | --- | 390 | --- | 590 | --- | 18 | ST | 277 max. HB; 29 max. HRB |
| JIS G 4303:2012 | Symbol SUS329J1 | --- | --- | d ≤ 75 | --- | 390 | --- | 590 | --- | 18 | ST | 277 max. HBW; 29 max. HRC; 292 max. HV |
| ASME SA-479/SA-479M | --- | S32906 | --- | --- | --- | 550 | 80 | 750 | 109 | 25 | A | 310 max. HB |
| ASTM A479/A479M-14 | --- | S32906 | --- | --- | --- | 550 | 80 | 750 | 109 | 25 | SA | 310 max. HB |
| EN 10088-3:2014 | X2CrNiMoN29-7-2 | --- | 1.4477 | t ≤ 10 | --- | 650 | --- | 800-1050 | --- | 25 L | SA | 310 max. HBW; L: 100 J @ RT |
| | | | | 10 < t ≤ 160 | --- | 550 | --- | 750-1000 | --- | 25 L | SA | 310 max. HBW; L: 100 J @ RT |

# Chapter 9

# *STEELS FOR SPECIAL USE*

## Free-Machining Steels

### ASME Standard

| | |
|---|---|
| ASME SA-29/SA-29M | Steel Bars, Carbon and Alloy, Hot-Wrought, General Requirements for |

### ASTM Standards

| | |
|---|---|
| ASTM A29/A29M-12e1 | General Requirements for Steel Bars, Carbon and Alloy, Hot-Wrought |
| ASTM A493-09 (2013) | Stainless Steel Wire and Wire Rods for Cold Heading and Cold Forging |
| ASTM A576-90b (2012) | Steel Bars, Carbon, Hot-Wrought, Special Quality |
| ASTM A581/A581M-95b (2014) | Free-Machining Stainless Steel Wire and Wire Rods |
| ASTM A582/A582M-12e1 | Free-Machining Stainless Steel Bars |
| ASTM A895-89 (2009) | Free-Machining Stainless Steel Plate, Sheet, and Strip |

### EN Standards

| | |
|---|---|
| EN 10087:1998 C2:2006 | Free cutting steels – Technical delivery conditions for semi-finished products, hot-rolled bars and rods |
| EN 10088-3:2014 | Stainless steels – Part 3: Technical delivery conditions for semi-finished products, bars, rods, wire, sections and bright products of corrosion resisting steels for general purposes |
| EN 10277-3:2008 | Bright steel products – Technical delivery conditions – Part 3: Free-cutting steels |

### GB Standard

| | |
|---|---|
| GB 8731-88 | Free-Cutting Steel - Technical Requirements |

### ISO Standard

| | |
|---|---|
| ISO 683-9-1988 | Heat-Treatable Steels, Alloy Steels and Free-Cutting Steels - Part 9: Wrought Free-Cutting Steels |

### JIS Standards

| | |
|---|---|
| JIS G 4308:2013 | Stainless steel wire rods |
| JIS G 4804:2008 | Free-cutting steels |

### SAE Standard

| | |
|---|---|
| SAE J403 JUN14 | Chemical Compositions of SAE Carbon Steels |

## Spring Steels

### ASTM Standards

| | |
|---|---|
| ASTM A313/A313M-13 | Stainless Steel Spring Wire |
| ASTM A684/A684M-14 | Steel, Strip, High-Carbon, Cold-Rolled |
| ASTM A713-04 (2010) | Steel Wire, High-Carbon Spring, for Heat-Treated Components |
| ASTM A1000/A1000M-11 | Steel Wire, Carbon and Alloy Specialty Spring Quality |

### EN Standards

| | |
|---|---|
| EN 10089:2002 | Hot rolled steels for quenched and tempered springs – Technical delivery conditions |
| EN 10132-4:2000 | Cold rolled narrow steel strip for heat treatment – Technical delivery conditions – Part 4: Spring steels and other applications |
| EN 10151:2002 | Stainless steel strip for springs - Technical delivery conditions |
| EN 10270-2:2011 | Steel wire for mechanical springs – Part 2: Oil hardened and tempered spring steel wire |
| EN 10270-3:2011 | Steel wire for mechanical springs – Part 3: Stainless spring steel wire |

### GB Standards

| | |
|---|---|
| GB/T 1222-84 | Spring Steel |
| GB 3522-83 | Cold-Rolled Quality Carbon Structural Steel Strips |
| GB/T 4231-93 | Cold Rolled Stainless Steel Strips for Springs |
| GB/T 4358-1995 | Carbon Spring Steel Wire for Significant Use |
| GB/T 18983-2003 | Oil-Hardened and Tempered Steel Wire for Mechanical Springs |

### ISO Standards

| | |
|---|---|
| ISO 683-14:2004 | Heat-Treatable Steels, Alloy Steels and Free-Cutting Steels - Part 14: Hot-Rolled Steels for Quenched and Tempered Springs |
| ISO 8458-3:2002 | Steel Wire for Mechanical Springs - Part 3: Oil-Hardened and Tempered Wire |

### JIS Standards

| | |
|---|---|
| JIS G 4313:2011 | Cold rolled stainless steel strip for springs |
| JIS G 4801:2011 | Spring steels |
| JIS G 4802:2011 | Cold-rolled steel strip for springs |

## Tool Steels

### ASTM Standards

| | |
|---|---|
| ASTM A600-92a (2010) | Tool Steel High Speed |
| ASTM A681-08 | Tool Steels Alloy |
| ASTM A686-92 (2010) | Tool Steel, Carbon |

### GB Standards

| | |
|---|---|
| GB 1298-86 | Carbon Tool Steels - Technical Requirements |
| GB/T 1299-2000 | Alloy Tool Steels |
| GB/T 3080-2001 | High Speed Tool Steel Wire |

### ISO Standards

| | |
|---|---|
| ISO 4957:1999 | Tool Steels |

### JIS Standards

| | |
|---|---|
| JIS G 4401:2009 | Carbon tool steels |
| JIS G 4403:2006 | High speed tool steels |
| JIS G 4404:2006 | Alloy tool steels |

### SAE Standard

| | |
|---|---|
| SAE J438b MAY70 | Tool and Die Steels |

## Bearing Steels

### ASTM Standards

| | |
|---|---|
| ASTM A295/A295M-14 | High-Carbon Anti-Friction Bearing Steel |
| ASTM A485-14 | High Hardenability Antifriction Bearing Steel |

### GB Standard

| | |
|---|---|
| GB/T 18254-2002 | High-Carbon Chromium Bearing Steel |

### ISO Standard

| | |
|---|---|
| ISO 683-17:1999 | Heat-Treated Steels, Alloy Steels and Free-Cutting Steels - Part 17: Ball and Roller Bearing Steels |

### JIS Standard

| | |
|---|---|
| JIS G 4805:2008 | High carbon chromium bearing steels |

## 9.1 Free-Machining Steels

### 9.1.1 Chemical Composition of Resulfurized Carbon Steels for Free-Machining Applications

| Specification | Designation | UNS No. | Steel No. | Weight, %, max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASME SA-29/SA-29M | Grade 1109 | G11090 | --- | 0.08-0.13 | 0.60-0.90 | --- | 0.040 | 0.08-0.13 | --- | --- | --- | --- |
| ASTM A29/A29M-12e1 | Grade 1109 | G11090 | --- | 0.08-0.13 | 0.60-0.90 | --- | 0.040 | 0.08-0.13 | --- | --- | --- | --- |
| ASTM A576-90b (2012) | Grade 1109 | G11090 | --- | 0.08-0.13 | 0.60-0.90 | --- | 0.040 | 0.08-0.13 | --- | --- | --- | --- |
| EN 10087:1998 C2:2006 | 10S20 | --- | 1.0721 | 0.07-0.13 | 0.70-1.10 | 0.40 | 0.06 | 0.15-0.25 | --- | --- | --- | --- |
| EN 10277-3:2008 | 10S20 | --- | 1.0721 | 0.07-0.13 | 0.70-1.10 | 0.40 | 0.06 | 0.15-0.25 | --- | --- | --- | --- |
| GB 8731-88 | Grade Y12 | --- | --- | 0.08-0.16 | 0.70-1.00 | 0.15-0.35 | 0.08-0.15 | 0.10-0.20 | --- | --- | --- | --- |
| ISO 683-9:1988 | Type 10 S 20 | --- | --- | 0.07-0.13 | 0.70-1.10 | 0.15-0.40 | 0.06 | 0.15-0.25 | --- | --- | --- | --- |
| ASME SA-29/SA-29M | Grade 1110 | G11100 | --- | 0.08-0.13 | 0.30-0.60 | --- | 0.040 | 0.08-0.13 | --- | --- | --- | --- |
| ASTM A29/A29M-12e1 | Grade 1110 | G11100 | --- | 0.08-0.13 | 0.30-0.60 | --- | 0.040 | 0.08-0.13 | --- | --- | --- | --- |
| ASTM A576-90b (2012) | Grade 1110 | G11100 | --- | 0.08-0.13 | 0.30-0.60 | --- | 0.040 | 0.08-0.13 | --- | --- | --- | --- |
| ASME SA-29/SA-29M | Grade 1117 | G11170 | --- | 0.14-0.20 | 1.00-1.30 | --- | 0.040 | 0.08-0.13 | --- | --- | --- | --- |
| | Grade 1118 | G11180 | --- | 0.14-0.20 | 1.30-1.60 | --- | 0.040 | 0.08-0.13 | --- | --- | --- | --- |
| ASTM A29/A29M-12e1 | Grade 1117 | G11170 | --- | 0.14-0.20 | 1.00-1.30 | --- | 0.040 | 0.08-0.13 | --- | --- | --- | --- |
| | Grade 1118 | G11180 | --- | 0.14-0.20 | 1.30-1.60 | --- | 0.040 | 0.08-0.13 | --- | --- | --- | --- |
| ASTM A576-90b (2012) | Grade 1117 | G11170 | --- | 0.14-0.20 | 1.00-1.30 | --- | 0.040 | 0.08-0.13 | --- | --- | --- | --- |
| | Grade 1118 | G11180 | --- | 0.14-0.20 | 1.30-1.60 | --- | 0.040 | 0.08-0.13 | --- | --- | --- | --- |
| EN 10087:1998 C2:2006 | 15SMn13 | --- | 1.0725 | 0.12-0.18 | 0.90-1.30 | 0.40 | 0.06 | 0.08-0.18 | --- | --- | --- | --- |
| EN 10277-3:2008 | 15SMn13 | --- | 1.0725 | 0.12-0.18 | 0.90-1.30 | 0.40 | 0.06 | 0.08-0.18 | --- | --- | --- | --- |
| GB 8731-88 | Grade Y20 | --- | --- | 0.17-0.25 | 0.70-1.00 | 0.15-0.35 | 0.06 | 0.08-0.15 | --- | --- | --- | --- |
| ISO 683-9:1988 | Type 17 SMn 20 | --- | --- | 0.14-0.20 | 1.20-1.60 | 0.15-0.40 | 0.06 | 0.15-0.25 | --- | --- | --- | --- |
| JIS G 4804:2008 | Grade SUM 31 | --- | --- | 0.14-0.20 | 1.00-1.30 | --- | 0.040 | 0.08-0.13 | --- | --- | --- | --- |
| | Grade SUM 32 | --- | --- | 0.12-0.20 | 0.60-1.10 | --- | 0.040 | 0.10-0.20 | --- | --- | --- | --- |
| SAE J403 JUN14 | Grade 1117 | G11170 | --- | 0.14-0.20 | 1.00-1.30 | --- | 0.030 | 0.08-0.13 | --- | --- | --- | --- |
| | Grade 1118 | G11180 | --- | 0.14-0.20 | 1.30-1.60 | --- | 0.030 | 0.08-0.13 | --- | --- | --- | --- |
| ASME SA-29/SA-29M | Grade 1132 | G11320 | --- | 0.27-0.34 | 1.35-1.65 | --- | 0.040 | 0.08-0.13 | | | | |
| ASTM A29/A29M-12e1 | Grade 1132 | G11320 | --- | 0.27-0.34 | 1.35-1.65 | --- | 0.040 | 0.08-0.13 | --- | --- | --- | --- |
| ASTM A576-90b (2012) | Grade 1132 | G11320 | --- | 0.27-0.34 | 1.35-1.65 | --- | 0.040 | 0.08-0.13 | --- | --- | --- | --- |
| GB 8731-88 | Grade Y30 | --- | --- | 0.27-0.35 | 0.70-1.00 | 0.15-0.35 | 0.06 | 0.08-0.15 | --- | --- | --- | --- |
| SAE J403 JUN14 | Grade 1132 | G11320 | --- | 0.27-0.34 | 1.35-1.65 | --- | 0.030 | 0.08-0.13 | --- | --- | --- | --- |

## 9.1 Free-Machining Steels

### 9.1.1 Chemical Composition of Resulfurized Carbon Steels for Free-Machining Applications (Continued)

| Specification | Designation | UNS No. | Steel No. | Weight, %, max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASME SA-29/SA-29M | Grade 1137 | G11370 | --- | 0.32-0.39 | 1.35-1.65 | --- | 0.040 | 0.08-0.13 | --- | --- | --- | --- |
| ASTM A29/A29M-12e1 | Grade 1137 | G11370 | --- | 0.32-0.39 | 1.35-1.65 | --- | 0.040 | 0.08-0.13 | --- | --- | --- | --- |
| ASTM A576-90b (2012) | Grade 1137 | G11370 | --- | 0.32-0.39 | 1.35-1.65 | --- | 0.040 | 0.08-0.13 | --- | --- | --- | --- |
| EN 10087:1998 C2:2006 | 35S20 | --- | 1.0726 | 0.32-0.39 | 0.70-1.10 | 0.40 | 0.06 | 0.15-0.25 | --- | --- | --- | --- |
| | 36SMn14 | --- | 1.0764 | 0.32-0.39 | 1.30-1.70 | 0.40 | 0.06 | 0.10-0.18 | --- | --- | --- | --- |
| EN 10277-3:2008 | 35S20 | --- | 1.0726 | 0.32-0.39 | 0.70-1.10 | 0.40 | 0.06 | 0.15-0.25 | --- | --- | --- | --- |
| | 36SMn14 | --- | 1.0764 | 0.32-0.39 | 1.30-1.70 | 0.40 | 0.06 | 0.10-0.18 | --- | --- | --- | --- |
| GB 8731-88 | Grade Y35 | --- | --- | 0.32-0.40 | 0.70-1.00 | 0.15-0.35 | 0.06 | 0.08-0.15 | --- | --- | --- | --- |
| ISO 683-9:1988 | Type 35 S 20 | --- | --- | 0.32-0.39 | 0.70-1.10 | 0.15-0.40 | 0.06 | 0.15-0.25 | --- | --- | --- | --- |
| | Type 35 SMn 20 | --- | --- | 0.32-0.39 | 0.90-1.40 | 0.15-0.40 | 0.06 | 0.15-0.25 | --- | --- | --- | --- |
| JIS G 4804:2008 | Grade SUM 41 | --- | --- | 0.32-0.39 | 1.35-1.65 | --- | 0.040 | 0.08-0.13 | --- | --- | --- | --- |
| SAE J403 JUN14 | Grade 1137 | G11370 | --- | 0.32-0.39 | 1.35-1.65 | --- | 0.030 | 0.08-0.13 | --- | --- | --- | --- |
| ASME SA-29/SA-29M | Grade 1139 | G11390 | --- | 0.35-0.43 | 1.35-1.65 | --- | 0.040 | 0.13-0.20 | --- | --- | --- | --- |
| ASTM A29/A29M-12e1 | Grade 1139 | G11390 | --- | 0.35-0.43 | 1.35-1.65 | --- | 0.040 | 0.13-0.20 | --- | --- | --- | --- |
| ASTM A576-90b (2012) | Grade 1139 | G11390 | --- | 0.35-0.43 | 1.35-1.65 | --- | 0.040 | 0.13-0.2 | --- | --- | --- | --- |
| EN 10087:1998 C2:2006 | 38SMn28 | --- | 1.0760 | 0.35-0.40 | 1.20-1.50 | 0.40 | 0.06 | 0.24-0.33 | --- | --- | --- | --- |
| EN 10277-3:2008 | 38SMn28 | --- | 1.0760 | 0.35-0.40 | 1.20-1.50 | 0.40 | 0.06 | 0.24-0.33 | --- | --- | --- | --- |
| SAE J403 JUN14 | Grade 1138 | G11380 | --- | 0.34-0.40 | 0.70-1.00 | --- | 0.030 | 0.08-0.13 | --- | --- | --- | --- |
| ASME SA-29/SA-29M | Grade 1140 | G11400 | --- | 0.37-0.44 | 0.70-1.00 | --- | 0.040 | 0.08-0.13 | --- | --- | --- | --- |
| ASTM A29/A29M-12e1 | Grade 1140 | G11400 | --- | 0.37-0.44 | 0.70-1.00 | --- | 0.040 | 0.08-0.13 | --- | --- | --- | --- |
| ASTM A576-90b (2012) | Grade 1140 | G11400 | --- | 0.37-0.44 | 0.70-1.00 | --- | 0.040 | 0.08-0.13 | --- | --- | --- | --- |
| SAE J403 JUN14 | Grade 1140 | G11400 | --- | 0.37-0.44 | 0.70-1.00 | --- | 0.030 | 0.08-0.13 | --- | --- | --- | --- |
| ASME SA-29/SA-29M | Grade 1141 | G11410 | --- | 0.37-0.45 | 1.35-1.65 | --- | 0.040 | 0.08-0.13 | --- | --- | --- | --- |
| ASTM A29/A29M-12e1 | Grade 1141 | G11410 | --- | 0.37-0.45 | 1.35-1.65 | --- | 0.040 | 0.08-0.13 | --- | --- | --- | --- |
| ASTM A576-90b (2012) | Grade 1141 | G11410 | --- | 0.37-0.45 | 1.35-1.65 | --- | 0.040 | 0.08-0.13 | --- | --- | --- | --- |
| GB 8731-88 | Grade Y40Mn | --- | --- | 0.37-0.45 | 1.20-1.55 | 0.15-0.35 | 0.05 | 0.20-0.30 | --- | --- | --- | --- |
| JIS G 4804:2008 | Grade SUM 42 | --- | --- | 0.37-0.45 | 1.35-1.65 | --- | 0.040 | 0.08-0.13 | --- | --- | --- | --- |
| SAE J403 JUN14 | Grade 1141 | G11410 | --- | 0.37-0.45 | 1.35-1.65 | --- | 0.030 | 0.08-0.13 | --- | --- | --- | --- |
| ASME SA-29/SA-29M | Grade 1144 | G11440 | --- | 0.40-0.48 | 1.35-1.65 | --- | 0.040 | 0.24-0.33 | --- | --- | --- | --- |
| ASTM A29/A29M-12e1 | Grade 1144 | G11440 | --- | 0.40-0.48 | 1.35-1.65 | --- | 0.040 | 0.24-0.33 | --- | --- | --- | --- |
| ASTM A576-90b (2012) | Grade 1144 | G11440 | --- | 0.40-0.48 | 1.35-1.65 | --- | 0.040 | 0.24-0.33 | --- | --- | --- | --- |
| EN 10087:1998 C2:2006 | 44SMn28 | --- | 1.0762 | 0.40-0.48 | 1.30-1.70 | 0.40 | 0.06 | 0.24-0.33 | --- | --- | --- | --- |
| EN 10277-3:2008 | 44SMn28 | --- | 1.0762 | 0.40-0.48 | 1.30-1.70 | 0.40 | 0.06 | 0.24-0.33 | --- | --- | --- | --- |
| ISO 683-9:1988 | Type 44 SMn 28 | --- | --- | 0.40-0.48 | 1.30-1.70 | 0.15-0.40 | 0.06 | 0.24-0.33 | --- | --- | --- | --- |
| JIS G 4804:2008 | Grade SUM 43 | --- | --- | 0.40-0.48 | 1.35-1.65 | --- | 0.040 | 0.24-0.33 | --- | --- | --- | --- |
| SAE J403 JUN14 | Grade 1144 | G11440 | --- | 0.40-0.48 | 1.35-1.65 | --- | 0.030 | 0.24-0.33 | --- | --- | --- | --- |

## 9.1 Free-Machining Steels

### 9.1.1 Chemical Composition of Resulfurized Carbon Steels for Free-Machining Applications (Continued)

| Specification | Designation | UNS No. | Steel No. | Weight, %, max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASME SA-29/SA-29M | Grade 1146 | G11460 | --- | 0.42-0.49 | 0.70-1.00 | --- | 0.040 | 0.08-0.13 | --- | --- | --- | --- |
| ASTM A29/A29M-12e1 | Grade 1146 | G11460 | --- | 0.42-0.49 | 0.70-1.00 | --- | 0.040 | 0.08-0.13 | --- | --- | --- | --- |
| ASTM A576-90b (2012) | Grade 1146 | G11460 | --- | 0.42-0.49 | 0.70-1.00 | --- | 0.040 | 0.08-0.13 | --- | --- | --- | --- |
| GB 8731-88 | Grade Y45Ca | --- | --- | 0.42-0.50 | 0.60-0.90 | 0.20-0.40 | 0.04 | 0.04-0.08 | --- | --- | --- | Ca 0.002-0.006 |
| SAE J403 JUN14 | Grade 1146 | G11460 | --- | 0.42-0.49 | 0.70-1.00 | --- | 0.030 | 0.08-0.13 | --- | --- | --- | --- |
| EN 10087:1998 C2:2006 | 46S20 | --- | 1.0727 | 0.42-0.50 | 0.70-1.10 | 0.40 | 0.06 | 0.15-0.25 | --- | --- | --- | --- |
| EN 10277-3:2008 | 46S20 | --- | 1.0727 | 0.42-0.50 | 0.70-1.10 | 0.40 | 0.06 | 0.15-0.25 | --- | --- | --- | --- |
| ISO 683-9:1988 | Type 46 S 20 | --- | --- | 0.42-0.50 | 0.70-1.10 | 0.15-0.40 | 0.06 | 0.15-0.25 | --- | --- | --- | --- |
| ASME SA-29/SA-29M | Grade 1151 | G11510 | --- | 0.48-0.55 | 0.70-1.00 | --- | 0.040 | 0.08-0.13 | --- | --- | --- | --- |
| ASTM A29/A29M-12e1 | Grade 1151 | G11510 | --- | 0.48-0.55 | 0.70-1.00 | --- | 0.040 | 0.08-0.13 | --- | --- | --- | --- |
| ASTM A576-90b (2012) | Grade 1151 | G11510 | --- | 0.48-0.55 | 0.70-1.00 | --- | 0.040 | 0.08-0.13 | --- | --- | --- | --- |
| SAE J403 JUN14 | Grade 1151 | G11510 | --- | 0.48-0.55 | 0.70-0.90 | --- | 0.030 | 0.08-0.13 | --- | --- | --- | --- |

### 9.1.2 Chemical Composition of Rephosphorized and Resulfurized Carbon Steels for Free-Machining Applications

| Specification | Designation | UNS No. | Steel No. | Weight, %, max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASME SA-29/SA-29M | Grade 1212 | G12120 | --- | 0.13 | 0.70-1.00 | --- | 0.07-0.12 | 0.16-0.23 | --- | --- | --- | --- |
| ASTM A29/A29M-12e1 | Grade 1212 | G12120 | --- | 0.13 | 0.70-1.00 | --- | 0.07-0.12 | 0.16-0.23 | --- | --- | --- | --- |
| ASTM A576-90b (2012) | Grade 1212 | G12120 | --- | 0.13 | 0.70-1.00 | --- | 0.07-0.12 | 0.16-0.23 | --- | --- | --- | --- |
| ISO 683-9:1988 | Type 9 S 20 | --- | --- | 0.13 | 0.60-1.20 | 0.05 | 0.11 | 0.15-0.25 | --- | --- | --- | --- |
| JIS G 4804:2008 | Grade SUM 21 | --- | --- | 0.13 | 0.70-1.00 | --- | 0.07-0.12 | 0.16-0.23 | --- | --- | --- | --- |
| SAE J403 JUN14 | Grade 1212 | G12120 | --- | 0.13 | 0.70-1.00 | --- | 0.07-0.12 | 0.16-0.23 | --- | --- | --- | --- |
| ASME SA-29/SA-29M | Grade 1213 | G12130 | --- | 0.13 | 0.70-1.00 | --- | 0.07-0.12 | 0.24-0.33 | --- | --- | --- | --- |
| ASTM A29/A29M-12e1 | Grade 1213 | G12130 | --- | 0.13 | 0.70-1.00 | --- | 0.07-0.12 | 0.24-0.33 | --- | --- | --- | --- |
| ASTM A576-90b (2012) | Grade 1213 | G12130 | --- | 0.13 | 0.70-1.00 | --- | 0.07-0.12 | 0.24-0.33 | --- | --- | --- | --- |
| EN 10087:1998 C2:2006 | 11SMn30 | --- | 1.0715 | 0.14 | 0.90-1.30 | 0.05 | 0.11 | 0.27-0.33 | --- | --- | --- | --- |
| EN 10277-3:2008 | 11SMn30 | --- | 1.0715 | 0.14 | 0.90-1.30 | 0.05 | 0.11 | 0.27-0.33 | --- | --- | --- | --- |
| GB 8731-88 | Grade Y15 | --- | --- | 0.10-0.18 | 0.80-1.20 | 0.15 | 0.05-0.10 | 0.23-0.33 | --- | --- | --- | --- |
| ISO 683-9:1988 | Type 11 SMn 28 | --- | --- | 0.14 | 0.90-1.30 | 0.05 | 0.11 | 0.24-0.33 | --- | --- | --- | --- |
| JIS G 4804:2008 | Grade SUM 22 | --- | --- | 0.13 | 0.70-1.00 | --- | 0.07-0.12 | 0.24-0.33 | --- | --- | --- | --- |
| SAE J403 JUN14 | Grade 1213 | G12130 | --- | 0.13 | 0.70-1.00 | --- | 0.07-0.12 | 0.24-0.33 | --- | --- | --- | --- |
| ASME SA-29/SA-29M | Grade 1215 | G12150 | --- | 0.09 | 0.75-1.05 | --- | 0.04-0.09 | 0.26-0.35 | --- | --- | --- | --- |
| ASTM A29/A29M-12e1 | Grade 1215 | G12150 | --- | 0.09 | 0.75-1.05 | --- | 0.04-0.09 | 0.26-0.35 | --- | --- | --- | --- |
| ASTM A576-90b (2012) | Grade 1215 | G12150 | --- | 0.09 | 0.75-1.05 | --- | 0.04-0.09 | 0.26-0.35 | --- | --- | --- | --- |
| JIS G 4804:2008 | Grade SUM 23 | --- | --- | 0.09 | 0.75-1.05 | --- | 0.04-0.09 | 0.26-0.35 | --- | --- | --- | --- |
| SAE J403 JUN14 | Grade 1215 | G12150 | --- | 0.09 | 0.75-1.05 | --- | 0.04-0.09 | 0.26-0.35 | --- | --- | --- | --- |

**9.1 Free-Machining Steels**

**9.1.2 Chemical Composition of Rephosphorized and Resulfurized Carbon Steels for Free-Machining Applications (Continued)**

| Specification | Designation | UNS No. | Steel No. | Weight, %, max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| EN 10087:1998 C2:2006 | 11SMn37 | --- | 1.0736 | 0.14 | 1.00-1.50 | 0.05 | 0.11 | 0.34-0.40 | --- | --- | --- | --- |
| EN 10277-3:2008 | 11SMn37 | --- | 1.0736 | 0.14 | 1.00-1.50 | 0.05 | 0.11 | 0.34-0.40 | --- | --- | --- | --- |
| ISO 683-9:1988 | Type 12 SMn 35 | --- | --- | 0.15 | 1.00-1.50 | 0.05 | 0.11 | 0.30-0.40 | --- | --- | --- | --- |
| JIS G 4804:2008 | Grade SUM 25 | --- | --- | 0.15 | 0.90-1.40 | --- | 0.07-0.12 | 0.30-0.40 | --- | --- | --- | --- |

**9.1.3 Chemical Composition of Resulfurized and Leaded Carbon Steels for Free-Machining Applications**

| Specification | Designation | UNS No. | Steel No. | Weight, %, max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| EN 10087:1998 C2:2006 | 10SPb20 | --- | 1.0722 | 0.07-0.13 | 0.70-1.10 | 0.40 | 0.06 | 0.15-0.25 | --- | --- | --- | Pb 0.20-0.35 |
| EN 10277-3:2008 | 10SPb20 | --- | 1.0722 | 0.07-0.13 | 0.70-1.10 | 0.40 | 0.06 | 0.15-0.25 | --- | --- | --- | Pb 0.20-0.35 |
| GB 8731-88 | Grade Y12Pb | --- | --- | 0.08-0.16 | 0.70-1.10 | 0.15 | 0.05-0.10 | 0.15-0.25 | --- | --- | --- | Pb 0.15-0.35 |
| ISO 683-9:1988 | Type 10 SPb 20 | --- | --- | 0.07-0.13 | 0.70-1.10 | 0.15-0.40 | 0.06 | 0.15-0.25 | --- | --- | --- | Pb 0.15-0.35 |

**9.1.4 Chemical Composition of Rephosphorized, Resulfurized, and Leaded Carbon Steels for Free-Machining Applications**

| Specification | Designation | UNS No. | Steel No. | Weight, %, max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASME SA-29/SA-29M | Grade 12L13 | G12134 | --- | 0.13 | 0.70-1.00 | --- | 0.07-0.12 | 0.24-0.33 | --- | --- | --- | Pb 0.15-0.35 |
| ASTM A29/A29M-12e1 | Grade 12L13 | G12134 | --- | 0.13 | 0.70-1.00 | --- | 0.07-0.12 | 0.24-0.33 | --- | --- | --- | Pb 0.15-0.35 |
| EN 10087:1998 C2:2006 | 11SMnPb30 | --- | 1.0718 | 0.14 | 0.90-1.30 | 0.05 | 0.11 | 0.27-0.33 | --- | --- | --- | Pb 0.20-0.35 |
| EN 10277-3:2008 | 11SMnPb30 | --- | 1.0718 | 0.14 | 0.90-1.30 | 0.05 | 0.11 | 0.27-0.33 | --- | --- | --- | Pb 0.20-0.35 |
| GB 8731-88 | Grade Y15Pb | --- | --- | 0.10-0.18 | 0.80-1.20 | 0.15 | 0.05-0.10 | 0.23-0.33 | --- | --- | --- | Pb 0.15-0.35 |
| ISO 683-9:1988 | Type 11 SMnPb 28 | --- | --- | 0.14 | 0.90-1.30 | 0.05 | 0.11 | 0.24-0.33 | --- | --- | --- | Pb 0.15-0.35 |
| JIS G 4804:2008 | Grade SUM 22 L | --- | --- | 0.13 | 0.70-1.00 | --- | 0.07-0.12 | 0.24-0.33 | --- | --- | --- | Pb 0.10-0.35 |
| ASME SA-29/SA-29M | Grade 12L14 | G12144 | --- | 0.15 | 0.85-1.15 | --- | 0.04-0.09 | 0.26-0.35 | --- | --- | --- | Pb 0.15-0.35 |
| ASTM A29/A29M-12e1 | Grade 12L14 | G12144 | --- | 0.15 | 0.85-1.15 | --- | 0.04-0.09 | 0.26-0.35 | --- | --- | --- | Pb 0.15-0.35 |
| ASTM A576-90b (2012) | Grade 12L14 | G12144 | --- | 0.15 | 0.85-1.15 | --- | 0.04-0.09 | 0.26-0.35 | --- | --- | --- | Pb 0.15-0.35 |
| JIS G 4804:2008 | Grade SUM 24 L | --- | --- | 0.15 | 0.85-1.15 | --- | 0.04-0.09 | 0.26-0.35 | --- | --- | --- | Pb 0.10-0.35 |
| SAE J403 JUN14 | Grade 12L14 | G12144 | --- | 0.15 | 0.85-1.15 | --- | 0.04-0.09 | 0.26-0.35 | --- | --- | --- | Pb 0.15-0.35 |
| ASME SA-29/SA-29M | Grade 12L15 | --- | --- | 0.09 | 0.75-1.05 | --- | 0.04-0.09 | 0.26-0.35 | --- | --- | --- | Pb 0.15-0.35 |
| ASTM A29/A29M-12e1 | Grade 12L15 | --- | --- | 0.09 | 0.75-1.05 | --- | 0.04-0.09 | 0.26-0.35 | --- | --- | --- | Pb 0.15-0.35 |
| JIS G 4804:2008 | Grade SUM 23 L | --- | --- | 0.09 | 0.75-1.05 | --- | 0.04-0.09 | 0.26-0.35 | --- | --- | --- | Pb 0.10-0.35 |
| EN 10087:1998 C2:2006 | 11SMnPb37 | --- | 1.0737 | 0.14 | 1.00-1.50 | 0.05 | 0.11 | 0.34-0.40 | --- | --- | --- | Pb 0.20-0.35 |
| EN 10277-3:2008 | 11SMnPb37 | --- | 1.0737 | 0.14 | 1.00-1.50 | 0.05 | 0.11 | 0.34-0.40 | --- | --- | --- | Pb 0.20-0.35 |
| ISO 683-9:1988 | Type 12 SMnPb 35 | --- | --- | 0.15 | 1.00-1.50 | 0.05 | 0.11 | 0.30-0.40 | --- | --- | --- | Pb 0.15-0.35 |

### 9.1 Free-Machining Steels

#### 9.1.5 Chemical Composition of Free-Machining Stainless Steels

| Specification | Designation | UNS No. | Steel No. | Weight, %, max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASTM A581/A581M-95b (2014) | Type 303 | S30300 | --- | 0.15 | 2.00 | 1.00 | 0.20 | 0.15 min. | 17.0-19.0 | 8.0-10.0 | --- | --- |
| ASTM A582/A582M-12e1 | Type 303 | S30300 | --- | 0.15 | 2.00 | 1.00 | 0.20 | 0.15 min. | 17.0-19.0 | 8.0-10.0 | --- | --- |
| ASTM A895-89 (2009) | Type 303 | S30300 | --- | 0.15 | 2.00 | 1.00 | 0.20 | 0.15 min. | 17.0-19.0 | 8.00-10.00 | --- | --- |
| JIS G 4308:2013 | Symbol SUS303 | --- | --- | 0.15 | 2.00 | 1.00 | 0.20 | 0.15 min. | 17.00-19.00 | 8.00-10.00 | 0.60 | --- |
| ASTM A581/A581M-95b (2014) | Type 303Se | S30323 | --- | 0.15 | 2.00 | 1.00 | 0.20 | 0.06 | 17.0-19.0 | 8.0-10.0 | --- | Se 0.15 min. |
| JIS G 4308:2013 | Symbol SUS303Se | --- | --- | 0.15 | 2.00 | 1.00 | 0.20 | 0.060 | 17.00-19.00 | 8.00-10.00 | --- | Se 0.15 min. |
| ASTM A581/A581M-95b (2014) | Type 430 F | S43020 | --- | 0.12 | 1.25 | 1.00 | 0.06 | 0.15 min. | 16.0-18.0 | --- | --- | --- |
| JIS G 4308:2013 | Symbol SUS430F | --- | --- | 0.12 | 1.25 | 1.00 | 0.060 | 0.15 min. | 16.00-18.00 | 0.60 | 0.60 | --- |
| ASTM A581/A581M-95b (2014) | Type 416 | S41600 | --- | 0.15 | 1.25 | 1.00 | 0.06 | 0.15 min. | 12.0-14.0 | --- | --- | --- |
| JIS G 4308:2013 | Symbol SUS416 | --- | --- | 0.15 | 1.25 | 1.00 | 0.060 | 0.15 min. | 12.00-14.00 | 0.60 | 0.60 | --- |
| EN 10088-3:2014 | X12CrS13 | --- | 1.4005 | 0.06-0.15 | 1.50 | 1.00 | 0.040 | 0.15-0.35 | 12.0-14.0 | --- | 0.60 | --- |

### 9.2 Spring Steels

#### 9.2.1 Chemical Composition of Cold Rolled Carbon Spring Steels

#### 9 2.1.1 Chemical Composition of Cold Rolled Carbon Wire Spring Steels

| Specification | Designation | UNS No. | Steel No. | Weight, %, max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASTM A713-04 (2010) | Grade 1064 | G10640 | --- | 0.60-0.70 | 0.50-0.80 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| | Grade 1065 | G10650 | --- | 0.60-0.70 | 0.60-0.90 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| GB/T 4358-1995 | Grade 65Mn | --- | --- | 0.62-0.69 | 0.70-1.00 | 0.17-0.37 | 0.025 | 0.020 | 0.10 | 0.15 | --- | Cu 0.20 |
| ASTM A713-04 (2010) | Grade 1070 | G10700 | --- | 0.65-0.75 | 0.60-0.90 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| GB/T 4358-1995 | Grade 70 | --- | --- | 0.67-0.74 | 0.30-0.60 | 0.17-0.37 | 0.025 | 0.020 | 0.10 | 0.15 | --- | Cu 0.20 |
| EN 10270-2:2011 | Grade FDC | --- | --- | 0.60-0.75 | 0.50-1.20 | 0.10-0.35 | 0.030 | 0.025 | --- | --- | --- | Cu 0.12 |
| | Grade TDC | --- | --- | 0.60-0.75 | 0.50-1.20 | 0.10-0.35 | 0.020 | 0.020 | --- | --- | --- | Cu 0.10 |
| | Grade VDC | --- | --- | 0.60-0.75 | 0.50-1.00 | 0.15-0.30 | 0.020 | 0.020 | --- | --- | --- | Cu 0.06 |
| GB/T 18983-2003 | Grade FDC | --- | --- | 0.60-0.75 | 0.50-1.20 | 0.10-0.35 | 0.030 | 0.030 | --- | --- | --- | Cu 0.20 |
| | Grade TDC | --- | --- | 0.60-0.75 | 0.50-1.20 | 0.10-0.35 | 0.020 | 0.025 | --- | --- | --- | Cu 0.12 |
| | Grade VDC | --- | --- | 0.60-0.75 | 0.50-1.20 | 0.10-0.35 | 0.020 | 0.025 | --- | --- | --- | Cu 0.12 |
| ISO 8458-3:2002 | Grade FDC | --- | --- | 0.60-0.75 | 0.50-1.20 | 0.10-0.35 | 0.030 | 0.030 | --- | --- | --- | Cu 0.20 |
| | Grade TDC | --- | --- | 0.60-0.75 | 0.50-1.20 | 0.10-0.35 | 0.020 | 0.025 | --- | --- | --- | Cu 0.12 |
| | Grade VDC | --- | --- | 0.60-0.75 | 0.50-1.00 | 0.15-0.30 | 0.020 | 0.025 | --- | --- | --- | Cu 0.12 |

**9.2 Spring Steels**

**9.2.1.1 Chemical Composition of Cold Rolled Carbon Wire Spring Steels (Continued)**

| Specification | Designation | UNS No. | Steel No. | Weight, %, max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASTM A713-04 (2010) | Grade 1084 | G10840 | --- | 0.80-0.93 | 0.60-0.90 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| GB/T 4358-1995 | Grade T8MnA | --- | --- | 0.80-0.89 | 0.40-0.60 | 0.35 | 0.025 | 0.020 | 0.10 | 0.15 | --- | Cu 0.20 |
| ASTM A713-04 (2010) | Grade 1086 | G10860 | --- | 0.80-0.93 | 0.30-0.50 | --- | 0.040 | 0.050 | --- | --- | --- | --- |
| GB/T 4358-1995 | Grade T9A | --- | --- | 0.85-0.93 | 0.40 | 0.35 | 0.025 | 0.020 | 0.10 | 0.15 | --- | Cu 0.20 |

**9.2.1.2 Chemical Composition of Cold Rolled Carbon Strip Spring Steels**

| Specification | Designation | UNS No. | Steel No. | Weight, %, max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASTM A684/A684M-14 | Grade 1040, Type 1, Limit L | G10400 | --- | 0.37-0.44 | 0.60-0.90 | 0.15-0.30 | 0.030 | 0.035 | 0.25 | 0.30 | 0.10 | Cu 0.30; (Cu+Ni+Cr+Mo) 0.80 |
| | Grade 1040, Type 1, Limit H | G10400 | --- | 0.37-0.44 | 0.60-0.90 | 0.15-0.30 | 0.030 | 0.035 | 0.30 | 0.30 | 0.16 | Cu 0.50; (Cu+Ni+Cr+Mo) 0.80 |
| | Grade 1040, Type 2, Limit L | G10400 | --- | 0.37-0.44 | 0.60-0.90 | 0.10 | 0.030 | 0.035 | 0.25 | 0.30 | 0.10 | Cu 0.30; (Cu+Ni+Cr+Mo) 0.80 |
| | Grade 1040, Type 2, Limit H | G10400 | --- | 0.37-0.44 | 0.60-0.90 | 0.10 | 0.030 | 0.035 | 0.30 | 0.30 | 0.16 | Cu 0.50; (Cu+Ni+Cr+Mo) 0.80 |
| GB 3522-83 | Grade 40 | --- | --- | 0.37-0.44 | 0.50-0.80 | 0.17-0.37 | --- | --- | 0.25 | 0.30 | --- | Cu 0.25 |
| ASTM A684/A684M-14 | Grade 1050, Type 1, Limit L | G10500 | --- | 0.48-0.55 | 0.60-0.90 | 0.15-0.30 | 0.030 | 0.035 | 0.25 | 0.30 | 0.10 | Cu 0.30; (Cu+Ni+Cr+Mo) 0.80 |
| | Grade 1050, Type 1, Limit H | G10500 | --- | 0.48-0.55 | 0.60-0.90 | 0.15-0.30 | 0.030 | 0.035 | 0.30 | 0.30 | 0.16 | Cu 0.50; (Cu+Ni+Cr+Mo) 0.80 |
| | Grade 1050, Type 2, Limit L | G10500 | --- | 0.48-0.55 | 0.60-0.90 | 0.10 | 0.030 | 0.035 | 0.25 | 0.30 | 0.10 | Cu 0.30; (Cu+Ni+Cr+Mo) 0.80 |
| | Grade 1050, Type 2, Limit H | G10500 | --- | 0.48-0.55 | 0.60-0.90 | 0.10 | 0.030 | 0.035 | 0.30 | 0.30 | 0.16 | Cu 0.50; (Cu+Ni+Cr+Mo) 0.80 |
| GB 3522-83 | Grade 50 | --- | --- | 0.47-0.55 | 0.50-0.80 | 0.17-0.37 | --- | --- | 0.25 | 0.30 | --- | Cu 0.25 |
| JIS G 4802:2011 | Grade S50C-CSP | --- | --- | 0.47-0.53 | 0.60-0.90 | 0.15-0.35 | 0.030 | 0.035 | 0.20 | 0.20 | --- | Cu 0.30; (Ni+Cr) 0.35 |
| ASTM A684/A684M-14 | Grade 1055, Type 1, Limit L | G10550 | --- | 0.50-0.60 | 0.60-0.90 | 0.15-0.30 | 0.030 | 0.035 | 0.25 | 0.30 | 0.10 | Cu 0.30; (Cu+Ni+Cr+Mo) 0.80 |
| | Grade 1055, Type 1, Limit H | G10550 | --- | 0.50-0.60 | 0.60-0.90 | 0.15-0.30 | 0.030 | 0.035 | 0.30 | 0.30 | 0.16 | Cu 0.50; (Cu+Ni+Cr+Mo) 0.80 |
| | Grade 1055, Type 2, Limit L | G10550 | --- | 0.50-0.60 | 0.60-0.90 | 0.10 | 0.030 | 0.035 | 0.25 | 0.30 | 0.10 | Cu 0.30; (Cu+Ni+Cr+Mo) 0.80 |
| | Grade 1055, Type 2, Limit H | G10550 | --- | 0.50-0.60 | 0.60-0.90 | 0.10 | 0.030 | 0.035 | 0.30 | 0.30 | 0.16 | Cu 0.50; (Cu+Ni+Cr+Mo) 0.80 |
| EN 10132-4:2000 | C55S | --- | 1.1204 | 0.52-0.60 | 0.60-0.90 | 0.15-0.35 | 0.025 | 0.025 | 0.40 | 0.40 | 0.10 | --- |
| GB 3522-83 | Grade 55 | --- | --- | 0.52-0.60 | 0.50-0.80 | 0.17-0.37 | --- | --- | 0.25 | 0.30 | --- | Cu 0.25 |
| JIS G 4802:2011 | Grade S55C-CSP | --- | --- | 0.52-0.58 | 0.60-0.90 | 0.15-0.35 | 0.030 | 0.035 | 0.20 | 0.20 | --- | Cu 0.30; (Ni+Cr) 0.35 |
| ASTM A684/A684M-14 | Grade 1060, Type 1, Limit L | G10600 | --- | 0.55-0.65 | 0.60-0.90 | 0.15-0.30 | 0.030 | 0.035 | 0.25 | 0.30 | 0.10 | Cu 0.30; (Cu+Ni+Cr+Mo) 0.80 |
| | Grade 1060, Type 1, Limit H | G10600 | --- | 0.55-0.65 | 0.60-0.90 | 0.15-0.30 | 0.030 | 0.035 | 0.30 | 0.30 | 0.16 | Cu 0.50; (Cu+Ni+Cr+Mo) 0.80 |
| | Grade 1060, Type 2, Limit L | G10600 | --- | 0.55-0.65 | 0.60-0.90 | 0.10 | 0.030 | 0.035 | 0.25 | 0.30 | 0.10 | Cu 0.30; (Cu+Ni+Cr+Mo) 0.80 |
| | Grade 1060, Type 2, Limit H | G10600 | --- | 0.55-0.65 | 0.60-0.90 | 0.10 | 0.030 | 0.035 | 0.30 | 0.30 | 0.16 | Cu 0.50; (Cu+Ni+Cr+Mo) 0.80 |
| EN 10132-4:2000 | C60S | --- | 1.1211 | 0.57-0.65 | 0.60-0.90 | 0.15-0.35 | 0.025 | 0.025 | 0.40 | 0.40 | 0.10 | --- |
| GB 3522-83 | Grade 60 | --- | --- | 0.57-0.65 | 0.50-0.80 | 0.17-0.37 | --- | --- | 0.25 | 0.30 | --- | Cu 0.25 |
| JIS G 4802:2011 | Grade S60C-CSP | --- | --- | 0.55-0.65 | 0.60-0.90 | 0.15-0.35 | 0.030 | 0.035 | 0.20 | 0.20 | --- | Cu 0.30 |

**9.2 Spring Steels**

**9.2.1.2 Chemical Composition of Cold Rolled Carbon Strip Spring Steels (Continued)**

| Specification | Designation | UNS No. | Steel No. | Weight, %, max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASTM A684/A684M-14 | Grade 1064, Type 1, Limit L | G10640 | --- | 0.59-0.70 | 0.50-0.80 | 0.15-0.30 | 0.030 | 0.035 | 0.25 | 0.30 | 0.10 | Cu 0.30; (Cu+Ni+Cr+Mo) 0.80 |
| | Grade 1064, Type 1, Limit H | G10640 | --- | 0.59-0.70 | 0.50-0.80 | 0.15-0.30 | 0.030 | 0.035 | 0.30 | 0.30 | 0.16 | Cu 0.50; (Cu+Ni+Cr+Mo) 0.80 |
| | Grade 1064, Type 2, Limit L | G10640 | --- | 0.59-0.70 | 0.50-0.80 | 0.10 | 0.030 | 0.035 | 0.25 | 0.30 | 0.10 | Cu 0.30; (Cu+Ni+Cr+Mo) 0.80 |
| | Grade 1064, Type 2, Limit H | G10640 | --- | 0.59-0.70 | 0.50-0.80 | 0.10 | 0.030 | 0.035 | 0.30 | 0.30 | 0.16 | Cu 0.50; (Cu+Ni+Cr+Mo) 0.80 |
| | Grade 1065, Type 1, Limit L | G10650 | --- | 0.60-0.70 | 0.60-0.90 | 0.15-0.30 | 0.030 | 0.035 | 0.25 | 0.30 | 0.10 | Cu 0.30; (Cu+Ni+Cr+Mo) 0.80 |
| | Grade 1065, Type 1, Limit H | G10650 | --- | 0.60-0.70 | 0.60-0.90 | 0.15-0.30 | 0.030 | 0.035 | 0.30 | 0.30 | 0.16 | Cu 0.50; (Cu+Ni+Cr+Mo) 0.80 |
| | Grade 1065, Type 2, Limit L | G10650 | --- | 0.60-0.70 | 0.60-0.90 | 0.10 | 0.030 | 0.035 | 0.25 | 0.30 | 0.10 | Cu 0.30; (Cu+Ni+Cr+Mo) 0.80 |
| | Grade 1065, Type 2, Limit H | G10650 | --- | 0.60-0.70 | 0.60-0.90 | 0.10 | 0.030 | 0.035 | 0.30 | 0.30 | 0.16 | Cu 0.50; (Cu+Ni+Cr+Mo) 0.80 |
| GB 3522-83 | Grade 65 | --- | --- | 0.62-0.70 | 0.50-0.80 | 0.17-0.37 | --- | --- | 0.25 | 0.30 | --- | Cu 0.25 |
| JIS G 4802:2011 | Grade S65C-CSP | --- | --- | 0.60-0.70 | 0.60-0.90 | 0.15-0.35 | 0.030 | 0.035 | 0.20 | 0.20 | --- | Cu 0.30 |
| ASTM A684/A684M-14 | Grade 1070, Type 1, Limit L | G10700 | --- | 0.65-0.75 | 0.60-0.90 | 0.15-0.30 | 0.030 | 0.035 | 0.25 | 0.30 | 0.10 | Cu 0.30; (Cu+Ni+Cr+Mo) 0.80 |
| | Grade 1070, Type 1, Limit H | G10700 | --- | 0.65-0.75 | 0.60-0.90 | 0.15-0.30 | 0.030 | 0.035 | 0.30 | 0.30 | 0.16 | Cu 0.50; (Cu+Ni+Cr+Mo) 0.80 |
| | Grade 1070, Type 2, Limit L | G10700 | --- | 0.65-0.75 | 0.60-0.90 | 0.10 | 0.030 | 0.035 | 0.25 | 0.30 | 0.10 | Cu 0.30; (Cu+Ni+Cr+Mo) 0.80 |
| | Grade 1070, Type 2, Limit H | G10700 | --- | 0.65-0.75 | 0.60-0.90 | 0.10 | 0.030 | 0.035 | 0.30 | 0.30 | 0.16 | Cu 0.50; (Cu+Ni+Cr+Mo) 0.80 |
| EN 10132-4:2000 | C67S | --- | 1.1231 | 0.65-0.73 | 0.60-0.90 | 0.15-0.35 | 0.025 | 0.025 | 0.40 | 0.40 | 0.10 | --- |
| GB 3522-83 | Grade 70 | --- | --- | 0.67-0.75 | 0.50-0.80 | 0.17-0.37 | --- | --- | 0.25 | 0.30 | --- | Cu 0.25 |
| JIS G 4802:2011 | Grade S70C-CSP | --- | --- | 0.65-0.75 | 0.60-0.90 | 0.15-0.35 | 0.030 | 0.035 | 0.20 | 0.20 | --- | Cu 0.30 |
| ASTM A684/A684M-14 | Grade 1074, Type 1, Limit L | G10740 | --- | 0.70-0.80 | 0.50-0.80 | 0.15-0.30 | 0.030 | 0.035 | 0.25 | 0.30 | 0.10 | Cu 0.30; (Cu+Ni+Cr+Mo) 0.80 |
| | Grade 1074, Type 1, Limit H | G10740 | --- | 0.70-0.80 | 0.50-0.80 | 0.15-0.30 | 0.030 | 0.035 | 0.30 | 0.30 | 0.16 | Cu 0.50; (Cu+Ni+Cr+Mo) 0.80 |
| | Grade 1074, Type 2, Limit L | G10740 | --- | 0.70-0.80 | 0.50-0.80 | 0.10 | 0.030 | 0.035 | 0.25 | 0.30 | 0.10 | Cu 0.30; (Cu+Ni+Cr+Mo) 0.80 |
| | Grade 1074, Type 2, Limit H | G10740 | --- | 0.70-0.80 | 0.50-0.80 | 0.10 | 0.030 | 0.035 | 0.30 | 0.30 | 0.16 | Cu 0.50; (Cu+Ni+Cr+Mo) 0.80 |
| EN 10132-4:2000 | C75S | --- | 1.1248 | 0.70-0.80 | 0.60-0.90 | 0.15-0.35 | 0.025 | 0.025 | 0.40 | 0.40 | 0.10 | --- |
| ASTM A684/A684M-14 | Grade 1080, Type 1, Limit L | G10800 | --- | 0.75-0.88 | 0.60-0.90 | 0.15-0.30 | 0.030 | 0.035 | 0.25 | 0.30 | 0.10 | Cu 0.30; (Cu+Ni+Cr+Mo) 0.80 |
| | Grade 1080, Type 1, Limit H | G10800 | --- | 0.75-0.88 | 0.60-0.90 | 0.15-0.30 | 0.030 | 0.035 | 0.30 | 0.30 | 0.16 | Cu 0.50; (Cu+Ni+Cr+Mo) 0.80 |
| | Grade 1080, Type 2, Limit L | G10800 | --- | 0.75-0.88 | 0.60-0.90 | 0.10 | 0.030 | 0.035 | 0.25 | 0.30 | 0.10 | Cu 0.30; (Cu+Ni+Cr+Mo) 0.80 |
| | Grade 1080, Type 2, Limit H | G10800 | --- | 0.75-0.88 | 0.60-0.90 | 0.10 | 0.030 | 0.035 | 0.30 | 0.30 | 0.16 | Cu 0.50; (Cu+Ni+Cr+Mo) 0.80 |
| | Grade 1085, Type 1, Limit L | G10850 | --- | 0.80-0.93 | 0.70-1.00 | 0.15-0.30 | 0.030 | 0.035 | 0.25 | 0.30 | 0.10 | Cu 0.30; (Cu+Ni+Cr+Mo) 0.80 |
| | Grade 1085, Type 1, Limit H | G10850 | --- | 0.80-0.93 | 0.70-1.00 | 0.15-0.30 | 0.030 | 0.035 | 0.30 | 0.30 | 0.16 | Cu 0.50; (Cu+Ni+Cr+Mo) 0.80 |
| | Grade 1085, Type 2, Limit L | G10850 | --- | 0.80-0.93 | 0.70-1.00 | 0.10 | 0.030 | 0.035 | 0.25 | 0.30 | 0.10 | Cu 0.30; (Cu+Ni+Cr+Mo) 0.80 |
| | Grade 1085, Type 2, Limit H | G10850 | --- | 0.80-0.93 | 0.70-1.00 | 0.10 | 0.030 | 0.035 | 0.30 | 0.30 | 0.16 | Cu 0.50; (Cu+Ni+Cr+Mo) 0.80 |
| EN 10132-4:2000 | C85S | --- | 1.1269 | 0.80-0.90 | 0.40-0.70 | 0.15-0.35 | 0.025 | 0.025 | 0.40 | 0.40 | 0.10 | --- |
| JIS G 4802:2011 | Grade SK85-CSP | --- | --- | 0.80-0.90 | 0.50 | 0.35 | 0.030 | 0.030 | 0.30 | 0.25 | --- | Cu 0.25 |

**9.2 Spring Steels**

**9.2.1.2 Chemical Composition of Cold Rolled Carbon Strip Spring Steels (Continued)**

| Specification | Designation | UNS No. | Steel No. | Weight, %, max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASTM A684/A684M-14 | Grade 1086, Type 1, Limit L | G10860 | --- | 0.80-0.93 | 0.30-0.50 | 0.15-0.30 | 0.030 | 0.035 | 0.25 | 0.30 | 0.10 | Cu 0.30; (Cu+Ni+Cr+Mo) 0.80 |
| | Grade 1086, Type 1, Limit H | G10860 | --- | 0.80-0.93 | 0.30-0.50 | 0.15-0.30 | 0.030 | 0.035 | 0.30 | 0.30 | 0.16 | Cu 0.50; (Cu+Ni+Cr+Mo) 0.80 |
| | Grade 1086, Type 2, Limit L | G10860 | --- | 0.80-0.93 | 0.30-0.50 | 0.10 | 0.030 | 0.035 | 0.25 | 0.30 | 0.10 | Cu 0.30; (Cu+Ni+Cr+Mo) 0.80 |
| | Grade 1086, Type 2, Limit H | G10860 | --- | 0.80-0.93 | 0.30-0.50 | 0.10 | 0.030 | 0.035 | 0.30 | 0.30 | 0.16 | Cu 0.50; (Cu+Ni+Cr+Mo) 0.80 |
| EN 10132-4:2000 | C90S | --- | 1.1217 | 0.85-0.95 | 0.40-0.70 | 0.15-0.35 | 0.025 | 0.025 | 0.40 | 0.40 | 0.10 | --- |
| ASTM A684/A684M-14 | Grade 1095, Type 1, Limit L | G10950 | --- | 0.90-1.03 | 0.30-0.50 | 0.15-0.30 | 0.030 | 0.035 | 0.25 | 0.30 | 0.10 | Cu 0.30; (Cu+Ni+Cr+Mo) 0.80 |
| | Grade 1095, Type 1, Limit H | G10950 | --- | 0.90-1.03 | 0.30-0.50 | 0.15-0.30 | 0.030 | 0.035 | 0.30 | 0.30 | 0.16 | Cu 0.50; (Cu+Ni+Cr+Mo) 0.80 |
| | Grade 1095, Type 2, Limit L | G10950 | --- | 0.90-1.03 | 0.30-0.50 | 0.10 | 0.030 | 0.035 | 0.25 | 0.30 | 0.10 | Cu 0.30; (Cu+Ni+Cr+Mo) 0.80 |
| | Grade 1095, Type 2, Limit H | G10950 | --- | 0.90-1.03 | 0.30-0.50 | 0.10 | 0.030 | 0.035 | 0.30 | 0.30 | 0.16 | Cu 0.50; (Cu+Ni+Cr+Mo) 0.80 |
| EN 10132-4:2000 | C100S | --- | 1.1274 | 0.95-1.05 | 0.30-0.60 | 0.15-0.35 | 0.025 | 0.025 | 0.40 | 0.40 | 0.10 | --- |
| JIS G 4802:2011 | Grade SK95-CSP | --- | --- | 0.90-1.00 | 0.50 | 0.35 | 0.030 | 0.030 | 0.30 | 0.25 | --- | Cu 0.25 |

**9.2.2 Chemical Composition of Hot Rolled Alloy Spring Steels**

**9.2.2.1 Chemical Composition of Hot Rolled Si Alloy Spring Steels**

| Specification | Designation | UNS No. | Steel No. | Weight, %, max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| GB/T 18983-2003 | Grade FDSiMn | --- | --- | 0.56-0.64 | 0.60-0.90 | 1.50-2.00 | 0.035 | 0.035 | --- | --- | --- | Cu 0.25 |
| | Grade TDSiMn | --- | --- | 0.56-0.64 | 0.60-0.90 | 1.50-2.00 | 0.035 | 0.035 | --- | --- | --- | Cu 0.25 |
| JIS G 4801:2011 | Grade SUP6 | --- | --- | 0.56-0.64 | 0.70-1.00 | 1.50-1.80 | 0.030 | 0.030 | --- | --- | --- | Cu 0.30 |

**9.2.2.2 Chemical Composition of Hot Rolled Cr Alloy Spring Steels**

| Specification | Designation | UNS No. | Steel No. | Weight, %, max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| EN 10089:2002 | 55Cr3 | --- | 1.7176 | 0.52-0.59 | 0.70-1.00 | 0.40 | 0.025 | 0.025 | 0.70-1.00 | --- | --- | (Cu+10xSn)±0.60 |
| ISO 683-14:2004 | Type 55Cr3 | --- | --- | 0.52-0.59 | 0.70-1.00 | 0.40 | 0.030 | 0.030 | 0.70-1.00 | --- | --- | (Cu+10xSn) 0.60 |
| JIS G 4801:2011 | Grade SUP9 | --- | --- | 0.52-0.60 | 0.65-0.95 | 0.15-0.35 | 0.030 | 0.030 | 0.65-0.95 | --- | --- | Cu 0.30 |
| EN 10089:2002 | 60Cr3 | --- | 1.7177 | 0.55-0.65 | 0.70-1.00 | 0.40 | 0.025 | 0.025 | 0.60-0.90 | --- | --- | (Cu+10xSn)±0.60 |
| JIS G 4801:2011 | Grade SUP9A | --- | --- | 0.56-0.64 | 0.70-1.00 | 0.15-0.35 | 0.030 | 0.030 | 0.70-1.00 | --- | --- | Cu 0.30 |

## 9.2 Spring Steels

### 9.2.2 Chemical Composition of Hot Rolled Alloy Spring Steels

#### 9.2.2.3 Chemical Composition of Hot Rolled Cr-Si Alloy Spring Steels

| Specification | Designation | UNS No. | Steel No. | Weight, %, max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASTM A1000/A1000M-11 | Grade A | --- | --- | 0.51-0.59 | 0.50-0.80 | 1.20-1.60 | 0.025 | 0.025 | 0.60-0.80 | --- | --- | --- |
| | Grade D | --- | --- | 0.55-0.68 | 0.50-0.90 | 1.20-1.65 | 0.025 | 0.025 | 0.50-0.80 | --- | --- | V 0.08-0.25 |
| EN 10089:2002 | 54SiCr6 | --- | 1.7102 | 0.51-0.59 | 0.50-0.80 | 1.20-1.60 | 0.025 | 0.025 | 0.50-0.80 | --- | --- | (Cu+10xSn)±0.60 |
| EN 10270-2:2011 | Grade FDSiCr | --- | --- | 0.50-0.60 | 0.50-0.90 | 1.20-1.60 | 0.030 | 0.025 | 0.50-0.80 | --- | --- | Cu 0.12 |
| | Grade TDSiCr | --- | --- | 0.50-0.60 | 0.50-0.90 | 1.20-1.60 | 0.025 | 0.020 | 0.50-0.80 | --- | --- | Cu 0.10 |
| | Grade VDSiCr | --- | --- | 0.50-0.60 | 0.50-0.90 | 1.20-1.60 | 0.025 | 0.020 | 0.50-0.80 | --- | --- | Cu 0.06 |
| GB/T 18983-2003 | Grade FDCrSi | --- | --- | 0.50-0.60 | 0.50-0.90 | 1.20-1.60 | 0.030 | 0.030 | 0.50-0.80 | --- | --- | Cu 0.20 |
| | Grade TDCrSi | --- | --- | 0.50-0.60 | 0.50-0.90 | 1.20-1.60 | 0.025 | 0.025 | 0.50-0.80 | --- | --- | Cu 0.12 |
| | Grade VDCrSi | --- | --- | 0.50-0.60 | 0.50-0.90 | 1.20-1.60 | 0.025 | 0.025 | 0.50-0.80 | --- | --- | Cu 0.12 |
| ISO 683-14:2004 | Type 55SiCr6-3 | --- | --- | 0.51-0.59 | 0.50-0.80 | 1.20-1.60 | 0.030 | 0.030 | 0.50-0.80 | --- | --- | (Cu+10xSn) 0.60 |
| ISO 8458-3:2002 | Grade FDSiCr | --- | --- | 0.50-0.60 | 0.50-0.90 | 1.20-1.60 | 0.030 | 0.030 | 0.50-0.80 | --- | --- | Cu 0.20 |
| | Grade TDSiCr | --- | --- | 0.50-0.60 | 0.50-0.90 | 1.20-1.60 | 0.025 | 0.025 | 0.50-0.80 | --- | --- | Cu 0.12 |
| | Grade VDSiCr | --- | --- | 0.50-0.60 | 0.50-0.90 | 1.20-1.60 | 0.025 | 0.025 | 0.50-0.80 | --- | --- | Cu 0.12 |
| JIS G 4801:2011 | Grade SUP12 | --- | --- | 0.51-0.59 | 0.60-0.90 | 1.20-1.60 | 0.030 | 0.030 | 0.60-0.90 | --- | --- | Cu 0.30 |

#### 9.2.2.4 Chemical Composition of Hot Rolled Cr-Mo Alloy Spring Steels

| Specification | Designation | UNS No. | Steel No. | Weight, %, max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| EN 10089:2002 | 60CrMo3-1 | --- | 1.7239 | 0.56-0.64 | 0.70-1.00 | 0.40 | 0.025 | 0.025 | 0.70-1.00 | --- | 0.06-0.15 | (Cu+10xSn)±0.60 |
| | 60CrMo3-2 | --- | 1.7240 | 0.56-0.64 | 0.70-1.00 | 0.40 | 0.025 | 0.025 | 0.70-1.00 | --- | 0.15-0.25 | (Cu+10xSn)±0.60 |
| | 60CrMo3-3 | --- | 1.7241 | 0.56-0.64 | 0.70-1.00 | 0.40 | 0.025 | 0.025 | 0.70-1.00 | --- | 0.25-0.35 | (Cu+10xSn)±0.60 |
| ISO 683-14:2004 | Type 60CrMo3-3 | --- | --- | 0.56-0.64 | 0.70-1.00 | 0.40 | 0.030 | 0.030 | 0.70-1.00 | --- | 0.25-0.35 | (Cu+10xSn) 0.60 |
| JIS G 4801:2011 | Grade SUP13 | --- | --- | 0.56-0.64 | 0.70-1.00 | 0.15-0.35 | 0.030 | 0.030 | 0.70-0.90 | --- | 0.25-0.35 | Cu 0.30 |

**9.2 Spring Steels**

**9.2.2 Chemical Composition of Hot Rolled Alloy Spring Steels**

**9.2.2.5 Chemical Composition of Hot Rolled Cr-V Alloy Spring Steels**

| Specification | Designation | UNS No. | Steel No. | Weight, %, max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| EN 10089:2002 | 54SiCrV6 | --- | 1.8152 | 0.51-0.59 | 0.50-0.80 | 1.20-1.60 | 0.025 | 0.025 | 0.50-0.80 | --- | --- | V 0.10-0.20; (Cu+10xSn)±0.60 |
| | 51CrV4 | --- | 1.8159 | 0.47-0.55 | 0.70-1.10 | 0.40 | 0.025 | 0.025 | 0.90-1.20 | --- | --- | V 0.10-0.25; (Cu+10xSn)±0.60 |
| EN 10132-4:2000 | 51CrV4 | --- | 1.8159 | 0.47-0.55 | 0.70-1.10 | 0.40 | 0.025 | 0.025 | 0.90-1.20 | 0.40 | 0.10 | V 0.10-0.25 |
| GB/T 18983-2003 | Grade FDCrV-A | --- | --- | 0.47-0.55 | 0.60-1.20 | 0.10-0.40 | 0.030 | 0.030 | 0.80-1.10 | --- | --- | V 0.15-0.25; Cu 0.20 |
| | Grade TDCrV-A | --- | --- | 0.47-0.55 | 0.60-1.20 | 0.10-0.40 | 0.025 | 0.025 | 0.80-1.10 | --- | --- | V 0.15-0.25; Cu 0.12 |
| | Grade VDCrV-A | --- | --- | 0.47-0.55 | 0.60-1.20 | 0.10-0.40 | 0.025 | 0.025 | 0.80-1.10 | --- | --- | V 0.15-0.25; Cu 0.12 |
| ISO 683-14:2004 | Type 51CrV4 | --- | --- | 0.47-0.55 | 0.70-1.10 | 0.40 | 0.030 | 0.030 | 0.90-1.20 | --- | --- | V 0.10-0.25; (Cu+10xSn) 0.60 |
| ISO 8458-3:2002 | Grade FDCrV-A | --- | --- | 0.47-0.55 | 0.60-1.20 | 0.10-0.40 | 0.030 | 0.030 | 0.80-1.10 | --- | --- | V 0.15-0.25; Cu 0.20 |
| | Grade TDCrV-A | --- | --- | 0.47-0.55 | 0.60-1.20 | 0.10-0.40 | 0.025 | 0.025 | 0.80-1.10 | --- | --- | V 0.15-0.25; Cu 0.12 |
| | Grade VDCrV-A | --- | --- | 0.47-0.55 | 0.60-1.20 | 0.10-0.40 | 0.025 | 0.025 | 0.80-1.10 | --- | --- | V 0.15-0.25; Cu 0.12 |
| JIS G 4801:2011 | Grade SUP10 | --- | --- | 0.47-0.55 | 0.65-0.95 | 0.15-0.35 | 0.030 | 0.030 | 0.80-1.10 | --- | --- | V 0.15-0.25; Cu 0.30 |
| JIS G 4802:2011 | Grade SUP10-CSP | --- | --- | 0.47-0.55 | 0.65-0.95 | 0.15-0.35 | 0.035 | 0.035 | 0.80-1.00 | --- | --- | V 0.15-0.25; Cu 0.30 |
| ASTM A1000/A1000M-11 | Grade C | --- | --- | 0.60-0.70 | 0.50-0.90 | 0.15-0.30 | 0.025 | 0.025 | 0.35-0.60 | --- | --- | V 0.10-0.25 |
| EN 10270-2:2011 | Grade FDCrV | --- | --- | 0.62-0.72 | 0.50-0.90 | 0.15-0.30 | 0.030 | 0.025 | 0.40-0.60 | --- | --- | V 0.15-0.25; Cu 0.12 |
| | Grade TDCrV | --- | --- | 0.62-0.72 | 0.50-0.90 | 0.15-0.30 | 0.025 | 0.020 | 0.40-0.60 | --- | --- | V 0.15-0.25; Cu 0.10 |
| | Grade VDCrV | --- | --- | 0.62-0.72 | 0.50-0.90 | 0.15-0.30 | 0.025 | 0.020 | 0.40-0.60 | --- | --- | V 0.15-0.25; Cu 0.06 |
| GB/T 18983-2003 | Grade FDCrV-B | --- | --- | 0.62-0.72 | 0.50-0.90 | 0.15-0.30 | 0.030 | 0.030 | 0.40-0.60 | --- | --- | V 0.15-0.25; Cu 0.20 |
| | Grade TDCrV-B | --- | --- | 0.62-0.72 | 0.50-0.90 | 0.15-0.30 | 0.025 | 0.025 | 0.40-0.60 | --- | --- | V 0.15-0.25; Cu 0.12 |
| | Grade VDCrV-B | --- | --- | 0.62-0.72 | 0.50-0.90 | 0.15-0.30 | 0.025 | 0.025 | 0.40-0.60 | --- | --- | V 0.15-0.25; Cu 0.12 |
| ISO 8458-3:2002 | Grade FDCrV-B | --- | --- | 0.62-0.72 | 0.50-0.90 | 0.15-0.30 | 0.030 | 0.030 | 0.40-0.60 | --- | --- | V 0.15-0.25; Cu 0.20 |
| | Grade TDCrV-B | --- | --- | 0.62-0.72 | 0.50-0.90 | 0.15-0.30 | 0.025 | 0.025 | 0.40-0.60 | --- | --- | V 0.15-0.25; Cu 0.12 |
| | Grade VDCrV-B | --- | --- | 0.62-0.72 | 0.50-0.90 | 0.15-0.30 | 0.025 | 0.025 | 0.40-0.60 | --- | --- | V 0.15-0.25; Cu 0.12 |

**9.2 Spring Steels**

**9.2.2 Chemical Composition of Hot Rolled Alloy Spring Steels**

**9.2.2.6 Chemical Composition of Hot Rolled Cr-B Alloy Spring Steels**

| Specification | Designation | UNS No. | Steel No. | Weight, %, max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| GB/T 1222-84 | Grade 60CrMnBA | --- | --- | 0.56-0.64 | 0.70-1.00 | 0.17-0.37 | 0.030 | 0.030 | 0.70-1.00 | 0.35 | --- | B 0.0005-0.004 |
| JIS G 4801:2011 | Grade SUP11A | --- | --- | 0.56-0.64 | 0.70-1.00 | 0.15-0.35 | 0.030 | 0.030 | 0.70-1.00 | --- | --- | B 0.0005 min.; Cu 0.30 |

**9.2.3 Chemical Composition of Stainless Spring Steels**

| Specification | Designation | UNS No. | Steel No. | Weight, %, max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| EN 10151:2002 | X30Cr13 | --- | 1.4028 | 0.26-0.35 | 1.50 | 1.00 | 0.040 | 0.015 | 12.0-14.0 | --- | --- | --- |
| | X39Cr13 | --- | 1.4031 | 0.36-0.42 | 1.00 | 1.00 | 0.040 | 0.015 | 12.5-14.5 | --- | --- | --- |
| GB/T 4231-93 | Grade 3Cr13 | --- | --- | 0.26-0.40 | 1.00 | 1.00 | 0.035 | 0.030 | 12.00-14.00 | 0.60 | --- | --- |
| JIS G 4313:2011 | Symbol SUS 420J2-CSP | --- | --- | 0.26-0.40 | 1.00 | 1.00 | 0.040 | 0.030 | 12.00-14.00 | 0.60 | --- | --- |
| ASTM A313/A313M-13 | Type 302, Class 1 | S30200 | --- | 0.12 | 2.00 | 1.00 | 0.045 | 0.030 | 17.0-19.0 | 8.00-10.00 | --- | N 0.10 |
| | Type 302, Class 2 | S30200 | --- | 0.12 | 2.00 | 1.00 | 0.045 | 0.030 | 17.0-19.0 | 8.00-10.00 | --- | N 0.10 |
| EN 10151:2002 | X10CrNi18-8 | --- | 1.4310 | 0.05-0.15 | 2.00 | 2.00 | 0.045 | 0.015 | 16.0-19.0 | 6.0-9.5 | 0.80 | N 0.11 |
| EN 10270-3:2011 | X10CrNi18-8 | --- | 1.4310 | 0.05-0.15 | 2.00 | 2.00 | 0.045 | 0.015 | 16.0-19.0 | 6.0-9.5 | 0.80 | N 0.11 |
| GB/T 4231-93 | Grade 1Cr17Ni7 | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| JIS G 4313:2011 | Symbol SUS 301-CSP | --- | --- | 0.15 | 2.00 | 1.00 | 0.045 | 0.030 | 16.00-18.00 | 6.00-8.00 | --- | --- |
| ASTM A313/A313M-13 | Type 304 | S30400 | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 18.0-20.0 | 8.0-10.5 | --- | N 0.10 |
| EN 10151:2002 | X5CrNi18-10 | --- | 1.4301 | 0.07 | 2.00 | 1.00 | 0.045 | 0.015 | 17.5-19.5 | 8.0-10.5 | --- | N 0.11 |
| GB/T 4231-93 | Grade 0Cr19Ni9 | --- | --- | 0.08 | 2.50 | 1.00 | 0.035 | 0.030 | 18.00-20.00 | 7.00-10.50 | --- | N 0.10-0.25 |
| JIS G 4313:2011 | Symbol SUS 304-CSP | --- | --- | 0.08 | 2.00 | 1.00 | 0.045 | 0.030 | 18.00-20.00 | 8.00-10.50 | --- | --- |
| ASTM A313/A313M-13 | Type 316 | S31600 | --- | 0.07 | 2.00 | 1.00 | 0.045 | 0.030 | 16.5-18.0 | 10.5-13.5 | 2.00-2.50 | N 0.10 |
| EN 10151:2002 | X5CrNiMo17-12-2 | --- | 1.4401 | 0.07 | 2.00 | 1.00 | 0.045 | 0.015 | 16.5-18.5 | 10.0-13.0 | 2.00-2.50 | N 0.11 |
| EN 10270-3:2011 | X5CrNiMo17-12-2 | --- | 1.4401 | 0.07 | 2.00 | 1.00 | 0.045 | 0.015 | 16.5-18.5 | 10.0-13.0 | 2.00-2.50 | N 0.11 |
| ASTM A313/A313M-13 | Type 631 | S17700 | --- | 0.09 | 1.00 | 1.00 | 0.040 | 0.030 | 16.0-18.0 | 6.5-7.8 | --- | Al 0.75-1.50 |
| EN 10151:2002 | X7CrNiAl17-7 | --- | 1.4568 | 0.09 | 1.00 | 0.70 | 0.040 | 0.015 | 16.0-18.0 | 6.5-7.8 | --- | Al 0.70-1.50 |
| EN 10270-3:2011 | X7CrNiAl17-7 | --- | 1.4568 | 0.09 | 1.00 | 0.70 | 0.040 | 0.015 | 16.0-18.0 | 6.5-7.8 | --- | Al 0.70-1.50 |
| GB/T 4231-93 | Grade 0Cr17Ni7Al | --- | --- | 0.09 | 1.00 | 1.00 | 0.035 | 0.030 | 16.00-18.00 | 6.50-7.75 | --- | Al 0.75-1.00 |
| JIS G 4313:2011 | Symbol SUS 631-CSP | --- | --- | 0.09 | 1.00 | 1.00 | 0.040 | 0.030 | 16.00-18.00 | 6.50-7.75 | --- | Al 0.75-1.50 |

## 9.3 Tools Steels

### 9.3.1 Chemical Composition of Carbon Tool Steels

| Specification | Designation | UNS No. | Steel No. | Weight, %, max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| GB 1298-86 | Grade T7 | --- | --- | 0.65-0.74 | 0.40 | 0.35 | 0.035 | 0.030 | --- | --- | --- | --- |
| ISO 4957:1999 | C70U | --- | --- | 0.65-0.75 | 0.10-0.40 | 0.10-0.30 | 0.030 | 0.030 | --- | --- | --- | --- |
| JIS G 4401:2009 | Grade SK65 | --- | --- | 0.60-0.70 | 0.10-0.50 | 0.10-0.35 | 0.030 | 0.030 | 0.30 | 0.25 | --- | Cu 0.25 |
| GB 1298-86 | Grade T8 | --- | --- | 0.75-0.84 | 0.40 | 0.35 | 0.035 | 0.030 | --- | --- | --- | --- |
| ISO 4957:1999 | C80U | --- | --- | 0.75-0.85 | 0.10-0.40 | 0.10-0.30 | 0.030 | 0.030 | --- | --- | --- | --- |
| JIS G 4401:2009 | Grade SK75 | --- | --- | 0.70-0.80 | 0.10-0.50 | 0.10-0.35 | 0.030 | 0.030 | 0.30 | 0.25 | --- | Cu 0.25 |
| SAE J438b MAY70 | Grade W108 | T72301 | --- | 0.70-0.85 | --- | --- | --- | --- | --- | --- | --- | --- |
| ASTM A686-92 (2010) | Type W1, Grade A-8 | T72301 | --- | 0.80-0.90 | 0.10-0.40 | 0.10-0.40 | 0.030 | 0.030 | 0.15 | 0.20 | 0.10 | V 0.10; Cu 0.20; W 0.15 |
| GB 1298-86 | Grade T8Mn | --- | --- | 0.80-0.90 | 0.40-0.60 | 0.35 | 0.035 | 0.030 | --- | --- | --- | --- |
| JIS G 4401:2009 | Grade SK85 | --- | --- | 0.80-0.90 | 0.10-0.50 | 0.10-0.35 | 0.030 | 0.030 | 0.30 | 0.25 | --- | Cu 0.25 |
| ASTM A686-92 (2010) | Type W1, Grade A-8.5 | T72301 | --- | 0.85-0.95 | 0.10-0.40 | 0.10-0.40 | 0.030 | 0.030 | 0.15 | 0.20 | 0.10 | V 0.10; Cu 0.20; W 0.15 |
| GB 1298-86 | Grade T9 | --- | --- | 0.85-0.94 | 0.40 | 0.35 | 0.035 | 0.030 | --- | --- | --- | --- |
| ISO 4957:1999 | C90U | --- | --- | 0.85-0.95 | 0.10-0.40 | 0.10-0.30 | 0.030 | 0.030 | --- | --- | --- | --- |
| SAE J438b MAY70 | Grade W109 | T72301 | --- | 0.85-0.95 | --- | --- | --- | --- | --- | --- | --- | --- |
| ASTM A686-92 (2010) | Type W1, Grade A-9 | T72301 | --- | 0.90-1.00 | 0.10-0.40 | 0.10-0.40 | 0.030 | 0.030 | 0.15 | 0.20 | 0.10 | V 0.10; Cu 0.20; W 0.15 |
| JIS G 4401:2009 | Grade SK95 | --- | --- | 0.90-1.00 | 0.10-0.50 | 0.10-0.35 | 0.030 | 0.030 | 0.30 | 0.25 | --- | Cu 0.25 |
| ASTM A686-92 (2010) | Type W1, Grade A-10 | T72301 | --- | 1.00-1.10 | 0.10-0.40 | 0.10-0.40 | 0.030 | 0.030 | 0.15 | 0.20 | 0.10 | V 0.10; Cu 0.20; W 0.15 |
| GB 1298-86 | Grade T10 | --- | --- | 0.95-1.04 | 0.40 | 0.35 | 0.035 | 0.030 | --- | --- | --- | --- |
| ISO 4957:1999 | C105U | --- | --- | 1.00-1.10 | 0.10-0.40 | 0.10-0.30 | 0.030 | 0.030 | --- | --- | --- | --- |
| JIS G 4401:2009 | Grade SK105 | --- | --- | 1.00-1.10 | 0.10-0.50 | 0.10-0.35 | 0.030 | 0.030 | 0.30 | 0.25 | --- | Cu 0.25 |
| SAE J438b MAY70 | Grade W110 | T72301 | --- | 0.95-1.10 | --- | --- | --- | --- | --- | --- | --- | --- |
| ASTM A686-92 (2010) | Type W1, Grade A-11.5 | T72301 | --- | 1.15-1.25 | 0.10-0.40 | 0.10-0.40 | 0.030 | 0.030 | 0.15 | 0.20 | 0.10 | V 0.10; Cu 0.20; W 0.15 |
| GB 1298-86 | Grade T12 | --- | --- | 1.15-1.24 | 0.40 | 0.35 | 0.035 | 0.030 | --- | --- | --- | --- |
| ISO 4957:1999 | C120U | --- | --- | 1.15-1.25 | 0.10-0.40 | 0.10-0.30 | 0.030 | 0.030 | --- | --- | --- | --- |
| JIS G 4401:2009 | Grade SK120 | --- | --- | 1.15-1.25 | 0.10-0.50 | 0.10-0.35 | 0.030 | 0.030 | 0.30 | 0.25 | --- | Cu 0.25 |
| SAE J438b MAY70 | Grade W112 | T72301 | --- | 1.10-1.30 | --- | --- | --- | --- | --- | --- | --- | --- |
| ASTM A686-92 (2010) | Type W2, Grade A-9.5 | T72302 | --- | 0.95-1.10 | 0.10-0.40 | 0.10-0.40 | 0.030 | 0.030 | 0.15 | 0.20 | 0.10 | V 0.15-0.35; Cu 0.20; W 0.15 |
| ISO 4957:1999 | 105V | --- | --- | 1.00-1.10 | 0.10-0.40 | 0.10-0.30 | 0.030 | 0.030 | --- | --- | --- | V 0.10-0.20 |
| JIS G 4404:2006 | Grade SKS 43 | --- | --- | 1.00-1.10 | 0.10-0.40 | 0.10-0.30 | 0.030 | 0.030 | 0.20 | --- | --- | V 0.10-0.20 |
| ASTM A686-92 (2010) | Type W2, Grade A-8.5 | T72302 | --- | 0.85-0.95 | 0.10-0.40 | 0.10-0.40 | 0.030 | 0.030 | 0.15 | 0.20 | 0.10 | V 0.15-0.35; Cu 0.20; W 0.15 |
| JIS G 4404:2006 | Grade SKS 44 | --- | --- | 0.80-0.90 | 0.30 | 0.25 | 0.030 | 0.030 | 0.20 | --- | --- | V 0.10-0.25 |

### 9.3 Tools Steels

#### 9.3.2 Chemical Composition of High Speed Tools Steels

##### 9.3.2.1 Chemical Composition of Tungsten Type High Speed Tools Steels

| Specification | Designation | UNS No. | Steel No. | Weight, %, max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASTM A600-92a (2010) | Type T1 | T12001 | --- | 0.65-0.80 | 0.10-0.40 | 0.20-0.40 | 0.03 | 0.03 | 3.75-4.50 | --- | --- | V 0.90-1.30; W 17.25-18.75; (Ni+Cu) 0.75 |
| ISO 4957:1999 | HS18-0-1 | --- | --- | 0.73-0.83 | 0.40 | 0.45 | 0.030 | 0.03 | 3.80-4.50 | --- | --- | V 1.00-1.20; W 17.20-18.70 |
| JIS G 4403:2006 | Grade SKH2 | --- | --- | 0.73-0.83 | 0.40 | 0.45 | 0.030 | 0.030 | 3.80-4.50 | --- | --- | V 1.00-1.20; W 17.20-18.70; Cu 0.25 |
| SAE J438b MAY70 | Grade T1 | T12001 | --- | 0.65-0.75 | 0.20-0.40 | 0.20-0.40 | --- | --- | 3.75-4.50 | --- | --- | V 0.90-1.30; W 17.25-18.75 |
| ASTM A600-92a (2010) | Type T4 | T12004 | --- | 0.70-0.80 | 0.10-0.40 | 0.20-0.40 | 0.03 | 0.03 | 3.75-4.50 | --- | 0.40-1.00 | V 0.80-1.20; W 17.50-19.00; Co 4.25-5.75; (Ni+Cu) 0.75 |
| GB/T 3080-2001 | Grade W18Cr4V | --- | --- | 0.70-0.80 | 0.10-0.40 | 0.20-0.40 | 0.030 | 0.030 | 3.80-4.40 | --- | 0.30 | V 1.00-1.40; W 17.50-19.00 |
| JIS G 4403:2006 | Grade SKH3 | --- | --- | 0.73-0.83 | 0.40 | 0.45 | 0.030 | 0.030 | 3.80-4.50 | --- | --- | V 0.80-1.20; W 17.00-19.00; Co 4.50-5.50; Cu 0.25 |
| SAE J438b MAY70 | Grade T4 | T12004 | --- | 0.70-0.80 | 0.20-0.40 | 0.20-0.40 | --- | --- | 3.75-4.50 | --- | 0.70-1.00 | V 0.80-1.20; W 17.25-18.75; Co 4.25-5.75 |
| ASTM A600-92a (2010) | Type T5 | T12005 | --- | 0.75-0.85 | 0.20-0.40 | 0.20-0.40 | 0.03 | 0.03 | 3.75-5.00 | --- | 0.50-1.25 | V 1.80-2.40; W 17.50-19.00; Co 7.00-9.50; (Ni+Cu) 0.75 |
| JIS G 4403:2006 | Grade SKH4 | --- | --- | 0.73-0.83 | 0.40 | 0.45 | 0.030 | 0.030 | 3.80-4.50 | --- | --- | V 1.00-1.50; W 17.00-19.00; Co 9.00-11.00; Cu 0.25 |
| SAE J438b MAY70 | Grade T5 | T12005 | --- | 0.75-0.85 | 0.20-0.40 | 0.20-0.40 | --- | --- | 3.75-4.50 | --- | 0.70-1.00 | V 1.80-2.40; W 17.50-19.00; Co 7.00-9.00 |
| ASTM A600-92a (2010) | Type T15 | T12015 | --- | 1.50-1.60 | 0.15-0.40 | 0.15-0.40 | 0.03 | 0.03 | 3.75-5.00 | --- | 1.00 | V 4.50-5.25; W 11.75-13.00; Co 4.75-5.25; (Ni+Cu) 0.75 |
| JIS G 4403:2006 | Grade SKH10 | --- | --- | 1.45-1.60 | 0.40 | 0.45 | 0.030 | 0.030 | 3.80-4.50 | --- | --- | V 4.20-5.20; W 11.50-13.50; Co 4.20-5.20; Cu 0.25 |
| ASTM A600-92a (2010) | Type M1 | T11301 | --- | 0.78-0.88 | 0.15-0.40 | 0.20-0.50 | 0.03 | 0.03 | 3.50-4.00 | --- | 8.20-9.20 | V 1.00-1.35; W 1.40-2.10; (Ni+Cu) 0.75 |
| GB/T 3080-2001 | Grade W6Mo5Cr4V2 | --- | --- | 0.80-0.90 | 0.15-0.45 | 0.20-0.45 | 0.030 | 0.030 | 3.80-4.40 | --- | 4.50-5.50 | V 1.75-2.20; W 5.50-6.75 |
| ISO 4957:1999 | HS1-8-1 | --- | --- | 0.77-0.87 | 0.40 | 0.70 | 0.030 | 0.03 | 3.50-4.50 | --- | 8.00-9.00 | V 1.00-1.40; W 1.40-2.00 |
| JIS G 4403:2006 | Grade SKH50 | --- | --- | 0.77-0.87 | 0.45 | 0.70 | 0.030 | 0.030 | 3.50-4.50 | --- | 8.00-9.00 | V 1.00-1.40; W 1.40-2.00; Cu 0.25 |

**9.3 Tools Steels**

**9.3.2 Chemical Composition of High Speed Tools Steels**

**9.3.2.2 Chemical Composition of Molybdenum Type High Speed Tools Steels**

| Specification | Designation | UNS No. | Steel No. | Weight, %, max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASTM A600-92a (2010) | Type M2 (regular C) | T11302 | --- | 0.78-0.88 | 0.15-0.40 | 0.20-0.45 | 0.03 | 0.03 | 3.75-4.50 | --- | 4.50-5.50 | V 1.75-2.20; W 5.50-6.75; (Ni+Cu) 0.75 |
| | Type M2 (high C) | T11302 | --- | 0.95-1.05 | 0.15-0.40 | 0.20-0.45 | 0.03 | 0.03 | 3.75-4.50 | --- | 4.50-5.50 | V 1.75-2.20; W 5.50-6.75; (Ni+Cu) 0.75 |
| ISO 4957:1999 | HS6-5-2 | --- | --- | 0.80-0.88 | 0.40 | 0.45 | 0.030 | 0.03 | 3.80-4.50 | --- | 4.70-5.20 | V 1.70-2.10; W 5.90-6.70 |
| JIS G 4403:2006 | Grade SKH51 | --- | --- | 0.80-0.88 | 0.40 | 0.45 | 0.030 | 0.030 | 3.80-4.50 | --- | 4.70-5.20 | V 1.70-2.10; W 5.90-6.70; Cu 0.25 |
| SAE J438b MAY70 | Grade M2 | T11302 | --- | 0.78-0.88 | 0.20-0.40 | 0.20-0.40 | --- | --- | 3.75-4.50 | --- | 4.50-5.50 | V 1.60-2.20; W 5.50-6.75 |
| ASTM A600-92a (2010) | Type M3, Class 1 | T11313 | --- | 1.00-1.10 | 0.15-0.40 | 0.20-0.45 | 0.03 | 0.03 | 3.75-4.50 | --- | 4.75-6.50 | V 2.25-2.75; W 5.00-6.75; (Ni+Cu) 0.75 |
| ISO 4957:1999 | HS6-6-2 | --- | --- | 1.00-1.10 | 0.40 | 0.45 | 0.030 | 0.03 | 3.80-4.50 | --- | 5.50-6.50 | V 2.30-2.60; W 5.90-6.70 |
| JIS G 4403:2006 | Grade SKH52 | --- | --- | 1.00-1.10 | 0.40 | 0.45 | 0.030 | 0.030 | 3.80-4.50 | --- | 5.50-6.50 | V 2.30-2.60; W 5.90-6.70; Cu 0.25 |
| SAE J438b MAY70 | Grade M3 | T11313 | --- | 1.00-1.25 | 0.20-0.40 | 0.20-0.40 | --- | --- | 3.75-4.50 | --- | 4.75-6.25 | V 2.25-3.25; W 5.50-6.75 |
| ASTM A600-92a (2010) | Type M3, Class 2 | T11323 | --- | 1.15-1.25 | 0.15-0.40 | 0.20-0.45 | 0.03 | 0.03 | 3.75-4.50 | --- | 4.75-6.50 | V 2.75-3.25; W 5.00-6.75; (Ni+Cu) 0.75 |
| ISO 4957:1999 | HS6-5-3 | --- | --- | 1.15-1.25 | 0.40 | 0.45 | 0.030 | 0.03 | 3.80-4.50 | --- | 4.70-5.20 | V 2.70-3.20; W 5.90-6.70 |
| JIS G 4403:2006 | Grade SKH53 | --- | --- | 1.15-1.25 | 0.40 | 0.45 | 0.030 | 0.030 | 3.80-4.50 | --- | 4.70-5.20 | V 2.70-3.20; W 5.90-6.70; Cu 0.25 |
| ASTM A600-92a (2010) | Type M4 | T11304 | --- | 1.25-1.40 | 0.15-0.40 | 0.20-0.45 | 0.03 | 0.03 | 3.75-4.75 | --- | 4.25-5.50 | V 3.75-4.50; W 5.25-6.50; (Ni+Cu) 0.75 |
| ISO 4957:1999 | HS6-5-4 | --- | --- | 1.25-1.40 | 0.40 | 0.45 | 0.030 | 0.03 | 3.80-4.50 | --- | 4.20-5.00 | V 3.70-4.20; W 5.20-6.00 |
| JIS G 4403:2006 | Grade SKH54 | --- | --- | 1.25-1.40 | 0.40 | 0.45 | 0.030 | 0.030 | 3.80-4.50 | --- | 4.20-5.00 | V 3.70-4.20; W 5.20-6.00; Cu 0.25 |
| SAE J438b MAY70 | Grade M4 | T11304 | --- | 1.25-1.40 | 0.20-0.40 | 0.20-0.40 | --- | --- | 4.00-4.75 | --- | 4.50-5.50 | V 3.90-4.50; W 5.25-6.50 |
| ASTM A600-92a (2010) | Type M7 | T11307 | --- | 0.97-1.05 | 0.15-0.40 | 0.20-0.55 | 0.03 | 0.03 | 3.50-4.00 | --- | 8.20-9.20 | V 1.75-2.25; W 1.40-2.10; (Ni+Cu) 0.75 |
| ISO 4957:1999 | HS2-9-2 | --- | --- | 0.95-1.05 | 0.40 | 0.70 | 0.030 | 0.03 | 3.50-4.50 | --- | 8.20-9.20 | V 1.70-2.20; W 1.50-2.10 |
| JIS G 4403:2006 | Grade SKH58 | --- | --- | 0.95-1.05 | 0.40 | 0.70 | 0.030 | 0.030 | 3.50-4.50 | --- | 8.20-9.20 | V 1.70-2.20; W 1.50-2.10; Cu 0.25 |
| ASTM A600-92a (2010) | Type M36 | T11336 | --- | 0.80-0.90 | 0.15-0.40 | 0.20-0.45 | 0.03 | 0.03 | 3.75-4.50 | --- | 4.50-5.50 | V 1.75-2.25; W 5.50-6.50; Co 7.75-8.75; (Ni+Cu) 0.75 |
| JIS G 4403:2006 | Grade SKH56 | --- | --- | 0.85-0.95 | 0.40 | 0.45 | 0.030 | 0.030 | 3.80-4.50 | --- | 4.70-5.20 | V 1.70-2.10; W 5.90-6.70; Co 7.00-9.00; Cu 0.25 |

**9.3 Tools Steels**

**9.3.2 Chemical Composition of High Speed Tools Steels**

**9.3.2.2 Chemical Composition of Molybdenum Type High Speed Tools Steels (Continued)**

| Specification | Designation | UNS No. | Steel No. | Weight, %, max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASTM A600-92a (2010) | Type M42 | T11342 | --- | 1.05-1.15 | 0.15-0.40 | 0.15-0.65 | 0.03 | 0.03 | 3.50-4.25 | --- | 9.00-10.00 | V 0.95-1.35; W 1.15-1.85; Co 7.75-8.75; (Ni+Cu) 0.75 |
| ISO 4957:1999 | HS2-9-1-8 | --- | --- | 1.05-1.15 | 0.40 | 0.70 | 0.030 | 0.03 | 3.50-4.50 | --- | 9.00-10.00 | V 0.90-1.30; W 1.20-1.90; Co 7.50-8.50 |
| JIS G 4403:2006 | Grade SKH59 | --- | --- | 1.05-1.15 | 0.40 | 0.70 | 0.030 | 0.030 | 3.50-4.50 | --- | 9.00-10.00 | V 0.90-1.30; W 1.20-1.90; Co 7.50-8.50; Cu 0.25 |
| ISO 4957:1999 | HS6-5-2-5 | --- | --- | 0.87-0.95 | 0.40 | 0.45 | 0.030 | 0.03 | 3.80-4.50 | --- | 4.70-5.20 | V 1.70-2.10; W 5.90-6.70; Co 4.50-5.00 |
| JIS G 4403:2006 | Grade SKH55 | --- | --- | 0.87-0.95 | 0.40 | 0.45 | 0.030 | 0.030 | 3.80-4.50 | --- | 4.70-5.20 | V 1.70-2.10; W 5.90-6.70; Co 4.50-5.00; Cu 0.25 |
| ISO 4957:1999 | HS10-4-3-10 | --- | --- | 1.20-1.35 | 0.40 | 0.45 | 0.030 | 0.03 | 3.80-4.50 | --- | 3.20-3.90 | V 3.00-3.50; W 9.00-10.00; Co 9.50-10.50 |
| JIS G 4403:2006 | Grade SKH57 | --- | --- | 1.20-1.35 | 0.40 | 0.45 | 0.030 | 0.030 | 3.80-4.50 | --- | 3.20-3.90 | V 3.00-3.50; W 9.00-10.00; Co 9.50-10.50; Cu 0.25 |

**9.3.3 Chemical Composition of Cold Work Tool Steels**

| Specification | Designation | UNS No. | Steel No. | Weight, %, max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASTM A681-08 | Type A2 | T30102 | --- | 0.95-1.05 | 0.40-1.00 | 0.10-0.50 | 0.030 | 0.030 | 4.75-5.50 | --- | 0.90-1.40 | V 0.15-0.50; (Ni+Cu) 0.75 |
| GB/T 1299-2000 | Grade Cr5Mo1V | --- | --- | 0.95-1.05 | 1.00 | 0.50 | 0.030 | 0.030 | 4.75-5.50 | --- | 0.90-1.40 | V 0.15-0.50; Co 1.00; (Cu+Ni) 0.55 |
| ISO 4957:1999 | X100CrMoV5 | --- | --- | 0.95-1.05 | 0.40-0.80 | 0.10-0.40 | 0.030 | 0.030 | 4.80-5.50 | --- | 0.90-1.20 | V 0.15-0.35 |
| JIS G 4404:2006 | Grade SKD 12 | --- | --- | 0.95-1.05 | 0.40-0.80 | 0.10-0.40 | 0.030 | 0.030 | 4.80-5.50 | --- | 0.90-1.20 | V 0.15-0.35 |
| SAE J438b MAY70 | Grade A2 | T30102 | --- | 0.95-1.05 | 0.45-0.75 | 0.20-0.40 | --- | --- | 4.75-5.50 | --- | 0.90-1.40 | V 0.40 |
| ASTM A681-08 | Type D2 | T30402 | --- | 1.40-1.60 | 0.10-0.60 | 0.10-0.60 | 0.030 | 0.030 | 11.00-13.00 | --- | 0.70-1.20 | V 0.50-1.10; (Ni+Cu) 0.75 |
| GB/T 1299-2000 | Grade Cr12Mo1V1 | --- | --- | 1.40-1.60 | 0.60 | 0.60 | 0.030 | 0.030 | 11.00-13.00 | --- | 0.70-1.20 | V 0.5-1.10; Co 1.00; (Cu+Ni) 0.55 |
| JIS G 4404:2006 | Grade SKD 11 | --- | --- | 1.40-1.60 | 0.60 | 0.40 | 0.030 | 0.030 | 11.00-13.00 | --- | 0.80-1.20 | V 0.20-0.50 |
| SAE J438b MAY70 | Grade D2 | T30402 | --- | 1.40-1.60 | 0.30-0.50 | 0.30-0.50 | --- | --- | 11.00-13.00 | --- | 0.70-1.20 | V 0.80; Co 0.60 |
| ASTM A681-08 | Type D3 | T30403 | --- | 2.00-2.35 | 0.10-0.60 | 0.10-0.60 | 0.030 | 0.030 | 11.00-13.50 | --- | --- | V 1.00; W 1.00; (Ni+Cu) 0.75 |
| GB/T 1299-2000 | Grade Cr12 | --- | --- | 2.00-2.30 | 0.40 | 0.40 | 0.030 | 0.030 | 11.50-13.00 | --- | --- | Co 1.00; (Cu+Ni) 0.55 |
| ISO 4957:1999 | X210Cr12 | --- | --- | 1.90-2.20 | 0.20-0.60 | 0.10-0.60 | 0.030 | 0.030 | 11.0-13.0 | --- | --- | --- |
| JIS G 4404:2006 | Grade SKD 1 | --- | --- | 1.90-2.20 | 0.20-0.60 | 0.10-0.60 | 0.030 | 0.030 | 11.00-13.00 | --- | --- | V 0.30 |
| SAE J438b MAY70 | Grade D3 | T30403 | --- | 2.00-2.35 | 0.24-0.45 | 0.25-0.45 | --- | --- | 11.00-13.00 | --- | 0.80 | V 0.80; W 0.75 |
| ASTM A686-92 (2010) | Type W1, Grade A-10.5 | T72301 | --- | 1.05-1.15 | 0.10-0.40 | 0.10-0.40 | 0.030 | 0.030 | 0.15 | 0.20 | 0.10 | V 0.10; Cu 0.20; W 0.15 |
| GB 1298-86 | Grade T11 | --- | --- | 1.05-1.14 | 0.40 | 0.35 | 0.035 | 0.030 | 0.25 | 0.20 | --- | Cu 0.30 |

**9.3 Tools Steels**

**9.3.3 Chemical Composition of Cold Work Tool Steels (Continued)**

| Specification | Designation | UNS No. | Steel No. | Weight, %, max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASTM A681-08 | Type A6 | T30106 | --- | 0.65-0.75 | 1.80-2.50 | 0.10-0.70 | 0.030 | 0.030 | 0.90-1.40 | --- | 0.90-1.40 | (Ni+Cu) 0.75 |
| ISO 4957:1999 | 70MnMoCr8 | --- | --- | 0.65-0.75 | 1.80-2.50 | 0.10-0.50 | 0.030 | 0.030 | 0.90-1.20 | --- | 0.90-1.40 | --- |
| ASTM A681-08 | Type O1 | T31501 | --- | 0.85-1.00 | 1.00-1.40 | 0.10-0.50 | 0.030 | 0.030 | 0.40-0.70 | --- | --- | V 0.30; W 0.40-0.60; (Ni+Cu) 0.75 |
| GB/T 1299-2000 | Grade 9CrWMn | --- | --- | 0.85-0.95 | 0.90-1.20 | 0.40 | 0.030 | 0.030 | 0.50-0.80 | --- | --- | W 0.50-0.80; Nb 0.20-0.35; (Cu+Ni) 0.55 |
| ISO 4957:1999 | 95MnWCr5 | --- | --- | 0.90-1.00 | 1.05-1.35 | 0.10-0.40 | 0.030 | 0.030 | 0.40-0.65 | --- | --- | V 0.05-0.20; W 0.40-0.70 |
| JIS G 4404:2006 | Grade SKS 3 | --- | --- | 0.90-1.00 | 0.90-1.20 | 0.35 | 0.030 | 0.030 | 0.50-1.00 | --- | --- | W 0.50-1.00 |
| ASTM A681-08 | Type O2 | T31502 | --- | 0.85-0.95 | 1.40-1.80 | 0.50 | 0.030 | 0.030 | 0.50 | --- | 0.30 | V 0.30; (Ni+Cu) 0.75 |
| SAE J438b MAY70 | Grade O2 | T31502 | --- | 0.85-0.95 | 1.40-1.80 | 0.20-0.40 | --- | --- | 0.35 | --- | 0.30 | V 0.20 |
| GB/T 1299-2000 | Grade CrWMn | --- | --- | 0.90-1.05 | 0.80-1.10 | 0.40 | 0.030 | 0.030 | 0.90-1.20 | --- | --- | W 1.20-1.60; Nb 0.20-0.35; (Cu+Ni) 0.55 |
| JIS G 4404:2006 | Grade SKS 31 | --- | --- | 0.95-1.05 | 0.90-1.20 | 0.35 | 0.030 | 0.030 | 0.80-1.20 | --- | --- | W 1.00-1.50 |

**9.3.4 Chemical Composition of Hot Work Tool Steels**

| Specification | Designation | UNS No. | Steel No. | Weight, %, max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASTM A681-08 | Type H10 | T20810 | --- | 0.35-0.45 | 0.20-0.70 | 0.80-1.25 | 0.030 | 0.030 | 3.00-3.75 | --- | 2.00-3.00 | V 0.25-0.75; (Ni+Cu) 0.75 |
| ISO 4957:1999 | 32CrMoV12-28 | --- | --- | 0.28-0.35 | 0.15-0.45 | 0.10-0.40 | 0.030 | 0.020 | 2.70-3.20 | --- | 2.50-3.00 | V 0.40-0.70 |
| JIS G 4404:2006 | Grade SKD 7 | --- | --- | 0.28-0.35 | 0.15-0.45 | 0.10-0.40 | 0.030 | 0.020 | 2.70-3.20 | --- | 2.50-3.00 | V 0.40-0.70 |
| ASTM A681-08 | Type H11 | T20811 | --- | 0.33-0.43 | 0.20-0.60 | 0.80-1.25 | 0.030 | 0.030 | 4.75-5.50 | --- | 1.10-1.60 | V 0.30-0.60; (Ni+Cu) 0.75 |
| ISO 4957:1999 | X37CrMoV5-1 | --- | --- | 0.33-0.41 | 0.25-0.50 | 0.80-1.20 | 0.030 | 0.020 | 4.80-5.50 | --- | 1.10-1.50 | V 0.30-0.50 |
| JIS G 4404:2006 | Grade SKD 6 | --- | --- | 0.32-0.42 | 0.50 | 0.80-1.20 | 0.030 | 0.020 | 4.50-5.50 | --- | 1.00-1.50 | V 0.30-0.50 |
| SAE J438b MAY70 | Grade H11 | T20811 | --- | 0.30-0.40 | 0.20-0.40 | 0.80-1.20 | --- | --- | 4.75-5.50 | --- | 1.25-1.75 | V 0.30-0.50 |
| ASTM A681-08 | Type H12 | T20812 | --- | 0.30-0.40 | 0.20-0.60 | 0.80-1.25 | 0.030 | 0.030 | 4.75-5.50 | --- | 1.25-1.75 | V 0.20-0.50; W 1.00-1.70; (Ni+Cu) 0.75 |
| ISO 4957:1999 | X35CrWMoV5 | --- | --- | 0.32-0.40 | 0.20-0.50 | 0.80-1.20 | 0.030 | 0.020 | 4.75-5.50 | --- | 1.25-1.60 | V 0.20-0.50; W 1.10-1.60 |
| JIS G 4404:2006 | Grade SKD 62 | --- | --- | 0.32-0.40 | 0.20-0.50 | 0.80-1.20 | 0.030 | 0.020 | 4.75-5.50 | --- | 1.00-1.60 | V 0.20-0.50; W 1.00-1.60 |
| SAE J438b MAY70 | Grade H12 | T20812 | --- | 0.30-0.40 | 0.20-0.40 | 0.80-1.20 | --- | --- | 4.75-5.50 | --- | 1.25-1.75 | V 0.10-0.50; W 1.00-1.70 |
| ASTM A681-08 | Type H13 | T20813 | --- | 0.32-0.45 | 0.20-0.60 | 0.80-1.25 | 0.030 | 0.030 | 4.75-5.50 | --- | 1.10-1.75 | V 0.80-1.20; (Ni+Cu) 0.75 |
| ISO 4957:1999 | X40CrMoV5-1 | --- | --- | 0.35-0.42 | 0.25-0.50 | 0.80-1.20 | 0.030 | 0.020 | 4.80-5.50 | --- | 1.20-1.50 | V 0.85-1.15 |
| JIS G 4404:2006 | Grade SKD 61 | --- | --- | 0.35-0.42 | 0.25-0.50 | 0.80-1.20 | 0.030 | 0.020 | 4.80-5.50 | --- | 1.00-1.50 | V 0.80-1.15 |
| SAE J438b MAY70 | Grade H13 | T20813 | --- | 0.30-0.40 | 0.20-0.40 | 0.80-1.20 | --- | --- | 4.75-5.50 | --- | 1.25-1.75 | V 0.80-1.20 |

**9.3 Tools Steels**

**9.3.4 Chemical Composition of Hot Work Tool Steels (Continued)**

| Specification | Designation | UNS No. | Steel No. | Weight, %, max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASTM A681-08 | Type H19 | T20819 | --- | 0.32-0.45 | 0.20-0.50 | 0.15-0.50 | 0.030 | 0.030 | 4.00-4.75 | --- | 0.30-0.55 | V 1.75-2.20; W 3.75-4.50; Co 4.00-4.50; (Ni+Cu) 0.75 |
| ISO 4957:1999 | 38CrCoWV18-17-17 | --- | --- | 0.35-0.45 | 0.20-0.50 | 0.15-0.50 | 0.030 | 0.020 | 4.00-4.70 | --- | 0.30-0.50 | V 1.70-2.10; W 3.80-4.50; Co 4.00-4.50 |
| JIS G 4404:2006 | Grade SKD 8 | --- | --- | 0.35-0.45 | 0.20-0.50 | 0.15-0.50 | 0.030 | 0.020 | 4.00-4.70 | --- | 0.30-0.50 | V 1.70-2.10; W 3.80-4.50; Co 4.00-4.50 |
| ASTM A681-08 | Type H21 | T20821 | --- | 0.26-0.36 | 0.15-0.40 | 0.15-0.50 | 0.030 | 0.030 | 3.00-3.75 | --- | --- | V 0.30-0.60; W 8.50-10.00; (Ni+Cu) 0.75 |
| ISO 4957:1999 | X30WCrV9-3 | --- | --- | 0.25-0.35 | 0.15-0.45 | 0.10-0.40 | 0.030 | 0.020 | 2.50-3.20 | --- | --- | V 0.30-0.50; W 8.50-9.50 |
| JIS G 4404:2006 | Grade SKD 5 | --- | --- | 0.25-0.35 | 0.15-0.45 | 0.10-0.40 | 0.030 | 0.020 | 2.50-3.20 | --- | --- | V 0.30-0.50; W 8.50-9.50 |
| SAE J438b MAY70 | Grade H21 | T20821 | --- | 0.30-0.40 | 0.20-0.40 | 0.15-0.30 | --- | --- | 3.00-3.75 | --- | --- | V 0.30-0.50; W 8.75-10.00 |
| ISO 4957:1999 | 55NiCrMoV7 | --- | --- | 0.50-0.60 | 0.60-0.90 | 0.10-0.40 | 0.030 | 0.030 | 0.80-1.20 | 1.50-1.80 | 0.35-0.55 | V 0.05-0.15 |
| JIS G 4404:2006 | Grade SKT 4 | --- | --- | 0.50-0.60 | 0.60-0.90 | 0.10-0.40 | 0.030 | 0.020 | 0.80-1.20 | 1.50-1.80 | 0.35-0.55 | V 0.05-0.15 |

**9.3.5 Chemical Composition of Special Purpose Tool Steels**

| Specification | Designation | UNS No. | Steel No. | Weight, %, max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASTM A681-08 | Type L6 | T61206 | --- | 0.65-0.75 | 0.25-0.80 | 0.10-0.50 | 0.030 | 0.030 | 0.60-1.20 | 1.25-2.00 | 0.50 | --- |
| JIS G 4404:2006 | Grade SKS 51 | --- | --- | 0.75-0.85 | 0.50 | 0.35 | 0.030 | 0.030 | 0.20-0.50 | 1.30-2.00 | --- | --- |
| SAE J438b MAY70 | Grade L6 | T61206 | --- | 0.65-0.75 | 0.55-0.85 | 0.20-0.40 | --- | --- | 0.65-0.85 | 1.25-1.75 | 0.25 | V 0.25 |
| ASTM A681-08 | Type F2 | T60602 | --- | 1.20-1.40 | 0.10-0.50 | 0.10-0.50 | 0.030 | 0.030 | 0.20-0.40 | --- | --- | W 3.00-4.50 |
| JIS G 4404:2006 | Grade SKS 11 | --- | --- | 1.20-1.30 | 0.50 | 0.35 | 0.030 | 0.030 | 0.20-0.50 | --- | --- | V 0.10-0.30; W 3.00-4.00 |
| ASTM A681-08 | Type L3 | T61203 | --- | 0.95-1.10 | 0.25-0.80 | 0.10-0.50 | 0.030 | 0.030 | 1.30-1.70 | --- | --- | V 0.10-0.30; (Ni+Cu) 0.75 |
| GB/T 1299-2000 | Grade Cr2 | --- | --- | 0.95-1.10 | 0.40 | 0.40 | 0.030 | 0.030 | 1.30-1.65 | --- | --- | Co 1.00; (Cu+Ni) 0.55 |
| ISO 4957:1999 | 102Cr6 | --- | --- | 0.95-1.10 | 0.25-0.45 | 0.15-0.35 | 0.030 | 0.030 | 1.35-1.65 | --- | --- | --- |
| SAE J438b MAY70 | Grade L7 | --- | --- | 0.95-1.05 | 0.25-0.45 | 0.20-0.40 | --- | --- | 1.25-1.75 | --- | 0.30-0.50 | --- |
| ASTM A681-08 | Type S1 | T41901 | --- | 0.40-0.55 | 0.10-0.40 | 0.15-1.20 | 0.030 | 0.030 | 1.00-1.80 | --- | 0.50 | V 0.15-0.30; W 1.50-3.00; (Ni+Cu) 0.75 |
| GB/T 1299-2000 | Grade 5CrW2Si | --- | --- | 0.45-0.55 | 0.40 | 0.50-0.80 | 0.030 | 0.030 | 1.00-1.30 | --- | --- | W 2.00-2.50; Co 1.00; (Cu+Ni) 0.55 |
| ASTM A681-08 | Type S5 | T41905 | --- | 0.50-0.65 | 0.60-1.00 | 1.75-2.25 | 0.030 | 0.030 | 0.10-0.50 | --- | 0.20-1.35 | V 0.15-0.35; (Ni+Cu) 0.75 |
| GB/T 1299-2000 | Grade 6CrMnSi2Mo1 | --- | --- | 0.50-0.65 | 0.60-1.00 | 1.75-2.25 | 0.030 | 0.030 | 0.10-0.50 | --- | 0.20-1.35 | V 0.15-0.35; Co 1.00; (Cu+Ni) 0.55 |
| SAE J438b MAY70 | Grade S5 | T41905 | --- | 0.50-0.60 | 0.60-0.90 | 1.80-2.20 | --- | --- | 0.30 | --- | 0.30-0.50 | V 0.25 |
| ASTM A681-08 | Type S7 | T41907 | --- | 0.45-0.55 | 0.20-0.90 | 0.20-1.00 | 0.030 | 0.030 | 3.00-3.50 | --- | 1.30-1.80 | V 0.35; (Ni+Cu) 0.75 |
| GB/T 1299-2000 | Grade 5Cr3Mn1SiMo1V | --- | --- | 0.45-0.55 | 0.20-0.90 | 0.20-1.00 | 0.030 | 0.030 | 3.00-3.50 | --- | 1.30-1.80 | V 0.35; Co 1.00; (Cu+Ni) 0.55 |
| ISO 4957:1999 | 50CrMoV13-15 | --- | --- | 0.45-0.55 | 0.50-0.90 | 0.20-0.80 | 0.030 | 0.020 | 3.00-3.50 | --- | 1.30-1.70 | V 0.15-0.35 |

## 9.4 Bearing Steels

### 9.4.1 Chemical Composition of Bearing Steels

| Specification | Designation | UNS No. | Steel No. | Weight, %, max, Unless Otherwise Specified | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C | Mn | Si | P | S | Cr | Ni | Mo | Others |
| ASTM A295/A295M-14 | Grade 52100 | G52986 | --- | 0.93-1.05 | 0.25-0.45 | 0.15-0.35 | 0.025 | 0.015 | 1.35-1.60 | 0.25 | 0.10 | Al 0.050; Cu 0.30; O 0.0015 |
| GB/T 18254-2002 | Grade GCr15 | --- | --- | 0.95-1.05 | 0.25-0.45 | 0.15-0.35 | 0.025 | 0.025 | 1.40-1.65 | 0.30 | 0.10 | Cu 0.25; (Ni+Cu) 0.50 |
| ISO 683-17:1999 | 100Cr6 | --- | --- | 0.93-1.05 | 0.25-0.45 | 0.15-0.35 | 0.025 | 0.015 | 1.35-1.60 | --- | 0.10 | Al 0.050 |
| JIS G 4805:2008 | Grade SUJ2 | --- | --- | 0.95-1.10 | 0.50 | 0.15-0.35 | 0.025 | 0.025 | 1.30-1.60 | 0.25 | 0.08 | Cu 0.25 |
| ASTM A485-14 | Grade 1 | K19667 | --- | 0.90-1.05 | 0.90-1.20 | 0.45-0.75 | 0.025 | 0.015 | 0.90-1.20 | 0.25 | 0.10 | Al 0.050; Cu 0.30; Ti 0.0050; O 0.0015 |
| | Grade B2, 100CrMnSi4–4 | --- | --- | 0.93-1.05 | 0.90-1.20 | 0.45-0.75 | 0.025 | 0.015 | 0.90-1.20 | --- | 0.10 | Al 0.050; Cu 0.30; O 0.0015 |
| ISO 683-17:1999 | 100CrMnSi4-4 | --- | --- | 0.93-1.05 | 0.90-1.20 | 0.45-0.75 | 0.025 | 0.015 | 0.90-1.20 | --- | 0.10 | --- |
| JIS G 4805:2008 | Grade SUJ3 | --- | --- | 0.95-1.10 | 0.90-1.15 | 0.40-0.70 | 0.025 | 0.025 | 0.90-1.20 | 0.25 | 0.08 | Cu 0.25 |
| ASTM A485-14 | Grade B3, 100CrMnSi6–4 | --- | --- | 0.93-1.05 | 1.00-1.20 | 0.45-0.75 | 0.025 | 0.015 | 1.40-1.65 | --- | 0.10 | Al 0.050; Cu 0.30; O 0.0015 |
| GB/T 18254-2002 | Grade GCr15SiMn | --- | --- | 0.95-1.05 | 0.95-1.25 | 0.45-0.75 | 0.025 | 0.025 | 1.40-1.65 | 0.30 | 0.10 | Cu 0.25; (Ni+Cu) 0.50 |
| ISO 683-17:1999 | 100CrMnSi6-4 | --- | --- | 0.93-1.05 | 1.00-1.20 | 0.45-0.75 | 0.025 | 0.015 | 1.40-1.65 | --- | 0.10 | --- |
| ASTM A485-14 | Grade B4, 100CrMnSi6–6 | --- | --- | 0.93-1.05 | 1.40-1.70 | 0.45-0.75 | 0.025 | 0.015 | 1.40-1.65 | --- | 0.10 | Al 0.050; Cu 0.30; O 0.0015 |
| ISO 683-17:1999 | 100CrMnSi6-6 | --- | --- | 0.93-1.05 | 1.40-1.70 | 0.45-0.75 | 0.025 | 0.015 | 1.40-1.65 | --- | 0.10 | Cu 0.30 |
| ASTM A485-14 | Grade B5, 100CrMo7 | --- | --- | 0.93-1.05 | 0.25-0.45 | 0.15-0.35 | 0.025 | 0.015 | 1.65-1.95 | --- | 0.15-0.30 | Al 0.050; Cu 0.30; O 0.0015 |
| GB/T 18254-2002 | Grade GCr18Mo | --- | --- | 0.95-1.05 | 0.25-0.40 | 0.20-0.40 | 0.025 | 0.020 | 1.65-1.95 | 0.25 | 0.15-0.25 | Cu 0.25 |
| ISO 683-17:1999 | 100CrMo7 | --- | --- | 0.93-1.05 | 0.25-0.45 | 0.15-0.35 | 0.025 | 0.015 | 1.65-1.95 | --- | 0.15-0.30 | --- |
| ASTM A485-14 | Grade B6, 100CrMo7–3 | --- | --- | 0.93-1.05 | 0.60-0.80 | 0.15-0.35 | 0.025 | 0.015 | 1.65-1.95 | --- | 0.20-0.35 | Al 0.050; Cu 0.30; O 0.0015 |
| ISO 683-17:1999 | 100CrMo7-3 | --- | --- | 0.93-1.05 | 0.60-0.80 | 0.15-0.35 | 0.025 | 0.015 | 1.65-1.95 | --- | 0.20-0.35 | --- |
| ASTM A485-14 | Grade B7, 100CrMo7–4 | --- | --- | 0.93-1.05 | 0.60-0.80 | 0.15-0.35 | 0.025 | 0.015 | 1.65-1.95 | --- | 0.40-0.50 | Al 0.050; Cu 0.30; O 0.0015 |
| ISO 683-17:1999 | 100CrMo7-4 | --- | --- | 0.93-1.05 | 0.60-0.80 | 0.15-0.35 | 0.025 | 0.015 | 1.65-1.95 | --- | 0.40-0.50 | O 0.0015 |
| ASTM A485-14 | Grade B8, 100CrMnMoSi8–4–6 | --- | --- | 0.93-1.05 | 0.80-1.10 | 0.40-0.60 | 0.025 | 0.015 | 1.80-2.05 | --- | 0.50-0.60 | Al 0.050; Cu 0.30; O 0.0015 |
| ISO 683-17:1999 | 100CrMnMoSi8-4-6 | --- | --- | 0.93-1.05 | 0.80-1.10 | 0.40-0.60 | 0.025 | 0.015 | 1.80-2.05 | --- | 0.50-0.60 | --- |

# Appendix 1

# *ASTM FERROUS METAL STANDARDS*

| Standard | Title |
|---|---|
| ASTM A1-00 (2010) | Standard Specification for Carbon Steel Tee Rails |
| ASTM A2-02 (2014) | Standard Specification for Carbon Steel Girder Rails of Plain, Grooved, and Guard Types |
| ASTM A3-01 (2012) | Standard Specification for Steel Joint Bars, Low, Medium, and High Carbon (Non-Heat-Treated) |
| ASTM A6/A6M-14 | Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling |
| ASTM A20/A20M-14 | Standard Specification for General Requirements for Steel Plates for Pressure Vessels |
| ASTM A27/A27M-13 | Standard Specification for Steel Castings, Carbon, for General Application |
| ASTM A29/A29M-12 | Standard Specification for General Requirements for Steel Bars, Carbon and Alloy, Hot-Wrought |
| ASTM A31-14 | Standard Specification for Steel Rivets and Bars for Rivets, Pressure Vessels |
| ASTM A34/A34M-06 (2012) | Standard Practice for Sampling and Procurement Testing of Magnetic Materials |
| ASTM A36/A36M-14 | Standard Specification for Carbon Structural Steel |
| ASTM A47/A47M-99 (2014) | Standard Specification for Ferritic Malleable Iron Castings |
| ASTM A48/A48M-03 (2012) | Standard Specification for Gray Iron Castings |
| ASTM A49-12 | Standard Specification for Heat-Treated Carbon Steel Joint Bars, Microalloyed Joint Bars, and Forged Carbon Steel Compromise Joint Bars |
| ASTM A53/A53M-12 | Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless |
| ASTM A65-07 (2013) | Standard Specification for Steel Track Spikes |
| ASTM A66-07 (2013) | Standard Specification for Steel Screw Spikes |
| ASTM A67-00 (2010) | Standard Specification for Steel Tie Plates, Low-Carbon and High-Carbon-Hot-Worked |
| ASTM A74-13a | Standard Specification for Cast Iron Soil Pipe and Fittings |
| ASTM A90/A90M-13 | Standard Test Method for Weight [Mass] of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings |
| ASTM A99-03 (2014) | Standard Specification for Ferromanganese |
| ASTM A100-07 (2012) | Standard Specification for Ferrosilicon |
| ASTM A101-04 (2014) | Standard Specification for Ferrochromium |
| ASTM A102-04 (2014) | Standard Specification for Ferrovanadium |
| ASTM A105/A105M-14 | Standard Specification for Carbon Steel Forgings for Piping Applications |
| ASTM A106/A106M-14 | Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service |
| ASTM A108-13 | Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished |
| ASTM A109/A109M-14 | Standard Specification for Steel, Strip, Carbon (0.25 Maximum Percent), Cold-Rolled |
| ASTM A111-99a (2014) | Standard Specification for Zinc-Coated (Galvanized) “Iron” Telephone and Telegraph Line Wire |
| ASTM A116-11 | Standard Specification for Metallic-Coated, Steel Woven Wire Fence Fabric |
| ASTM A121-13 | Standard Specification for Metallic-Coated Carbon Steel Barbed Wire |
| ASTM A123/A123M-13 | Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products |
| ASTM A125-96 (2013) | Standard Specification for Steel Springs, Helical, Heat-Treated |
| ASTM A126-04 (2014) | Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings |
| ASTM A128/A128M-93 (2012) | Standard Specification for Steel Castings, Austenitic Manganese |
| ASTM A131/A131M-14 | Standard Specification for Structural Steel for Ships |
| ASTM A132-04 (2014) | Standard Specification for Ferromolybdenum |
| ASTM A134-96 (2012) | Standard Specification for Pipe, Steel, Electric-Fusion (Arc)-Welded (Sizes NPS 16 and Over) |
| ASTM A135/A135M-09 (2014) | Standard Specification for Electric-Resistance-Welded Steel Pipe |
| ASTM A139/A139M-04 (2010) | Standard Specification for Electric-Fusion (Arc)-Welded Steel Pipe (NPS 4 and Over) |
| ASTM A143/A143M-07 (2014) | Standard Practice for Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement |
| ASTM A144-04 (2014) | Specification for Ferrotungsten |
| ASTM A146-04 (2014) | Standard Specification for Molybdenum Oxide Products |
| ASTM A148/A148M-14 | Standard Specification for Steel Castings, High Strength, for Structural Purposes |
| ASTM A153/A153M-09 | Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware |
| ASTM A159-83 (2011) | Standard Specification for Automotive Gray Iron Castings |
| ASTM A178/A178M-02 (2012) | Standard Specification for Electric-Resistance-Welded Carbon Steel and Carbon-Manganese Steel Boiler and Superheater Tubes |
| ASTM A179/A179M-90a (2012) | Standard Specification for Seamless Cold-Drawn Low-Carbon Steel Heat-Exchanger and Condenser Tubes |
| ASTM A181/A181M-14 | Standard Specification for Carbon Steel Forgings, for General-Purpose Piping |
| ASTM A182/A182M-15 | Standard Specification for Forged or Rolled Alloy and Stainless Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service |
| ASTM A183-14 | Standard Specification for Carbon Steel Track Bolts and Nuts |
| ASTM A184/A184M-06 (2011) | Standard Specification for Welded Deformed Steel Bar Mats for Concrete Reinforcement |
| ASTM A192/A192M-02 (2012) | Standard Specification for Seamless Carbon Steel Boiler Tubes for High-Pressure Service |
| ASTM A193/A193M-15 | Standard Specification for Alloy-Steel and Stainless Steel Bolting for High-Temperature or High Pressure Service and Other Special Purpose Applications |
| ASTM A194/A194M-15 | Standard Specification for Carbon Steel, Alloy Steel, and Stainless Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both |
| ASTM A197/A197M-00 (2011) | Standard Specification for Cupola Malleable Iron |
| ASTM A203/A203M-12 | Standard Specification for Pressure Vessel Plates, Alloy Steel, Nickel |

| Standard | Title |
|---|---|
| ASTM A204/A204M-12 | Standard Specification for Pressure Vessel Plates, Alloy Steel, Molybdenum |
| ASTM A209/A209M-03 (2012) | Standard Specification for Seamless Carbon-Molybdenum Alloy-Steel Boiler and Superheater Tubes |
| ASTM A210/A210M-02 (2012) | Standard Specification for Seamless Medium-Carbon Steel Boiler and Superheater Tubes |
| ASTM A213/A213M-15a | Standard Specification for Seamless Ferritic and Austenitic Alloy-Steel Boiler, Superheater, and Heat-Exchanger Tubes |
| ASTM A214/A214M-96 (2012) | Standard Specification for Electric-Resistance-Welded Carbon Steel Heat-Exchanger and Condenser Tubes |
| ASTM A216/A216M-14 | Standard Specification for Steel Castings, Carbon, Suitable for Fusion Welding, for High- Temperature Service |
| ASTM A217/A217M-14 | Standard Specification for Steel Castings, Martensitic Stainless and Alloy, for Pressure- Containing Parts, Suitable for High-Temperature Service |
| ASTM A220/A220M-99 (2014) | Standard Specification for Pearlitic Malleable Iron |
| ASTM A225/A225M-12 | Standard Specification for Pressure Vessel Plates, Alloy Steel, Manganese-Vanadium-Nickel |
| ASTM A227/A227M-06 (2011) | Standard Specification for Steel Wire, Cold-Drawn for Mechanical Springs |
| ASTM A228/A228M-14 | Standard Specification for Steel Wire, Music Spring Quality |
| ASTM A229/A229M-12 | Standard Specification for Steel Wire, Quenched and Tempered for Mechanical Springs |
| ASTM A230/A230M-05 (2011) | Standard Specification for Steel Wire, Oil-Tempered Carbon Valve Spring Quality |
| ASTM A231/A231M-10 | Standard Specification for Chromium-Vanadium Alloy Steel Spring Wire |
| ASTM A232/A232M-05 (2011) | Standard Specification for Chromium-Vanadium Alloy Steel Valve Spring Quality Wire |
| ASTM A234/A234M-14 | Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service |
| ASTM A239-14 | Standard Practice for Locating the Thinnest Spot in a Zinc (Galvanized) Coating on Iron or Steel Articles |
| ASTM A240/A240M-15a | Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications |
| ASTM A242/A242M-13 | Standard Specification for High-Strength Low-Alloy Structural Steel |
| ASTM A247-10 | Standard Test Method for Evaluating the Microstructure of Graphite in Iron Castings |
| ASTM A249/A249M-14a | Standard Specification for Welded Austenitic Steel Boiler, Superheater, Heat-Exchanger, and Condenser Tubes |
| ASTM A250/A250M-05 (2014) | Standard Specification for Electric-Resistance-Welded Ferritic Alloy-Steel Boiler and Superheater Tubes |
| ASTM A252-10 | Standard Specification for Welded and Seamless Steel Pipe Piles |
| ASTM A254/A254M-12 | Standard Specification for Copper-Brazed Steel Tubing |
| ASTM A255-10 (2014) | Standard Test Methods for Determining Hardenability of Steel |
| ASTM A262-14 | Standard Practices for Detecting Susceptibility to Intergranular Attack in Austenitic Stainless Steels |
| ASTM A263-12 | Standard Specification for Stainless Chromium Steel-Clad Plate |
| ASTM A264-12 | Standard Specification for Stainless Chromium-Nickel Steel-Clad Plate |
| ASTM A265-12 | Standard Specification for Nickel and Nickel-Base Alloy-Clad Steel Plate |
| ASTM A266/A266M-13 | Standard Specification for Carbon Steel Forgings for Pressure Vessel Components |
| ASTM A268/A268M-10 | Standard Specification for Seamless and Welded Ferritic and Martensitic Stainless Steel Tubing for General Service |
| ASTM A269/A269M-14 | Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service |
| ASTM A270/A270M-15 | Standard Specification for Seamless and Welded Austenitic and Ferritic/Austenitic Stainless Steel Sanitary Tubing |
| ASTM A275/A275M-15 | Standard Practice for Magnetic Particle Examination of Steel Forgings |
| ASTM A276/A276M-15 | Standard Specification for Stainless Steel Bars and Shapes |
| ASTM A278/A278M-01 (2011) | Standard Specification for Gray Iron Castings for Pressure-Containing Parts for Temperatures Up to 650°F (350°C) |
| ASTM A283/A283M-13 | Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates |
| ASTM A285/A285M-12 | Standard Specification for Pressure Vessel Plates, Carbon Steel, Low- and Intermediate-Tensile Strength |
| ASTM A288-91 (2013) | Standard Specification for Carbon and Alloy Steel Forgings for Magnetic Retaining Rings for Turbine Generators |
| ASTM A289/A289M-97 (2013) | Standard Specification for Alloy Steel Forgings for Nonmagnetic Retaining Rings for Generators |
| ASTM A290/A290M-05 (2015) | Standard Specification for Carbon and Alloy Steel Forgings for Rings for Reduction Gears |
| ASTM A291/A291M-05 (2015) | Standard Specification for Steel Forgings, Carbon and Alloy, for Pinions, Gears and Shafts for Reduction Gears |
| ASTM A295/A295M-14 | Standard Specification for High-Carbon Anti-Friction Bearing Steel |
| ASTM A297/A297M-14 | Standard Specification for Steel Castings, Iron-Chromium and Iron-Chromium-Nickel, Heat Resistant, for General Application |
| ASTM A299/A299M-09 (2014) | Standard Specification for Pressure Vessel Plates, Carbon Steel, Manganese-Silicon |
| ASTM A302/A302M-12 | Standard Specification for Pressure Vessel Plates, Alloy Steel, Manganese-Molybdenum and Manganese-Molybdenum-Nickel |
| ASTM A304-11 | Standard Specification for Carbon and Alloy Steel Bars Subject to End-Quench Hardenability Requirements |

| Standard | Title |
|---|---|
| ASTM A307-14 | Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength |
| ASTM A308/A308M-10 | Standard Specification for Steel Sheet, Terne (Lead-Tin Alloy) Coated by the Hot-Dip Process |
| ASTM A309-01 (2012) | Standard Test Method for Weight and Composition of Coating on Terne Sheet by the Triple-Spot Test |
| ASTM A311/A311M-04 (2015) | Standard Specification for Cold-Drawn, Stress-Relieved Carbon Steel Bars Subject to Mechanical Property Requirements |
| ASTM A312/A312M-15 | Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes |
| ASTM A313/A313M-13 | Standard Specification for Stainless Steel Spring Wire |
| ASTM A314-13a | Standard Specification for Stainless Steel Billets and Bars for Forging |
| ASTM A319-71 (2011) | Standard Specification for Gray Iron Castings for Elevated Temperatures for Non-Pressure Containing Parts |
| ASTM A320/A320M-15 | Standard Specification for Alloy-Steel and Stainless Steel Bolting for Low-Temperature Service |
| ASTM A322-13 | Standard Specification for Steel Bars, Alloy, Standard Grades |
| ASTM A323-05 (2010) | Standard Specification for Ferroboron |
| ASTM A324-08 (2013) | Standard Specification for Ferrotitanium |
| ASTM A325-14 | Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength |
| ASTM A325M-14 | Standard Specification for Structural Bolts, Steel, Heat Treated 830 MPa Minimum Tensile Strength (Metric) |
| ASTM A327/A327M-11 | Standard Test Methods for Impact Testing of Cast Irons |
| ASTM A328/A328M-13a | Standard Specification for Steel Sheet Piling |
| ASTM A333/A333M-13 | Standard Specification for Seamless and Welded Steel Pipe for Low-Temperature Service and Other Applications with Required Notch Toughness |
| ASTM A334/A334M-04a (2010) | Standard Specification for Seamless and Welded Carbon and Alloy-Steel Tubes for Low-Temperature Service |
| ASTM A335/A335M-15 | Standard Specification for Seamless Ferritic Alloy-Steel Pipe for High-Temperature Service |
| ASTM A336/A336M-10a | Standard Specification for Alloy Steel Forgings for Pressure and High-Temperature Parts |
| ASTM A338-84 (2014) | Standard Specification for Malleable Iron Flanges, Pipe Fittings, and Valve Parts for Railroad, Marine, and Other Heavy Duty Service at Temperatures Up to 650°F (345°C) |
| ASTM A340-14 | Standard Terminology of Symbols and Definitions Relating to Magnetic Testing |
| ASTM A341/A341M-00 (2011) | Standard Test Method for Direct Current Magnetic Properties of Materials Using D-C Permeameters and the Ballistic Test Methods |
| ASTM A342/A342M-14 | Standard Test Methods for Permeability of Weakly Magnetic Materials |
| ASTM A343/ A 343M-14 | Standard Test Method for Alternating-Current Magnetic Properties of Materials at Power Frequencies Using Wattmeter-Ammeter-Voltmeter Method and 25-cm Epstein Test Frame |
| ASTM A345-14 | Standard Specification for Flat-Rolled Electrical Steels for Magnetic Applications |
| ASTM A348/A348M-05 (2011) | Standard Test Method for Alternating Current Magnetic Properties of Materials Using the Wattmeter-Ammeter-Voltmeter Method, 100 to 10 000 Hz and 25-cm Epstein Frame |
| ASTM A350/A350M-15 | Standard Specification for Carbon and Low-Alloy Steel Forgings, Requiring Notch Toughness Testing for Piping Components |
| ASTM A351/A351M-14 | Standard Specification for Castings, Austenitic, for Pressure-Containing Parts |
| ASTM A352/A352M-06 (2012) | Standard Specification for Steel Castings, Ferritic and Martensitic, for Pressure-Containing Parts, Suitable for Low-Temperature Service |
| ASTM A353/A353M-09 (2014) | Standard Specification for Pressure Vessel Plates, Alloy Steel, Double-Normalized and Tempered 9% Nickel |
| ASTM A354-11 | Standard Specification for Quenched and Tempered Alloy Steel Bolts, Studs, and Other Externally Threaded Fasteners |
| ASTM A355-89 (2012) | Standard Specification for Steel Bars, Alloys, for Nitriding |
| ASTM A356/A356M-11 | Standard Specification for Steel Castings, Carbon, Low Alloy, and Stainless Steel, Heavy-Walled for Steam Turbines |
| ASTM A358/A358M-14a | Standard Specification for Electric-Fusion-Welded Austenitic Chromium-Nickel Stainless Steel Pipe for High-Temperature Service and General Applications |
| ASTM A363-03 (2014) | Standard Specification for Zinc-Coated (Galvanized) Steel Overhead Ground Wire Strand |
| ASTM A367-11 | Standard Test Methods of Chill Testing of Cast Iron |
| ASTM A368-95a (2013) | Standard Specification for Stainless Steel Wire Strand |
| ASTM A369/A369M-11 | Standard Specification for Carbon and Ferritic Alloy Steel Forged and Bored Pipe for High-Temperature Service |
| ASTM A370-14 | Standard Test Methods and Definitions for Mechanical Testing of Steel Products |
| ASTM A372/A372M-15 | Standard Specification for Carbon and Alloy Steel Forgings for Thin-Walled Pressure Vessels |
| ASTM A376/A376M-14 | Standard Specification for Seamless Austenitic Steel Pipe for High-Temperature Service |
| ASTM A377-03 (2014) | Standard Index of Specifications for Ductile-Iron Pressure Pipe |
| ASTM A380/A380M-13 | Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems |
| ASTM A381-96 (2012) | Standard Specification for Metal-Arc-Welded Steel Pipe for Use With High-Pressure Transmission Systems |
| ASTM A384/ A 384M-07 (2013) | Standard Practice for Safeguarding Against Warpage and Distortion During Hot-Dip Galvanizing of Steel Assemblies |

| Standard | Title |
|---|---|
| ASTM A385/A385M-11 | Standard Practice for Providing High-Quality Zinc Coatings (Hot-Dip) |
| ASTM A387/A387M-11 | Standard Specification for Pressure Vessel Plates, Alloy Steel, Chromium-Molybdenum |
| ASTM A388/A388M-15 | Standard Practice for Ultrasonic Examination of Steel Forgings |
| ASTM A389/A389M-13 | Standard Specification for Steel Castings, Alloy, Specially Heat-Treated, for Pressure-Containing Parts, Suitable for High-Temperature Service |
| ASTM A390-06 (2011) | Standard Specification for Zinc-Coated (Galvanized) Steel Poultry Fence Fabric (Hexagonal and Straight Line) |
| ASTM A391/A391M-07 (2012) | Standard Specification for Grade 80 Alloy Steel Chain |
| ASTM A392-11a | Standard Specification for Zinc-Coated Steel Chain-Link Fence Fabric |
| ASTM A394-08 (2015) | Standard Specification for Steel Transmission Tower Bolts, Zinc-Coated and Bare |
| ASTM A395/A395M-99 (2014) | Standard Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures |
| ASTM A400-69 (2012) | Standard Practice for Steel Bars, Selection Guide, Composition, and Mechanical Properties |
| ASTM A401/A401M-10 | Standard Specification for Steel Wire, Chromium-Silicon Alloy |
| ASTM A403/A403M-15 | Standard Specification for Wrought Austenitic Stainless Steel Piping Fittings |
| ASTM A407-07 (2013) | Standard Specification for Steel Wire, Cold-Drawn, for Coiled-Type Springs |
| ASTM A409/A409M-15 | Standard Specification for Welded Large Diameter Austenitic Steel Pipe for Corrosive or High-Temperature Service |
| ASTM A411-08 (2013) | Standard Specification for Zinc-Coated (Galvanized) Low-Carbon Steel Armor Wire |
| ASTM A413/A413M-07 (2012) | Standard Specification for Carbon Steel Chain |
| ASTM A414/A414M-14 | Standard Specification for Steel, Sheet, Carbon, and High-Strength, Low-Alloy for Pressure Vessels |
| ASTM A416/A416M-12a | Standard Specification for Steel Strand, Uncoated Seven-Wire for Prestressed Concrete |
| ASTM A418/A418M-15 | Standard Practice for Ultrasonic Examination of Turbine and Generator Steel Rotor Forgings |
| ASTM A420/A420M-14 | Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Low-Temperature Service |
| ASTM A421/A421M-10 | Standard Specification for Uncoated Stress-Relieved Steel Wire for Prestressed Concrete |
| ASTM A423/A423M-09 (2014) | Standard Specification for Seamless and Electric-Welded Low-Alloy Steel Tubes |
| ASTM A424/A424M-09a | Standard Specification for Steel, Sheet, for Porcelain Enameling |
| ASTM A426/A426M-13 | Standard Specification for Centrifugally Cast Ferritic Alloy Steel Pipe for High-Temperature Service |
| ASTM A427/A427M-10 (2015) | Standard Specification for Wrought Alloy Steel Rolls for Cold and Hot Reduction |
| ASTM A428/A428M-10 (2014) | Standard Test Method for Weight [Mass] of Coating on Aluminum-Coated Iron or Steel Articles |
| ASTM A434-06 (2012) | Standard Specification for Steel Bars, Alloy, Hot-Wrought or Cold-Finished, Quenched and Tempered |
| ASTM A435/A435M-90 (2012) | Standard Specification for Straight-Beam Ultrasonic Examination of Steel Plates |
| ASTM A436-84 (2011) | Standard Specification for Austenitic Gray Iron Castings |
| ASTM A437/A437M-12 | Standard Specification for Stainless and Alloy-Steel Turbine-Type Bolting Specially Heat Treated for High-Temperature Service |
| ASTM A439-83 (2009) | Standard Specification for Austenitic Ductile Iron Castings |
| ASTM A447/A447M-11 | Standard Specification for Steel Castings, Chromium-Nickel-Iron Alloy (25-12 Class), for High-Temperature Service |
| ASTM A449-14 | Standard Specification for Hex Cap Screws, Bolts and Studs, Steel, Heat Treated, 120/105/90 ksi Minimum Tensile Strength, General Use |
| ASTM A450/A450M-15 | Standard Specification for General Requirements for Carbon and Low Alloy Steel Tubes |
| ASTM A451/A451M-14 | Standard Specification for Centrifugally Cast Austenitic Steel Pipe for High-Temperature Service |
| ASTM A453/A453M-12 | Standard Specification for High-Temperature Bolting, with Expansion Coefficients Comparable to Austenitic Stainless Steels |
| ASTM A455/A455M-12a | Standard Specification for Pressure Vessel Plates, Carbon Steel, High-Strength Manganese |
| ASTM A456/A456M-08 (2013) | Standard Specification for Magnetic Particle Examination of Large Crankshaft Forgings |
| ASTM A459-08 (2013) | Standard Specification for Zinc-Coated Flat Steel Armoring Tape |
| ASTM A460-11 | Standard Specification for Copper-Clad Steel Wire Strand |
| ASTM A463/A463M-10 (2015) | Standard Specification for Steel Sheet, Aluminum-Coated, by the Hot-Dip Process |
| ASTM A466/A466M-07 (2012) | Standard Specification for Weldless Chain |
| ASTM A467/A467M-07 (2012) | Standard Specification for Machine and Coil Chain |
| ASTM A469/A469M-07 (2012) | Standard Specification for Vacuum-Treated Steel Forgings for Generator Rotors |
| ASTM A470/A470M-05 (2015) | Standard Specification for Vacuum-Treated Carbon and Alloy Steel Forgings for Turbine Rotors and Shafts |
| ASTM A471/A471M-09 (2014) | Standard Specification for Vacuum-Treated Alloy Steel Forgings for Turbine Rotor Disks and Wheels |
| ASTM A472/A472M-07 (2012) | Standard Specification for Heat Stability of Steam Turbine Shafts and Rotor Forgings |
| ASTM A473-15 | Standard Specification for Stainless Steel Forgings |
| ASTM A474-03 (2013) | Standard Specification for Aluminum-Coated Steel Wire Strand |
| ASTM A475-03 (2014) | Standard Specification for Zinc-Coated Steel Wire Strand |
| ASTM A476/A476M-00 (2014) | Standard Specification for Ductile Iron Castings for Paper Mill Dryer Rolls |
| ASTM A478-97 (2013) | Standard Specification for Chromium-Nickel Stainless Steel Weaving and Knitting Wire |
| ASTM A479/A479M-14 | Standard Specification for Stainless Steel Bars and Shapes for Use in Boilers and Other Pressure Vessels |

| Standard | Title |
|---|---|
| ASTM A480/A480M-14b | Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip |
| ASTM A481-05 (2010) | Standard Specification for Chromium Metal |
| ASTM A482/A482M-11 | Standard Specification for Ferrochrome-Silicon |
| ASTM A483/A483M-10 | Standard Specification for Silicomanganese |
| ASTM A484/A484M-15 | Standard Specification for General Requirements for Stainless Steel Bars, Billets, and Forgings |
| ASTM A485-14 | Standard Specification for High Hardenability Antifriction Bearing Steel |
| ASTM A487/A487M-14 | Standard Specification for Steel Castings Suitable for Pressure Service |
| ASTM A488/A488M-12 | Standard Practice for Steel Castings, Welding, Qualifications of Procedures and Personnel |
| ASTM A489-12 | Standard Specification for Carbon Steel Lifting Eyes |
| ASTM A490-14a | Standard Specification for Structural Bolts, Alloy Steel, Heat Treated, 150 ksi Minimum Tensile Strength |
| ASTM A490M-14a | Standard Specification for High-Strength Steel Bolts, Classes 10.9 and 10.9.3, for Structural Steel Joints (Metric) |
| ASTM A491-11 | Standard Specification for Aluminum-Coated Steel Chain-Link Fence Fabric |
| ASTM A492-95 (2013) | Standard Specification for Stainless Steel Rope Wire |
| ASTM A493-09 (2013) | Standard Specification for Stainless Steel Wire and Wire Rods for Cold Heading and Cold Forging |
| ASTM A494/A494M-15 | Standard Specification for Castings, Nickel and Nickel Alloy |
| ASTM A495-06 (2010) | Standard Specification for Calcium-Silicon Alloys |
| ASTM A498/A498M-14 | Standard Specification for Seamless and Welded Carbon Steel Heat-Exchanger Tubes with Integral Fins |
| ASTM A499-15 | Standard Specification for Steel Bars and Shapes, Carbon Rolled from "T" Rails |
| ASTM A500/A500M-13 | Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes |
| ASTM A501/A501M-14 | Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing |
| ASTM A502-03 (2015) | Standard Specification for Rivets, Steel, Structural |
| ASTM A503/A503M-15 | Standard Specification for Ultrasonic Examination of Forged Crankshafts |
| ASTM A504/A504-14 | Standard Specification for Wrought Carbon Steel Wheels |
| ASTM A505-12 | Standard Specification for Steel, Sheet and Strip, Alloy, Hot-Rolled and Cold-Rolled, General Requirements for |
| ASTM A506-12 | Standard Specification for Alloy and Structural Alloy Steel, Sheet and Strip, Hot-Rolled and Cold-Rolled |
| ASTM A507-12 | Standard Specification for Drawing Alloy Steel, Sheet and Strip, Hot-Rolled and Cold-Rolled |
| ASTM A508/A508M-14 | Standard Specification for Quenched and Tempered Vacuum-Treated Carbon and Alloy Steel Forgings for Pressure Vessels |
| ASTM A510/A510M-13 | Standard Specification for General Requirements for Wire Rods and Coarse Round Wire, Carbon Steel, and Alloy Steel |
| ASTM A511/A511M-15a | Standard Specification for Seamless Stainless Steel Mechanical Tubing |
| ASTM A512-06 (2012) | Standard Specification for Cold-Drawn Buttweld Carbon Steel Mechanical Tubing |
| ASTM A513/A513M-15 | Standard Specification for Electric-Resistance-Welded Carbon and Alloy Steel Mechanical Tubing |
| ASTM A514/A514M-14 | Standard Specification for High-Yield-Strength, Quenched and Tempered Alloy Steel Plate, Suitable for Welding |
| ASTM A515/A515M-10 | Standard Specification for Pressure Vessel Plates, Carbon Steel, for Intermediate- and Higher-Temperature Service |
| ASTM A516/A516M-10 | Standard Specification for Pressure Vessel Plates, Carbon Steel, for Moderate- and Lower-Temperature Service |
| ASTM A517/A517M-10 | Standard Specification for Pressure Vessel Plates, Alloy Steel, High-Strength, Quenched and Tempered |
| ASTM A518/A518M-99 (2012) | Standard Specification for Corrosion-Resistant High-Silicon Iron Castings |
| ASTM A519-06 (2012) | Standard Specification for Seamless Carbon and Alloy Steel Mechanical Tubing |
| ASTM A521/A521M-06 (2011) | Standard Specification for Steel, Closed-Impression Die Forgings for General Industrial Use |
| ASTM A522/A522M-14 | Standard Specification for Forged or Rolled 8 and 9% Nickel Alloy Steel Flanges, Fittings, Valves, and Parts for Low-Temperature Service |
| ASTM A523-96 (2012) | Standard Specification for Plain End Seamless and Electric-Resistance-Welded Steel Pipe for High-Pressure Pipe-Type Cable Circuits |
| ASTM A524-96 (2012) | Standard Specification for Seamless Carbon Steel Pipe for Atmospheric and Lower Temperatures |
| ASTM A529/A529M-14 | Standard Specification for High-Strength Carbon-Manganese Steel of Structural Quality |
| ASTM A530/A530M-12 | Standard Specification for General Requirements for Specialized Carbon and Alloy Steel Pipe |
| ASTM A531/A531M-13 | Standard Practice for Ultrasonic Examination of Turbine-Generator Steel Retaining Rings |
| ASTM A532/A532M-10 (2014) | Standard Specification for Abrasion-Resistant Cast Irons |
| ASTM A533/A533M-09 (2014) | Standard Specification for Pressure Vessel Plates, Alloy Steel, Quenched and Tempered, Manganese-Molybdenum and Manganese-Molybdenum-Nickel |
| ASTM A534-14 | Standard Specification for Carburizing Steels for Anti-Friction Bearings |
| ASTM A536-84 (2014) | Standard Specification for Ductile Iron Castings |
| ASTM A537/A537M-13 | Standard Specification for Pressure Vessel Plates, Heat-Treated, Carbon-Manganese-Silicon Steel |
| ASTM A540/A540M-11 | Standard Specification for Alloy-Steel Bolting for Special Applications |

| Standard | Title |
|---|---|
| ASTM A541/A541M-05 (2015) | Standard Specification for Quenched and Tempered Carbon and Alloy Steel Forgings for Pressure Vessel Components |
| ASTM A542/A542M-13 | Standard Specification for Pressure Vessel Plates, Alloy Steel, Quenched-and-Tempered, Chromium-Molybdenum, and Chromium-Molybdenum-Vanadium |
| ASTM A543/A543M-09 (2013) | Standard Specification for Pressure Vessel Plates, Alloy Steel, Quenched and Tempered Nickel-Chromium-Molybdenum |
| ASTM A550-06 (2010) | Standard Specification for Ferrocolumbium |
| ASTM A551/A551M-08 (2013) | Standard Specification for Carbon Steel Tires for Railway and Rapid Transit Applications |
| ASTM A553/A553M-14 | Standard Specification for Pressure Vessel Plates, Alloy Steel, Quenched and Tempered 7, 8, and 9% Nickel |
| ASTM A554-15 | Standard Specification for Welded Stainless Steel Mechanical Tubing |
| ASTM A555/A555M-05 (2014) | Standard Specification for General Requirements for Stainless Steel Wire and Wire Rods |
| ASTM A556/A556M-96 (2012) | Standard Specification for Seamless Cold-Drawn Carbon Steel Feedwater Heater Tubes |
| ASTM A560/A560M-12 | Standard Specification for Castings, Chromium-Nickel Alloy |
| ASTM A561-08 (2014) | Standard Practice for Macroetch Testing of Tool Steel Bars |
| ASTM A562/A562M-10 | Standard Specification for Pressure Vessel Plates, Carbon Steel, Manganese-Titanium for Glass or Diffused Metallic Coatings |
| ASTM A563-15 | Standard Specification for Carbon and Alloy Steel Nuts |
| ASTM A564/A564M-13 | Standard Specification for Hot-Rolled and Cold-Finished Age-Hardening Stainless Steel Bars and Shapes |
| ASTM A565/A565M-10 | Standard Specification for Martensitic Stainless Steel Bars for High-Temperature Service |
| ASTM A568/A568M-14 | Standard Specification for Steel, Sheet, Carbon, Structural, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements for |
| ASTM A571/A571M-01 (2011) | Standard Specification for Austenitic Ductile Iron Castings for Pressure-Containing Parts Suitable for Low-Temperature Service |
| ASTM A572/A572M-15 | Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel |
| ASTM A573/A573M-13 | Standard Specification for Structural Carbon Steel Plates of Improved Toughness |
| ASTM A574-13 | Standard Specification for Alloy Steel Socket-Head Cap Screws |
| ASTM A574M-12 | Standard Specification for Alloy Steel Socket-Head Cap Screws (Metric) |
| ASTM A575-96 (2013) | Standard Specification for Steel Bars, Carbon, Merchant Quality, M-Grades |
| ASTM A576-90b (2012) | Standard Specification for Steel Bars, Carbon, Hot-Wrought, Special Quality |
| ASTM A577/A577M-90 (2012) | Standard Specification for Ultrasonic Angle-Beam Examination of Steel Plates |
| ASTM A578/A578M-07 (2012) | Standard Specification for Straight-Beam Ultrasonic Examination of Rolled Steel Plates for Special Applications |
| ASTM A579/A579M-04a (2014) | Standard Specification for Superstrength Alloy Steel Forgings |
| ASTM A580/A580M-15 | Standard Specification for Stainless Steel Wire |
| ASTM A581/A581M-95b (2014) | Standard Specification for Free-Machining Stainless Steel Wire and Wire Rods |
| ASTM A582/A582M-12 | Standard Specification for Free-Machining Stainless Steel Bars |
| ASTM A586-04a (2014) | Standard Specification for Zinc-Coated Parallel and Helical Steel Wire Structural Strand |
| ASTM A587-96 (2012) | Standard Specification for Electric-Resistance-Welded Low-Carbon Steel Pipe for the Chemical Industry |
| ASTM A588/A588M-15 | Standard Specification for High-Strength Low-Alloy Structural Steel, up to 50 ksi [345 MPa] Minimum Yield Point, with Atmospheric Corrosion Resistance |
| ASTM A589/A589M-06 (2012) | Standard Specification for Seamless and Welded Carbon Steel Water-Well Pipe |
| ASTM A592/A592M-10 (2015) | Standard Specification for High-Strength Quenched and Tempered Low-Alloy Steel Forged Parts for Pressure Vessels |
| ASTM A595/A595M-14 | Standard Specification for Steel Tubes, Low-Carbon or High Strength Low-Alloy, Tapered for Structural Use |
| ASTM A596/A596M-14 | Standard Test Method for Direct-Current Magnetic Properties of Materials Using the Ballistic Method and Ring Specimens |
| ASTM A597/A597M-14 | Standard Specification for Cast Tool Steel |
| ASTM A598/A598M-02 (2015) | Standard Test Method for Magnetic Properties of Magnetic Amplifier Cores |
| ASTM A599/A599M-07 (2012) | Standard Specification for Tin Mill Products, Electrolytic Tin-Coated, Cold-Rolled Sheet |
| ASTM A600-92a (2010) | Standard Specification for Tool Steel High Speed |
| ASTM A601/A601M-10 | Standard Specification for Electrolytic Manganese Metal |
| ASTM A602-94 (2014) | Standard Specification for Automotive Malleable Iron Castings |
| ASTM A603-98 (2014) | Standard Specification for Zinc-Coated Steel Structural Wire Rope |
| ASTM A604/A604M-07 (2012) | Standard Practice for Macroetch Testing of Consumable Electrode Remelted Steel Bars and Billets |
| ASTM A606/A606M-09a | Standard Specification for Steel, Sheet and Strip, High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, with Improved Atmospheric Corrosion Resistance |
| ASTM A608/A608M-14 | Standard Specification for Centrifugally Cast Iron-Chromium-Nickel High-Alloy Tubing for Pressure Application at High Temperatures |
| ASTM A609/A609M-12 | Standard Practice for Castings, Carbon, Low-Alloy, and Martensitic Stainless Steel, Ultrasonic Examination Thereof |
| ASTM A610-79 (2014) | Standard Test Methods for Sampling and Testing Ferroalloys for Determination of Size |

| Standard | Title |
|---|---|
| ASTM A612/A612M-12 | Standard Specification for Pressure Vessel Plates, Carbon Steel, High Strength, for Moderate and Lower Temperature Service |
| ASTM A615/A615M-15a | Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement |
| ASTM A618/A618M-04 (2010) | Standard Specification for Hot-Formed Welded and Seamless High-Strength Low-Alloy Structural Tubing |
| ASTM A623-11 | Standard Specification for Tin Mill Products, General Requirements |
| ASTM A623M-11 | Standard Specification for Tin Mill Products, General Requirements [Metric] |
| ASTM A624/A624M-13 | Standard Specification for Tin Mill Products, Electrolytic Tin Plate, Single Reduced |
| ASTM A625/A625M-13 | Standard Specification for Tin Mill Products, Black Plate, Single Reduced |
| ASTM A626/A626M-13 | Standard Specification for Tin Mill Products, Electrolytic Tin Plate, Double Reduced |
| ASTM A627-03 (2011) | Standard Test Methods for Tool-Resisting Steel Bars, Flats, and Shapes for Detention and Correctional Facilities |
| ASTM A630-03 (2014) | Standard Test Methods for Determination of Tin Coating Weights for Electrolytic Tin Plate |
| ASTM A632-04 (2014) | Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing (Small-Diameter) for General Service |
| ASTM A633/A633M-13 | Standard Specification for Normalized High-Strength Low-Alloy Structural Steel Plates |
| ASTM A635/A635M-14 | Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Hot-Rolled, Alloy, Carbon, Structural, High-Strength Low-Alloy, and High-Strength Low-Alloy with Improved Formability, General Requirements for |
| ASTM A636-08 (2013) | Standard Specification for Nickel Oxide Sinter |
| ASTM A638/A638M-10 | Standard Specification for Precipitation Hardening Iron Base Superalloy Bars, Forgings, and Forging Stock for High-Temperature Service |
| ASTM A640-97 (2014) | Standard Specification for Zinc-Coated Steel Strand for Messenger Support of Figure 8 Cable |
| ASTM A641/A641M-09a (2014) | Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire |
| ASTM A644-14 | Standard Terminology Relating to Iron Castings |
| ASTM A645/A645M-10 | Standard Specification for Pressure Vessel Plates, 5% and 5½% Nickel Alloy Steels, Specially Heat Treated |
| ASTM A646/A646M-06 (2011) | Standard Specification for Premium Quality Alloy Steel Blooms and Billets for Aircraft and Aerospace Forgings |
| ASTM A648-12 | Standard Specification for Steel Wire, Hard Drawn for Prestressing Concrete Pipe |
| ASTM A649/A649M-10 (2015) | Standard Specification for Forged Steel Rolls Used for Corrugating Paper Machinery |
| ASTM A650/A650M-13 | Standard Specification for Tin Mill Products, Black Plate, Double Reduced |
| ASTM A653/A653M-13 | Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process |
| ASTM A656/A656M-13 | Standard Specification for Hot-Rolled Structural Steel, High-Strength Low-Alloy Plate with Improved Formability |
| ASTM A657/A657M-13 | Standard Specification for Tin Mill Products, Black Plate Electrolytic Chromium-Coated, Single and Double Reduced |
| ASTM A659/A659M-12 | Standard Specification for Commercial Steel (CS), Sheet and Strip, Carbon (0.16 Maximum to 0.25 Maximum Percent), Hot-Rolled |
| ASTM A660/A660M-11 | Standard Specification for Centrifugally Cast Carbon Steel Pipe for High-Temperature Service |
| ASTM A662/A662M-12 | Standard Specification for Pressure Vessel Plates, Carbon-Manganese-Silicon Steel, for Moderate and Lower Temperature Service |
| ASTM A663/A663M-12 | Standard Specification for Steel Bars, Carbon, Merchant Quality, Mechanical Properties |
| ASTM A664-15 | Standard Practice for Identification of Standard Electrical Steel Grades in ASTM Specifications |
| ASTM A666-15 | Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar |
| ASTM A667/A667M-87 (2012) | Standard Specification for Centrifugally Cast Dual Metal (Gray and White Cast Iron) Cylinders |
| ASTM A668/A668M-15 | Standard Specification for Steel Forgings, Carbon and Alloy, for General Industrial Use |
| ASTM A671/A671M-14 | Standard Specification for Electric-Fusion-Welded Steel Pipe for Atmospheric and Lower Temperatures |
| ASTM A672/A672M-14 | Standard Specification for Electric-Fusion-Welded Steel Pipe for High-Pressure Service at Moderate Temperatures |
| ASTM A673/A673M-07 (2012) | Standard Specification for Sampling Procedure for Impact Testing of Structural Steel |
| ASTM A674-10 (2014) | Standard Practice for Polyethylene Encasement for Ductile Iron Pipe for Water or Other Liquids |
| ASTM A675/A675M-14 | Standard Specification for Steel Bars, Carbon, Hot-Wrought, Special Quality, Mechanical Properties |
| ASTM A677-12 | Standard Specification for Nonoriented Electrical Steel Fully Processed Types |
| ASTM A679/A679M-06 (2012) | Standard Specification for Steel Wire, High Tensile Strength, Cold Drawn |
| ASTM A681-08 | Standard Specification for Tool Steels Alloy |
| ASTM A683-05 (2010) | Standard Specification for Nonoriented Electrical Steel, Semiprocessed Types |
| ASTM A684/A684M-14 | Standard Specification for Steel, Strip, High-Carbon, Cold-Rolled |
| ASTM A686-92 (2010) | Standard Specification for Tool Steel, Carbon |
| ASTM A688/A688M-15 | Standard Specification for Seamless and Welded Austenitic Stainless Steel Feedwater Heater Tubes |
| ASTM A689-97 (2013) | Standard Specification for Carbon and Alloy Steel Bars for Springs |
| ASTM A690/A690M-13a | Standard Specification for High-Strength Low-Alloy Nickel, Copper, Phosphorus Steel H-Piles and Sheet Piling with Atmospheric Corrosion Resistance for Use in Marine Environments |

| Standard | Title |
|---|---|
| ASTM A691/A691M-09 (2014) | Standard Specification for Carbon and Alloy Steel Pipe, Electric-Fusion-Welded for High-Pressure Service at High Temperatures |
| ASTM A693-13 | Standard Specification for Precipitation-Hardening Stainless and Heat-Resisting Steel Plate, Sheet, and Strip |
| ASTM A694/A694M-14 | Standard Specification for Carbon and Alloy Steel Forgings for Pipe Flanges, Fittings, Valves, and Parts for High-Pressure Transmission Service |
| ASTM A696-90a (2012) | Standard Specification for Steel Bars, Carbon, Hot-Wrought or Cold-Finished, Special Quality, for Pressure Piping Components |
| ASTM A697/A697M-13 | Standard Test Method for Alternating Current Magnetic Properties of Laminated Core Specimen Using Voltmeter-Ammeter-Wattmeter Methods |
| ASTM A698/A698M-15 | Standard Test Method for Magnetic Shield Efficiency in Attenuating Alternating Magnetic Fields |
| ASTM A700-14 | Standard Guide for Packaging, Marking, and Loading Methods for Steel Products for Shipment |
| ASTM A701/A701M-10 | Standard Specification for Ferromanganese-Silicon |
| ASTM A702-13 | Standard Specification for Steel Fence Posts, Hot Wrought |
| ASTM A703/A703M-15 | Standard Specification for Steel Castings, General Requirements, for Pressure-Containing Parts |
| ASTM A704/A704M-06 (2011) | Standard Specification for Welded Steel Plain Bar or Rod Mats for Concrete Reinforcement |
| ASTM A705/A705M-13 | Standard Specification for Age-Hardening Stainless Steel Forgings |
| ASTM A706/A706M-14 | Standard Specification for Deformed and Plain Low-Alloy Steel Bars for Concrete Reinforcement |
| ASTM A707/A707M-14 | Standard Specification for Forged Carbon and Alloy Steel Flanges for Low-Temperature Service |
| ASTM A709/A709M-13a | Standard Specification for Structural Steel for Bridges |
| ASTM A710/A710M-02 (2013) | Standard Specification for Precipitation-Strengthened Low-Carbon Nickel-Copper-Chromium-Molybdenum-Columbium Alloy Structural Steel Plates |
| ASTM A711/A711M-07 (2012) | Standard Specification for Steel Forging Stock |
| ASTM A712-14 | Standard Test Method for Electrical Resistivity of Soft Magnetic Alloys |
| ASTM A713-04 (2010) | Standard Specification for Steel Wire, High-Carbon Spring, for Heat-Treated Components |
| ASTM A716-08 (2014) | Standard Specification for Ductile Iron Culvert Pipe |
| ASTM A717/A717M-12 | Standard Test Method for Surface Insulation Resistivity of Single-Strip Specimens |
| ASTM A719/A719M-14 | Standard Test Method for Lamination Factor of Magnetic Materials |
| ASTM A720/A720M-02 (2011) | Standard Test Method for Ductility of Nonoriented Electrical Steel |
| ASTM A721/A721M-02 (2011) | Standard Test Method for Ductility of Oriented Electrical Steel |
| ASTM A722/A722M-15 | Standard Specification for High-Strength Steel Bar for Prestressing Concrete |
| ASTM A723/A723M-10 (2015) | Standard Specification for Alloy Steel Forgings for High-Strength Pressure Component Application |
| ASTM A724/A724M-09 (2013) | Standard Specification for Pressure Vessel Plates, Carbon-Manganese-Silicon Steel, Quenched and Tempered, for Welded Pressure Vessels |
| ASTM A726-05 (2010) | Standard Specification for Cold-Rolled Magnetic Lamination Quality Steel, Semiprocessed Types |
| ASTM A727/A727M-14 | Standard Specification for Carbon Steel Forgings for Piping Components with Inherent Notch Toughness |
| ASTM A729/A729M-15 | Standard Specification for Carbon and Alloy Steel Axles, Heat-Treated, for Mass Transit and Electric Railway Service |
| ASTM A732/A732M-14 | Standard Specification for Castings, Investment, Carbon and Low Alloy Steel for General Application, and Cobalt Alloy for High Strength at Elevated Temperatures |
| ASTM A733-13 | Standard Specification for Welded and Seamless Carbon Steel and Austenitic Stainless Steel Pipe Nipples |
| ASTM A734/A734M-12 | Standard Specification for Pressure Vessel Plates, Alloy Steel and High-Strength Low-Alloy Steel, Quenched-and-Tempered |
| ASTM A735/A735M-12 | Standard Specification for Pressure Vessel Plates, Low-Carbon Manganese-Molybdenum-Columbium Alloy Steel, for Moderate and Lower Temperature Service |
| ASTM A736/A736M-12 | Standard Specification for Pressure Vessel Plates, Low-Carbon Age-Hardening Nickel-Copper-Chromium-Molybdenum-Columbium Alloy Steel |
| ASTM A737/A737M-09 (2013) | Standard Specification for Pressure Vessel Plates, High-Strength, Low-Alloy Steel |
| ASTM A738/A738M-12a | Standard Specification for Pressure Vessel Plates, Heat-Treated, Carbon-Manganese-Silicon Steel, for Moderate and Lower Temperature Service |
| ASTM A739-90a (2012) | Standard Specification for Steel Bars, Alloy, Hot-Wrought, for Elevated Temperature or Pressure-Containing Parts, or Both |
| ASTM A740-98 (2014) | Standard Specification for Hardware Cloth (Woven or Welded Galvanized Steel Wire Fabric) |
| ASTM A741-11 | Standard Specification for Metallic-Coated Steel Wire Rope and Fittings for Highway Guardrail |
| ASTM A742/A742M-13 | Standard Specification for Steel Sheet, Metallic Coated and Polymer Precoated for Corrugated Steel Pipe |
| ASTM A743/A743M-13a | Standard Specification for Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion Resistant, for General Application |
| ASTM A744/A744M-13 | Standard Specification for Castings, Iron-Chromium-Nickel, Corrosion Resistant, for Severe Service |
| ASTM A745/A745M-15 | Standard Practice for Ultrasonic Examination of Austenitic Steel Forgings |
| ASTM A746-09 (2014) | Standard Specification for Ductile Iron Gravity Sewer Pipe |
| ASTM A747/A747M-12 | Standard Specification for Steel Castings, Stainless, Precipitation Hardening |

| Standard | Title |
|---|---|
| ASTM A748/A748M-87 (2012) | Standard Specification for Statically Cast Chilled White Iron-Gray Iron Dual Metal Rolls for Pressure Vessel Use |
| ASTM A749/A749M-14 | Standard Specification for Steel, Strip, Carbon and High-Strength, Low-Alloy, Hot-Rolled, General Requirements for |
| ASTM A751-14a | Standard Test Methods, Practices, and Terminology for Chemical Analysis of Steel Products |
| ASTM A753-08 (2013) | Standard Specification for Wrought Nickel-Iron Soft Magnetic Alloys (UNS K94490, K94840, N14076, N14080) |
| ASTM A754/A754M-11 | Standard Test Method for Coating Weight (Mass) of Metallic Coatings on Steel by X-Ray Fluorescence |
| ASTM A755/A755M-15 | Standard Specification for Steel Sheet, Metallic Coated by the Hot-Dip Process and Prepainted by the Coil-Coating Process for Exterior Exposed Building Products |
| ASTM A756-09 (2014) | Standard Specification for Stainless Anti-Friction Bearing Steel |
| ASTM A757/A757M-15 | Standard Specification for Steel Castings, Ferritic and Martensitic, for Pressure-Containing and Other Applications, for Low-Temperature Service |
| ASTM A758/A758M-14 | Standard Specification for Wrought-Carbon Steel Butt-Welding Piping Fittings with Improved Notch Toughness |
| ASTM A759-10 | Standard Specification for Carbon Steel Crane Rails |
| ASTM A760/A760M-15 | Standard Specification for Corrugated Steel Pipe, Metallic-Coated for Sewers and Drains |
| ASTM A761/A761M-15 | Standard Specification for Corrugated Steel Structural Plate, Zinc-Coated, for Field-Bolted Pipe, Pipe-Arches, and Arches |
| ASTM A762/A762M-15 | Standard Specification for Corrugated Steel Pipe, Polymer Precoated for Sewers and Drains |
| ASTM A763-15 | Standard Practices for Detecting Susceptibility to Intergranular Attack in Ferritic Stainless Steels |
| ASTM A764-07 (2012) | Standard Specification for Metallic Coated Carbon Steel Wire, Coated at Size and Drawn to Size for Mechanical Springs |
| ASTM A765/A765M-07 (2012) | Standard Specification for Carbon Steel and Low-Alloy Steel Pressure-Vessel-Component Forgings with Mandatory Toughness Requirements |
| ASTM A767/A767M-09 | Standard Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement |
| ASTM A768/A768M-05 (2015) | Standard Specification for Vacuum-Treated 12% Chromium Alloy Steel Forgings for Turbine Rotors and Shafts |
| ASTM A769/A769M-05 (2010) | Standard Specification for Carbon and High-Strength Electric Resistance Forge-Welded Steel Structural Shapes |
| ASTM A770/A770M-03 (2012) | Standard Specification for Through-Thickness Tension Testing of Steel Plates for Special Applications |
| ASTM A772/A772M-00 (2011) | Standard Test Method for AC Magnetic Permeability of Materials Using Sinusoidal Current |
| ASTM A773/A773M-14 | Standard Test Method for Direct Current Magnetic Properties of Low Coercivity Magnetic Materials Using Hysteresigraphs |
| ASTM A774/A774M-14 | Standard Specification for As-Welded Wrought Austenitic Stainless Steel Fittings for General Corrosive Service at Low and Moderate Temperatures |
| ASTM A775/A775M-07b (2014) | Standard Specification for Epoxy-Coated Steel Reinforcing Bars |
| ASTM A778-01 (2009) | Standard Specification for Welded, Unannealed Austenitic Stainless Steel Tubular Products |
| ASTM A779/A779M-12 | Standard Specification for Steel Strand, Seven-Wire, Uncoated, Compacted for Prestressed Concrete |
| ASTM A780/A780M-09 (2015) | Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings |
| ASTM A781/A781M-14b | Standard Specification for Castings, Steel and Alloy, Common Requirements, for General Industrial Use |
| ASTM A786/A786M-05 (2009) | Standard Specification for Hot-Rolled Carbon, Low-Alloy, High-Strength Low-Alloy, and Alloy Steel Floor Plates |
| ASTM A787/A787M-15 | Standard Specification for Electric-Resistance-Welded Metallic-Coated Carbon Steel Mechanical Tubing |
| ASTM A788/A788M-15 | Standard Specification for Steel Forgings, General Requirements |
| ASTM A789/A789M-14 | Standard Specification for Seamless and Welded Ferritic/Austenitic Stainless Steel Tubing for General Service |
| ASTM A790/A790M-14a | Standard Specification for Seamless and Welded Ferritic/Austenitic Stainless Steel Pipe |
| ASTM A792/A792M-10 | Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process |
| ASTM A793-96 (2014) | Standard Specification for Rolled Floor Plate, Stainless Steel |
| ASTM A794/A794M-12 | Standard Specification for Commercial Steel (CS), Sheet, Carbon (0.16% Maximum to 0.25% Maximum), Cold-Rolled |
| ASTM A795/A795M-13 | Standard Specification for Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use |
| ASTM A796/A796M-15 | Standard Practice for Structural Design of Corrugated Steel Pipe, Pipe-Arches, and Arches for Storm and Sanitary Sewers and Other Buried Applications |
| ASTM A798/A798M-13 | Standard Practice for Installing Factory-Made Corrugated Steel Pipe for Sewers and Other Applications |
| ASTM A799/A799M-10 | Standard Practice for Steel Castings, Stainless, Instrument Calibration, for Estimating Ferrite Content |
| ASTM A800/A800M-14 | Standard Practice for Steel Casting, Austenitic Alloy, Estimating Ferrite Content Thereof |
| ASTM A801-14 | Standard Specification for Wrought Iron-Cobalt High Magnetic Saturation Alloys (UNS R30005 and K92650) |
| ASTM A802-95 (2010) | Standard Practice for Steel Castings, Surface Acceptance Standards, Visual Examination |
| ASTM A803/A803M-12 | Standard Specification for Seamless and Welded Ferritic Stainless Steel Feedwater Heater Tubes |

| Standard | Title |
|---|---|
| ASTM A804/A804M-04 (2009) | Standard Test Methods for Alternating-Current Magnetic Properties of Materials at Power Frequencies Using Sheet-Type Test Specimens |
| ASTM A805/A805M-09 | Standard Specification for Steel, Flat Wire, Carbon, Cold-Rolled |
| ASTM A807/A807M-13 | Standard Practice for Installing Corrugated Steel Structural Plate Pipe for Sewers and Other Applications |
| ASTM A809-08 (2013) | Standard Specification for Aluminum-Coated (Aluminized) Carbon Steel Wire |
| ASTM A810-01 (2014) | Standard Specification for Zinc-Coated (Galvanized) Steel Pipe Winding Mesh |
| ASTM A811-15 | Standard Specification for Soft Magnetic Iron Parts Fabricated by Powder Metallurgy Techniques |
| ASTM A813/A813M-14 | Standard Specification for Single- or Double-Welded Austenitic Stainless Steel Pipe |
| ASTM A814/A814M-15 | Standard Specification for Cold-Worked Welded Austenitic Stainless Steel Pipe |
| ASTM A815/A815M-14 | Standard Specification for Wrought Ferritic, Ferritic/Austenitic, and Martensitic Stainless Steel Piping Fittings |
| ASTM A817-12 | Standard Specification for Metallic-Coated Steel Wire for Chain-Link Fence Fabric and Marcelled Tension Wire |
| ASTM A818-06 (2010) | Standard Specification for Coppered Carbon Steel Wire |
| ASTM A820/A820M-11 | Standard Specification for Steel Fibers for Fiber-Reinforced Concrete |
| ASTM A821/A821M-15 | Standard Specification for Steel Wire, Hard Drawn for Prestressing Concrete Tanks |
| ASTM A822/A822M-04 (2010) | Standard Specification for Seamless Cold-Drawn Carbon Steel Tubing for Hydraulic System Service |
| ASTM A823-99 (2012) | Standard Specification for Statically Cast Permanent Mold Gray Iron Castings |
| ASTM A824-01 (2012) | Standard Specification for Metallic-Coated Steel Marcelled Tension Wire for Use With Chain Link Fence |
| ASTM A827/A827M-14 | Standard Specification for Plates, Carbon Steel, for Forging and Similar Applications |
| ASTM A829/A829M-14 | Standard Specification for Alloy Structural Steel Plates |
| ASTM A830/A830M-14 | Standard Specification for Plates, Carbon Steel, Structural Quality, Furnished to Chemical Composition Requirements |
| ASTM A832/A832M-10 | Standard Specification for Pressure Vessel Plates, Alloy Steel, Chromium-Molybdenum-Vanadium |
| ASTM A833-08a (2014) | Standard Practice for Indentation Hardness of Metallic Materials by Comparison Hardness Testers |
| ASTM A834-95 (2011) | Standard Specification for Common Requirements for Iron Castings for General Industrial Use |
| ASTM A835/A835M-10 | Standard Specification for Sizes of Ferroalloys and Alloy Additives |
| ASTM A836/A836M-14 | Standard Specification for Titanium-Stabilized Carbon Steel Forgings for Glass-Lined Piping and Pressure Vessel Service |
| ASTM A837/A837M-06 (2011) | Standard Specification for Steel Forgings, Alloy, for Carburizing Applications |
| ASTM A838-02 (2013) | Standard Specification for Free-Machining Ferritic Stainless Soft Magnetic Alloy Bar for Relay Applications |
| ASTM A839-15 | Standard Specification for Iron-Phosphorus Powder Metallurgy Parts for Soft Magnetic Applications |
| ASTM A841/A841M-13 | Standard Specification for Steel Plates for Pressure Vessels, Produced by Thermo-Mechanical Control Process (TMCP) |
| ASTM A842-11a | Standard Specification for Compacted Graphite Iron Castings |
| ASTM A844/A844M-09 | Standard Specification for Steel Plates, 9% Nickel Alloy, for Pressure Vessels, Produced by the Direct-Quenching Process |
| ASTM A847/A847M-14 | Standard Specification for Cold-Formed Welded and Seamless High-Strength, Low Alloy Structural Tubing with Improved Atmospheric Corrosion Resistance |
| ASTM A848-01 (2011) | Standard Specification for Low-Carbon Magnetic Iron |
| ASTM A849-15 | Standard Specification for Post-Applied Coatings, Pavings, and Linings for Corrugated Steel Sewer and Drainage Pipe |
| ASTM A853-04 (2010) | Standard Specification for Steel Wire, Carbon, for General Use |
| ASTM A854/A854M-08 (2013) | Standard Specification for Metallic-Coated Steel Smooth High-Tensile Fence and Trellis Wire |
| ASTM A855/A855M-03 (2014) | Standard Specification for Zinc-5% Aluminum-Mischmetal Alloy-Coated Steel Wire Strand |
| ASTM A856/A856M-03 (2014) | Standard Specification for Zinc-5% Aluminum-Mischmetal Alloy-Coated Carbon Steel Wire |
| ASTM A857/A857M-07 (2013) | Standard Specification for Steel Sheet Piling, Cold Formed, Light Gage |
| ASTM A858/A858M-14 | Standard Specification for Heat-Treated Carbon Steel Fittings for Low-Temperature and Corrosive Service |
| ASTM A859/A859M-04 (2014) | Standard Specification for Age-Hardening Alloy Steel Forgings for Pressure Vessel Components |
| ASTM A860/A860M-14 | Standard Specification for Wrought High-Strength Ferritic Steel Butt-Welding Fittings |
| ASTM A861-04 (2013) | Standard Specification for High-Silicon Iron Pipe and Fittings |
| ASTM A862/A862M-98 (2014) | Standard Practice for Application of Asphalt Coatings to Corrugated Steel Sewer and Drainage Pipe |
| ASTM A865/A865M-06 (2012) | Standard Specification for Threaded Couplings, Steel, Black or Zinc-Coated (Galvanized) Welded or Seamless, for Use in Steel Pipe Joints |
| ASTM A866-14 | Standard Specification for Medium Carbon Anti-Friction Bearing Steel |
| ASTM A867-03 (2013) | Standard Specification for Iron-Silicon Relay Steels |
| ASTM A871/A871M-14 | Standard Specification for High-Strength Low-Alloy Structural Steel Plate With Atmospheric Corrosion Resistance |
| ASTM A872/A872M-14 | Standard Specification for Centrifugally Cast Ferritic/Austenitic Stainless Steel Pipe for Corrosive Environments |
| ASTM A874/A874M-98 (2014) | Standard Specification for Ferritic Ductile Iron Castings Suitable for Low-Temperature Service |
| ASTM A875/A875M-13 | Standard Specification for Steel Sheet, Zinc-5% Aluminum Alloy-Coated by the Hot-Dip Process |

| Standard | Title |
|---|---|
| ASTM A876-12 | Standard Specification for Flat-Rolled, Grain-Oriented, Silicon-Iron, Electrical Steel, Fully Processed Types |
| ASTM A877/A877M-10 | Standard Specification for Steel Wire, Chromium-Silicon Alloy, Chrome-Silicon-Vanadium Alloy Valve Spring Quality |
| ASTM A878/A878M-05 (2011) | Standard Specification for Steel Wire, Modified Chromium Vanadium Valve Spring Quality |
| ASTM A879/A879M-12 | Standard Specification for Steel Sheet, Zinc Coated by the Electrolytic Process for Applications Requiring Designation of the Coating Mass on Each Surface |
| ASTM A881/A881M-10 | Standard Specification for Steel Wire, Indented, Low-Relaxation for Prestressed Concrete Railroad Ties |
| ASTM A882/A882M-04a (2010) | Standard Specification for Filled Epoxy-Coated Seven-Wire Prestressing Steel Strand |
| ASTM A884/A884M-14 | Standard Specification for Epoxy-Coated Steel Wire and Welded Wire Reinforcement |
| ASTM A886/A886M-12 | Standard Specification for Steel Strand, Indented, Seven-Wire Stress-Relieved for Prestressed Concrete |
| ASTM A887-89 (2014) | Standard Specification for Borated Stainless Steel Plate, Sheet, and Strip for Nuclear Application |
| ASTM A888-13a | Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications |
| ASTM A889/A889M-14 | Standard Test Method for Alternating-Current Magnetic Properties of Materials at Low Magnetic Flux Density Using the Voltmeter-Ammeter-Wattmeter-Varmeter Method and 25-cm Epstein Frame |
| ASTM A890/A890M-13 | Standard Specification for Castings, Iron-Chromium-Nickel-Molybdenum Corrosion-Resistant, Duplex (Austenitic/Ferritic) for General Application |
| ASTM A891/A891M-10 (2015) | Standard Specification for Precipitation Hardening Iron Base Superalloy Forgings for Turbine Rotor Disks and Wheels |
| ASTM A892-09 (2014) | Standard Guide for Defining and Rating the Microstructure of High Carbon Bearing Steels |
| ASTM A893/A893M-03 (2015) | Standard Test Method for Complex Dielectric Constant of Nonmetallic Magnetic Materials at Microwave Frequencies |
| ASTM A894/A894M-00 (2011) | Standard Test Method for Saturation Magnetization or Induction of Nonmetallic Magnetic Materials |
| ASTM A895-89 (2009) | Standard Specification for Free-Machining Stainless Steel Plate, Sheet, and Strip |
| ASTM A896/A896M-09 (2014) | Standard Practice for Conducting Case Studies on Galvanized Structures |
| ASTM A897/A897M-15 | Standard Specification for Austempered Ductile Iron Castings |
| ASTM A898/A898M-07 (2012) | Standard Specification for Straight Beam Ultrasonic Examination of Rolled Steel Structural Shapes |
| ASTM A899-91 (2014) | Standard Specification for Steel Wire, Epoxy-Coated |
| ASTM A900/A900M-01 (2012) | Standard Test Method for Lamination Factor of Amorphous Magnetic Strip |
| ASTM A901-12 | Standard Specification for Amorphous Magnetic Core Alloys, Semi-Processed Types |
| ASTM A902-15 | Standard Terminology Relating to Metallic Coated Steel Products |
| ASTM A903/A903M-99 (2012) | Standard Specification for Steel Castings, Surface Acceptance Standards, Magnetic Particle and Liquid Penetrant Inspection |
| ASTM A904-14 | Standard Specification for 50 Nickel-50 Iron Powder Metallurgy Soft Magnetic Parts |
| ASTM A905-04 (2010) | Standard Specification for Steel Wire, Pressure Vessel Winding |
| ASTM A906/A906M-02 (2010) | Standard Specification for Grade 80 and Grade 100 Alloy Steel Chain Slings for Overhead Lifting |
| ASTM A908-03 (2013) | Standard Specification for Stainless Steel Needle Tubing |
| ASTM A909/A909M-06 (2011) | Standard Specification for Steel Forgings, Microalloy, for General Industrial Use |
| ASTM A910/A910M-12 | Standard Specification for Uncoated, Weldless, 2-Wire and 3-Wire Steel Strand for Prestressed Concrete |
| ASTM A911/A911M-11 | Standard Specification for Uncoated, Stress-Relieved Steel Bars for Prestressed Concrete Railroad Ties |
| ASTM A912/A912M-11 | Standard Test Method for Alternating-Current Magnetic Properties of Amorphous Materials at Power Frequencies Using Wattmeter-Ammeter-Voltmeter Method with Toroidal Specimens |
| ASTM A913/A913M-15 | Standard Specification for High-Strength Low-Alloy Steel Shapes of Structural Quality, Produced by Quenching and Self-Tempering Process (QST) |
| ASTM A914/A914M-92 (2011) | Standard Specification for Steel Bars Subject to Restricted End-Quench Hardenability Requirements |
| ASTM A915/A915M-08 (2013) | Standard Specification for Steel Castings, Carbon, and Alloy, Chemical Requirements Similar to Standard Wrought Grades |
| ASTM A917-08 (2015) | Standard Specification for Steel Sheet, Coated by the Electrolytic Process for Applications Requiring Designation of the Coating Mass on Each Surface (General Requirements) |
| ASTM A918-06 (2011) | Standard Specification for Steel Sheet, Zinc-Nickel Alloy Coated by the Electrolytic Process for Applications Requiring Designation of the Coating Mass on Each Surface |
| ASTM A920/A920M-14 | Standard Specification for Steel Bars, Microalloy, Hot-Wrought, Special Quality, Mechanical Properties |
| ASTM A921/A921M-93 (2011) | Standard Specification for Steel Bars, Microalloy, Hot-Wrought, Special Quality, for Subsequent Hot Forging |
| ASTM A922-05 (2010) | Standard Specification for Silicon Metal |
| ASTM A923-14 | Standard Test Methods for Detecting Detrimental Intermetallic Phase in Duplex Austenitic/Ferritic Stainless Steels |
| ASTM A924/A924M-14 | Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process |
| ASTM A925-03 (2014) | Standard Specification for Zinc-5% Aluminum-Mischmetal Alloy-Coated Steel Overhead Ground Wire Strand |

| Standard | Title |
|---|---|
| ASTM A926-03 (2014) | Standard Test Method for Comparing the Abrasion Resistance of Coating Materials for Corrugated Metal Pipe |
| ASTM A927/A927M-11 | Standard Test Method for Alternating-Current Magnetic Properties of Toroidal Core Specimens Using the Voltmeter-Ammeter-Wattmeter Method |
| ASTM A928/A928M-14 | Standard Specification for Ferritic/Austenitic (Duplex) Stainless Steel Pipe Electric Fusion Welded with Addition of Filler Metal |
| ASTM A929/A929M-01 (2013) | Standard Specification for Steel Sheet, Metallic-Coated by the Hot-Dip Process for Corrugated Steel Pipe |
| ASTM A930-09 (2014) | Standard Practice for Life-Cycle Cost Analysis of Corrugated Metal Pipe Used for Culverts, Storm Sewers, and Other Buried Conduits |
| ASTM A931-08 (2013) | Standard Test Method for Tension Testing of Wire Ropes and Strand |
| ASTM A932/A932M-01 (2012) | Standard Test Method for Alternating-Current Magnetic Properties of Amorphous Materials at Power Frequencies Using Wattmeter-Ammeter-Voltmeter Method with Sheet Specimens |
| ASTM A933/A933M-14 | Standard Specification for Vinyl-Coated Steel Wire and Welded Wire Reinforcement |
| ASTM A934/A934M-13 | Standard Specification for Epoxy-Coated Prefabricated Steel Reinforcing Bars |
| ASTM A937/A937M-12 | Standard Test Method for Determining Interlaminar Resistance of Insulating Coatings Using Two Adjacent Test Surfaces |
| ASTM A938-07 (2013) | Standard Test Method for Torsion Testing of Wire |
| ASTM A939/A939M-15 | Standard Practice for Ultrasonic Examination from Bored Surfaces of Cylindrical Forgings |
| ASTM A940/A940M-06 (2011) | Standard Specification for Vacuum Treated Steel Forgings, Alloy, Differentially Heat Treated, for Turbine Rotors |
| ASTM A941-13b | Standard Terminology Relating to Steel, Stainless Steel, Related Alloys, and Ferroalloys |
| ASTM A942/A942M-95 (2012) | Standard Specification for Centrifugally Cast White Iron/Gray Iron Dual Metal Abrasion-Resistant Roll Shells |
| ASTM A943/A943M-01 (2014) | Standard Specification for Spray-Formed Seamless Austenitic Stainless Steel Pipes |
| ASTM A944-10 | Standard Test Method for Comparing Bond Strength of Steel Reinforcing Bars to Concrete Using Beam-End Specimens |
| ASTM A945/A945M-06 (2011) | Standard Specification for High-Strength Low-Alloy Structural Steel Plate with Low Carbon and Restricted Sulfur for Improved Weldability, Formability, and Toughness |
| ASTM A947M-13 | Standard Specification for Textured Stainless Steel Sheet [Metric] |
| ASTM A949/A949M-01 (2014) | Standard Specification for Spray-Formed Seamless Ferritic/Austenitic Stainless Steel Pipe |
| ASTM A950/A950M-11 | Standard Specification for Fusion Bonded Epoxy-Coated Structural Steel H-Piles and Sheet Piling |
| ASTM A951/A951M-14 | Standard Specification for Steel Wire for Masonry Joint Reinforcement |
| ASTM A952/A952M-02 (2010) | Standard Specification for Forged Grade 80 and Grade 100 Steel Lifting Components and Welded Attachment Links |
| ASTM A955M/ A 955M-15 | Standard Specification for Deformed and Plain Stainless-Steel Bars for Concrete Reinforcement |
| ASTM A956-12 | Standard Test Method for Leeb Hardness Testing of Steel Products |
| ASTM A957/A957M-15 | Standard Specification for Investment Castings, Steel and Alloy, Common Requirements, for General Industrial Use |
| ASTM A958/A958M-14 | Standard Specification for Steel Castings, Carbon, and Alloy, with Tensile Requirements, Chemical Requirements Similar to Standard Wrought Grades |
| ASTM A959-11 | Standard Guide for Specifying Harmonized Standard Grade Compositions for Wrought Stainless Steels |
| ASTM A960/A960M-14a | Standard Specification for Common Requirements for Wrought Steel Piping Fittings |
| ASTM A961/A961M-14 | Standard Specification for Common Requirements for Steel Flanges, Forged Fittings, Valves, and Parts for Piping Applications |
| ASTM A962/A962M-14a | Standard Specification for Common Requirements for Bolting Intended for Use at Any Temperature from Cryogenic to the Creep Range |
| ASTM A964/A964M-03 (2011) | Standard Specification for Corrugated Steel Box Culverts |
| ASTM A965/A965M-14 | Standard Specification for Steel Forgings, Austenitic, for Pressure and High Temperature Parts |
| ASTM A966/A966M-15 | Standard Practice for Magnetic Particle Examination of Steel Forgings Using Alternating Current |
| ASTM A967/A967M-13 | Standard Specification for Chemical Passivation Treatments for Stainless Steel Parts |
| ASTM A968/A968M-96 (2014) | Standard Specification for Chromium, Chromium-Nickel, and Silicon Alloy Steel Bars and Shapes for Corrosion and Heat-Resisting Service |
| ASTM A970/A970M-15 | Standard Specification for Headed Steel Bars for Concrete Reinforcement |
| ASTM A971/A971M-10 | Standard Test Method for Measuring Edge Taper and Crown of Flat-Rolled Electrical Steel Coils |
| ASTM A972/A972M-00 (2010) | Standard Specification for Fusion Bonded Epoxy-Coated Pipe Piles |
| ASTM A973/A973M-07 (2012) | Standard Specification for Grade 100 Alloy Steel Chain |
| ASTM A974-97 (2011) | Standard Specification for Welded Wire Fabric Gabions and Gabion Mattresses (Metallic Coated or Polyvinyl Chloride (PVC) Coated) |
| ASTM A975-11 | Standard Specification for Double-Twisted Hexagonal Mesh Gabions and Revet Mattresses (Metallic-Coated Steel Wire or Metallic-Coated Steel Wire With Poly(Vinyl Chloride) (PVC) Coating) |
| ASTM A976-13 | Standard Classification of Insulating Coatings for Electrical Steels by Composition, Relative Insulating Ability and Application |
| ASTM A977/A977M-07 (2013) | Standard Test Method for Magnetic Properties of High-Coercivity Permanent Magnet Materials Using Hysteresigraphs |

| Standard | Title |
|---|---|
| ASTM A978/A978M-08 (2013) | Standard Specification for Composite Ribbed Steel Pipe, Precoated and Polyethylene Lined for Gravity Flow Sanitary Sewers, Storm Sewers, and Other Special Applications |
| ASTM A979/A979M-03 (2014) | Standard Specification for Concrete Pavements and Linings Installed in Corrugated Steel Structures in the Field |
| ASTM A980/A980M-11 | Standard Specification for Steel, Sheet, Carbon, Ultra High Strength Cold Rolled |
| ASTM A981/A981M-11 | Standard Test Method for Evaluating Bond Strength for 0.600-in. [15.24-mm] Diameter Steel Prestressing Strand, Grade 270 [1860], Uncoated, Used in Prestressed Ground Anchors |
| ASTM A982/A982M-10 (2015) | Standard Specification for Steel Forgings, Stainless, for Compressor and Turbine Airfoils |
| ASTM A983/A983M-06 (2011) | Standard Specification for Continuous Grain Flow Forged Carbon and Alloy Steel Crankshafts for Medium Speed Diesel Engines |
| ASTM A985/A985M-14 | Standard Specification for Steel Investment Castings General Requirements, for Pressure-Containing Parts |
| ASTM A986/A986M-01 (2011) | Standard Specification for Magnetic Particle Examination of Continuous Grain Flow Crankshaft Forgings |
| ASTM A987/A987M-09 (2014) | Standard Practice for Measuring Shape Characteristics of Tin Mill Products |
| ASTM A988/A988M-15 | Standard Specification for Hot Isostatically-Pressed Stainless Steel Flanges, Fittings, Valves, and Parts for High Temperature Service |
| ASTM A989/A989M-15 | Standard Specification for Hot Isostatically-Pressed Alloy Steel Flanges, Fittings, Valves, and Parts for High Temperature Service |
| ASTM A990/A990M-14a | Standard Specification for Castings, Iron-Nickel-Chromium and Nickel Alloys, Specially Controlled for Pressure Retaining Parts for Corrosion Service |
| ASTM A991/A991M-10 (2015) | Standard Test Method for Conducting Temperature Uniformity Surveys of Furnaces Used to Heat Treat Steel Products |
| ASTM A992/A992M-11 | Standard Specification for Structural Steel Shapes |
| ASTM A994-13 | Standard Guide for Editorial Procedures and Form of Product Specifications for Steel, Stainless Steel, and Related Alloys |
| ASTM A995/A995M-13 | Standard Specification for Castings, Austenitic-Ferritic (Duplex) Stainless Steel, for Pressure-Containing Parts |
| ASTM A996/A996M-15 | Standard Specification for Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement |
| ASTM A997-08 (2012) | Standard Practice for Investment Castings, Surface Acceptance Standards, Visual Examination |
| ASTM A998/A998M-12 | Standard Practice for Structural Design of Reinforcements for Fittings in Factory-Made Corrugated Steel Pipe for Sewers and Other Applications |
| ASTM A999/A999M-14 | Standard Specification for General Requirements for Alloy and Stainless Steel Pipe |
| ASTM A1000/A1000M-11 | Standard Specification for Steel Wire, Carbon and Alloy Specialty Spring Quality |
| ASTM A1001-01 (2010) | Standard Specification for High Strength Steel Castings in Heavy Sections |
| ASTM A1002-10 | Standard Specification for Castings, Nickel-Aluminum Ordered Alloy |
| ASTM A1003/A1003M-15 | Standard Specification for Steel Sheet, Carbon, Metallic- and Nonmetallic-Coated for Cold-Formed Framing Members |
| ASTM A1004/A1004M-99 (2014) | Standard Practice for Establishing Conformance to the Minimum Expected Corrosion Characteristics of Metallic, Painted-Metallic, and Nonmetallic-Coated Steel Sheet Intended for Use as Cold Formed Framing Members |
| ASTM A1007-15 | Standard Specification for Carbon Steel Wire for Wire Rope |
| ASTM A1008/A1008M-15 | Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable |
| ASTM A1009-05 (2010) | Standard Specification for Soft Magnetic MnZn Ferrite Core Materials for High Frequency (10 kHz-1 MHz) Power Transformer and Filter Inductor Applications |
| ASTM A1010/ A 1010M-13 | Standard Specification for Higher-Strength Martensitic Stainless Steel Plate, Sheet, and Strip |
| ASTM A1011/A1011M-14 | Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength |
| ASTM A1012-10 | Standard Specification for Seamless and Welded Ferritic, Austenitic and Duplex Alloy Steel Condenser and Heat Exchanger Tubes With Integral Fins |
| ASTM A1013-00 (2013) | Standard Test Method for High-Frequency (10 kHz-1 MHz) Core Loss of Soft Magnetic Core Components at Controlled Temperatures Using the Voltmeter-Ammeter-Wattmeter Method |
| ASTM A1014/A1014M-10 | Standard Specification for Precipitation-Hardening Bolting (UNS N07718) for High Temperature Service |
| ASTM A1015-01 (2014) | Standard Guide for Videoborescoping of Tubular Products for Sanitary Applications |
| ASTM A1016/A1016M-14 | Standard Specification for General Requirements for Ferritic Alloy Steel, Austenitic Alloy Steel, and Stainless Steel Tubes |
| ASTM A1017/A1017M-11 | Standard Specification for Pressure Vessel Plates, Alloy Steel, Chromium-Molybdenum-Tungsten |
| ASTM A1018/A1018M-10 | Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Hot-Rolled, Carbon, Commercial, Drawing, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength |
| ASTM A1020/A1020M-02 (2012) | Standard Specification for Steel Tubes, Carbon and Carbon Manganese, Fusion Welded, for Boiler, Superheater, Heat Exchanger and Condenser Applications |
| ASTM A1021/A1021M-05 (2015) | Standard Specification for Martensitic Stainless Steel Forgings and Forging Stock for High-Temperature Service |

| Standard | Title |
|---|---|
| ASTM A1022/A1022M-15 | Standard Specification for Deformed and Plain Stainless Steel Wire and Welded Wire for Concrete Reinforcement |
| ASTM A1023/A1023M-15 | Standard Specification for Stranded Carbon Steel Wire Ropes for General Purposes |
| ASTM A1024/A1024M-02 (2012) | Standard Specification for Steel Line Pipe, Black, Plain-End, Seamless |
| ASTM A1025/A1025M-10 | Standard Specification for Ferroalloys and Other Alloying Materials, General Requirements |
| ASTM A1028-03 (2015) | Standard Specification for Stainless Steel Bars for Compressor and Turbine Airfoils |
| ASTM A1030/A1030M-11 | Standard Practice for Measuring Flatness Characteristics of Steel Sheet Products |
| ASTM A1031/A1031M-12 | Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Alloy, Drawing Steel and Structural Steel, Hot-Rolled |
| ASTM A1032-15 | Standard Test Method for Hydrogen Embrittlement Resistance for Steel Wire Hard Drawn Used for Prestressed Concrete Pipe |
| ASTM A1033-10 (2015) | Standard Practice for Quantitative Measurement and Reporting of Hypoeutectoid Carbon and Low-Alloy Steel Phase Transformations |
| ASTM A1034/A1034M-10a | Standard Test Methods for Testing Mechanical Splices for Steel Reinforcing Bars |
| ASTM A1035/A1035M-15 | Standard Specification for Deformed and Plain, Low-Carbon, Chromium, Steel Bars for Concrete Reinforcement |
| ASTM A1036-04 (2009) | Standard Guide for Measuring Power Frequency Magnetic Properties of Flat-Rolled Electrical Steels Using Small Single Sheet Testers |
| ASTM A1037/A1037M-05 (2012) | Standard Specification for Steel Line Pipe, Black, Furnace-Butt-Welded |
| ASTM A1038-13 | Standard Test Method for Portable Hardness Testing by the Ultrasonic Contact Impedance Method |
| ASTM A1039/A1039M-13 | Standard Specification for Steel, Sheet, Hot Rolled, Carbon, Commercial, Structural, and High-Strength Low-Alloy, Produced by the Twin-Roll Casting Process |
| ASTM A1040-10 | Standard Guide for Specifying Harmonized Standard Grade Compositions for Wrought Carbon, Low-Alloy, and Alloy Steels |
| ASTM A1043/A1043M-14 | Standard Specification for Structural Steel with Low Yield to Tensile Ratio for Use in Buildings |
| ASTM A1044/A1044M-15 | Standard Specification for Steel Stud Assemblies for Shear Reinforcement of Concrete |
| ASTM A1045-10 (2014) | Standard Specification for Flexible Poly (Vinyl Chloride) (PVC) Gaskets used in Connection of Vitreous China Plumbing Fixtures to Sanitary Drainage System |
| ASTM A1046/A1046M-14 | Standard Specification for Steel Sheet, Zinc-Aluminum-Magnesium Alloy-Coated by the Hot-Dip Process |
| ASTM A1047/A1047M-05 (2014) | Standard Test Method for Pneumatic Leak Testing of Tubing |
| ASTM A1048/A1048M-06 (2011) | Standard Specification for Pressure Vessel Forgings, Alloy Steel, Higher Strength Chromium-Molybdenum-Tungsten for Elevated Temperature Service |
| ASTM A1049/A1049M-10 (2015) | Standard Specification for Stainless Steel Forgings, Ferritic/Austenitic (Duplex), for Pressure Vessels and Related Components |
| ASTM A1053/A1053M-12 | Standard Specification for Welded Ferritic-Martensitic Stainless Steel Pipe |
| ASTM A1054-14 | Standard Specification for Sintered Ceramic Ferrite Permanent Magnets |
| ASTM A1055/A1055M-10 | Standard Specification for Zinc and Epoxy Duel-Coated Steel Reinforcing Bars |
| ASTM A1056-12 | Standard Specification for Cast Iron Couplings Used for Joining Hubless Cast Iron Soil Pipe and Fittings |
| ASTM A1057/A1057-08 (2014) | Standard Specification for Steel, Structural Tubing, Cold Formed, Welded, Carbon, Zinc-Coated (Galvanized) by the Hot-Dip Process |
| ASTM A1058-14 | Standard Test Methods for Mechanical Testing of Steel Products-Metric |
| ASTM A1059/A1059M-08 (2013) | Standard Specification for Zinc Alloy Thermo-Diffusion Coatings (TDC) on Steel Fasteners, Hardware, and Other Products |
| ASTM A1060/A1060M-14 | Standard Specification for Zinc-Coated (Galvanized) Steel Welded Wire Reinforcement, Plain and Deformed, for Concrete |
| ASTM A1061/A1061M-09 | Standard Test Methods for Testing Multi-Wire Steel Strand |
| ASTM A1062-10 | Standard Specification for Steel Castings Sampling |
| ASTM A1063/A1063M-11a | Standard Specification for Steel Sheet, Twin-Rolled Cast, Zinc-Coated (Galvanized) by the Hot-Dip Process |
| ASTM A1064/A1064M-15 | Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete |
| ASTM A1065/A1065M-15 | Standard Specification for Cold-Formed Electric-Fusion (Arc) Welded High-Strength Low-Alloy Structural Tubing in Shapes, with 50 ksi [345 MPa] Minimum Yield Point |
| ASTM A1066/A1066M-11 | Standard Specification for High-Strength Low-Alloy Structural Steel Plate Produced by Thermo-Mechanical Controlled Process (TMCP) |
| ASTM A1067/A1067M-12a | Standard Specification for Test Coupons for Steel Castings |
| ASTM A1068-10 (2015) | Standard Practice for Life-Cycle Cost Analysis of Corrosion Protection Systems on Iron and Steel Products |
| ASTM A1069/A1069M-11 | Standard Specifications for Laser-Fused Stainless Steel Bars, Plates, and Shapes |
| ASTM A1071/A1071M-11 | Standard Test Method for Evaluating Hygrothermal Corrosion Resistance of Permanent Magnet Alloys |
| ASTM A1072/A1072M-11 | Standard Specification for Zinc-5% Aluminum (Hot-Dip) Coatings on Iron and Steel Products |
| ASTM A1073/A1073M-14 | Standard Practice for Using Hand Micrometers to Measure the Thickness of Nonmetallic-Coated Steel Sheet |
| ASTM A1074-11 | Standard Specification for Hot Tin and Hot Tin/Lead Dip on Ferrous and Non-Ferrous Metals |

| Standard | Title |
|---|---|
| ASTM A1075-12 | Standard Specification for Flanged Steel U-Channel Posts |
| ASTM A1076/A1076M-13 | Standard Specification for Cold Formed Carbon Structural Steel Tubing Made from Metallic Precoated Sheet Steel |
| ASTM A1077/A1077M-14 | Standard Specification for Structural Steel with Improved Yield Strength at High Temperature for Use in Buildings |
| ASTM A1078/A1078M-12 | Standard Specification for Epoxy-Coated Steel Dowels for Concrete Pavement |
| ASTM A1079-13 | Standard Specification for Steel Sheet, Complex Phase (CP), Duel Phase (DP) and Transformation Induced Plasticity (TRIP), Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process |
| ASTM A1080-15 | Standard Practice for Hot Isostatic Pressing of Steel, Stainless Steel, and Related Alloy Castings |
| ASTM A1081/A1081M-12 | Standard Test Method for Evaluating Bond of Seven-Wire Steel Prestressing Strand |
| ASTM A1082/A1082M-15 | Standard Specification for High Strength Precipitation Hardening and Duplex Stainless Steel Bolting for Special Purpose Applications |
| ASTM A1083/A1083M-12 | Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, Produced by Twin-Roll Casting Process |
| ASTM A1084-15 | Standard Test Method for Detecting Detrimental Phases in Lean Duplex Austenitic/Ferritic Stainless Steels |
| ASTM A1085-13 | Standard Specification for Cold-Formed Welded Carbon Steel Hollow Structural Sections (HSS) |
| ASTM A1086-13 | Standard Specification for Thin-Gauge Nonoriented Electrical Steel Fully Processed Types |
| ASTM A1087/A1087M-13 | Standard Practice for Using Hand Calipers to Measure the Width of Steel Sheet |
| ASTM A1088-13 | Standard Specification for Steel, Sheet, Cold-Rolled, Complex Phase (CP), Duel Phase (DP) and Transformation Induced Plasticity (TRIP) |
| ASTM A1089/A1089M-14 | Standard Specification for Highly Loaded Anti-Friction Bearing Steel |
| ASTM A1090/A1090M-14 | Standard Specification for Forged Rings and Hollows Produced from Steels with Atmospheric Corrosion Resistance |
| ASTM A1092-15 | Standard Specification for Steel Sheet, as Cold-Reduced, for Conversion to Annealed Cold-Rolled Steel Sheet, and Hot Dip Metallic-Coated Steel Sheet |
| ASTM A1094/A1094M-15 | Standard Specification for Continuous Hot-Dip Galvanized Steel Bars for Concrete Reinforcement |

# Appendix 2

## *DISCONTINUED FERROUS METAL STANDARDS*

## ASTM STANDARDS

| Discontinued | Replaced By |
|---|---|
| A4 (1965) | A3 – Steel Joint Bars, Low, Medium and High Carbon (Non-Heat-Treated) |
| A5 (1979) | A3 – Steel Joint Bars, Low, Medium and High Carbon (Non-Heat-Treated) |
| A7 (1967) | A36/A36M – Carbon Structural Steel<br>A283/A283M – Low and Intermediate Tensile Strength Carbon Steel Plates<br>A306 – Discontinued 1975; Replaced by A663/A663M – Steel Bars, Carbon, Merchant Quality, Mechanical Properties, and A675/A675M – Steel Bars, Carbon, Hot-Wrought, Special Quality, Mechanical Properties |
| A8 (1963) | No Replacement |
| A9 (1940) | No Replacement |
| A10 (1970) | A283/A283M – Low and Intermediate Tensile Strength Carbon Steel Plates |
| A11 (1930) | A113 – Discontinued 1979; No Replacement |
| A12 (1934) | A131/A131M – Structural Steel for Ships |
| A13 (1934) | A131/A131M – Structural Steel for Ships |
| A14 (1950) | A68 – Discontinued 1975; Replaced by A689 – Carbon and Alloy Steel Bars for Springs |
| A15 (1969) | A615/A615M – Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement |
| A16 (1969) | A616 – Discontinued 1999; Replaced by A996/A996M – Magnetic Particle Examination of Steel Forgings Using Alternating Current |
| A17 (1945) | A273 – Discontinued 1975; Replaced by A711/A711M – Steel Forging Stock<br>A274 – Discontinued 1975; Replaced by A711/A711M – Steel Forging Stock |
| A18 (1940) | A236 – Discontinued 1981; No Replacement |
| A19 (1936) | A236 – Discontinued 1981; No Replacement |
| A21 (2003) | No Replacement |
| A22 (1934) | A57 – Discontinued 1966; Replaced by A504/A504M – Wrought Carbon Steel Wheels |
| A23 (1917) | A57 – Discontinued 1966; Replaced by A504/A504M – Wrought Carbon Steel Wheels |
| A24 (1917) | A57 – Discontinued 1966; Replaced by A504/A504M – Wrought Carbon Steel Wheels |
| A25 (1993) | A504/A504M – Wrought Carbon Steel Wheels |
| A26 (1966) | A551/A551M – Carbon Steel Tires for Railway and Rapid Transit Applications |
| A28 (1925) | A83 – Discontinued 1967; Replaced by A192/A192M – Seamless Carbon Steel Boiler Tubes for High-Pressure Service |
| A30 (1964) | No Replacement |
| A32 (1927) | A107 – Discontinued 1968; Replaced by A575 – Steel Bars, Carbon, Merchant Quality, M-Grades, and A576 – Steel Bars, Carbon, Hot-Wrought, Special Quality<br>A108 – Steel Bars, Carbon, Cold Finished, Standard Quality |
| A33 (1937) | E30 – Discontinued 1995; No Replacement |
| A35 (1937) | No Replacement |
| A37 (1936) | No Replacement |
| A38 (1924) | A83 – Discontinued 1967; Replaced by A192/A192M – Seamless Carbon Steel Boiler Tubes for High-Pressure Service |
| A39 (1920) | A84 – Discontinued 1972; No Replacement |
| A40 (1920) | A84 – Discontinued 1972; No Replacement |
| A41 (1956) | No Replacement |
| A42 (1972) | No Replacement |
| A43 (1992) | No Replacement |
| A44 (1955) | A377 – Index of Specifications for Ductile-Iron Pressure Pipe |
| A45 (1943) | A377 – Index of Specifications for Ductile-Iron Pressure Pipe |
| A46 (1943) | No Replacement |
| A47M (1998) | A47/A47M – Ferritic Malleable Iron Castings |
| A48M (2000) | A48/A48M – Gray Iron Castings |
| A50 (1937) | A183 – Carbon Steel Track Bolts and Nuts |
| A51 (1937) | A183 – Carbon Steel Track Bolts and Nuts |
| A52 (1925) | A83 – Discontinued 1967; Replaced by A192/A192M – Seamless Carbon Steel Boiler Tubes for High-Pressure Service |
| A54 (1927) | A107 – Discontinued 1968; Replaced by A575 – Steel Bars, Carbon, Merchant Quality, M-Grades, and A576 – Steel Bars, Carbon, Hot-Wrought, Special Quality<br>A108 – Steel Bars, Carbon, Cold Finished, Standard Quality |
| A55 (1937) | E30 – Discontinued 1995; No Replacement |
| A56 (1972) | No Replacement |
| A57 (1966) | A504/A504M – Wrought Carbon Steel Wheels |

| Discontinued | Replaced By |
|---|---|
| A58 (1943) | A689 – Carbon and Alloy Steel Bars for Springs |
| A59 (1966) | A689 – Carbon and Alloy Steel Bars for Springs |
| A60 (1966) | A689 – Carbon and Alloy Steel Bars for Springs |
| A61 (1969) | A616 – Discontinued 1999; Replaced by A996/A996M – Magnetic Particle Examination of Steel Forgings Using Alternating Current |
| A62 (1949) | No Replacement |
| A63 (1941) | A237 – Discontinued 1975; Replaced by A668/A668M – Steel Forgings, Carbon and Alloy, for General Industrial Use<br>A238 – Discontinued 1989; Replaced by A730 – Discontinued 2004; Replaced by A668/A668M – Steel Forgings, Carbon and Alloy, for General Industrial Use |
| A64 (1937) | E30 – Discontinued 1995; No Replacement |
| A68 (1975) | A689 – Carbon and Alloy Steel Bars for Springs |
| A69 (1927) | No Replacement |
| A70 (1947) | A285/A285M – Pressure Vessel Plates, Carbon Steel, Low- and Intermediate-Tensile Strength |
| A71 (1937) | No Replacement |
| A72 (1972) | No Replacement |
| A73 (1972) | No Replacement |
| A75 (1921) | A47/A47M – Ferritic Malleable Iron Castings |
| A76 (1981) | A183 – Carbon Steel Track Bolts and Nuts |
| A77 (1935) | No Replacement |
| A78 (1947) | A283/A283M – Low and Intermediate Tensile Strength Carbon Steel Plates |
| A79 (1921) | A84 – Discontinued 1972; No Replacement |
| A80 (1927) | A107 – Discontinued 1968; Replaced by A575 – Steel Bars, Carbon, Merchant Quality, M-Grades, and A576 – Steel Bars, Carbon, Hot-Wrought, Special Quality<br>A108 – Steel Bars, Carbon, Cold Finished, Standard Quality |
| A81 (1972) | No Replacement |
| A82/A82M (2013) | A1064/A1064M – Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete |
| A83 (1967) | A192/A192M – Seamless Carbon Steel Boiler Tubes for High-Pressure Service |
| A84 (1972) | No Replacement |
| A85 (1953) | No Replacement |
| A86 (1963) | No Replacement |
| A87 (1947) | A27/A27M – Steel Castings, Carbon, for General Application |
| A88 (1933) | A48/A48M – Gray Iron Castings |
| A89 (1947) | A285/A285M – Pressure Vessel Plates, Carbon Steel, Low- and Intermediate-Tensile Strength |
| A91 (1940) | No Replacement |
| A92 (1937) | No Replacement |
| A93 (1965) | A525/A525M – Discontinued 1994; Replaced by A653/A653M – Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process, and A924/A924M – General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process |
| A94 (1966) | No Replacement |
| A95 (1957) | A216/A216M – Steel Castings, Carbon, Suitable for Fusion Welding, for High-Temperature Service |
| A96 (1965) | A193/A193M – Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications |
| A97 (1935) | No Replacement |
| A98 (1992) | No Replacement |
| A103 (1939) | E32 – Discontinued 2015; No Replacement |
| A104 (1939) | E31 – Discontinued 1995; No Replacement |
| A107 (1968) | A575 – Steel Bars, Carbon, Merchant Quality, M-Grades<br>A576 – Steel Bars, Carbon, Hot-Wrought, Special Quality |
| A109M (1998) | A109/A109M – Steel, Strip, Carbon (0.25 Maximum Percent), Cold-Rolled |
| A110 (1936) | A90/A90M – Test Method for Weight [Mass] of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings |
| A112 (1990) | No Replacement |
| A113 (1979) | No Replacement |
| A114 (1940) | No Replacement |
| A115 (1937) | No Replacement |
| A117 (1956) | A392 – Zinc-Coated Steel Chain-Link Fence Fabric |
| A118 (1933) | No Replacement |

| Discontinued | Replaced By |
|---|---|
| A119 (1942) | E44 – Discontinued 1993; Replaced by A919 – Discontinued 1999; Replaced by A941 – Terminology Relating to Steel, Stainless Steel, Related Alloys, and Ferroalloys |
| A120 (1987) | A53/A53M – Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless |
| A122 (1963) | A475 – Zinc-Coated Steel Wire Strand |
| A124 (1940) | No Replacement |
| A127 (1949) | Redesignated A340 – Terminology of Symbols and Definitions Relating to Magnetic Testing |
| A129 (1969) | No Replacement |
| A130 (1937) | E30 – Discontinued 1995; No Replacement |
| A133 (1941) | A237 – Discontinued 1975; Replaced by A668/A668M – Steel Forgings, Carbon and Alloy, for General Industrial Use<br>A238 – Discontinued 1989; Replaced by A730 – Discontinued 2004; Replaced by A668/A668M – Steel Forgings, Carbon and Alloy, for General Industrial Use |
| A136 (1945) | No Replacement |
| A137 (1943) | No Replacement |
| A138 (1945) | No Replacement |
| A140 (1935) | No Replacement |
| A141 (1967) | A502 – Rivets, Steel, Structural |
| A142 (1977) | A716 – Ductile Iron Culvert Pipe |
| A145 (1940) | A132 – Ferromolybdenum |
| A147 (1984) | No Replacement |
| A149 (1940) | A212 – Discontinued 1967; Replaced by A515/A515M – Pressure Vessel Plates, Carbon Steel, for Intermediate- and Higher-Temperature Service, and A516/A516M – Pressure Vessel Plates, Carbon Steel, for Moderate- and Lower-Temperature Service |
| A150 (1940) | A212 – Discontinued 1967; Replaced by A515/A515M – Pressure Vessel Plates, Carbon Steel, for Intermediate- and Higher-Temperature Service, and A516/A516M – Pressure Vessel Plates, Carbon Steel, for Moderate- and Lower-Temperature Service |
| A151 (1938) | No Replacement |
| A152 (1972) | No Replacement |
| A154 (1936) | A180 – Discontinued 1937; Replaced by A27/A27M – Steel Castings, Carbon, for General Application |
| A155 (1978) | A671/A671M – Electric-Fusion-Welded Steel Pipe for Atmospheric and Lower Temperatures<br>A672/A672M – Electric-Fusion-Welded Steel Pipe for High-Pressure Service at Moderate Temperatures<br>A691/A691M – Carbon and Alloy Steel Pipe, Electric Fusion-Welded for High-Pressure Service at High Temperatures |
| A156 (1936) | A146 – Molybdenum Oxide Products |
| A157 (1953) | A217/A217M – Steel Castings, Martensitic Stainless and Alloy, for Pressure-Containing Parts, Suitable for High-Temperature Service<br>A351/A351 – Castings, Austenitic, for Pressure-Containing Parts |
| A158 (1953) | A335/A335M – Seamless Ferritic Alloy-Steel Pipe for High-Temperature Service |
| A160 (1969) | A617 – Discontinued 1999; Replaced by A996/A996M – Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement |
| A161 (1999) | A192/A192M – Seamless Carbon Steel Boiler Tubes for High Pressure Service<br>A209/A209M – Seamless Carbon-Molybdenum Alloy-Steel Boiler and Superheater Tubes |
| A162 (1973) | No Replacement |
| A163 (1972) | No Replacement |
| A164 (1981) | B663 – Silver-Tungsten Carbide Electrical Contact Material |
| A165 (1988) | B766 – Electrodeposited Coatings of Cadmium |
| A166 (1968) | B456 – Electrodeposited Coatings of Copper Plus Nickel Plus Chromium and Nickel Plus Chromium |
| A167 (2014) | No Replacement |
| A168 (1947) | A296 – Discontinued 1980; Replaced by A743/A743M – Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion-Resistant, for General Application, and A744/A744M – Castings, Iron-Chromium-Nickel, Corrosion-Resistant, for Severe Service<br>A297/A297M – Steel Castings, Iron-Chromium and Iron-Chromium-Nickel, Heat-Resistant, for General Application |
| A169 (1947) | A296 – Discontinued 1980; Replaced by A743/A743M – Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion-Resistant, for General Application, and A744/A744M – Castings, Iron-Chromium-Nickel, Corrosion-Resistant, for Severe Service<br>A297/A297M – Steel Castings, Iron-Chromium and Iron-Chromium-Nickel, Heat-Resistant, for General Application |

| Discontinued | Replaced By |
|---|---|
| A170 (1947) | A296 – Discontinued 1980; Replaced by A743/A743M – Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion-Resistant, for General Application, and A744/A744M – Castings, Iron-Chromium-Nickel, Corrosion-Resistant, for Severe Service<br>A297/A297M – Steel Castings, Iron-Chromium and Iron-Chromium-Nickel, Heat-Resistant, for General Application |
| A171 (1947) | A296 – Discontinued 1980; Replaced by A743/A743M – Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion-Resistant, for General Application, and A744/A744M – Castings, Iron-Chromium-Nickel, Corrosion-Resistant, for Severe Service<br>A297/A297M – Steel Castings, Iron-Chromium and Iron-Chromium-Nickel, Heat-Resistant, for General Application |
| A172 (1947) | A296 – Discontinued 1980; Replaced by A743/A743M – Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion-Resistant, for General Application, and A744/A744M – Castings, Iron-Chromium-Nickel, Corrosion-Resistant, for Severe Service<br>A297/A297M – Steel Castings, Iron-Chromium and Iron-Chromium-Nickel, Heat-Resistant, for General Application |
| A173 (1954) | A296 – Discontinued 1980; Replaced by A743/A743M – Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion-Resistant, for General Application, and A744/A744M – Castings, Iron-Chromium-Nickel, Corrosion-Resistant, for Severe Service<br>A297/A297M – Steel Castings, Iron-Chromium and Iron-Chromium-Nickel, Heat-Resistant, for General Application |
| A174 (1940) | A296 – Discontinued 1980; Replaced by A743/A743M – Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion-Resistant, for General Application, and A744/A744M – Castings, Iron-Chromium-Nickel, Corrosion-Resistant, for Severe Service<br>A297/A297M – Steel Castings, Iron-Chromium and Iron-Chromium-Nickel, Heat-Resistant, for General Application |
| A175 (1947) | A296 – Discontinued 1980; Replaced by A743/A743M – Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion-Resistant, for General Application, and A744/A744M – Castings, Iron-Chromium-Nickel, Corrosion-Resistant, for Severe Service<br>A297/A297M – Steel Castings, Iron-Chromium and Iron-Chromium-Nickel, Heat-Resistant, for General Application |
| A176 (2015) | A240/A240M – Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications |
| A177 (1989) | A666 – Annealed or Cold-Worked Austenitic Stainless Steel, Sheet, Strip, Plate, and Flat Bar |
| A180 (1937) | A27/A27M – Steel Castings, Carbon, for General Application |
| A185/A185M (2013) | A1064/A1064M – Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete |
| A186 (1966) | A504/A504M – Wrought Carbon Steel Wheels |
| A187 (1943) | No Replacement |
| A188 (1943) | No Replacement |
| A189 (1972) | No Replacement |
| A190 (1962) | No Replacement |
| A191 (1942) | A239 – Practice for Locating the Thinnest Spot in a Zinc (Galvanized) Coating on Iron or Steel Articles1, 2 |
| A195 (1966) | A502 – Rivets, Steel, Structural |
| A196 (1962) | No Replacement |
| A197M (1999) | A197/A197M – Cupola Malleable Iron |
| A198 (1947) | A296 – Discontinued 1980; Replaced by A743/A743M – Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion-Resistant, for General Application, and A744/A744M – Castings, Iron-Chromium-Nickel, Corrosion-Resistant, for Severe Service<br>A297/A297M – Steel Castings, Iron-Chromium and Iron-Chromium-Nickel, Heat-Resistant, for General Application |
| A199/A199M (1995) | A200 – Discontinued 1999; Replaced by A213/A213M – Seamless Ferritic and Austenitic Alloy-Steel Boiler, Superheater, and Heat-Exchanger Tubes |
| A200 (1999) | A213/A213M – Seamless Ferritic and Austenitic Alloy-Steel Boiler, Superheater, and Heat-Exchanger Tubes |
| A201 (1967) | A515/A515M – Pressure Vessel Plates, Carbon Steel, for Intermediate- and Higher-Temperature Service<br>A516/A516M – Pressure Vessel Plates, Carbon Steel, for Moderate- and Lower-Temperature Service |
| A202/A202M (2004) | No Replacement |
| A205 (1967) | A233 – Discontinued 1970; No Replacement<br>A251 – Discontinued 1970; No Replacement |
| A206 (1953) | A335/A335M – Seamless Ferritic Alloy-Steel Pipe for High-Temperature Service |
| A207 (1972) | No Replacement |
| A208 (1941) | A239 – Practice for Locating the Thinnest Spot in a Zinc (Galvanized) Coating on Iron or Steel Articles |
| A211 (1993) | No Replacement |
| A212 (1967) | A515/A515M – Pressure Vessel Plates, Carbon Steel, for Intermediate- and Higher-Temperature Service<br>A516/A516M – Pressure Vessel Plates, Carbon Steel, for Moderate- and Lower-Temperature Service |

| Discontinued | Replaced By |
|---|---|
| A215 (1947) | A27/A27M – Steel Castings, Carbon, for General Application |
| A218 (1963) | A475 – Zinc-Coated Steel Wire Strand |
| A219 (1972) | B487 – Test Method for Measurement of Metal and Oxide Coating Thicknesses by Microscopical Examination of a Cross Section<br>B499 – Test Method for Measurement of Coating Thicknesses by the Magnetic Method: Nonmagnetic Coatings on Magnetic Basis Metals<br>B504 – Test Method for Measurement of Thickness of Metallic Coatings by the Coulometric Method<br>B529 – Discontinued 1979; Replaced by B244 – Test Method for Measurement of Thickness of Anodic Coatings on Aluminum and of Other Nonconductive Coatings on Nonmagnetic Basis Metals with Eddy-Current Instruments<br>B530 – Test Method for Measurement of Coating Thicknesses by the Magnetic Method: Electrodeposited Nickel Coatings on Magnetic and Nonmagnetic Substrates |
| A220M (1999) | A220/A220M – Pearlitic Malleable Iron |
| A221 (1947) | A296 – Discontinued 1980; Replaced by A743/A743M – Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion-Resistant, for General Application, and A744/A744M – Castings, Iron-Chromium-Nickel, Corrosion-Resistant, for Severe Service<br>A297/A297M – Steel Castings, Iron-Chromium and Iron-Chromium-Nickel, Heat-Resistant, for General Application |
| A222 (1947) | A296 – Discontinued 1980; Replaced by A743/A743M – Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion-Resistant, for General Application, and A744/A744M – Castings, Iron-Chromium-Nickel, Corrosion-Resistant, for Severe Service<br>A297/A297M – Steel Castings, Iron-Chromium and Iron-Chromium-Nickel, Heat-Resistant, for General Application |
| A223 (1947) | A296 – Discontinued 1980; Replaced by A743/A743M – Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion-Resistant, for General Application, and A744/A744M – Castings, Iron-Chromium-Nickel, Corrosion-Resistant, for Severe Service<br>A297/A297M – Steel Castings, Iron-Chromium and Iron-Chromium-Nickel, Heat-Resistant, for General Application |
| A224 (1969) | G4 – Guide for Conducting Corrosion Tests in Field Applications |
| A226/A226M (1997) | No Replacement |
| A233 (1970) | No Replacement |
| A235 (1975) | A668/A668M – Steel Forgings, Carbon and Alloy, for General Industrial Use |
| A236 (1981) | No Replacement |
| A237 (1975) | A668/A668M – Steel Forgings, Carbon and Alloy, for General Industrial Use |
| A238 (1989) | A730 – Discontinued 2004; Replaced by A668/A668M – Steel Forgings, Carbon and Alloy, for General Industrial Use |
| A241 (1979) | A67 – Steel Tie Plates, Low-Carbon and High-Carbon Hot-Worked |
| A243 (1975) | A668/A668M – Steel Forgings, Carbon and Alloy, for General Industrial Use |
| A244 (1947) | A504/A504M – Wrought Carbon Steel Wheels |
| A245 (1972) | A570 – Discontinued 2000; Replaced by A1011/A1011M – Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength<br>A611 – Discontinued 2000; Replaced by A1008/A1008M – Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable |
| A246 (1958) | A245 – Discontinued 1972; Replaced by A570 – Discontinued 2000; Replaced by A1011/A1011M – Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength<br>A611 – Discontinued 2000; Replaced by A1008/A1008M – Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable |
| A248 (1972) | A273 – Discontinued 1975; Replaced by A711/A711M – Steel Forging Stock<br>A274 – Discontinued 1975; Replaced by A711/A711M – Steel Forging Stock |
| A251 (1970) | No Replacement |
| A253 (1962) | No Replacement |
| A256 (1990) | No Replacement |
| A257 (1945) | A34/A34M – Practice for Sampling and Procurement Testing of Magnetic Materials |
| A258 (1945) | A34/A34M – Practice for Sampling and Procurement Testing of Magnetic Materials |
| A259 (1945) | A34/A34M – Practice for Sampling and Procurement Testing of Magnetic Materials |
| A260 (1966) | No Replacement |
| A261 (1959) | No Replacement |
| A267 (1954) | No Replacement |
| A271 (1999) | A213/A213M – Seamless Ferritic and Austenitic Alloy-Steel Boiler, Superheater, and Heat-Exchanger Tubes |

| Discontinued | Replaced By |
|---|---|
| A272 (1945) | E109 – Discontinued 1981; Replaced by E709 – Guide for Magnetic Particle Testing |
| A273 (1975) | A711/A711M – Steel Forging Stock |
| A274 (1975) | A711/A711M – Steel Forging Stock |
| A277 (1952) | A338 – Malleable Iron Flanges, Pipe Fittings, and Valve Parts for Railroad, Marine, and Other Heavy Duty Service at Temperatures Up to 650°F (345°C) |
| A278M (2001) | A278/A278M – Gray Iron Castings for Pressure-Containing Parts for Temperatures Up to 650oF (350oC) |
| A279 (1945) | G31 – Guide for Laboratory Immersion Corrosion Testing of Metals |
| A280 (1953) | A335/A335M – Seamless Ferritic Alloy-Steel Pipe for High-Temperature Service |
| A281 (1947) | A27/A27M – Steel Castings, Carbon, for General Application |
| A282 (1945) | A148/A148M – Steel Castings, High Strength, for Structural Purposes |
| A284/A284M (1992) | A283/A283M – Low and Intermediate Tensile Strength Carbon Steel Plates |
| A286 (1960) | A434 – Steel Bars, Alloy, Hot-Wrought or Cold-Finished, Quenched and Tempered |
| A287 (1955) | No Replacement |
| A292 (1968) | A469/A469M – Vacuum-Treated Steel Forgings for Generator Rotors |
| A293 (1984) | A470/A470M – Vacuum-Treated Carbon and Alloy Steel Forgings for Turbine Rotors and Shafts |
| A294 (1988) | A471/A471M – Vacuum-Treated Alloy Steel Forgings for Turbine Rotor Disks and Wheels |
| A296 (1980) | A743/A743M – Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion-Resistant, for General Application<br>A744/A744M – Castings, Iron-Chromium-Nickel, Corrosion-Resistant, for Severe Service |
| A298 (1970) | No Replacement |
| A300 (1975) | No Replacement |
| A301 (1956) | A387/A387M – Pressure Vessel Plates, Alloy Steel, Chromium-Molybdenum |
| A303 (1970) | A570 – Discontinued 2000; Replaced by A1011/A1011M – Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength |
| A305 (1968) | A615/A615M – Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement<br>A616 – Discontinued 1999; Replaced by A996/A996M – Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement<br>A617 – Discontinued 1999; Replaced by A996/A996M – Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement |
| A306 (1975) | A663/A663M – Steel Bars, Carbon, Merchant Quality, Mechanical Properties<br>A675/A675M – Steel Bars, Carbon, Hot-Wrought, Special Quality, Mechanical Properties |
| A310 (1949) | Redesignated A345 – Flat-Rolled Electrical Steels for Magnetic Applications |
| A315 (1952) | A335/A335M – Seamless Ferritic Alloy-Steel Pipe for High-Temperature Service |
| A316 (1969) | No Replacement |
| A317 (1975) | E381 – Method of Macroetch Testing Steel Bars, Billets, Blooms, and Forgings |
| A318 (1976) | A370 – Test Methods and Definitions for Mechanical Testing of Steel Products |
| A321 (2007) | No Replacement |
| A326 (1990) | No Replacement |
| A327M (2011) | A327/A327M – Test Methods for Impact Testing of Cast Irons |
| A329 (1965) | A551/A551M – Carbon Steel Tires for Railway and Rapid Transit Applications |
| A330 (1954) | A370 – Test Methods and Definitions for Mechanical Testing of Steel Products |
| A331 (2004) | A108 – Steel Bar, Carbon and Alloy, Cold-Finished |
| A332 (1965) | A689 – Carbon and Alloy Steel Bars for Springs |
| A337 (1955) | A392 – Zinc-Coated Steel Chain-Link Fence Fabric |
| A339 (1965) | A536 – Ductile Iron Castings |
| A344 (1977) | A370 – Test Methods and Definitions for Mechanical Testing of Steel Products<br>A712 – Test Method for Electrical Resistivity of Soft Magnetic Alloys<br>A717/A717M – Test Method for Surface Insulation Resistivity of Single-Strip Specimens<br>A718 – Discontinued 1996; No Replacement<br>A719/A719M – Test Method for Lamination Factor of Magnetic Materials<br>A720/A720M – Test Method for Ductility of Nonoriented Electrical Steel |
| A346 (1998) | No Replacement |
| A347 (1996) | No Replacement |
| A349 (1984) | No Replacement |
| A357 (1973) | A387/A387M – Pressure Vessel Plates, Alloy Steel, Chromium-Molybdenum |
| A359 (1954) | A370 – Test Methods and Definitions for Mechanical Testing of Steel Products |
| A360 (1993) | No Replacement |
| A360M (1993) | No Replacement |
| A361/A361M (1995) | No Replacement |

| Discontinued | Replaced By |
|---|---|
| A362 (1977) | No Replacement |
| A364 (1959) | A434 – Steel Bars, Alloy, Hot-Wrought or Cold-Finished, Quenched and Tempered |
| A365 (1968) | A619/A619M – Discontinued 1997; No Replacement<br>A620/A620M – Discontinued 2000; Replaced by A1008/A1008M – Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable |
| A366/A366M (2000) | A1008/A1008M – Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable |
| A371 (1969) | No Replacement |
| A373 (1966) | Combined with A36/A36M – Carbon Structural Steel |
| A374 (1971) | A606/A606M – Steel, Sheet and Strip, High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, with Improved Atmospheric Corrosion Resistance<br>A607 – Discontinued 2000; Replaced by A1008/A1008M – Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable, and A1011/A1011M – Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength |
| A375 (1971) | A606/A606M – Steel, Sheet and Strip, High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, with Improved Atmospheric Corrosion Resistance<br>A607 – Discontinued 2000; Replaced by A1008/A1008M – Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable, and A1011/A1011M – Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength |
| A378 (1955) | A345 – Flat-Rolled Electrical Steels for Magnetic Applications |
| A379 (1955) | A345 – Flat-Rolled Electrical Steels for Magnetic Applications |
| A382 (1971) | No Replacement |
| A383 (1996) | No Replacement |
| A386 (1984) | A123/A123M – Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products |
| A393 (1974) | A262 – Practices for Detecting Susceptibility to Intergranular Attack in Austenitic Stainless Steels |
| A395M (1998) | A395/A395M – Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures |
| A396 (1965) | A536 – Ductile Iron Castings |
| A397 (1958) | No Replacement |
| A398 (1969) | No Replacement |
| A399 (1969) | No Replacement |
| A402 (1958) | No Replacement |
| A404 (1974) | No Replacement |
| A405 (1995) | No Replacement |
| A406 (1965) | No Replacement |
| A407M (1989) | No Replacement |
| A408 (1968) | A615/A615M – Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement |
| A410 (1976) | No Replacement |
| A412 (1988) | No Replacement |
| A415 (1970) | A569/A569M – Discontinued 2000; Replaced by A1011/A1011M – Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength |
| A417 (2008) | No Replacement |
| A417M (1989) | No Replacement |
| A419 (1971) | No Replacement |
| A422 (1994) | No Replacement |
| A425 (1970) | A569/A569M – Discontinued 2000; Replaced by A1011/A1011M – Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength |
| A429 (1976) | A276 – Stainless Steel Bars and Shapes |
| A430/A430M (1995) | A312/A312M – Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes |
| A431 (1968) | A615/A615M – Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement |
| A432 (1968) | A615/A615M – Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement |
| A433 (1972) | No Replacement |
| A438 (2003) | No Replacement |
| A440 (1979) | No Replacement |
| A441/A441M (1988) | A572/A572M – High-Strength Low-Alloy Columbium-Vanadium Structural Steel |
| A442/A442M (1991) | No Replacement |

| Discontinued | Replaced By |
|---|---|
| A443 (1966) | Combined with A370 – Test Methods and Definitions for Mechanical Testing of Steel Products |
| A444/A444M (1995) | A929/A929M – Steel Sheet, Metallic-Coated by the Hot-Dip Process for Corrugated Steel Pipe |
| A445 (1974) | A395/A395M – Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures |
| A446/A446M (1994) | A653/A653M – Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process<br>A924/A924M – General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process |
| A448 (1976) | No Replacement |
| A452 (1995) | No Replacement |
| A454 (1980) | No Replacement |
| A457 (1990) | No Replacement |
| A458 (1991) | No Replacement |
| A461 (1971) | A564/A564M – Hot-Rolled and Cold-Finished Age-Hardening Stainless Steel Bars and Shapes<br>A637 – Discontinued; Redesignated B637 – Precipitation-Hardening and Cold Worked Nickel Alloy Bars, Forgings, and Forging Stock for Moderate or High-Temperature Service<br>A638 – Precipitation Hardening Iron Base Superalloy Bars, Forgings, and Forging Stock for High-Temperature Service<br>A639 – Discontinued; Redesignated B639 – Precipitation Hardening Cobalt-Containing Alloys (UNS R30155 and UNS R30816) Rod, Bar, Forgings, and Forging Stock for High-Temperature Service |
| A462 (1970) | E165 – Practice for Liquid Penetrant Examination for General Industry |
| A464 (1968) | A376/A376M – Seamless Austenitic Steel Pipe for High-Temperature Service |
| A465 (1975) | No Replacement |
| A468 (1969) | A6/A6M – General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling<br>A341/A341M – Test Method for Direct Current Magnetic Properties of Materials Using D-C Permeameters and the Ballistic Test Methods |
| A476M (2000) | A476/A476M – Ductile Iron Castings for Paper Mill Dryer Rolls |
| A477 (1991) | No Replacement |
| A486/A486M (1987) | No Replacement |
| A496/A496M (2013) | A1064/A1064M – Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete |
| A497/A497M (2013) | A1064/A1064M – Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete |
| A502 (1999)* | No Replacement |
| A509 (1983) | A788/A788M – Steel Forgings, General Requirements |
| A510M (2011) | A510/A510M – General Requirements for Wire Rods and Coarse Round Wire, Carbon Steel, and Alloy Steel |
| A518 M (1999) | A518/A518 M – Corrosion-Resistant High-Silicon Iron Castings |
| A520 (2000) | No Replacement |
| A525 (1994) | A653/A653M – Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process<br>A924/A924M – General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process |
| A525M (1994) | A653/A653M – Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process<br>A924/A924M – General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process |
| A526/A526M (1994) | A653/A653M – Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process<br>A924/A924M – General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process |
| A527/A527M (1994) | A653/A653M – Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process<br>A924/A924M – General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process |
| A528/A528M (1994) | A653/A653M – Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process<br>A924/A924M – General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process |
| A535 (1998) | No Replacement |
| A538/A538M (1989) | No Replacement |
| A539 (2004) | No Replacement |
| A544 (1991) | No Replacement |
| A545 (1991) | No Replacement |
| A546 (1991) | No Replacement |
| A547 (1991) | No Replacement |
| A548 (1991) | No Replacement |
| A549 (1991) | No Replacement |
| A552 (1974) | A689 – Carbon and Alloy Steel Bars for Springs |
| A557/A557M (1995) | A178/A178M – Electric-Resistance-Welded Carbon Steel and Carbon-Manganese Steel Boiler and Superheater Tubes |

| Discontinued | Replaced By |
|---|---|
| A558 (1969) | No Replacement |
| A559 (1969) | No Replacement |
| A566 (1984) | No Replacement |
| A567/A567M (1985) | No Replacement |
| A568M (1990) | A568/A568M – Steel, Sheet, Carbon, Structural, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements for |
| A569/A569M (2000) | A1011/A1011M – Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength |
| A570/A570M (2000) | A1011/A1011M – Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength |
| A571M (2001) | A571/A571M – Austenitic Ductile Iron Castings for Pressure-Containing Parts Suitable for Low-Temperature Service |
| A583 (2004) | No Replacement |
| A584 (2002) | A116 – Metallic-Coated, Steel Woven Wire Fence Fabric |
| A585 (2002) | A121 – Metallic-Coated Carbon Steel Barbed Wire |
| A590 (1984) | No Replacement |
| A591/A591M (2005) | A879/A879M – Steel Sheet, Zinc Coated by the Electrolytic Process for Applications Requiring Designation of the Coating Mass on Each Surface |
| A593 (1976) | No Replacement |
| A594 (1986) | No Replacement |
| A599 (1992) | A599/A599M – Tin Mill Products, Electrolytic Tin-Coated, Cold-Rolled Sheet |
| A605/A605M (1987) | No Replacement |
| A607 (2000) | A1008/A1008M – Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable, and A1011/A1011M – Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength |
| A611 (2000) | A1008/A1008M – Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable |
| A613 (1984) | No Replacement |
| A614 (1986) | No Replacement |
| A615M (1993) | A615/A615M – Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement |
| A616/A616M (1999) | A996/A996M – Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement |
| A617/A617M (1999) | A996/A996M – Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement |
| A619/A619M (1997) | No Replacement |
| A620/A620M (2000) | A1008/A1008M – Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable |
| A621/A621M (1997) | No Replacement |
| A622/A622M (2000) | A1011/A1011M – Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength |
| A624M (1995) | A624/A624M – Tin Mill Products, Electrolytic Tin Plate, Single Reduced |
| A625M (1992) | A625/A625M – Tin Mill Products, Black Plate, Single Reduced |
| A626M (1995) | A626/A626M – Tin Mill Products, Electrolytic Tin Plate, Double Reduced |
| A628 (1981) | No Replacement |
| A629 (2004) | A627 – Test Methods for Tool-Resisting Steel Bars, Flats, and Shapes for Detention and Correctional Facilities |
| A631 (1993) | A583 – Discontinued 2004; No Replacement |
| A634 (1977) | No Replacement |
| A635M (1990) | A635/A635M – Steel, Sheet and Strip, Heavy-Thickness Coils, Hot-Rolled, Alloy, Carbon, Structural, High-Strength Low-Alloy, and High-Strength Low-Alloy with Improved Formability, General Requirements for |
| A637 (1981) | Redesignated B637 – Precipitation-Hardening and Cold Worked Nickel Alloy Bars, Forgings, and Forging Stock for Moderate or High-Temperature Service |
| A639 (1980) | Redesignated B639 – Precipitation Hardening Cobalt-Containing Alloys (UNS R30155 and UNS R30816) Rod, Bar, Forgings, and Forging Stock for High-Temperature Service |
| A641M (1997) | A641/A641M – Zinc-Coated (Galvanized) Carbon Steel Wire |
| A642/A642M (1994) | A653/A653M – Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process<br>A924/A924M – General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process |
| A643 (1982) | No Replacement |
| A647 (1981) | No Replacement |
| A650M (1988) | A650/A650M – Tin Mill Products, Black Plate, Double Reduced |
| A651 (1986) | No Replacement |

| Discontinued | Replaced By |
|---|---|
| A652 (1983) | No Replacement |
| A654 (1983) | No Replacement |
| A655 (1983) | No Replacement |
| A658/A658M (1988) | No Replacement |
| A661 | Not Yet Assigned |
| A665 (1987) | A876 – Flat-Rolled, Grain-Oriented, Silicon-Iron, Electrical Steel, Fully Processed Types |
| A665M (1987) | A876 – Flat-Rolled, Grain-Oriented, Silicon-Iron, Electrical Steel, Fully Processed Types |
| A667M (1987) | A667/A667M – Centrifugally Cast Dual Metal (Gray and White Cast Iron) Cylinders |
| A669 (1983) | A789/A789M – Seamless and Welded Ferritic/Austenitic Stainless Steel Tubing for General Service |
| A670 (1979) | Redesignated B670 – Precipitation-Hardening Nickel Alloy (UNS N07718) Plate, Sheet, and Strip for High-Temperature Service |
| A676 (1990) | No Replacement |
| A677M (2000) | A677 – Nonoriented Electrical Steel Fully Processed Types |
| A678/A678M (2010) | No Replacement |
| A680/A680M (1986) | A684/A684M – Steel, Strip, High-Carbon, Cold-Rolled |
| A682/A682M (2009) | A684/A684M – Steel, Strip, High-Carbon, Cold-Rolled |
| A683M (1999) | A683 – Nonoriented Electrical Steel, Semiprocessed Types |
| A685 (1985) | A681 – Tool Steels Alloy |
| A687 (1999) | No Replacement |
| A692 (1995) | A209/A209M – Seamless Carbon-Molybdenum Alloy-Steel Boiler and Superheater Tubes |
| A695 (2002) | No Replacement |
| A699 (1985) | No Replacement |
| A708 (1988) | No Replacement |
| A714 (2014) | No Replacement |
| A715 (2000) | A1008/A1008M – Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable, and A1011/A1011M – Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength |
| A718 (1996) | No Replacement |
| A725 (1988) | A876 – Flat-Rolled, Grain-Oriented, Silicon-Iron, Electrical Steel, Fully Processed Types |
| A725M (1988) | A876M – Discontinued 1998; Replaced by A876 – Flat-Rolled, Grain-Oriented, Silicon-Iron, Electrical Steel, Fully Processed Types |
| A726M (1998) | A726 – Cold-Rolled Magnetic Lamination Quality Steel, Semiprocessed Types |
| A728 | Not Yet Assigned |
| A730 (2004) | A668/A668M – Steel Forgings, Carbon and Alloy, for General Industrial Use |
| A731/A731M (1995) | A268/A268M – Seamless and Welded Ferritic and Martensitic Stainless Steel Tubing for General Service |
| A749M (1991) | A749/A749M – Steel, Strip, Carbon and High-Strength, Low-Alloy, Hot-Rolled, General Requirements for |
| A750 (2004) | No Replacement |
| A752 (2011) | A510/A510M – General Requirements for Wire Rods and Coarse Round Wire, Carbon Steel, and Alloy Steel |
| A752M (2011) | A510/A510M – General Requirements for Wire Rods and Coarse Round Wire, Carbon Steel, and Alloy Steel |
| A766/A766M (1989) | No Replacement |
| A771/A771M (2004) | No Replacement |
| A776 | Not Yet Assigned |
| A777 (1995) | No Replacement |
| A782/A782M (2010) | No Replacement |
| A783 (1986) | No Replacement |
| A784 (1987) | No Replacement |
| A785 (1987) | No Replacement |
| A791/A791M (1995) | A268/A268M – Seamless and Welded Ferritic and Martensitic Stainless Steel Tubing for General Service |
| A792M (1994) | A792/A792M – Steel Sheet, 55 % Aluminum-Zinc Alloy-Coated by the Hot-Dip Process |
| A797 (1988) | No Replacement |
| A806/A806M (1995) | No Replacement |
| A808/A808M (2005) | A656/A656M – Hot-Rolled Structural Steel, High-Strength Low-Alloy Plate with Improved Formability |
| A812/A812M (1997) | No Replacement |
| A816/A816M (1994) | A653/A653M – Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process<br>A924/A924M – General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process |

| Discontinued | Replaced By |
|---|---|
| A819 (1995) | A929/A929M – Steel Sheet, Metallic-Coated by the Hot-Dip Process for Corrugated Steel Pipe |
| A825 (1989) | No Replacement |
| A826/A826M (2004) | No Replacement |
| A828 | Not Yet Assigned |
| A831/A831M (2005) | No Replacement |
| A840/A840M (2011) | No Replacement |
| A843 (1987) | A876 – Flat-Rolled, Grain-Oriented, Silicon-Iron, Electrical Steel, Fully Processed Types |
| A845 (2005) | No Replacement |
| A846 (2005) | No Replacement |
| A850 (1990) | No Replacement |
| A851 (2002) | No Replacement |
| A852/A852M (2010) | No Replacement |
| A863 (1990) | No Replacement |
| A864/A864M (1997) | No Replacement |
| A868 | Not Yet Assigned |
| A869 | Not Yet Assigned |
| A870 | Not Yet Assigned |
| A873/A873M (1997) | No Replacement |
| A874M (1999) | A874/A874M – Ferritic Ductile Iron Castings Suitable for Low-Temperature Service |
| A876M (1998) | A876 – Flat-Rolled, Grain-Oriented, Silicon-Iron, Electrical Steel, Fully Processed Types |
| A880 (2004) | No Replacement |
| A883/A883M (2006) | No Replacement |
| A885/A885M (2006) | No Replacement |
| A897M (2001) | A897/A897M – Austempered Ductile Iron Castings |
| A900 | A900/A900M – Test Method for Lamination Factor of Amorphous Magnetic Strip |
| A907/A907M (2001) | A1018/A1018M – Steel, Sheet and Strip, Heavy-Thickness Coils, Hot-Rolled, Carbon, Commercial, Drawing, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength |
| A916 (1995) | A929/A929M – Steel Sheet Metallic-Coated by the Hot-Dip Process for Corrugated Steel Pipe |
| A919 (1999) | A941 – Terminology Relating to Steel, Stainless Steel, Related Alloys and Ferroalloys |
| A935/A935M (2001) | A1018/A1018M – Steel, Sheet and Strip, Heavy-Thickness Coils, Hot-Rolled, Carbon, Commercial, Drawing, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength |
| A936/A936M (2001) | A1018/A1018M – Steel, Sheet and Strip, Heavy-Thickness Coils, Hot-Rolled, Carbon, Commercial, Drawing, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength |
| A946 (2012) | No Replacement |
| A948 | Not listed |
| A953 (2005) | No Replacement |
| A954 (2005) | No Replacement |
| A963/A963M (2000) | A1008/A1008M – Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable |
| A969/A969M (2000) | A1008/A1008M – Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable |
| A984/A984M (2014) | No Replacement |
| A993 (2004) | No Replacement |
| A995 | A995/A995M – Castings, Austenitic-Ferritic (Duplex) Stainless Steel, for Pressure-Containing Parts |
| A1005/A1005M (2014) | No Replacement |
| A1006/A1006M (2014) | No Replacement |
| A1019/A1019M (2012) | No Replacement |
| A1026 (2007) | No Replacement |
| A1027 | Not listed |
| A1029 | Not listed |
| A1041/A1041M (2013) | No Replacement |
| A1042/A1042M (2015) | No Replacement |
| A1050 | Not listed |
| A1051 | Not listed |
| A1052 | Not listed |

| Discontinued | Replaced By |
|---|---|
| A1070 | Not listed |
| A1091 | Not listed |
| A1093 | Not listed |

*Note: A502-93 (Standard Specification for Steel Structural Rivets) was withdrawn in 1999. A502-03 (Standard Specification for Rivets, Steel, Structural) became an active standard, and has been reapproved in 2015.

## AFNOR STANDARDS

| Discontinued | Replaced By |
|---|---|
| NF A32-053:1992 | No Replacement |
| NF A49-141:1978 | No Replacement |
| NF A49-214:1978 | No Replacement |
| NF A49-244:1993 | EN 10217-7:2014 |
| NF A49-247:1981 | EN 10217-7:2014 |
| NF A49-250:1979 | No Replacement |
| NF A49-317:1980 | EN 10297-2:2005 |

## DIN STANDARD

| Discontinued | Replaced By |
|---|---|
| DIN 1615:1984 | No Replacement |

## BSI STANDARDS

| Discontinued | Replaced By |
|---|---|
| BS 3605-1:1991<br>AMD 2:1997 | EN 10216-5:2013 |
| BS 3605-2:1991<br>AMD 1:1997 | EN 10217-7:2014 |
| BS 6258:1988 A1:1992 | EN 10294-1:2005 and EN 10294-2:2012 |

## EN STANDARDS

| Discontinued | Replaced By |
|---|---|
| EN 10016-1 | EN ISO 16120-1 |
| EN 10016-2 | EN ISO 16120-2 |
| EN 10016-3 | EN ISO 16120-3 |
| EN 10016-4 | EN ISO 16120-4 |
| EN 10113-1 | EN 10025-1, EN 10025-3, EN 10025-4 |
| EN 10113-2 | EN 10025-1, EN 10025-3 |
| EN 10113-3 | EN 10025-1, EN 10025-4 |
| EN 10137-1 | EN 10025-1, EN 10025-6 |
| EN 10137-2 | EN 10025-1, EN 10025-6 |
| EN 10137-3 | No Replacement |
| EN 10155 | EN 10025-1, EN 10025-5 |
| EN 10165 | EN 10341 |
| EN 10169-2 | EN 10169 |
| EN 10208-1 | EN ISO 3183 |
| EN 10208-2 | EN ISO 3183 |
| EN 10258 | EN ISO 9445-1 |
| EN 10259 | EN ISO 9445-2 |
| EN 10292 | EN 10346 |
| EN 10327 | EN 10346 |
| EN 12070 | EN ISO 21952 |
| EN 12072 | EN ISO 14343 |

| Discontinued | Replaced By |
|---|---|
| EN 1599 | EN ISO 3580 |
| EN 1600 | EN ISO 3581 |
| EN 1668 | EN ISO 636 |
| EN 440 | EN ISO 14341 |
| EN 50112 | EN 50446 |
| EN 756 | EN ISO 14171 |
| EN 758 | EN ISO 17632 |

## ISO Standards

| Discontinued | Replaced By |
|---|---|
| ISO 3183-1:1996 | EN ISO 3183 |
| ISO 3183-2:1996 | EN ISO 3183 |

## JIS Standards

| Standard | Date Withdrawn/Replaced by |
|---|---|
| JIS G 0204:2000 | Withdrawn in: 2014-09-22 Replaced by: G 0203 |
| JIS G 0301:1950 | Withdrawn in: 1954-12-18 |
| JIS G 0302:1956 | Withdrawn in: 1966-11-01 Replaced by: G 1501; G 1511; G 1512; G1513 |
| JIS G 0304:1951 | Withdrawn in: 1957-10-30 |
| JIS G 0305:1953 | Withdrawn in: 1962-03-01 |
| JIS G 0405:1950 | Withdrawn in: 1959-12-01 Replaced by: G 4801 |
| JIS G 0406:1950 | Withdrawn in: 1959-12-01 Replaced by: G 4801 |
| JIS G 0501:1952 | Withdrawn in: 1955-02-12 Replaced by: G 3421; G 3422; G 3423 |
| JIS G 0502:1952 | Withdrawn in: 1955-02-12 Replaced by: G 3436; G 3437; G 3438 |
| JIS G 0552:1998 | Withdrawn in: 2005-01-20 Replaced by: G 0551 |
| JIS G 0565:1992 | Withdrawn in: 2007-01-20 Replaced by: Z 2320-1; Z 2320-2; Z 2320-3 |
| JIS G 0574:1980 | Withdrawn in: 2004-03-20 |
| JIS G 0704:1977 | Withdrawn in: 1980-03-01 |
| JIS G 1202:1975 | Withdrawn in: 1995-07-01 Replaced by: G 1253 |
| JIS G 1203:1977 | Withdrawn in: 1986-06-01 Replaced by: Z 2611 |
| JIS G 1204:1978 | Withdrawn in: 2004-03-20 |
| JIS G 1230:1969 | Withdrawn in: 1982-09-01 Replaced by: G 1257 |
| JIS G 1231:1969 | Withdrawn in: 1981-03-01 Replaced by: G 1236; G 1237 |
| JIS G 1238:1992 | Withdrawn in: 2005-02-20 Replaced by: G 1217 |
| JIS G 1251:1976 | Withdrawn in: 1995-07-01 |
| JIS G 1252:1975 | Withdrawn in: 1995-07-01 Replaced by: G 1253 |
| JIS G 1254:1976 | Withdrawn in: 1986-06-01 Replaced by: G 1256 |
| JIS G 1255:1977 | Withdrawn in: 1986-06-01 Replaced by: G 1256 |
| JIS G 1257:1994 | Withdrawn in: 2013-11-20 |
| JIS G 1258:1999 | Withdrawn in: 2007-07-20 Replaced by: G 1258-0; G 1258-1; G 1258-2; G 1258-3; G 1258-4; G 1258-5; G 1258-6; G 1258-7 |
| JIS G 1315:1974 | Withdrawn in: 1983-11-01 |
| JIS G 1511:1976 | Withdrawn in: 1986-02-01 Replaced by: G 1601 |
| JIS G 1512:1976 | Withdrawn in: 1986-02-01 Replaced by: G 1601 |
| JIS G 1513:1976 | Withdrawn in: 1986-02-01 Replaced by: G 1601 |
| JIS G 1514:1976 | Withdrawn in: 1986-02-01 Replaced by: G 1601 |
| JIS G 1515:1976 | Withdrawn in: 1986-02-01 Replaced by: G 1601 |
| JIS G 1516:1976 | Withdrawn in: 1986-02-01 Replaced by: G 1601 |
| JIS G 1517:1975 | Withdrawn in: 1985-03-01 |
| JIS G 1518:1976 | Withdrawn in: 1986-02-01 Replaced by: G 1602 |
| JIS G 1519:1975 | Withdrawn in: 1986-02-01 Replaced by: G 1602 |
| JIS G 1520:1976 | Withdrawn in: 1986-02-01 Replaced by: G 1602 |
| JIS G 1521:1975 | Withdrawn in: 1986-02-01 Replaced by: G 1602 |

| Standard | Date Withdrawn/Replaced by |
|---|---|
| JIS G 1522:1975 | Withdrawn in: 1986-02-01 Replaced by: G 1603 |
| JIS G 1523:1975 | Withdrawn in: 1986-02-01 Replaced by: G 1603 |
| JIS G 1524:1976 | Withdrawn in: 1986-02-01 Replaced by: G 1603 |
| JIS G 1525:1975 | Withdrawn in: 1986-02-01 Replaced by: G 1603 |
| JIS G 1526:1976 | Withdrawn in: 1986-02-01 Replaced by: G 1603 |
| JIS G 1527:1976 | Withdrawn in: 1986-02-01 Replaced by: G 1601 |
| JIS G 1528:1968 | Withdrawn in: 1986-02-01 Replaced by: G 1604 |
| JIS G 1529:1975 | Withdrawn in: 1985-03-01 |
| JIS G 1530:1975 | Withdrawn in: 1986-02-01 Replaced by: G 1603 |
| JIS G 1531:1975 | Withdrawn in: 1986-02-01 Replaced by: G 1602 |
| JIS G 2201:1976 | Withdrawn in: 2000-12-20 |
| JIS G 2202:1976 | Withdrawn in: 2000-12-20 |
| JIS G 2203:1950 | Withdrawn in: 1953-11-07 Replaced by: G 2201; G 2202 |
| JIS G 2204:1950 | Withdrawn in: 1953-11-07 Replaced by: G 2201; G 2202 |
| JIS G 2205:1953 | Withdrawn in: 1953-11-07 Replaced by: G 2201; G 2202 |
| JIS G 2305:1969 | Withdrawn in: 1978-12-01 |
| JIS G 2317:1969 | Withdrawn in: 1978-12-01 |
| JIS G 3102:1964 | Withdrawn in: 1965-07-01 Replaced by: G 4051 |
| JIS G 3104:2004 | Withdrawn in: 2011-02-21 |
| JIS G 3107:1952 | Withdrawn in: 1956-04-18 Replaced by: G 3111 |
| JIS G 3110:1953 | Withdrawn in: 1965-03-01 Replaced by: G 3112 |
| JIS G 3111:2005 | Withdrawn in: 2013-02-20 |
| JIS G 3115-1:1995 | Withdrawn in: 2000-06-20 Replaced by: G 3115 |
| JIS G 3121:1951 | Withdrawn in: 1955-02-12 Replaced by: G 3123 |
| JIS G 3122:1952 | Withdrawn in: 1955-02-12 Replaced by: G 3123 |
| JIS G 3128:2009 | Note: JIS G 3128:2009 no longer has Annexes attached to the standard, thus no longer containing the following grades that were included in DS67C:<br>• Grade E355 Quality DD<br>• Grade E355 Quality E<br>• Grade E460 Quality CC<br>• Grade E460 Quality DD<br>• Grade E460 Quality E<br>• Grade E550 Quality DD<br>• Grade E550 Quality E<br>• Grade E690 Quality DD<br>• Grade E690 Quality E |
| JIS G 3211:1977 | Withdrawn in: 1982-07-01 Replaced by: G 3202; G 3203; G 3204; G 3205 |
| JIS G 3212:1977 | Withdrawn in: 1982-07-01 Replaced by: G 3202; G 3203; G 3204; G 3205 |
| JIS G 3213:1977 | Withdrawn in: 1982-07-01 Replaced by: G 3202; G 3203; G 3204; G 3205 |
| JIS G 3301:1965 | Withdrawn in: 1967-07-01 Replaced by: G 3131 |
| JIS G 3304:1950 | Withdrawn in: 1956-07-17 Replaced by: G 3301 |
| JIS G 3305:1953 | Withdrawn in: 1956-07-17 Replaced by: G 3310 |
| JIS G 3306:1954 | Withdrawn in: 1956-07-17 Replaced by: G 3310 |
| JIS G 3307:1965 | Withdrawn in: 1967-07-01 Replaced by: G 3131 |
| JIS G 3308:1957 | Withdrawn in: 1969-08-06 Replaced by: G 3141 |
| JIS G 3309:1950 | Withdrawn in: 1953-05-08 |
| JIS G 3310:1965 | Withdrawn in: 1969-08-06 Replaced by: G 3141 |
| JIS G 3391:1953 | Withdrawn in: 1988-10-01 |
| JIS G 3421:1951 | Withdrawn in: 1955-02-12 Replaced by: G 3432; G 3433; G 3434; G 3435; G 3436 |
| JIS G 3422:1951 | Withdrawn in: 1955-02-12 Replaced by: G 3433 |
| JIS G 3423:1951 | Withdrawn in: 1955-02-12 Replaced by: G 3435 |
| JIS G 3424:1951 | Withdrawn in: 1955-02-12 Replaced by: G 3436 |
| JIS G 3425:1951 | Withdrawn in: 1955-02-12 Replaced by: G 3437 |
| JIS G 3426:1951 | Withdrawn in: 1955-02-12 Replaced by: G 3438 |
| JIS G 3427:1951 | Withdrawn in: 1955-02-12 Replaced by: G 3432 |
| JIS G 3428:1950 | Withdrawn in: 1956-04-18 Replaced by: G 3440 |
| JIS G 3430:1952 | Withdrawn in: 1957-10-30 Replaced by: G 3443 |

| Standard | Date Withdrawn/Replaced by |
|---|---|
| JIS G 3431:1952 | Withdrawn in: 1957-10-30 Replaced by: G 3443 |
| JIS G 3432:1958 | Withdrawn in: 1962-03-01 Replaced by: G 3452 |
| JIS G 3433:1958 | Withdrawn in: 1962-03-01 Replaced by: G 3454; G 3456 |
| JIS G 3434:1958 | Withdrawn in: 1962-03-01 Replaced by: G 3455 |
| JIS G 3435:1958 | Withdrawn in: 1962-03-01 Replaced by: G 3458; G 3459 |
| JIS G 3436:1958 | Withdrawn in: 1962-03-01 Replaced by: G 3461; G 3462; G 3463 |
| JIS G 3437:1965 | Withdrawn in: 1968-05-01 |
| JIS G 3438:1958 | Withdrawn in: 1962-03-01 Replaced by: G 3459; G 3461; G 3462; G 3463 |
| JIS G 3439:1988 | Withdrawn in: 1996-01-01 |
| JIS G 3440:1956 | Withdrawn in: 1961-02-01 Replaced by: G 3444; G 3445 |
| JIS G 3443:2004 | Withdrawn in: 2007-02-20 Replaced by: G 3443-1 |
| JIS G 3451:1987 | Withdrawn in: 2007-02-20 Replaced by: G 3443-2 |
| JIS G 3491:1993 | Withdrawn in: 2007-02-20 |
| JIS G 3492:1993 | Withdrawn in: 2004-03-20 |
| JIS G 3501:1953 | Withdrawn in: 1956-08-21 Replaced by: G 3505; G 3506 |
| JIS G 3507:1991 | Withdrawn in: 2005-01-20 Replaced by: G 3507-1 |
| JIS G 3508:1991 | Withdrawn in: 2005-01-20 Replaced by: G 3508-1 |
| JIS G 3524:1953 | Withdrawn in: 1957-10-30 Replaced by: Z 3211 |
| JIS G 3526:1962 | Withdrawn in: 1980-03-01 |
| JIS G 3527:1951 | Withdrawn in: 1954-01-30 Replaced by: G 3532 |
| JIS G 3528:1951 | Withdrawn in: 1954-01-30 Replaced by: G 3533 |
| JIS G 3529:1951 | Withdrawn in: 1954-01-30 |
| JIS G 3530:1977 | Withdrawn in: 1980-03-01 |
| JIS G 3531:1977 | Withdrawn in: 1980-03-01 |
| JIS G 3534:1954 | Withdrawn in: 1957-06-21 Replaced by: Z 3201 |
| JIS G 3534:1988 | Withdrawn in: 1994-06-01 |
| JIS G 3539:1991 | Withdrawn in: 2005-01-20 Replaced by: G 3507-2 |
| JIS G 3541:1988 | Withdrawn in: 1992-02-01 |
| JIS G 3545:1991 | Withdrawn in: 2005-01-20 Replaced by: G 3508-2 |
| JIS G 3565:1988 | Withdrawn in: 1994-06-01 |
| JIS G 3566:1988 | Withdrawn in: 1994-06-01 Replaced by: G 3561 |
| JIS G 3567:1988 | Withdrawn in: 1994-06-01 Replaced by: G 3560 |
| JIS G 3568:1989 | Withdrawn in: 1994-06-01 Replaced by: G 3560 |
| JIS G 4102:1979 | Withdrawn in: 2003-05-20 Replaced by: G 4053 |
| JIS G 4103:1979 | Withdrawn in: 2003-05-20 Replaced by: G 4053 |
| JIS G 4104:1979 | Withdrawn in: 2003-05-20 Replaced by: G 4053 |
| JIS G 4105:1979 | Withdrawn in: 2003-05-20 Replaced by: G 4053 |
| JIS G 4106:1979 | Withdrawn in: 2003-05-20 Replaced by: G 4053 |
| JIS G 4201:1950 | Withdrawn in: 1953-11-07 Replaced by: G 3102; G 4102; G 4103; G 4104; G 4105 |
| JIS G 4202:2005 | Withdrawn in: 2008-11-20 Replaced by: G 4053 |
| JIS G 4301:1955 | Withdrawn in: 1959-12-01 Replaced by: G 4303; G 4304; G 4305; G 4306; G 4307; G 4308; G 4309 |
| JIS G 4302:1954 | Withdrawn in: 1964-09-01 Replaced by: G 4311; G 4312 |
| JIS G 4306:1988 | Withdrawn in: 1991-11-01 Replaced by: G 4304 |
| JIS G 4307:1987 | Withdrawn in: 1991-11-01 Replaced by: G 4305 |
| JIS G 4310:1999 | Withdrawn in: 2012-01-20 Replaced by: G 4304; G 4305; G 4312 |
| JIS G 4402:1953 | Withdrawn in: 1956-04-18 Replaced by: G 4404 |
| JIS G 4405:1954 | Withdrawn in: 1956-04-18 |
| JIS G 4406:1954 | Withdrawn in: 1956-04-18 |
| JIS G 4407:1954 | Withdrawn in: 1956-04-18 Replaced by: G 4404 |
| JIS G 4410:1984 | Withdrawn in: 2005-07-20 |
| JIS G 5521:1977 | Withdrawn in: 1983-02-01 |
| JIS G 5522:1977 | Withdrawn in: 1983-02-01 |
| JIS G 5523:1977 | Withdrawn in: 1983-02-01 |
| JIS G 5524:1977 | Withdrawn in: 1989-01-01 |
| JIS G 5701:1952 | Withdrawn in: 1960-03-01 Replaced by: G 5702; G 5703; G 5704 |

| Standard | Date Withdrawn/Replaced by |
|---|---|
| JIS G 5702:1988 | Withdrawn in: 2000-02-20 Replaced by: G 5705 |
| JIS G 5703:1988 | Withdrawn in: 2000-02-20 Replaced by: G 5705 |
| JIS G 5704:1988 | Withdrawn in: 2000-02-20 Replaced by: G 5705 |
| JIS G 7101:2000 | Withdrawn in: 2014-09-22 Replaced by: G 3114 |
| JIS G 7102:2000 | Withdrawn in: 2013-11-20 Replaced by: G 3125 |
| JIS G 7103:2000 | Withdrawn in: 2014-02-20 Replaced by: G 3112 |
| JIS G 7104:2000 | Withdrawn in: 2014-02-20 Replaced by: G 3112 |
| JIS G 7121:2000 | Withdrawn in: 2013-11-20 Replaced by: G 3303 |
| JIS G 7122:2000 | Withdrawn in: 2013-11-20 Replaced by: G 3315 |
| JIS G 7123:2000 | Withdrawn in: 2013-11-20 Replaced by: G 3303 |
| JIS G 7124:2000 | Withdrawn in: 2013-11-20 Replaced by: G 3314 |
| JIS G 7219:2003 | Withdrawn in: 2013-11-20 Replaced by: G 3454 |
| JIS G 7220:2003 | Withdrawn in: 2013-11-20 Replaced by: G 3455; G 3456; G 3458; G 3461; G 3462 |
| JIS G 7221:2003 | Withdrawn in: 2013-11-20 Replaced by: G 3460; G 3464 |
| JIS G 7222:2003 | Withdrawn in: 2013-11-20 Replaced by: G 3459; G 3463 |
| JIS G 7223:2003 | Withdrawn in: 2013-11-20 Replaced by: G 3454 |
| JIS G 7224:2003 | Withdrawn in: 2013-11-20 Replaced by: G 3456; G 3461; G 3462 |
| JIS G 7225:2003 | Withdrawn in: 2013-11-20 Replaced by: G 3460; G 3464 |
| JIS G 7226:2003 | Withdrawn in: 2013-11-20 Replaced by: G 3459; G 3463; G 3468 |
| JIS G 7301:1998 | Withdrawn in: 2013-11-20 |
| JIS G 7501:2000 | Withdrawn in: 2014-02-20 Replaced by: G 4051; G 4052 |
| JIS G 7503:2000 | Withdrawn in: 2014-02-20 Replaced by: G 4051; G 4052; G 4053 |
| JIS G 7601:2000 | Withdrawn in: 2014-09-22 Replaced by: G 4311; G 4312; G 4901; G 4902 |
| JIS G 7602:2000 | Withdrawn in: 2014-09-22 Replaced by: G 4314 |
| JIS G 7603:2000 | Withdrawn in: 2014-09-22 Replaced by: G 4311 |
| JIS G 7604:2000 | Withdrawn in: 2014-09-22 Replaced by: G 4901; H 4553 |
| JIS G 7605:2001 | Withdrawn in: 2014-09-22 Replaced by: H 4551 |
| JIS G 7751:2000 | Withdrawn in: 2014-02-20 Replaced by: G 4801 |
| JIS G 9071:1976 | Withdrawn in: 1992-02-01 |
| JIS G 9072:1976 | Withdrawn in: 1992-02-01 |

# Appendix

# 3

## *JIS STEEL AND RELATED STANDARDS*

| Standard | Title |
|---|---|
| G 3101:2015 | Rolled steels for general structure |
| G 3103:2012 | Carbon steel and molybdenum alloy steel plates for boilers and pressure vessels |
| G 3105:2004 | Steel bars for chains |
| G 3106:2015 | Rolled steels for welded structure |
| G 3108:2004 | Rolled carbon steel for cold-finished steel bars |
| G 3109:2008 | Steel bars for prestressed concrete |
| G 3112:2010 | Steel bars for concrete reinforcement |
| G 3113:2006 | Hot-rolled steel plate, sheet and strip for automobile structural uses |
| G 3114:2008 | Hot-rolled atmospheric corrosion resisting steels for welded structure |
| G 3115:2010 | Steel plates for pressure vessels for intermediate temperature service |
| G 3116:2013 | Steel sheet, plates and strip for gas cylinders |
| G 3117:1987 | Rerolled steel bars for concrete reinforcement |
| G 3118:2010 | Carbon steel plates for pressure vessels for intermediate and moderate temperature services |
| G 3119:2013 | Manganese-molybdenum and manganese-molybdenum-nickel alloy steel plates for boilers and pressure vessels |
| G 3120:2014 | Manganese-molybdenum and manganese-molybdenum-nickel alloy steel plates quenched and tempered for pressure vessels |
| G 3123:2004 | Cold finished carbon and alloy steel bars |
| G 3124:2015 | High strength steel plates for pressure vessel for intermediate and moderate temperature service |
| G 3125:2010 | Superior atmospheric corrosion resisting rolled steels |
| G 3126:2015 | Carbon steel plates for pressure vessels for low temperature service |
| G 3127:2013 | Nickel steel plates for pressure vessels for low temperature services |
| G 3128:2009 | High yield strength steel plates for welded structure |
| G 3129:2005 | High tensile strength steel for tower structural purposes |
| G 3131:2010 | Hot-rolled mild steel plates, sheets and strip |
| G 3132:2011 | Hot-rolled carbon steel strip for pipes and tubes |
| G 3133:2015 | Decarburized steel sheet and strip for porcelain enamelling |
| G 3134:2006 | Hot-rolled high strength steel plate, sheet and strip with improved formability for automobile structural uses |
| G 3135:2006 | Cold-reduced high strength steel sheet and strip with improved formability for automobile structural uses |
| G 3136:2012 | Rolled steels for building structure |
| G 3137:2008 | Small diameter steel bars for prestressed concrete |
| G 3138:2005 | Rolled steel bars for building structure |
| G 3141:2011 | Cold-reduced carbon steel sheet and strip |
| G 3191:2012 | Dimensions, mass and permissible variations of hot rolled steel bars and bar in coil |
| G 3192:2014 | Dimensions, mass and permissible variations of hot rolled steel sections |
| G 3193:2008 | Dimensions, mass and permissible variations of hot rolled steel plates, sheets and strips |
| G 3194:1998 | Dimensions, mass and permissible variations of hot rolled flat steel |
| G 3199:2009 | Specification for through-thickness characteristics of steel plate, wide flat and sections |
| G 3201:1988 | Carbon steel forgings for general use |
| G 3202:1988 | Carbon steel forgings for pressure vessels |
| G 3203:1988 | Alloy steel forgings for pressure vessels for high-temperature service |
| G 3204:1988 | Quenched and tempered alloy steel forgings for pressure vessels |
| G 3205:1988 | Carbon and alloy steel forgings for pressure vessels for low-temperature service |
| G 3206:1993 | High strength chromium-molybdenum alloy steel forgings for pressure vessels under high-temperature service |
| G 3214:1991 | Stainless steel forgings for pressure vessels |
| G 3221:1988 | Chromium molybdenum steel forgings for general use |
| G 3222:1988 | Nickel chromium molybdenum steel forgings for general use |
| G 3223:1988 | High tensile strength steel forgings for tower flanges |
| G 3251:1988 | Carbon steel blooms and billets for forgings |
| G 3302:2010 | Hot-dip zinc-coated steel sheet and strip |
| G 3303:2008 | Tinplate and blackplate |
| G 3311:2010 | Cold rolled special steel strip |
| G 3312:2012 | Prepainted hot-dip zinc-coated steel sheet and strip |
| G 3313:2015 | Electrolytic zinc-coated steel sheet and strip |
| G 3314:2010 | Hot-dip aluminium-coated steel sheet and strip |
| G 3315:2008 | Chromium coated tin free steel |
| G 3316:1987 | Shapes and dimensions of corrugated steel sheets |

| Standard | Title |
|---|---|
| G 3317:2010 | Hot-dip zinc-5% aluminium alloy-coated steel sheet and strip |
| G 3318:2012 | Prepainted hot-dip zinc-5% aluminium alloy-coated steel sheet and strip |
| G 3320:1999 | Coated stainless steel sheets |
| G 3321:2010 | Hot-dip 55% aluminium-zinc alloy-coated steel sheet and strip |
| G 3322:2012 | Prepainted hot-dip 55% aluminium-zinc alloy-coated steel sheet and strip |
| G 3350:2009 | Light gauge steel sections for general structure |
| G 3351:1987 | Expanded metals |
| G 3352:2014 | Steel decks |
| G 3353:2011 | Welded light gauge steel H sections for general structure |
| G 3429:2013 | Seamless steel tubes for high pressure gas cylinders |
| G 3441:2015 | Alloy steel tubes for machine purposes |
| G 3442:2015 | Galvanized steel pipes for ordinary piping |
| G 3443-1:2014 | Coated steel pipes for water service – Part 1: Pipes |
| G 3443-2:2014 | Coated steel pipes for water service – Part 2: Fittings |
| G 3443-3:2014 | Coated steel pipes for water service – Part 3: Long-life external plastic coatings |
| G 3443-4:2014 | Coated steel pipes for water service – Part 4: Internal epoxy coatings |
| G 3444:2010 | Carbon steel tubes for general structure |
| G 3445:2010 | Carbon steel tubes for machine structure |
| G 3446:2012 | Stainless steel pipes for machine and structural purposes |
| G 3447:2015 | Stainless steel sanitary pipes |
| G 3448:2012 | Light gauge stainless steel tubes for ordinary piping |
| G 3452:2014 | Carbon steel pipes for ordinary piping |
| G 3454:2012 | Carbon steel tubes for pressure service |
| G 3455:2012 | Carbon steel pipes for high pressure service |
| G 3456:2014 | Carbon steel pipes for high temperature service |
| G 3457:2012 | Arc welded carbon steel pipes |
| G 3458:2013 | Alloy steel pipes |
| G 3459:2012 | Stainless steel pipes |
| G 3460:2013 | Steel tubes for low temperature service |
| G 3461:2012 | Carbon steel boiler and heat exchanger tubes |
| G 3462:2014 | Alloy steel tubes for boiler and heat exchanger |
| G 3463:2012 | Stainless steel boiler and heat exchanger tubes |
| G 3464:2013 | Steel heat exchanger tubes for low temperature service |
| G 3465:2014 | Seamless steel tubes for drilling |
| G 3466:2010 | Carbon steel square and rectangular tubes for general structure |
| G 3467:2013 | Steel tubes for fired heater |
| G 3468:2011 | Large diameter welded stainless steel pipes |
| G 3469:2010 | Polyethylene coated steel pipes |
| G 3471:2012 | Corrugated steel pipe |
| G 3472:2013 | Electric resistance welded carbon steel tubes for automobile |
| G 3473:2013 | Carbon steel tubes for cylinder barrels |
| G 3474:2014 | High strength steel tubes for steel tower |
| G 3475:2014 | Carbon steel tubes for building structure |
| G 3502:2013 | Piano wire rods |
| G 3503:2006 | Wire rods for core wire of covered electrode |
| G 3505:2004 | Low carbon steel wire rods |
| G 3506:2004 | High carbon steel wire rods |
| G 3507-1:2010 | Carbon steels for cold heading – Part 1: Wire rods |
| G 3507-2:2005 | Carbon steels for cold heading – Part 2: Wires |
| G 3508-1:2010 | Boron steels for cold heading – Part 1: Wire rods |
| G 3508-2:2005 | Boron steels for cold heading – Part 2: Wires |
| G 3509-1:2010 | Low-alloyed steels for cold heading – Part 1: Wire rods |
| G 3509-2:2003 | Low-alloyed steels for cold heading – Part 2: Wires |
| G 3510:1992 | Testing methods for steel tire cords |
| G 3521:1991 | Hard drawn steel wires |

| Standard | Title |
|---|---|
| G 3522:2014 | Piano wires |
| G 3523:1980 | Core wires for covered electrode |
| G 3525:2013 | Wire ropes |
| G 3532:2011 | Low carbon steel wires |
| G 3533:1993 | Barbed wires |
| G 3535:2012 | Wire ropes for aircraft control |
| G 3536:2014 | Steel wires and strands for prestressed concrete |
| G 3537:2011 | Zinc-coated steel wire strands |
| G 3538:1994 | Hard drawn steel wire for prestressed concrete |
| G 3540:2012 | Wire ropes for mechanical control |
| G 3542:1993 | Precoated color zinc-coated steel wires |
| G 3543:2005 | Steel wire coated with colored plastics |
| G 3544:1993 | Hot-dip aluminium-coated steel wires |
| G 3546:2012 | Wire ropes with profile wires |
| G 3547:2015 | Zinc-coated low carbon steel wires |
| G 3548:2011 | Zinc-coated steel wires |
| G 3549:2000 | Wire ropes for structure |
| G 3550:2003 | Stainless steel wire ropes for structure |
| G 3551:2005 | Welded steel wire and bar fabrics |
| G 3552:2007 | Chain link wire netting |
| G 3553:2002 | Crimped wire cloth |
| G 3554:2002 | Hexagonal wire netting |
| G 3555:2004 | Woven wire cloth |
| G 3556:2002 | Industrial woven wire cloth |
| G 3557:2004 | Stainless steel wire ropes for general purposes |
| G 3560:1994 | Oil tempered wire for mechanical springs |
| G 3561:1994 | Oil tempered wire for valve springs |
| G 3601:2012 | Stainless-clad steels |
| G 3602:2012 | Nickel and nickel alloy clad steels |
| G 3603:2012 | Titanium clad steels |
| G 3604:2012 | Copper and copper alloy clad steels |
| G 4051:2009 | Carbon steels for machine structural use |
| G 4052:2008 | Structural steels with specified hardenability bands |
| G 4053:2008 | Low-alloyed steels for machine structural use |
| G 4107:2007 | Alloy steel bolting materials for high temperature service |
| G 4108:2007 | Alloy steel bars for special application bolting materials |
| G 4109:2013 | Chromium-molybdenum alloy steel plates for boilers and pressure vessels |
| G 4110:2015 | High strength chromium-molybdenum and chromium-molybdenum-vanadium alloy steel plates for pressure vessels under high-temperature service |
| G 4303:2012 | Stainless steel bars |
| G 4304:2012 | Hot-rolled stainless steel plate, sheet and strip |
| G 4305:2012 | Cold-rolled stainless steel plate, sheet and strip |
| G 4308:2013 | Stainless steel wire rods |
| G 4309:2013 | Stainless steel wires |
| G 4311:2011 | Heat-resisting steel bars and wire rods |
| G 4312:2011 | Heat-resisting steel plate, sheet and strip |
| G 4313:2011 | Cold rolled stainless steel strip for springs |
| G 4314:2013 | Stainless steel wires for springs |
| G 4315:2013 | Stainless steel wires for cold heading and cold forging |
| G 4316:1991 | Stainless steel wire rods for welding |
| G 4317:2013 | Hot-formed stainless steel sections |
| G 4318:1998 | Cold finished stainless steel bars |
| G 4319:1991 | Stainless steel blooms and billets for forgings |
| G 4320:2003 | Cold-formed stainless steel sections |
| G 4321:2000 | Stainless steel for building structure |
| G 4401:2009 | Carbon tool steels |

| Standard | Title |
|---|---|
| G 4403:2006 | High speed tool steels |
| G 4404:2006 | Alloy tool steels |
| G 4801:2011 | Spring steels |
| G 4802:2011 | Cold-rolled steel strip for springs |
| G 4804:2008 | Free-cutting steels |
| G 4805:2008 | High carbon chromium bearing steels |
| G 4901:1999 | Corrosion-resisting and heat-resisting superalloy bars |
| G 4902:1991 | Corrosion-resisting and heat-resisting superalloy plates and sheets |
| G 4903:2008 | Seamless nickel-chromium-iron alloy pipes |
| G 4904:2008 | Seamless nickel-chromium-iron alloy heat exchanger tubes |
| G 5101:1991 | Carbon steel castings |
| G 5102:1991 | Steel castings for welded structure |
| G 5111:1991 | High tensile strength carbon steel castings and low alloy steel castings for structural purposes |
| G 5121:2003 | Corrosion-resistant cast steels for general applications |
| G 5122:2003 | Heat-resistant cast steels and alloys for general applications |
| G 5131:2008 | High manganese steel castings |
| G 5151:1991 | Steel castings for high temperature and high pressure service |
| G 5152:1991 | Steel castings for low temperature and high pressure service |
| G 5201:1991 | Centrifugally cast steel pipes for welded structure |
| G 5202:1991 | Centrifugally cast steel pipes for high temperature and high pressure service |
| G 5501:1995 | Grey iron castings |
| G 5502:2001 | Spheroidal graphite iron castings |
| G 5503:1995 | Austempered spheroidal graphite iron castings |
| G 5504:2005 | Heavy-walled ferritic spheroidal graphite iron castings for low temperature service |
| G 5510:2012 | Austenitic iron castings |
| G 5511:1991 | Low thermal expansive Fe-alloy castings |
| G 5525:2000 | Cast-iron drainage pipes and fittings |
| G 5526:2014 | Ductile iron pipes |
| G 5527:2014 | Ductile iron fittings |
| G 5528:2014 | Epoxy-powder coating for interior of ductile iron pipes and fittings |
| G 5705:2000 | Malleable iron castings |
| G 5901:1974 | Molding silica sand |
| G 5902:1974 | Molding natural sand |
| G 5903:1975 | Cast shot and grit |
| G 5904:1966 | Testing method of cast shot and grit grain size |
| G 7105:2000 | Heat-treatable steels, alloy steels and free-cutting steels – Part 18: Bright products of unalloyed and low alloy steels |
| G 7125:2003 | Hollow steel bars for machining (ISO specifications) |
| G 7214:2000 | Seamless nickel and nickel alloy tube |
| G 7215:2003 | Plain end seamless steel tubes for mechanical application (ISO specifications) |
| G 7216:2003 | Plain end seamless precision steel tubes – Technical conditions for delivery (ISO specifications) |
| G 7217:2003 | Plain end welded precision steel tubes – Technical conditions for delivery (ISO specifications) |
| G 7218:2003 | Plain end as-welded and sized precision steel tubes – Technical conditions for delivery (ISO specifications) |
| G 7302:2000 | Zinc coatings for steel wire |
| G 7303:2000 | Zinc-coated steel wire for fencing |
| G 7304:2000 | Steel wire for mechanical springs – Part 1: General requirements |
| G 7305:2000 | Steel wire for mechanical springs – Part 2: Cold-drawn carbon steel wire |
| G 7306:2000 | Steel wire for mechanical springs – Part 3: Oil-hardened and tempered wire |
| G 7307:2000 | Steel for the prestressing of concrete – Part 1: General requirements |
| G 7308:2000 | Steel for the prestressing of concrete – Part 2: Cold-drawn wire |
| G 7309:2000 | Steel for the prestressing of concrete – Part 3: Quenched and tempered wire |
| G 7310:2000 | Steel for the prestressing of concrete – Part 4: Strand |
| G 7311:2000 | Steel for the prestressing of concrete – Part 5: Hot-rolled steel bars with or without subsequent processing |
| G 7401:2000 | Steels for cold heading and cold extruding |
| G 7502:2000 | Wrought nitriding steels |
| G 7701:2000 | Tool steels |

| Standard | Title |
|---|---|
| G 7821:2000 | Cast carbon steels for general engineering purposes |

# Appendix 4

# *EN CURRENT STEEL STANDARDS*

| Standard | Title |
|---|---|
| EN 39:2001 | Loose steel tubes for tube and coupler scaffolds - Technical delivery conditions |
| EN 502:2013 | Roofing products from metal sheet - Specification for fully supported roofing products of stainless steel sheet |
| EN 505:2013 | Roofing products from metal sheet - Specification for fully supported roofing products of steel sheet |
| EN 508-1:2014 | Roofing and cladding products from metal sheet - Specification for self-supporting of steel, aluminium or stainless steel sheet - Part 1: Steel |
| EN 508-2:2008 | Roofing products from metal sheet - Specification for self-supporting products of steel, aluminium or stainless steel sheet - Part 2: Aluminium |
| EN 508-3:2008 | Roofing products from metal sheet - Specification for self-supporting products of steel, aluminium or stainless steel sheet - Part 3: Stainless steel |
| EN 523:2003 | Steel strip sheaths for prestressing tendons - Terminology, requirements, quality control |
| EN 524-1:1997 | Steel strip sheaths for prestressing tendons - Test methods - Part 1: Determination of shape and dimensions |
| EN 524-2:1997 | Steel strip sheaths for prestressing tendons - Test methods - Part 2: Determination of flexural behaviour |
| EN 524-3:1997 | Steel strip sheaths for prestressing tendons - Methods of test - Part 3: To-and-fro bending test |
| EN 524-4:1997 | Steel strip sheaths for prestressing tendons - Test methods - Part 4: Determination of lateral load resistance |
| EN 524-5:1997 | Steel strip sheaths for prestressing tendons - Test methods - Part 5: Determination of tensile load resistance |
| EN 524-6:1997 | Steel strip sheaths for prestressing tendons - Test methods - Part 6: Determination of leaktightness (determination of water loss) |
| EN 544:2011 | Bitumen shingles with mineral and/or synthetic reinforcements - Product specification and test methods |
| EN 1123-1:1999 | Pipes and fittings of longitudinally welded hot-dip galvanized steel pipes with spigot and socket for waste water systems - Part 1: Requirements, testing, quality control |
| EN 1123-2:2006 | Pipes and fittings of longitudinally welded hot-dip galvanized steel tube with spigot and socket for waste water systems - Part 2: Dimensions |
| EN 1123-3:2004 | Pipes and fittings of longitudinally welded hot-dip galvanized steel pipes with spigot and socket for waste water systems - Part 3: Dimensions and special requirements for vacuum drainage systems and for drainage systems in ship-building |
| EN 1124-1:1999 | Pipes and fittings of longitudinally welded stainless steel pipes with spigot and socket for waste water systems - Part 1: Requirements, testing, quality control |
| EN 1124-2:2014 | Pipes and fittings of longitudinally welded stainless steel pipes with spigot and socket for waste water systems - Part 2: System S, forms and dimensions |
| EN 1124-3:2008 | Pipes and fittings of longitudinally welded stainless steel pipes with spigot and socket for waste water systems - Part 3: System X - Dimensions |
| EN 1124-4:2013 | Pipes and fittings of longitudinally welded stainless steel pipes with spigot and socket for wastewater systems - Part 4: Components for vacuum drainage systems and for drainage systems on ships |
| EN 1370:2011 | Founding - Examination of surface condition |
| EN 1503-1:2000 | Valves - Materials for bodies, bonnets and covers - Part 1: Steels specified in European Standards |
| EN 1503-2:2000 | Valves - Materials for bodies, bonnets and covers - Part 2: Steels other than those specified in European Standards |
| EN 1503-3:2000 | Valves - Materials for bodies, bonnets and covers - Part 3: Cast irons specified in European Standards |
| EN 1503-4:2002 | Valves - Materials for bodies, bonnets and covers - Part 4: Copper alloys specified in European Standards |
| EN 1559-1:2011 | Founding - Technical conditions of delivery - Part 1: General |
| EN 1559-2:2014 | Founding - Technical conditions of delivery - Part 2: Additional requirements for steel castings |
| EN 1559-3:2011 | Founding - Technical conditions of delivery - Part 3: Additional requirements for iron castings |
| EN 1559-4:2015 | Founding - Technical conditions of delivery - Part 4: Additional requirements for aluminium alloy castings |
| EN 1559-5:1997 | Founding - Technical conditions of delivery - Part 5: Additional requirements for magnesium alloy castings |
| EN 1559-6:1998 | Founding - Technical conditions of delivery - Part 6: Additional requirements for zinc alloy castings |
| EN 1561:2011 | Founding - Grey cast irons |
| EN 1562:2012 | Founding - Malleable cast irons |
| EN 1563:2011 | Founding - Spheroidal graphite cast irons |
| EN 1677-1:2000 | Components for slings - Safety - Part 1: Forged steel components, Grade 8 |
| EN 1677-2:2000 | Components for slings - Safety - Part 2: Forged steel lifting hooks with latch, Grade 8 |
| EN 1677-3:2001 | Components for slings - Safety - Part 3: Forged steel self-locking hooks - Grade 8 |
| EN 1677-4:2000 | Components for slings - Safety - Part 4: Links, Grade 8 |
| EN 1677-5:2001 | Components for slings - Safety - Part 5: Forged steel lifting hooks with latch - Grade 4 |
| EN 1677-6:2001 | Components for slings - Safety - Part 6: Links - Grade 4 |
| EN 1759-1:2004 | Flanges and their joints - Circular flanges for pipes, valves, fittings and accessories, Class designated - Part 1: Steel flanges, NPS 1/2 to 24 |
| EN 2515:1990 | Rod ends, adjustable single fork and threaded shank - Dimensions and loads |
| EN 3305:1996 | Screws, 100° countersunk reduced head, offset cruciform recess, close tolerance normal shank, short thread, in alloy steel, cadmium plated - Classification: 1 100 MPa (at ambient temperature)/235 °C |
| EN 10024:1995 | Hot rolled taper flange I sections - Tolerances on shape and dimensions |
| EN 10025-1:2004 | Hot rolled products of structural steels - Part 1: General technical delivery conditions |
| EN 10025-2:2004 | Hot rolled products of structural steels - Part 2: Technical delivery conditions for non-alloy structural steels |

| Standard | Title |
|---|---|
| EN 10025-3:2004 | Hot rolled products of structural steels - Part 3: Technical delivery conditions for normalized/normalized rolled weldable fine grain structural steels |
| EN 10025-4:2004 | Hot rolled products of structural steels - Part 4: Technical delivery conditions for thermomechanical rolled weldable fine grain structural steels |
| EN 10025-5:2004 | Hot rolled products of structural steels - Part 5: Technical delivery conditions for structural steels with improved atmospheric corrosion resistance |
| EN 10025-6:2004 | Hot rolled products of structural steels - Part 6: Technical delivery conditions for flat products of high yield strength structural steels in the quenched and tempered condition |
| EN 10027-1:2005 | Designation systems for steels - Part 1: Steel names |
| EN 10027-2:2015 | Designation systems for steels - Part 2: Numerical system |
| EN 10028-1:2007 | Flat products made of steels for pressure purposes - Part 1: General requirements |
| EN 10028-2:2009 | Flat products made of steels for pressure purposes - Part 2: Non-alloy and alloy steels with specified elevated temperature properties |
| EN 10028-3:2009 | Flat products made of steels for pressure purposes - Part 3: Weldable fine grain steels, normalized |
| EN 10028-4:2009 | Flat products made of steels for pressure purposes - Part 4: Nickel alloy steels with specified low temperature properties |
| EN 10028-5:2009 | Flat products made of steels for pressure purposes - Part 5: Weldable fine grain steels, thermomechanically rolled |
| EN 10028-6:2009 | Flat products made of steels for pressure purposes - Part 6: Weldable fine grain steels, quenched and tempered |
| EN 10028-7:2007 | Flat products made of steels for pressure purposes - Part 7: Stainless steels |
| EN 10029:2010 | Hot-rolled steel plates 3 mm thick or above - Tolerances on dimensions and shape |
| EN 10034:1993 | Structural steel I and H sections - Tolerances on shape and dimensions |
| EN 10048:1996 | Hot rolled narrow steel strip - Tolerances on dimensions and shape |
| EN 10051:2010 | Continuously hot-rolled strip and plate/sheet cut from wide strip of non-alloy and alloy steels - Tolerances on dimensions and shape |
| EN 10055:1995 | Hot rolled steel equal flange tees with radiused root and toes - Dimensions and tolerances on shape and dimensions |
| EN 10056-1:1998 | Structural steel equal and unequal leg angles - Part 1: Dimensions |
| EN 10056-2:1993 | Structural steel equal and unequal leg angles - Part 2: Tolerances on shape and dimensions |
| EN 10067:1996 | Hot rolled bulb flats - Dimensions and tolerances on shape, dimensions and mass |
| EN 10079:2007 | Definition of steel products |
| EN 10080:2005 | Steel for the reinforcement of concrete - Weldable reinforcing steel - General |
| EN 10083-1:2006 | Steels for quenching and tempering - Part 1: General technical delivery conditions |
| EN 10083-2:2006 | Steels for quenching and tempering - Part 2: Technical delivery conditions for non-alloy steels |
| EN 10083-3:2006 | Steels for quenching and tempering - Part 3: Technical delivery conditions for alloy steels |
| EN 10084:2008 | Case hardening steels - Technical delivery conditions |
| EN 10085:2001 | Nitriding steel - Technical delivery conditions |
| EN 10087:1998 | Free cutting steels - Technical delivery conditions for semi-finished products, hot-rolled bars and rods |
| EN 10088-1:2014 | Stainless steels - Part 1: List of stainless steels |
| EN 10088-2:2014 | Stainless steels - Part 2: Technical delivery conditions for sheet/plate and strip of corrosion resisting steels for general purposes |
| EN 10088-3:2014 | Stainless steels - Part 3: Technical delivery conditions for semi-finished products, bars, rods, wire, sections and bright products of corrosion resisting steels for general purposes |
| EN 10088-4:2009 | Stainless steels - Part 4: Technical delivery conditions for sheet/plate and strip of corrosion resisting steels for construction purposes |
| EN 10088-5:2009 | Stainless steels - Part 5: Technical delivery conditions for bars, rods, wire, sections and bright products of corrosion resisting steels for construction purposes |
| EN 10089:2002 | Hot-rolled steels for quenched and tempered springs - Technical delivery conditions |
| EN 10090:1998 | Valve steels and alloys for internal combustion engines |
| EN 10095:1999 | Heat resisting steel and nickel alloys |
| EN 10106:2007 | Cold rolled non-oriented electrical steel sheet and strip delivered in the fully processed state |
| EN 10107:2014 | Grain-oriented electrical steel strip and sheet delivered in the fully processed state |
| EN 10111:2008 | Continuously hot rolled low carbon steel sheet and strip for cold forming - Technical delivery conditions |
| EN 10120:1996 | Steel sheet and strip for welded gas cylinders |
| EN 10130:2006 | Cold rolled low carbon steel flat products for cold forming - Technical delivery conditions |
| EN 10131:2006 | Cold rolled uncoated and zinc or zinc-nickel electrolytically coated low carbon and high yield strength steel flat products for cold forming - Tolerances on dimensions and shape |
| EN 10132-1:2000 | Cold rolled narrow steel strip for heat treatment - Technical delivery conditions - Part 1: General |
| EN 10132-2:2000 | Cold rolled narrow steel strip for heat treatment - Technical delivery conditions - Part 2: Case hardening steels |
| EN 10132-3:2000 | Cold rolled narrow steel strip for heat treatment - Technical delivery conditions - Part 3: Steels for quenching and tempering |
| EN 10132-4:2000 | Cold rolled narrow steel strip for heat treatment - Technical delivery conditions - Part 4: Spring steels and other applications |

| Standard | Title |
|---|---|
| EN 10139:1997 | Cold rolled uncoated mild steel narrow strip for cold forming - Technical delivery conditions |
| EN 10140:2006 | Cold rolled narrow steel strip - Tolerances on dimensions and shape |
| EN 10143:2006 | Continuously hot-dip metal coated steel sheet and strip - Tolerances on dimensions and shape |
| EN 10149-1:2013 | Hot rolled flat products made of high yield strength steels for cold forming - Part 1: General technical delivery conditions |
| EN 10149-2:2013 | Hot rolled flat products made of high yield strength steels for cold forming - Part 2: Technical delivery conditions for thermomechanically rolled steels |
| EN 10149-3:2013 | Hot rolled flat products made of high yield strength steels for cold forming - Part 3: Technical delivery conditions for normalized or normalized rolled steels |
| EN 10151:2002 | Stainless steel strip for springs - Technical delivery conditions |
| EN 10152:2009 | Electrolytically zinc coated cold rolled steel flat products for cold forming - Technical delivery conditions |
| EN 10160:1999 | Ultrasonic testing of steel flat product of thickness equal or greater than 6 mm (reflection method) |
| EN 10162:2003 | Cold rolled steel sections - Technical delivery conditions - Dimensions and cross-sectional tolerances |
| EN 10163-1:2004 | Delivery requirements for surface condition of hot-rolled steel plates, wide flats and sections - Part 1: General requirements |
| EN 10163-2:2004 | Delivery requirements for surface condition of hot-rolled steel plates, wide flats and sections - Part 2: Plate and wide flats |
| EN 10163-3:2004 | Delivery requirements for surface condition of hot-rolled steel plates, wide flats and sections - Part 3: Sections |
| EN 10164:2004 | Steel products with improved deformation properties perpendicular to the surface of the product - Technical delivery conditions |
| EN 10169:2010 | Continuously organic coated (coil coated) steel flat products - Technical delivery conditions |
| EN 10202:2001 | Cold reduced tinmill products - Electrolytic tinplate and electrolytic chromium/chromium oxide coated steel |
| EN 10204:2004 | Metallic products - Types of inspection documents |
| EN 10205:1991 | Cold reduced blackplate in coil form for the production of tinplate or electrolytic chromium/chromium oxide coated steel |
| EN 10207:2005 | Steels for simple pressure vessels - Technical delivery requirements for plates, strips and bars |
| EN 10209:2013 | Cold rolled low carbon steel flat products for vitreous enamelling - Technical delivery conditions |
| EN 10210-1:2006 | Hot finished structural hollow sections of non-alloy and fine grain steels - Part 1: Technical delivery conditions |
| EN 10210-2:2006 | Hot finished structural hollow sections of non-alloy and fine grain steels - Part 2: Tolerances, dimensions and sectional properties |
| EN 10213:2007 | Steel castings for pressure purposes |
| EN 10216-1:2013 | Seamless steel tubes for pressure purposes - Technical delivery conditions - Part 1: Non-alloy steel tubes with specified room temperature properties |
| EN 10216-2:2013 | Seamless steel tubes for pressure purposes - Technical delivery conditions - Part 2: Non-alloy and alloy steel tubes with specified elevated temperature properties |
| EN 10216-3:2013 | Seamless steel tubes for pressure purposes - Technical delivery conditions - Part 3: Alloy fine grain steel tubes |
| EN 10216-4:2013 | Seamless steel tubes for pressure purposes - Technical delivery conditions - Part 4: Non-alloy and alloy steel tubes with specified low temperature properties |
| EN 10216-5:2013 | Seamless steel tubes for pressure purposes - Technical delivery conditions - Part 5: Stainless steel tubes |
| EN 10217-1:2002 | Welded steel tubes for pressure purposes - Technical delivery conditions - Part 1: Non-alloy steel tubes with specified room temperature properties |
| EN 10217-2:2002 | Welded steel tubes for pressure purposes - Technical delivery conditions - Part 2: Electric welded non-alloy and alloy steel tubes with specified elevated temperature properties |
| EN 10217-3:2002 | Welded steel tubes for pressure purposes - Technical delivery conditions - Part 3: Alloy fine grain steel tubes |
| EN 10217-4:2002 | Welded steel tubes for pressure purposes - Technical delivery conditions - Part 4: Electric welded non-alloy steel tubes with specified low temperature properties |
| EN 10217-5:2002 | Welded steel tubes for pressure purposes - Technical delivery conditions - Part 5: Submerged arc welded non-alloy and alloy steel tubes with specified elevated temperature properties |
| EN 10217-6:2002 | Welded steel tubes for pressure purposes - Technical delivery conditions - Part 6: Submerged arc welded non-alloy steel tubes with specified low temperature properties |
| EN 10217-7:2014 | Welded steel tubes for pressure purposes - Technical delivery conditions - Part 7: Stainless steel tubes |
| EN 10218-1:2012 | Steel wire and wire products - General - Part 1: Test methods |
| EN 10218-2:2012 | Steel wire and wire products - General - Part 2: Wire dimensions and tolerances |
| EN 10219-1:2006 | Cold formed welded structural hollow sections of non-alloy and fine grain steels - Part 1: Technical delivery conditions |
| EN 10219-2:2006 | Cold formed welded structural hollow sections of non-alloy and fine grain steels - Part 2: Tolerances, dimensions and sectional properties |
| EN 10221:1995 | Surface quality classes for hot-rolled bars and rods - Technical delivery conditions |
| EN 10222-1:1998 | Steel forgings for pressure purposes - Part 1: General requirements for open die forgings |
| EN 10222-2:1999 | Steel forgings for pressure purposes - Part 2: Ferritic and martensitic steels with specified elevated temperature properties |
| EN 10222-3:1998 | Steel forgings for pressure purposes - Part 3: Nickel steels with specified low-temperature properties |
| EN 10222-4:1998 | Steel forgings for pressure purposes - Part 4: Weldable fine-grain steels with high proof strength |

| Standard | Title |
|---|---|
| EN 10222-5:1999 | Steel forgings for pressure purposes - Part 5: Martensitic, austenitic and austenitic-ferritic stainless steels |
| EN 10223-1:2012 | Steel wire and wire products for fencing and netting - Part 1: Zinc and zinc-alloy coated steel barbed wire |
| EN 10223-2:2012 | Steel wire and wire products for fencing and netting - Part 2: Hexagonal steel wire netting for agricultural, insulation and fencing purposes |
| EN 10223-3:2013 | Steel wire and wire products for fencing and netting - Part 3: Hexagonal steel wire mesh products for civil engineering purposes |
| EN 10223-4:2012 | Steel wire and wire products for fencing and netting - Part 4: Steel wire welded mesh fencing |
| EN 10223-5:2012 | Steel wire and wire products for fencing and netting - Part 5: Steel wire woven hinged joint and knotted mesh fencing |
| EN 10223-6:2012 | Steel wire and wire products for fencing and netting - Part 6: Steel wire chain link fencing |
| EN 10223-7:2012 | Steel wire and wire products for fencing and netting - Part 7: Steel wire welded panels for fencing |
| EN 10224:2002 | Non-alloy steel tubes and fittings for the conveyance of aqueous liquids including water for human consumption - Technical delivery conditions |
| EN 10225:2009 | Weldable structural steels for fixed offshore structures - Technical delivery conditions |
| EN 10228-1:1999 | Non-destructive testing of steel forgings - Part 1: Magnetic particle inspection |
| EN 10228-2:1998 | Non-destructive testing of steel forgings - Part 2: Penetrant testing |
| EN 10228-3:1998 | Non-destructive testing of steel forgings - Part 3: Ultrasonic testing of ferritic or martensitic steel forgings |
| EN 10228-4:1999 | Non-destructive testing of steel forgings - Part 4: Ultrasonic testing of austenitic and austenitic-ferritic stainless steel forgings |
| EN 10238:2009 | Automatically blast-cleaned and automatically prefabrication primed structural steel products |
| EN 10240:1997 | Internal and/or external protective coatings for steel tubes - Specification for hot dip galvanized coatings applied in automatic plants |
| EN 10241:2000 | Steel threaded pipe fittings |
| EN 10243-1:1999 | Steel die forgings - Tolerances on dimensions - Part 1: Drop and vertical press forgings |
| EN 10243-2:1999 | Steel die forgings - Tolerances on dimensions - Part 2: Upset forgings made on horizontal forging machines |
| EN 10244-1:2009 | Steel wire and wire products - Non-ferrous metallic coatings on steel wire - Part 1: General principles |
| EN 10244-2:2009 | Steel wire and wire products - Non-ferrous metallic coatings on steel wire - Part 2: Zinc or zinc alloy coatings |
| EN 10244-3:2001 | Steel wire and wire products - Non-ferrous metallic coatings on steel wire - Part 3: Aluminium coatings |
| EN 10244-4:2001 | Steel wire and wire products - Non-ferrous metallic coatings on steel wire - Part 4: Tin coatings |
| EN 10244-5:2001 | Steel wire and wire products - Non-ferrous metallic coatings on steel wire - Part 5: Nickel coatings |
| EN 10244-6:2001 | Steel wire and wire products - Non-ferrous metallic coatings on steel wire - Part 6: Copper, bronze or brass coatings |
| EN 10245-1:2011 | Steel wire and wire products - Organic coatings on steel wire - Part 1: General rules |
| EN 10245-2:2011 | Steel wire and wire products - Organic coatings on steel wire - Part 2: PVC finished wire |
| EN 10245-3:2011 | Steel wire and wire products - Organic coatings on steel wire - Part 3: PE coated wire |
| EN 10245-4:2011 | Steel wire and wire products - Organic coatings on steel wire - Part 4: Polyester coated wire |
| EN 10245-5:2011 | Steel wire and wire products - Organic coatings on steel wire - Part 5: Polyamide coated wire |
| EN 10248-1:1995 | Hot rolled sheet piling of non alloy steels - Part 1: Technical delivery conditions |
| EN 10248-2:1995 | Hot rolled sheet piling of non alloy steels - Part 2: Tolerances on shape and dimensions |
| EN 10249-1:1995 | Cold formed sheet piling of non alloy steels - Part 1: Technical delivery conditions |
| EN 10249-2:1995 | Cold formed sheet piling of non alloy steels - Part 2: Tolerances on shape and dimensions |
| EN 10250-1:1999 | Open die steel forgings for general engineering purposes - Part 1: General requirements |
| EN 10250-2:1999 | Open die steel forgings for general engineering purposes - Part 2: Non-alloy quality and special steels |
| EN 10250-3:1999 | Open die steel forgings for general engineering purposes - Part 3: Alloy special steels |
| EN 10250-4:1999 | Open die steel forgings for general engineering purposes - Part 4: Stainless steels |
| EN 10251:1997 | Magnetic materials - Methods of determination of the geometrical characteristics of electrical steel sheet and strip |
| EN 10252:1997 | Magnetic materials - Methods of measurement of magnetic properties of magnetic steel sheet and strip at medium frequencies |
| EN 10253-1:1999 | Butt-welding pipe fittings - Part 1: Wrought carbon steel for general use and without specific inspection requirements |
| EN 10253-2:2007 | Butt-welding pipe fittings - Part 2: Non-alloy and ferritic alloy steels with specific inspection requirements |
| EN 10253-3:2008 | Butt-welding pipe fittings - Part 3: Wrought austenitic and austenitic-ferritic (duplex) stainless steels without specific inspection requirements |
| EN 10253-4:2008 | Butt-welding pipe fittings - Part 4: Wrought austenitic and austenitic-ferritic (duplex) stainless steels with specific inspection requirements |
| EN 10254:1999 | Steel closed die forgings - General technical delivery conditions |
| EN 10255:2004 | Non-alloy steel tubes suitable for welding and threading - Technical delivery conditions |
| EN 10257-1:2011 | Zinc or zinc alloy coated non-alloy steel wire for armouring either power cables or telecommunication cables - Part 1: Land cables |
| EN 10257-2:2011 | Zinc or zinc alloy coated non-alloy steel wire for armouring either power cables or telecommunication cables - Part 2: Submarine cables |
| EN 10263-1:2001 | Steel rod, bars and wire for cold heading and cold extrusion - Part 1: General technical delivery conditions |
| EN 10263-2:2001 | Steel rod, bars and wire for cold heading and cold extrusion - Part 2: Technical delivery conditions for steels not |

| Standard | Title |
|---|---|
| | intended for heat treatment after cold working |
| EN 10263-3:2001 | Steel rod, bars and wire for cold heading and cold extrusion - Part 3: Technical delivery conditions for case hardening steels |
| EN 10263-4:2001 | Steel rod, bars and wire for cold heading and cold extrusion - Part 4: Technical delivery conditions for steels for quenching and tempering |
| EN 10263-5:2001 | Steel rod, bars and wire for cold heading and cold extrusion - Part 5: Technical delivery conditions for stainless steels |
| EN 10264-1:2012 | Steel wire and wire products - Steel wire for ropes - Part 1: General requirements |
| EN 10264-2:2012 | Steel wire and wire products - Steel wire for ropes - Part 2: Cold drawn non alloy steel wire for ropes for general applications |
| EN 10264-3:2012 | Steel wire and wire products - Steel wire for ropes - Part 3: Round and shaped non alloyed steel wire for high duty applications |
| EN 10264-4:2012 | Steel wire and wire products - Steel wire for ropes - Part 4: Stainless steel wire |
| EN 10267:1998 | Ferritic-pearlitic steels for precipitation hardening from hot-working temperatures |
| EN 10268:2006 | Cold rolled steel flat products with high yield strength for cold forming - Technical delivery conditions |
| EN 10269:2013 | Steels and nickel alloys for fasteners with specified elevated and/or low temperature properties |
| EN 10270-1:2011 | Steel wire for mechanical springs - Part 1: Patented cold drawn unalloyed spring steel wire |
| EN 10270-2:2011 | Steel wire for mechanical springs - Part 2: Oil hardened and tempered spring steel wire |
| EN 10270-3:2011 | Steel wire for mechanical springs - Part 3: Stainless spring steel wire |
| EN 10271:1998 | Electrolytically zinc-nickel (ZN) coated steel flat products - Technical delivery conditions |
| EN 10272:2007 | Stainless steel bars for pressure purposes |
| EN 10273:2007 | Hot rolled weldable steel bars for pressure purposes with specified elevated temperature properties |
| EN 10277-1:2008 | Bright steel products - Technical delivery conditions - Part 1: General |
| EN 10277-2:2008 | Bright steel products - Technical delivery conditions - Part 2: Steels for general engineering purposes |
| EN 10277-3:2008 | Bright steel products - Technical delivery conditions - Part 3: Free-cutting steels |
| EN 10277-4:2008 | Bright steel products - Technical delivery conditions - Part 4: Case-hardening steels |
| EN 10277-5:2008 | Bright steel products - Technical delivery conditions - Part 5: Steels for quenching and tempering |
| EN 10278:1999 | Dimensions and tolerances of bright steel products |
| EN 10279:2000 | Hot rolled steel channels - Tolerances on shape, dimensions and mass |
| EN 10283:2010 | Corrosion resistant steel castings |
| EN 10293:2015 | Steel castings - Steel castings for general engineering uses |
| EN 10294-1:2005 | Hollow bars for machining - Technical delivery conditions - Part 1: Non alloy and alloy steels |
| EN 10294-2:2012 | Hollow bars for machining - Technical delivery conditions - Part 2: Stainless steels with specified machinability properties |
| EN 10295:2002 | Heat resistant steel castings |
| EN 10296-1:2003 | Welded circular steel tubes for mechanical and general engineering purposes - Technical delivery conditions - Part 1: Non-alloy and alloy steel tubes |
| EN 10296-2:2005 | Welded circular steel tubes for mechanical and general engineering purposes - Technical delivery conditions - Part 2: Stainless steel |
| EN 10297-1:2003 | Seamless circular steel tubes for mechanical and general engineering purposes - Technical delivery conditions - Part 1: Non-alloy and alloy steel tubes |
| EN 10297-2:2005 | Seamless circular steel tubes for mechanical and general engineering purposes - Technical delivery conditions - Part 2: Stainless steel |
| EN 10302:2008 | Creep resisting steels, nickel and cobalt alloys |
| EN 10303:2001 | Thin magnetic steel sheet and strip for use at medium frequencies |
| EN 10305-1:2010 | Steel tubes for precision applications - Technical delivery conditions - Part 1: Seamless cold drawn tubes |
| EN 10305-2:2010 | Steel tubes for precision applications - Technical delivery conditions - Part 2: Welded cold drawn tubes |
| EN 10305-3:2010 | Steel tubes for precision applications - Technical delivery conditions - Part 3: Welded cold sized tubes |
| EN 10305-4:2011 | Steel tubes for precision applications - Technical delivery conditions - Part 4: Seamless cold drawn tubes for hydraulic and pneumatic power systems |
| EN 10305-5:2010 | Steel tubes for precision applications - Technical delivery conditions - Part 5: Welded cold sized square and rectangular tubes |
| EN 10305-6:2005 | Steel tubes for precision applications - Technical delivery conditions - Part 6: Welded cold drawn tubes for hydraulic and pneumatic power systems |
| EN 10312:2002 | Welded stainless steel tubes for the conveyance of aqueous liquids including water for human consumption - Technical delivery conditions |
| EN 10324:2004 | Steel wire and wire products - Hose reinforcement wire |
| EN 10325:2006 | Steel - Determination of yield strength increase by the effect of heat treatment [Bake-Hardening-Index] |
| EN 10340:2007 | Steel castings for structural uses |
| EN 10341:2006 | Cold rolled electrical non-alloy and alloy steel sheet and strip delivered in the semi-processed state |
| EN 10343:2009 | Steels for quenching and tempering for construction purposes - Technical delivery conditions |
| EN 10346:2015 | Continuously hot-dip coated steel flat products for cold forming - Technical delivery conditions |

| Standard | Title |
|---|---|
| EN 10347:2006 | Guidance for forming of structural steels in processing |
| EN 12007-1:2012 | Gas infrastructure - Pipelines for maximum operating pressure up to and including 16 bar - Part 1: General functional requirements |
| EN 12007-2:2012 | Gas infrastructure - Pipelines for maximum operating pressure up to and including 16 bar - Part 2: Specific functional requirements for polyethylene (MOP up to and including 10 bar) |
| EN 12007-3:2015 | Gas infrastructure - Pipelines for maximum operating pressure up to and including 16 bar - Part 3: Specific functional requirements for steel |
| EN 12007-4:2012 | Gas infrastructure - Pipelines for maximum operating pressure up to and including 16 bar - Part 4: Specific functional requirements for renovation |
| EN 12007-5:2014 | Gas infrastructure - Pipelines for maximum operating pressure up to and including 16 bar - Part 5: Service lines - Specific functional requirements |
| EN 12269-1:2000 | Determination of the bond behaviour between reinforcing steel and autoclaved aerated concrete by the "beam test" - Part 1: Short term test |
| EN 12269-2:2010 | Determination of the bond behaviour between reinforcing steel and autoclaved aerated concrete by the beam test - Part 2: Long term test |
| EN 12385-1:2002 | Steel wire ropes - Safety - Part 1: General requirements |
| EN 12385-2:2002 | Steel wire ropes - Safety - Part 2: Definitions, designation and classification |
| EN 12385-3:2004 | Steel wire ropes - Safety - Part 3: Information for use and maintenance |
| EN 12385-4:2002 | Steel wire ropes - Safety - Part 4: Stranded ropes for general lifting applications |
| EN 12385-5:2002 | Steel wire ropes - Safety - Part 5: Stranded ropes for lifts |
| EN 12385-6:2004 | Steel wire ropes - Safety - Part 6: Stranded ropes for mine shafts |
| EN 12385-7:2002 | Steel wire ropes - Safety - Part 7: Locked coil ropes for mine shafts |
| EN 12385-8:2002 | Steel wire ropes - Safety - Part 8: Stranded hauling and carrying-hauling ropes for cableway installations designed to carry persons |
| EN 12385-9:2002 | Steel wire ropes - Safety - Part 9: Locked coil carrying ropes for cableway installations designed to carry persons |
| EN 12385-10:2003 | Steel wire ropes - Safety - Part 10: Spiral ropes for general structural applications |
| EN 12513:2011 | Founding - Abrasion resistant cast irons |
| EN 12536:2000 | Welding consumables - Rods for gas welding of non alloy and creep-resisting steels - Classification |
| EN 13262:2004 | Railway applications - Wheelsets and bogies - Wheels - Product requirement |
| EN 13411-1:2002 | Terminations for steel wire ropes - Safety - Part 1: Thimbles for steel wire rope slings |
| EN 13411-2-2001 | Terminations for steel wire ropes - Safety - Part 2: Splicing of eyes for wire rope slings |
| EN 13411-3:2004 | Terminations for steel wire ropes - Safety - Part 3: Ferrules and ferrule-securing |
| EN 13411-4:2011 | Terminations for steel wire ropes - Safety - Part 4: Metal and resin socketing |
| EN 13411-5:2003 | Terminations for steel wire ropes - Safety - Part 5: U-bolt wire rope grips |
| EN 13411-6:2004 | Terminations for steel wire ropes - Safety - Part 6: Asymmetric wedge socket |
| EN 13674-1:2011 | Railway applications - Track - Rail - Part 1: Vignole railway rails 46 kg/m and above |
| EN 13674-2:2006 | Railway applications - Track - Rail - Part 2: Switch and crossing rails used in conjunction with Vignole railway rails 46 kg/m and above |
| EN 13674-3:2006 | Railway applications - Track - Rail - Part 3: Check rails |
| EN 13674-4:2006 | Railway applications - Track - Rail - Part 4: Vignole railway rails from 27 kg/m to, but excluding 46 kg/m |
| EN 13835:2012 | Founding - Austenitic cast irons |
| EN 14195:2014 | Metal framing components for gypsum board systems - Definitions, requirements and test methods |
| EN 14783:2013 | Fully supported metal sheet and strip for roofing, external cladding and internal lining - Product specification and requirements |
| EN 50446:2006 | Straight thermocouple assembly with metal or ceramic protection tube and accessories |

# Appendix 5

# *EN ISO CURRENT STEEL STANDARDS*

| Standard | Title |
|---|---|
| EN ISO 636:2008 | Welding consumables - Rods, wires and deposits for tungsten inert gas welding of non-alloy and fine-grain steels - Classification |
| EN ISO 683-17:2014 | Heat-treated steels, alloy steels and free-cutting steels - Part 17: Ball and roller bearing steels |
| EN ISO 1127:1996 | Stainless steel tubes - Dimensions, tolerances and conventional masses per unit length |
| EN ISO 3183:2012 | Petroleum and natural gas industries - Steel pipe for pipeline transportation systems |
| EN ISO 3580:2011 | Welding consumables - Covered electrodes for manual metal arc welding of creep-resisting steels - Classification |
| EN ISO 3581:2012 | Welding consumables - Covered electrodes for manual metal arc welding of stainless and heat-resisting steels - Classification |
| EN ISO 3766:2003 | Construction drawings - Simplified representation of concrete reinforcement |
| EN ISO 4957:1999 | Tool steels |
| EN ISO 7153-1:2000 | Surgical instruments - Metallic Materials - Part 1: Stainless steel |
| EN ISO 9445-1:2010 | Continuously cold-rolled stainless steel - Tolerances on dimensions and form - Part 1: Narrow strip and cut lengths |
| EN ISO 9445-2:2010 | Continuously cold-rolled stainless steel - Tolerances on dimensions and form - Part 2: Wide strip and plate/sheet |
| EN ISO 10893-1:2011 | Non-destructive testing of steel tubes - Part 1: Automated electromagnetic testing of seamless and welded (except submerged arc-welded) steel tubes for the verification of hydraulic leaktightness |
| EN ISO 10893-2:2011 | Non-destructive testing of steel tubes - Part 2: Automated eddy current testing of seamless and welded (except submerged arc-welded) steel tubes for the detection of imperfections |
| EN ISO 10893-3:2011 | Non-destructive testing of steel tubes - Part 3: Automated full peripheral flux leakage testing of seamless and welded (except submerged arc-welded) ferromagnetic steel tubes for the detection of longitudinal and/or transverse imperfections |
| EN ISO 10893-4:2011 | Non-destructive testing of steel tubes - Part 4: Liquid penetrant inspection of seamless and welded steel tubes for the detection of surface imperfections |
| EN ISO 10893-5:2011 | Non-destructive testing of steel tubes - Part 5: Magnetic particle inspection of seamless and welded ferromagnetic steel tubes for the detection of surface imperfections |
| EN ISO 10893-6:2011 | Non-destructive testing of steel tubes - Part 6: Radiographic testing of the weld seam of welded steel tubes for the detection of imperfections |
| EN ISO 10893-7:2011 | Non-destructive testing of steel tubes - Part 7: Digital radiographic testing of the weld seam of welded steel tubes for the detection of imperfections |
| EN ISO 10893-8:2011 | Non-destructive testing of steel tubes - Part 8: Automated ultrasonic testing of seamless and welded steel tubes for the detection of laminar imperfections |
| EN ISO 10893-9:2011 | Non-destructive testing of steel tubes - Part 9: Automated ultrasonic testing for the detection of laminar imperfections in strip/plate used for the manufacture of welded steel tubes |
| EN ISO 10893-10:2011 | Non-destructive testing of steel tubes - Part 10: Automated full peripheral ultrasonic testing of seamless and welded (except submerged arc-welded) steel tubes for the detection of longitudinal and/or transverse imperfections |
| EN ISO 10893-11:2011 | Non-destructive testing of steel tubes - Part 11: Automated ultrasonic testing of the weld seam of welded steel tubes for the detection of longitudinal and/or transverse imperfections |
| EN ISO 10893-12:2011 | Non-destructive testing of steel tubes - Part 12: Automated full peripheral ultrasonic thickness testing of seamless and welded (except submerged arc-welded) steel tubes |
| EN ISO 11960:2014 | Petroleum and natural gas industries - Steel pipes for use as casing or tubing for wells |
| EN ISO 14171:2010 | Welding consumables - Solid wire electrodes, tubular cored electrodes and electrode/flux combinations for submerged arc welding of non alloy and fine grain steels - Classification |
| EN ISO 14341:2011 | Welding consumables - Wire electrodes and weld deposits for gas shielded metal arc welding of non alloy and fine grain steels - Classification |
| EN ISO 14343:2009 | Welding consumables - Wire electrodes, strip electrodes, wires and rods for arc welding of stainless and heat resisting steels - Classification |
| EN ISO 16120-1:2011 | Non-alloy steel wire rod for conversion to wire - Part 1: General requirements |
| EN ISO 16120-2:2011 | Non-alloy steel wire rod for conversion to wire - Part 2: Specific requirements for general-purpose wire rod |
| EN ISO 16120-3:2011 | Non-alloy steel wire rod for conversion to wire - Part 3: Specific requirements for rimmed and rimmed substitute, low-carbon steel wire rod |
| EN ISO 16120-4:2011 | Non-alloy steel wire rod for conversion to wire - Part 4: Specific requirements for wire rod for special applications |
| EN ISO 17632:2008 | Welding consumables - Tubular cored electrodes for gas shielded and non-gas shielded metal arc welding of non-alloy and fine grain steels - Classification |
| EN ISO 21952:2012 | Welding consumables - Wire electrodes, wires, rods and deposits for gas shielded arc welding of creep-resisting steels - Classification |

# Appendix

# 6

## *ISO IRON AND STEEL PRODUCT STANDARDS*

| Standard | Title |
|---|---|
| ISO 65:1981 | Carbon steel tubes suitable for screwing in accordance with ISO 7-1 |
| ISO 404:1992 | Steel and steel products -- General technical delivery requirements |
| ISO 559:1991 | Steel tubes for water and sewage |
| ISO 630:1995 | Structural steels -- Plates, wide flats, bars, sections and profiles |
| ISO 630-2:2000 | Structural steels – Part 2: Technical delivery requirements for hot-finished hollow sections |
| ISO 657-1:1989 | Hot-rolled steel sections -- Part 1: Equal-leg angles -- Dimensions |
| ISO 657-2:1989 | Hot-rolled steel sections -- Part 2: Unequal-leg angles -- Dimensions |
| ISO 657-5:1976 | Hot-rolled steel sections -- Part 5: Equal-leg angles and unequal-leg angles -- Tolerances for metric and inch series |
| ISO 657-11:1980 | Hot-rolled steel sections -- Part 11: Sloping flange channel sections (Metric series) -- Dimensions and sectional properties |
| ISO 657-14:2000 | Hot-rolled steel sections -- Part 14: Hot-finished structural hollow sections -- Dimensions and sectional properties |
| ISO 657-15:1980 | Hot-rolled steel sections -- Part 15: Sloping flange beam sections (Metric series) -- Dimensions and sectional properties |
| ISO 657-16:1980 | Hot-rolled steel sections -- Part 16: Sloping flange column sections (metric series) -- Dimensions and sectional properties |
| ISO 657-18:1980 | Hot-rolled steel sections -- Part 18: L sections for shipbuilding (metric series) -- Dimensions, sectional properties and tolerances |
| ISO 657-19:1980 | Hot-rolled steel sections -- Part 19: Bulb flats (metric series) -- Dimensions, sectional properties and tolerances |
| ISO 657-21:1983 | Hot-rolled steel sections -- Part 21: T-sections with equal depth and flange width -- Dimensions |
| ISO 683-1:1987 | Heat-treatable steels, alloy steels and free-cutting steels -- Part 1: Direct-hardening unalloyed and low-alloyed wrought steel in form of different black products |
| ISO 683-9:1988 | Heat-treatable steels, alloy steels and free-cutting steels -- Part 9: Wrought free-cutting steels |
| ISO 683-10:1987 | Heat-treatable steels, alloy steels and free-cutting steels -- Part 10: Wrought nitriding steels |
| ISO 683-11:1987 | Heat-treatable steels, alloy steels and free-cutting steels -- Part 11: Wrought case-hardening steels |
| ISO 683-14:2004 | Heat-treatable steels, alloy steels and free-cutting steels -- Part 14: Hot-rolled steels for quenched and tempered springs |
| ISO 683-15:1992 | Heat-treatable steels, alloy steels and free-cutting steels -- Part 15: Valve steels for internal combustion engines |
| ISO 683-17:1999 | Heat-treated steels, alloy steels and free-cutting steels -- Part 17: Ball and roller bearing steels |
| ISO 683-18:1996 | Heat-treatable steels, alloy steels and free- cutting steels -- Part 18: Bright products of unalloyed and low alloy steels |
| ISO 722:1991 | Rock drilling equipment -- Hollow drill steels in bar form, hexagonal and round |
| ISO 1035-1:1980 | Hot-rolled steel bars -- Part 1: Dimensions of round bars |
| ISO 1035-2:1980 | Hot-rolled steel bars -- Part 2: Dimensions of square bars |
| ISO 1035-3:1980 | Hot-rolled steel bars -- Part 3: Dimensions of flat bars |
| ISO 1035-4:1982 | Hot-rolled steel bars -- Part 4: Tolerances |
| ISO 1052:1982 | Steels for general engineering purposes |
| ISO 1127:1992 | Stainless steel tubes -- Dimensions, tolerances and conventional masses per unit length |
| ISO 1129:1980 | Steel tubes for boilers, superheaters and heat exchangers -- Dimensions, tolerances and conventional masses per unit length |
| ISO 1834:1999 | Short link chain for lifting purposes -- General conditions of acceptance |
| ISO 1835:1980 | Short link chain for lifting purposes -- Grade M (4), non-calibrated, for chain slings etc. |
| ISO 1837:2003 | Lifting hooks -- Nomenclature |
| ISO 2037:1992 | Stainless steel tubes for the food industry |
| ISO 2232:1990 | Round drawn wire for general purpose non-alloy steel wire ropes and for large diameter steel wire ropes -- Specifications |
| ISO 2262:1984 | General purpose thimbles for use with steel wire ropes -- Specification |
| ISO 2308:1972 | Hooks for lifting freight containers of up to 30 tonnes capacity -- Basic requirements |
| ISO 2408:2004 | Steel wire ropes for general purposes -- Minimum requirements |
| ISO 2415:2004 | Forged shackles for general lifting purposes -- Dee shackles and bow shackles |
| ISO 2531:1998 | Ductile iron pipes, fittings, accessories and their joints for water or gas applications |
| ISO 2532:1974 | Steel wire ropes -- Vocabulary |
| ISO 2605-3:1985 | Steel products for pressure purposes -- Derivation and verification of elevated temperature properties -- Part 3: An alternative procedure for deriving the elevated temperature yield or proof stress properties when data are limited |
| ISO 2701:1977 | Drawn wire for general purpose non-alloy steel wire ropes -- Terms of acceptance |
| ISO 2937:1974 | Plain end seamless steel tubes for mechanical application |
| ISO 2938:1974 | Hollow steel bars for machining |
| ISO 3056:1986 | Non-calibrated round steel link lifting chain and chain slings -- Use and maintenance |
| ISO 3075:1980 | Short link chain for lifting purposes -- Grade S (6) non calibrated, for chain slings etc. |
| ISO 3076:1984 | Short link chain for lifting purposes -- Grade T (8), non-calibrated, for chain slings etc. |

| Standard | Title |
|---|---|
| ISO 3077:2001 | Short-link chain for lifting purposes -- Grade T, (types T, DAT and DT), fine-tolerance hoist chain |
| ISO 3108:1974 | Steel wire ropes for general purposes -- Determination of actual breaking load |
| ISO 3183:2007 | Petroleum and natural gas industries -- Steel pipe for pipeline transportation systems |
| ISO 3189-1:1985 | Sockets for wire ropes for general purposes -- Part 1: General characteristics and conditions of acceptance |
| ISO 3189-2:1985 | Sockets for wire ropes for general purposes -- Part 2: Special requirements for sockets produced by forging or machined from the solid |
| ISO 3189-3:1985 | Sockets for wire ropes for general purposes -- Part 3: Special requirements for sockets produced by casting |
| ISO 3266:1984 | Eyebolts for general lifting purposes |
| ISO 3304:1985 | Plain end seamless precision steel tubes -- Technical conditions for delivery |
| ISO 3305:1985 | Plain end welded precision steel tubes -- Technical conditions for delivery |
| ISO 3306:1985 | Plain end as-welded and sized precision steel tubes -- Technical conditions for delivery |
| ISO 3545-1:1989 | Steel tubes and fittings -- Symbols for use in specifications -- Part 1: Tubes and tubular accessories with circular cross-section |
| ISO 3545-2:1989 | Steel tubes and fittings -- Symbols for use in specifications -- Part 2: Square and rectangular hollow sections |
| ISO 3573:1999 | Hot-rolled carbon steel sheet of commercial and drawing qualities |
| ISO 3574:1999 | Cold-reduced carbon steel sheet of commercial and drawing qualities |
| ISO 3575:2005 | Continuous hot-dip zinc-coated carbon steel sheet of commercial and drawing qualities |
| ISO 3755:1991 | Cast carbon steels for general engineering purposes |
| ISO 4019:2001 | Structural steels -- Cold-formed, welded, structural hollow sections -- Dimensions and sectional properties |
| ISO 4101:1983 | Drawn steel wire for elevator ropes -- Specifications |
| ISO 4179:2005 | Ductile iron pipes for pressure and non-pressure pipelines -- Centrifugal cement mortar lining -- General requirements |
| ISO 4200:1991 | Plain end steel tubes, welded and seamless -- General tables of dimensions and masses per unit length |
| ISO 4308-1:2003 | Cranes and lifting appliances -- Selection of wire ropes -- Part 1: General |
| ISO 4308-2:1988 | Cranes and lifting appliances -- Selection of wire ropes -- Part 2: Mobile cranes -- Coefficient of utilization |
| ISO 4309:2004 | Cranes -- Wire ropes -- Care, maintenance, installation, examination and discard |
| ISO 4344:2004 | Steel wire ropes for lifts -- Minimum requirements |
| ISO 4345:1988 | Steel wire ropes -- Fibre main cores -- Specification |
| ISO 4346:1977 | Steel wire ropes for general purposes -- Lubricants -- Basic requirements |
| ISO 4778:1981 | Chain slings of welded construction -- Grades M (4), S (6) and T (8) |
| ISO 4779:1986 | Forged steel lifting hooks with point and eye for use with steel chains of grade M(4) |
| ISO 4885:1996 | Ferrous products -- Heat treatments -- Vocabulary |
| ISO 4950-1:1995 | High yield strength flat steel products -- Part 1: General requirements |
| ISO 4950-2:1995 | High yield strength flat steel products -- Part 2: Products supplied in the normalized or controlled rolled condition |
| ISO 4950-3:1995 | High yield strength flat steel products -- Part 3: Products supplied in the heat-treated (quenched + tempered) condition |
| ISO 4951-1:2001 | High yield strength steel bars and sections -- Part 1: General delivery requirements |
| ISO 4951-2:2001 | High yield strength steel bars and sections -- Part 2: Delivery conditions for normalized, normalized rolled and as-rolled steels |
| ISO 4951-3:2001 | High yield strength steel bars and sections -- Part 3: Delivery conditions for thermomechanically-rolled steels |
| ISO 4952:2006 | Structural steels with improved atmospheric corrosion resistance |
| ISO 4954:1993 | Steels for cold heading and cold extruding |
| ISO 4955:2005 | Heat-resistant steels |
| ISO 4957:1999 | Tool steels |
| ISO 4960:1999 | Cold-reduced carbon steel strip with a carbon content over 0,25 % |
| ISO 4978:1983 | Flat rolled steel products for welded gas cylinders |
| ISO 4986:1992 | Steel castings -- Magnetic particle inspection |
| ISO 4987:1992 | Steel castings -- Penetrant inspection |
| ISO 4990:2003 | Steel castings -- General technical delivery requirements |
| ISO 4991:2005 | Steel castings for pressure purposes |
| ISO 4993:1987 | Steel castings -- Radiographic inspection |
| ISO 4995:2001 | Hot-rolled steel sheet of structural quality |
| ISO 4996:2007 | Hot-rolled steel sheet of high yield stress structural quality |
| ISO 4997:2007 | Cold-reduced carbon steel sheet of structural quality |
| ISO 4998:2005 | Continuous hot-dip zinc-coated carbon steel sheet of structural quality |
| ISO 4999:2005 | Continuous hot-dip terne (lead alloy) coated cold-reduced carbon steel sheet of commercial, drawing and structural qualities |
| ISO 5000:2005 | Continuous hot-dip aluminium-silicon-coated cold-reduced carbon steel sheet of commercial and drawing qualities |

| Standard | Title |
|---|---|
| ISO 5001:2007 | Cold-reduced carbon steel sheet for vitreous enamelling |
| ISO 5002:1999 | Hot-rolled and cold-reduced electrolytic zinc-coated carbon steel sheet of commercial and drawing qualities |
| ISO 5252:1991 | Steel tubes -- Tolerance systems |
| ISO 5256:1985 | Steel pipes and fittings for buried or submerged pipe lines -- External and internal coating by bitumen or coal tar derived materials |
| ISO 5949:1983 | Tool steels and bearing steels -- Micrographic method for assessing the distribution of carbides using reference photomicrographs |
| ISO 5950:2000 | Continuous electrolytic tin-coated cold-reduced carbon steel sheet of commercial and drawing qualities |
| ISO 5951:2001 | Hot-rolled steel sheet of higher yield strength with improved formability |
| ISO 5952:2005 | Continuously hot-rolled steel sheet of structural quality with improved atmospheric corrosion resistance |
| ISO 5954:1998 | Cold-reduced carbon steel sheet according to hardness requirements |
| ISO 6303:1981 | Pressure vessel steels not included in ISO 2604, Parts 1 to 6 -- Derivation of long-time stress rupture properties |
| ISO 6316:2000 | Hot-rolled steel strip of structural quality |
| ISO 6317:2000 | Hot-rolled carbon steel strip of commercial and drawing qualities |
| ISO 6594:2006 | Cast iron drainage pipes and fittings -- Spigot series |
| ISO 6758:1980 | Welded steel tubes for heat exchangers |
| ISO 6759:1980 | Seamless steel tubes for heat exchangers |
| ISO 6761:1981 | Steel tubes -- Preparation of ends of tubes and fittings for welding |
| ISO 6929:1987 | Steel products -- Definitions and classification |
| ISO 6930-1:2001 | High yield strength steel plates and wide flats for cold forming -- Part 1: Delivery conditions for thermomechanically-rolled steels |
| ISO 6930-2:2004 | High yield strength steel plates and wide flats for cold forming -- Part 2: Delivery condition for normalized, normalized rolled and as-rolled steels |
| ISO 6931-1:1994 | Stainless steels for springs -- Part 1: Wire |
| ISO 6931-2:2005 | Stainless steels for springs -- Part 2: Narrow strip |
| ISO 6932:2001 | Cold-reduced carbon steel strip with a maximum carbon content of 0,25 % |
| ISO 6934-1:1991 | Steel for the prestressing of concrete -- Part 1: General requirements |
| ISO 6934-2:1991 | Steel for the prestressing of concrete -- Part 2: Cold-drawn wire |
| ISO 6934-3:1991 | Steel for the prestressing of concrete -- Part 3: Quenched and tempered wire |
| ISO 6934-4:1991 | Steel for the prestressing of concrete -- Part 4: Strand |
| ISO 6934-5:1991 | Steel for the prestressing of concrete -- Part 5: Hot-rolled steel bars with or without subsequent processing |
| ISO 6935-1:1991 | Steel for the reinforcement of concrete -- Part 1: Plain bars |
| ISO 6935-2:1991 | Steel for the reinforcement of concrete -- Part 2: Ribbed bars |
| ISO 6935-3:1992 | Steel for the reinforcement of concrete -- Part 3: Welded fabric |
| ISO 6984:1990 | Round non-alloy steel wires for stranded wire ropes for mine hoisting -- Specifications |
| ISO 7153-1:1991 | Surgical instruments -- Metallic materials -- Part 1: Stainless steel Amd 1:1999 |
| ISO 7186:1996 | Ductile iron products for sewage applications |
| ISO 7452:2002 | Hot-rolled structural steel plates -- Tolerances on dimensions and shape |
| ISO/TR 7468:1981 | Summary of average stress rupture properties of wrought steels for boilers and pressure vessels |
| ISO 7531:1987 | Wire rope slings for general purposes -- Characteristics and specifications |
| ISO 7592:1983 | Calibrated round steel link lifting chains -- Guidelines to proper use and maintenance |
| ISO 7593:1986 | Chain slings assembled by methods other than welding -- Grade T(8) |
| ISO 7597:1987 | Forged steel lifting hooks with point and eye for use with steel chains of grade T(8) |
| ISO 7598:1988 | Stainless steel tubes suitable for screwing in accordance with ISO 7-1 |
| ISO 7778:1983 | Steel plate with specified through-thickness characteristics |
| ISO 7788:1985 | Steel -- Surface finish of hot-rolled plates and wide flats -- Delivery requirements |
| ISO 7900:2006 | Steel wire and wire products for fences -- Zinc-and zinc-alloy-coated steel barbed wire |
| ISO 7989-1:2006 | Steel wire and wire products -- Non-ferrous metallic coatings on steel wire -- Part 1: General principles |
| ISO 7989-2:2007 | Steel wire and wire products -- Non-ferrous metallic coatings on steel wire -- Part 2: Zinc or zinc-alloy coating |
| ISO 8179-1:2004 | Ductile iron pipes -- External zinc-based coating -- Part 1: Metallic zinc with finishing layer |
| ISO 8179-2:1995 | Ductile iron pipes -- External zinc coating -- Part 2: Zinc rich paint with finishing layer |
| ISO 8180:2006 | Ductile iron pipes -- Polyethylene sleeving for site application |
| ISO 8458-1:2002 | Steel wire for mechanical springs -- Part 1: General requirements |
| ISO 8458-2:2002 | Steel wire for mechanical springs -- Part 2: Patented cold-drawn non-alloy steel wire |
| ISO 8458-3:2002 | Steel wire for mechanical springs -- Part 3: Oil-hardened and tempered wire |
| ISO 8539:1986 | Forged steel lifting components for use with grade T(8) chain |
| ISO 8792:1986 | Wire rope slings -- Safety criteria and inspection procedures for use |

| Standard | Title |
|---|---|
| ISO 8793:1986 | Steel wire ropes -- Ferrule-secured eye terminations |
| ISO 8794:1986 | Steel wire ropes -- Spliced eye terminations for slings |
| ISO 9034:1987 | Hot-rolled structural steel wide flats -- Tolerances on dimensions and shape |
| ISO 9095:1990 | Steel tubes -- Continuous character marking and colour coding for material identification |
| ISO 9302:1994 | Seamless and welded (except submerged arc-welded) steel tubes for pressure purposes -- Electromagnetic testing for verification of hydraulic leak-tightness |
| ISO 9303:1989 | Seamless and welded (except submerged arc-welded) steel tubes for pressure purposes -- Full peripheral ultrasonic testing for the detection of longitudinal imperfections |
| ISO 9304:1989 | Seamless and welded (except submerged arc-welded) steel tubes for pressure purposes -- Eddy current testing for the detection of imperfections |
| ISO 9305:1989 | Seamless steel tubes for pressure purposes -- Full peripheral ultrasonic testing for the detection of transverse imperfections |
| ISO 9327-1:1999 | Steel forgings and rolled or forged bars for pressure purposes -- Technical delivery conditions -- Part 1: General requirements |
| ISO 9327-2:1999 | Steel forgings and rolled or forged bars for pressure purposes -- Technical delivery conditions -- Part 2: Non-alloy and alloy (Mo, Cr and CrMo) steels with specified elevated temperature properties |
| ISO 9327-3:1999 | Steel forgings and rolled or forged bars for pressure purposes -- Technical delivery conditions -- Part 3: Nickel steels with specified low temperature properties |
| ISO 9327-4:1999 | Steel forgings and rolled or forged bars for pressure purposes -- Technical delivery conditions -- Part 4: Weldable fine grain steels with high proof strength |
| ISO 9327-5:1999 | Steel forgings and rolled or forged bars for pressure purposes -- Technical delivery conditions -- Part 5: Stainless steels |
| ISO 9328-1:2003 | Steel flat products for pressure purposes -- Technical delivery conditions -- Part 1: General requirements |
| ISO 9328-2:2004 | Steel flat products for pressure purposes -- Technical delivery conditions -- Part 2: Non-alloy and alloy steels with specified elevated temperature properties |
| ISO 9328-3:2004 | Steel flat products for pressure purposes -- Technical delivery conditions -- Part 3: Weldable fine grain steels, normalized |
| ISO 9328-4:2004 | Steel flat products for pressure purposes -- Technical delivery conditions -- Part 4: Nickel-alloy steels with specified low temperature properties |
| ISO 9328-5:2004 | Steel flat products for pressure purposes -- Technical delivery conditions -- Part 5: Weldable fine grain steels, thermomechanically rolled |
| ISO 9328-6:2004 | Steel flat products for pressure purposes -- Technical delivery conditions -- Part 6: Weldable fine grain steels, quenched and tempered |
| ISO 9328-7:2004 | Steel flat products for pressure purposes -- Technical delivery conditions -- Part 7: Stainless steels |
| ISO 9329-1:1989 | Seamless steel tubes for pressure purposes -- Technical delivery conditions -- Part 1: Unalloyed steels with specified room temperature properties |
| ISO 9329-2:1997 | Seamless steel tubes for pressure purposes -- Technical delivery conditions -- Part 2: Unalloyed and alloyed steels with specified elevated temperature properties |
| ISO 9329-3:1997 | Seamless steel tubes for pressure purposes -- Technical delivery conditions -- Part 3: Unalloyed and alloyed steels with specified low temperature properties |
| ISO 9329-4:1997 | Seamless steel tubes for pressure purposes -- Technical delivery conditions -- Part 4: Austenitic stainless steels |
| ISO 9330-1:1990 | Welded steel tubes for pressure purposes -- Technical delivery conditions -- Part 1: Unalloyed steel tubes with specified room temperature properties |
| ISO 9330-2:1997 | Welded steel tubes for pressure purposes -- Technical delivery conditions -- Part 2: Electric resistance and induction welded unalloyed and alloyed steel tubes with specified elevated temperature properties |
| ISO 9330-3:1997 | Welded steel tubes for pressure purposes -- Technical delivery conditions -- Part 3: Electric resistance and induction welded unalloyed and alloyed steel tubes with specified low temperature properties |
| ISO 9330-4:2000 | Welded steel tubes for pressure purposes -- Technical delivery conditions -- Part 4: Submerged arc-welded unalloyed and alloyed steel tubes with specified elevated temperature properties |
| ISO 9330-5:2000 | Welded steel tubes for pressure purposes -- Technical delivery conditions -- Part 5: Submerged arc-welded unalloyed and alloyed steel tubes with specified low temperature properties |
| ISO 9330-6:1997 | Welded steel tubes for pressure purposes -- Technical delivery conditions -- Part 6: Longitudinally welded austenitic stainless steel tubes |
| ISO 9364:2006 | Continuous hot-dip aluminium/zinc-coated steel sheet of commercial, drawing and structural qualities |
| ISO 9402:1989 | Seamless and welded (except submerged arc-welded) steel tubes for pressure purposes -- Full peripheral magnetic transducer/flux leakage testing of ferromagnetic steel tubes for the detection of longitudinal imperfections |
| ISO 9442:1988 | Steel -- Hot-rolled ribbed and grooved flats for spring leaves -- Tolerances and dimensions |
| ISO 9443:1991 | Heat-treatable and alloy steels -- Surface quality classes for hot-rolled round bars and wire rods -- Technical delivery conditions |
| ISO 9444:2002 | Continuously hot-rolled stainless steel strip, plate/sheet and cut lengths -- Tolerances on dimensions and form |
| ISO 9445:2002 | Continuously cold-rolled stainless steel narrow strip, wide strip, plate/sheet and cut lengths -- Tolerances on dimensions and form |
| ISO 9473-1:2006 | Textile machinery and accessories -- Strip steel for dents of reeds -- Part 1: Cold rolled strip steel |
| ISO 9473-2:2006 | Textile machinery and accessories -- Strip steel for dents of reeds -- Part 2: Hardened strip steel |

| Standard | Title |
|---|---|
| ISO 9477:1992 | High strength cast steels for general engineering and structural purposes |
| ISO 9598:1989 | Seamless steel tubes for pressure purposes -- Full peripheral magnetic transducer/flux leakage testing of ferromagnetic steel tubes for the detection of transverse imperfections |
| ISO 9764:1989 | Electric resistance and induction welded steel tubes for pressure purposes -- Ultrasonic testing of the weld seam for the detection of longitudinal imperfections |
| ISO 9765:1990 | Submerged arc-welded steel tubes for pressure purposes -- Ultrasonic testing of the weld seam for the detection of longitudinal and/or transverse imperfections |
| ISO 9975:1990 | Round non-alloy steel wires for locked coil mine winding ropes -- Specifications |
| ISO 10124:1994 | Seamless and welded (except submerged arc-welded) steel tubes for pressure purposes -- Ultrasonic testing for the detection of laminar imperfections |
| ISO 10144:1991 | Certification scheme for steel bars and wires for the reinforcement of concrete structures |
| ISO 10332:1994 | Seamless and welded (except submerged arc-welded) steel tubes for pressure purposes -- Ultrasonic testing for the verification of hydraulic leak-tightness |
| ISO 10384:2001 | Hot-rolled carbon steel sheet for machinery |
| ISO 10425:2003 | Steel wire ropes for the petroleum and natural gas industries -- Minimum requirements and terms of acceptance |
| ISO 10474:1991 | Steel and steel products -- Inspection documents |
| ISO 10543:1993 | Seamless and hot-stretch-reduced welded steel tubes for pressure purposes -- Full peripheral ultrasonic thickness testing |
| ISO 10544:1992 | Cold-reduced steel wire for the reinforcement of concrete and the manufacture of welded fabric |
| ISO 10763:1994 | Hydraulic fluid power -- Plain-end, seamless and welded precision steel tubes -- Dimensions and nominal working pressures |
| ISO 10799:2001 | Structural steels -- Cold-formed, welded, structural hollow sections -- Technical delivery requirements |
| ISO 10803:1999 | Design method for ductile iron pipes |
| ISO 11054:2006 | Cutting tools -- Designation of high-speed steel groups |
| ISO 11082:1992 | Certification scheme for welded fabric for the reinforcement of concrete structures |
| ISO 11484:1994 | Steel tubes for pressure purposes -- Qualification and certification of non-destructive testing (NDT) personnel |
| ISO 11496:1993 | Seamless and welded steel tubes for pressure purposes -- Ultrasonic testing of tube ends for the detection of laminar imperfections |
| ISO/TR 11637:1997 | Boron treated engineering steels for quenching and tempering |
| ISO 11692:1994 | Ferritic-pearlitic engineering steels for precipitation hardening from hot-working temperatures |
| ISO 11949:1995 | Cold-reduced electrolytic tinplate |
| ISO 11950:1995 | Cold-reduced electrolytic chromium/chromium oxide-coated steel |
| ISO 11951:1995 | Cold-reduced blackplate in coil form for the production of tinplate or electrolytic chromium/chromium oxide-coated steel |
| ISO 11960:2004 | Petroleum and natural gas industries -- Steel pipes for use as casing or tubing for wells |
| ISO 11961:1996 | Petroleum and natural gas industries -- Steel pipes for use as drill pipe -- Specification |
| ISO 11970:2001 | Specification and approval of welding procedures for production welding of steel castings |
| ISO 11971:1997 | Visual examination of surface quality of steel castings |
| ISO 11972:1998 | Corrosion-resistant cast steels for general applications |
| ISO 11973:1999 | Heat-resistant cast steels and alloys for general applications |
| ISO 12094:1994 | Welded steel tubes for pressure purposes -- Ultrasonic testing for the detection of laminar imperfections in strips/plates used in the manufacture of welded tubes |
| ISO 12095:1994 | Seamless and welded steel tubes for pressure purposes -- Liquid penetrant testing |
| ISO 12096:1996 | Submerged arc-welded steel tubes for pressure purposes -- Radiographic testing of the weld seam for the detection of imperfections |
| ISO/TR 12662:1997 | Certification scheme for prestressing steels |
| ISO 13521:1999 | Austenitic manganese steel castings |
| ISO 13583-1:2000 | Centrifugally cast steel and alloy products -- Part 1: General testing and tolerances |
| ISO 13583-2:2003 | Centrifugally cast steel and alloy products -- Part 2: Heat resistant materials |
| ISO 13663:1995 | Welded steel tubes for pressure purposes -- Ultrasonic testing of the area adjacent to the weld seam for the detection of laminar imperfections |
| ISO 13664:1997 | Seamless and welded steel tubes for pressure purposes -- Magnetic particle inspection of the tube ends for the detection of laminar imperfections |
| ISO 13665:1997 | Seamless and welded steel tubes for pressure purposes -- Magnetic particle inspection of the tube body for the detection of surface imperfections |
| ISO 13680:2000 | Petroleum and natural gas industries -- Corrosion-resistant alloy seamless tubes for use as casing, tubing and coupling stock -- Technical delivery conditions |
| ISO 13887:2004 | Cold-reduced steel sheet of higher yield strength with improved formability |
| ISO 13976:2005 | Hot-rolled steel sheet in coils of structural quality and heavy thickness |
| ISO 14590:2005 | Cold-reduced steel sheet of high tensile strength and low yield point with improved formability |

| Standard | Title |
|---|---|
| ISO 14654:1999 | Epoxy-coated steel for the reinforcement of concrete |
| ISO 14655:1999 | Epoxy-coated strand for the prestressing of concrete |
| ISO 14656:1999 | Epoxy powder and sealing material for the coating of steel for the reinforcement of concrete |
| ISO 14657:2005 | Zinc-coated steel for the reinforcement of concrete |
| ISO 14737:2003 | Cast non-alloy and low alloy steels for general applications |
| ISO 14788:2005 | Continuous hot-dip zinc-5 % aluminium alloy coated steel sheet |
| ISO/TR 15461:1997 | Steel forgings -- Testing frequency, sampling conditions and test methods for mechanical tests |
| ISO/TR 15510:2003 | Stainless steels -- Chemical composition |
| ISO 15630-1:2002 | Steel for the reinforcement and prestressing of concrete -- Test methods -- Part 1: Reinforcing bars, wire rod and wire |
| ISO 15630-2:2002 | Steel for the reinforcement and prestressing of concrete -- Test methods -- Part 2: Welded fabric |
| ISO 15630-3:2002 | Steel for the reinforcement and prestressing of concrete -- Test methods -- Part 3: Prestressing steel |
| ISO 16120-1:2001 | Non-alloy steel wire rod for conversion to wire -- Part 1: General requirements |
| ISO 16120-2:2001 | Non-alloy steel wire rod for conversion to wire -- Part 2: Specific requirements for general purpose wire rod |
| ISO 16120-3:2001 | Non-alloy steel wire rod for conversion to wire -- Part 3: Specific requirements for rimmed and rimmed-substitute, low-carbon steel wire rod |
| ISO 16120-4:2001 | Non-alloy steel wire rod for conversion to wire -- Part 4: Specific requirements for wire rod for special applications |
| ISO 16143-1:2004 | Stainless steels for general purposes -- Part 1: Flat products |
| ISO 16143-2:2004 | Stainless steels for general purposes -- Part 2: Semi-finished products, bars, rods and sections |
| ISO 16143-3:2005 | Stainless steels for general purposes -- Part 3: wire |
| ISO 16160:2005 | Continuously hot-rolled steel sheet products -- Dimensional and shape tolerances |
| ISO 16162:2005 | Continuously cold-rolled steel sheet products -- Dimensional and shape tolerances |
| ISO 16163:2005 | Continuously hot-dipped coated steel sheet products -- Dimensional and shape tolerances |
| ISO 16172:2006 | Continuous hot-dip metallic-coated steel sheet for corrugated steel pipe |
| ISO 16650:2004 | Bead wire |
| ISO 20723:2004 | Structural steels -- Surface condition of hot-rolled sections -- Delivery requirements |
| ISO 20805:2005 | Hot-rolled steel sheet in coils of higher yield strength with improved formability and heavy thickness for cold forming |
| ISO 23717:2006 | Steel wire and wire products -- Hose reinforcement wire |
| ISO 24314:2006 | Structural steels -- Structural steels for building with improved seismic resistance -- Technical delivery conditions |

# Appendix

# 7

# *ASTM A941-15 STANDARD TERMINOLOGY RELATING TO STEEL, STAINLESS STEEL, RELATED ALLOYS, AND FERROALLOYS*

Designation: A941 – 15

# Standard Terminology Relating to Steel, Stainless Steel, Related Alloys, and Ferroalloys[1]

This standard is issued under the fixed designation A941; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

## 1. Scope*

1.1 This standard is a compilation of definitions of terms related to steel, stainless steel, related alloys, and ferroalloys.

1.2 When a term is used in an ASTM document for which Committee A01 is responsible, it is included herein only when judged, after review by Subcommittee A01.92, to be a generally usable term.

1.3 Some definitions include a discussion section, which is a mandatory part of the definition and contains additional information that is relevant to the meaning of the defined term.

1.4 Definitions of terms specific to a particular standard will appear in that standard and will supersede any definitions of identical terms in this standard.

## 2. Referenced Documents

2.1 *ASTM Standards:*[2]

E112 Test Methods for Determining Average Grain Size

## 3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

$Ac_{cm}$, $Ac_1$, $Ac_3$, $Ac_4$—See **transformation temperature**.

$Ae_{cm}$, $Ae_1$, $Ae_3$, $Ae_4$—See **transformation temperature**.

**age hardening,** *n*—hardening by **aging**, usually after rapid cooling or **cold working**.

**age hardening,** *n*—see **precipitation hardening**.

**aging,** *n*—a change in the properties of certain **steels** that occurs at ambient or moderately elevated temperatures after hot working or a heat treatment (**quench aging, natural aging,** or **artificial aging**) or after a cold-working operation (**strain aging**).

DISCUSSION—The change in properties is often, but not always, due to **precipitation hardening**, but never involves a change in the chemical composition of the **steel**.

**alloy steel,** *n*—a **steel**, other than a **stainless steel**, that conforms to a specification that requires one or more of the following elements, by mass percent, to have a minimum content equal to or greater than: 0.30 for aluminum; 0.0008 for boron; 0.30 for chromium; 0.30 for cobalt; 0.40 for copper; 0.40 for lead; 1.65 for manganese; 0.08 for molybdenum; 0.30 for nickel; 0.06 for niobium (columbium); 0.60 for silicon; 0.05 for titanium; 0.30 for tungsten (wolfram); 0.10 for vanadium; 0.05 for zirconium; or 0.10 for any other alloying element, except sulphur, phosphorus, carbon, and nitrogen.

**annealing,** *n*—a generic term covering any of several **heat treatments**.

DISCUSSION—This treatment is used for purposes such as reducing hardness, improving machinability, facilitating **cold working**, producing a desired microstructure, or obtaining desired mechanical, physical, or other properties. Where applicable, it is preferred that the following more specific terms be used: **box annealing, bright annealing, full annealing, intermediate annealing, isothermal annealing, process annealing, spheroidizing**, and **subcritical annealing**. The term "**annealing**," without qualification, implies **full annealing**. Any process of **annealing** will usually reduce stresses; however, if the treatment is applied for the sole purpose of stress reduction, it should be designated **stress relieving**.

$Ar_{cm}$, $Ar_1$, $Ar_3$, $Ar_4$—See **transformation temperature**.

**artificial aging,** *n*—**aging** above room temperature.

**atmospheric corrosion resistance,** *n*—the ability to resist degradation or alteration of material through chemical reaction with the surrounding atmosphere.

DISCUSSION—This term generally pertains to carbon steel, low alloy steel, or micro-alloyed steel.

**austempering,** *n*—**heat treatment** involving **quenching** a steel object from a temperature above the **transformation range** in a medium maintained at a temperature above the **martensite range** sufficiently fast to avoid the formation of high temperature transformation products, and then holding it at that temperature until transformation is complete.

**austenitizing,** *n*—forming austenite by heating a steel object above the **transformation range**.

[1] This terminology is under the jurisdiction of ASTM Committee A01 on Steel, Stainless Steel and Related Alloys and is the direct responsibility of Subcommittee A01.92 on Terminology.

Current edition approved Nov. 1, 2015. Published December 2015. Originally approved in 1995. Last previous edition approved in 2013 as A941-13b. DOI: 10.1520/A0941-15.

[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

***A Summary of Changes section appears at the end of this standard**

Copyright © ASTM International, 100 Barr Harbor Drive, PO Box C700, West Conshohocken, PA 19428-2959. United States

**baking,** *n*—heating to a low temperature in order to remove gases.

**batch furnace,** *n*—a heating device within which steel objects are held stationary or oscillated during the thermal processing cycle.

**blank carburizing,** *n*—simulating the **carburizing** operation without introducing carbon.

DISCUSSION—This is usually accomplished by using an inert material in place of the carburizing agent, or by applying a suitable protective coating on the object being heat treated.

**blank nitriding,** *n*—simulating the nitriding operation without introducing nitrogen.

DISCUSSION—This is usually accomplished by using an inert material in place of the nitriding agent, or by applying a suitable protective coating on the object being heat treated.

**bluing,** *n*—subjecting the scale-free surface of a steel object to the action of air, steam, or other agents at a suitable temperature, thereby forming a thin blue film of oxide and improving the object's appearance and corrosion resistance.

DISCUSSION—This term is ordinarily applied to sheet, strip, or finished parts. It is used also to denote the heating of springs after fabrication in order to improve their properties.

**box annealing,** *n*—**annealing** in a sealed container under conditions that minimize oxidation.

DISCUSSION—The charge is usually heated slowly to a temperature below the **transformation range**, but sometimes above or within it, and is then cooled slowly.

**bright annealing,** *n*—**annealing** in a protective medium to prevent discoloration of the bright surface.

**capped steel,** *n*—a **rimmed steel** in which, during ingot solidification, the rimming action was limited by mechanical or chemical means.

**carbon potential,** *n*—the carbon content at the surface of a specimen of pure iron in equilibrium with the carburizing medium considered, and under the conditions specified.

**carbon restoration,** *n*—replacing the carbon lost from the surface layer in previous processing by carburizing this layer to substantially the original carbon level.

**carbon steel,** *n*—a **steel** that conforms to a specification that prescribes a maximum limit, by **heat analysis** in mass percent, of not more than: 2.00 for carbon and 1.65 for manganese, but does not prescribe a minimum limit for chromium, cobalt, molybdenum, nickel, niobium (columbium), tungsten (wolfram), vanadium, or zirconium.

DISCUSSION—Except as required above, it is permissible for carbon steel specifications to prescribe limits (minimum or maximum, or both) for each specified alloying element, subject to the following restrictions for the heat analysis limits in mass percent:

(a) for wrought carbon steel products, the specified maximum limit is not to exceed: 0.10 for aluminum, 0.60 for silicon, and 0.050 for titanium;

(b) for carbon steel castings, the specified maximum limit is not to exceed: 0.10 for aluminum, 1.00 for silicon, and 0.050 for titanium.

(c) for **carbon steels** that are required to be rephosphorized, the specified minimum limit for phosphorus is not to be less than 0.040;

(d) for **carbon steels** that are required to be resulfurized, the specified minimum limit for sulfur is not to be less than 0.060;

(e) for **carbon steels** that are not required to be rephosphorized or resulfurized, the specified maximum limit is not to exceed: 0.60 for copper, 0.050 for phosphorus, and 0.060 for sulfur; and

(f) for **carbon steels** that are required to contain boron, copper, or lead, the specified minimum limit is not to exceed: 0.0005 for boron, 0.35 for copper, and 0.25 for lead.

**carbonitriding,** *n*—**case hardening** in which a suitable steel object is heated above $Ac_1$ in a gaseous atmosphere of such composition as to cause simultaneous absorption of carbon and nitrogen by the surface and, by diffusion, to create a concentration gradient.

**carburizing,** *n*—a process in which an austenitized steel object is brought into contact with a carbonaceous environment of sufficient carbon potential to cause absorption of carbon at the surface and, by diffusion, to create a concentration gradient.

**case,** *n—in case hardening*, the outer portion that has been made harder than the **core** as a result of altered composition or microstructure, or both, from treatments such as **carburizing, nitriding**, and **induction hardening**.

**case hardening,** *n*—a generic term covering any of several processes applicable to **steel** that change the chemical composition or microstructure, or both, of the surface layer.

DISCUSSION—The processes commonly used are: **carburizing** and **quench hardening**; **nitriding**; and **carbonitriding**. It is preferred that the applicable specific process name be used.

*cast analysis*—Deprecated term. Use the preferred term **heat analysis**.

**cementation,** *n*—the introduction of one or more elements into the outer portion of a steel object by means of diffusion at high temperature.

**certificate of compliance,** *n—in manufactured products*, a document that states that the product was manufactured, sampled, tested, and inspected in accordance with the requirements of the specification (including year of issue) and any other requirements specified in the purchase order or contract, and has been found to meet such requirements.

DISCUSSION—A single document, containing test report information and certificate of compliance information, may be used.

**certifying organization,** *n—in product specifications*, the entity responsible for the conformance and certification of the product to the specification requirements.

*check analysis*—Deprecated term. Use the preferred term **product analysis**.

**coarse grain practice,** *n*—a steelmaking practice for other than **stainless steel** that is intended to produce a **killed steel** in which aluminum, niobium (columbium), titanium, and vanadium are **residual elements**.

**cold working,** *n*—mechanical deformation of a metal at temperatures below its **recrystallization temperature**.

**cold treatment,** *n*—exposing a steel object to temperatures below room temperature for the purpose of obtaining desired conditions or properties, such as dimensional or structural stability.

**conditioning heat treatment,** *n*—a preliminary **heat treatment** used to prepare a steel object for a desired reaction to a subsequent **heat treatment**.

**continuous-conveyance furnace,** *n*—a heating device through which steel objects are intentionally moved at a constant rate during the thermal processing cycle.

**controlled cooling,** *n*—cooling a steel object from an elevated temperature in a predetermined manner to avoid hardening, cracking, or internal damage, or to produce a desired microstructure or mechanical properties.

**core,** *n—in case hardening,* the interior portion of unaltered composition or microstructure, or both, of a case hardened steel object.

**core,** *n—in clad products,* the central portion of a multilayer composite metallic material.

**critical cooling rate,** *n*—the slowest rate of continuous cooling at which austenite can be cooled from above the **transformation range** to prevent its transformation above $M_s$.

**cycle annealing,** *n*—**annealing** employing a predetermined and closely controlled time-temperature cycle to produce specific properties or a specific microstructure.

**decarburization,** *n*—the loss of carbon from the surface of a steel object as a result of its being heated in a medium that reacts with the carbon.

**defect,** *n*—an imperfection of sufficient magnitude to warrant rejection based on the specified requirements.

**differential heating,** *n*—heating that intentionally produces a temperature gradient within a steel object such that, after cooling, a desired stress distribution or variation in properties is present within the object.

**diffusion coating,** *n*—any process whereby a base metal is either coated with another metal and heated to a sufficient temperature in a suitable environment, or exposed to a gaseous or liquid medium containing the other metal, thereby causing diffusion of the coating or other metal into the base metal, with a resultant change in the composition and properties of its surface.

**direct quenching,** *n—in thermochemical processing*, **quenching** immediately following the thermochemical treatment.

**direct quenching,** *n—in thermomechanical processing*, **quenching** immediately following the final hot deformation.

**document,** *n*—a written, printed, or electronic record that provides information, evidence, or official statements.

**double aging,** *n*—employment of two different aging treatments, in sequence, to control the type of precipitate formed from a supersaturated alloy matrix in order to obtain the desired properties.

DISCUSSION—the first aging treatment, sometimes referred to as intermediate or stabilizing, is usually carried out at a higher temperature than the second.

**double tempering,** *n*—a treatment in which a quench-hardened steel object is given two complete tempering cycles at substantially the same temperature for the purpose of ensuring completion of the tempering reaction and promoting stability of the resultant microstructure.

**electronic data interchange,** *n*—the computer to computer exchange of business information in a standardized format.

**ellipsis,** *n—in a tabular entry*, three periods (...) that indicate that there is no requirement.

**ferritizing anneal,** *n*—a **heat treatment** that produces a predominantly ferritic matrix in a steel object.

**ferroalloy,** *n*—an alloy of iron and one or more other metals, for use as an addition to the molten metal during the manufacture of **steels**, nickel alloys, or cobalt alloys.

**ferrous material,** *n*—metals and alloys that contain iron as the principal component.

DISCUSSION—The iron content is not always stated in the specification and is not always determined by chemical analysis. The iron content may be taken to be 100 % minus the sum of the mean values permitted by the specification for all other elements having a specified range or a specified maximum. For conformance purposes, the mean value for iron, whether specified or calculated, is compared on an individual basis to the mean values permitted by the specification for each of the other elements having a specified range or a specified maximum. If an element other than iron is not specified, but is listed as remainder or balance, then, for conformance purposes the mean value for iron is compared to the calculated value for that other element.

**fine grain practice,** *n*—a steelmaking practice for other than **stainless steel** that is intended to produce a **killed steel** that is capable of meeting the requirements specified for fine austenitic grain size.

DISCUSSION—It normally involves the addition of one or more austenitic grain refining elements in amounts that have been established by the steel producer as being sufficient. Austenitic grain refining elements include, but are not limited to, aluminum, niobium (columbium), titanium, and vanadium.

**flame annealing,** *n*—**annealing** in which the heat is applied directly by a flame.

**flame hardening,** *n*—a process in which only the surface layer of a suitable steel object is heated by flame to above $Ac_3$ or $Ac_{cm}$, and then the object is **quenched**.

**fog quenching,** *n*—**quenching** in a mist.

**full annealing,** *n*—**annealing** a steel object by **austenitizing** it and then cooling it slowly through the **transformation range**.

DISCUSSION—The austenitizing temperature is usually above $Ac_3$ for hypoeutectoid steels and between $Ac_1$ and $Ac_{cm}$ for hypereutectoid steels.

**grain growth,** *n*—an increase in the grain size of a steel object, usually as a result of exposure to elevated temperatures.

**grain size,** *n*—the dimensions of the grains or crystals in a polycrystalline metal, exclusive of twinned regions and subgrains when present.

DISCUSSION—**Grain size** is usually estimated or measured on the cross section of an aggregate of grains, and designated by an ASTM grain size number. (See Test Methods E112.)

**graphitization annealing,** *n*—**annealing** a steel object in such a way that some or all of the carbon is precipitated as graphite.

**hardenability,** *n*—the property that determines the depth and distribution of hardness induced by **quenching** a steel object.

**hardening,** *n*—increasing the hardness by suitable treatment, usually involving heating and cooling.

DISCUSSION—Where applicable, it is preferred that the following more specific terms be used: **age hardening**, **case hardening**, **flame hardening**, **induction hardening**, **precipitation hardening**, and **quench hardening**.

**heat,** *n*—a generic term denoting a specific **lot** of **steel**, based upon steelmaking and casting considerations.

DISCUSSION—Where it is necessary to be more definitive, the following more specific terms are used: **primary heat**, **multiple heat**, and **remelted heat**. In product specifications, the term **heat** generally is used, without qualification, to mean the **primary**, **multiple**, or **remelted heat**, whichever is applicable.

**heat analysis,** *n*—the chemical analysis determined by the steel producer as being representative of a specific **heat** of **steel**.

DISCUSSION—Where the analysis reported by the steel producer is not sufficiently complete for conformance with the heat analysis requirements of the applicable product specification to be fully assessed, the **manufacturer** may complete the assessment of conformance with such heat analysis requirements by using a product analysis for the **specified elements** that were not reported by the steel producer, provided that product analysis tolerances are not applied and the **heat analysis** is not altered.

**heat number,** *n*—the alpha, numeric, or alphanumeric designator used to identify a specific **heat** of **steel**.

**heat treatment,** *n*—heating and cooling a steel object in such a way as to obtain desired conditions or properties.

DISCUSSION—Heating for the sole purpose of hot working is excluded from the meaning of this definition.

**high-strength low-alloy steel,** *n*—a **steel**, other than a **carbon steel** or an **interstitial-free steel**, that conforms to a specification that requires the minimum content for each specified alloying element to be lower than the applicable limit in the definition for **alloy steel**, and the yield point or yield strength of the product to be at least 36 ksi or 250 MPa.

**homogeneous carburizing,** *n*—a process that converts a low-carbon steel to one of substantially uniform and higher carbon content throughout the section, so that a specific response to **hardening** may be obtained.

**homogenizing,** *n*—holding a steel object at high temperature to eliminate or decrease chemical segregation by diffusion.

**hot-cold working,** *n*—the mechanical deformation of austenitic and precipitation hardening steels at a temperature just below the **recrystallization temperature** to increase the yield strength and hardness by plastic deformation or precipitation hardening effects induced by plastic deformation, or both.

**hot-finished,** *n*—the condition of a product that has been cooled directly after the last **hot-working** operation, without **cold-working** (except for straightening or flattening), and independent of the temperature at which hot-working was completed.

DISCUSSION—The tolerances and surface finish of hot-finished product can be different from those of cold-finished, cold-drawn, or cold-rolled product.

**hot quenching,** *n*—an imprecise term used to cover a variety of quenching procedures in which the quenching medium is maintained at a prescribed temperature above 160 °F or 70 °C.

**hot working,** *n*—mechanical deformation of a metal at temperatures above its **recrystallization temperature**.

**imperfection,** *n*—a material discontinuity or irregularity that is detectable by **inspection**.

**inclusion shape control,** *n*—the addition of elements during steel making in order to affect the inclusion morphology.

**induction hardening,** *n*—*in surface hardening*, a process in which only the surface layer of a suitable steel object is heated by electrical induction to above $Ac_3$ or $Ac_{cm}$, and then the object is **quenched**.

**induction hardening,** *n*—*in through hardening*, a process in which a suitable steel object is heated by electrical induction to above $Ac_3$ or $Ac_{cm}$ throughout its section, and then the object is **quenched**.

**induction heating,** *n*—heating by electrical induction.

**inspection,** *n*—the process of measuring, examining, testing, gaging, or otherwise comparing the unit of product with the applicable requirements.

**intermediate annealing,** *n*—**annealing** wrought steel objects at one or more stages during manufacture prior to final thermal treatment.

**interrupted aging,** *n*—**aging** at two or more temperatures, by steps, and cooling to room temperature after each step.

**interrupted quenching,** *n*—**quenching** in which the object being quenched is removed from the quenching medium while the object is at a temperature substantially higher than that of the quenching medium.

**interstitial-free steel,** *n*—a **steel** that has essentially all of its carbon and nitrogen chemically combined with stabilization elements rather than being present interstitially.

DISCUSSION—The heat analysis limits (minimum or maximum, or both) that are permitted to be prescribed in interstitial-free steel specifications are as given in the definition for **carbon steel**, except that the 0.050 % maximum limit for titanium does not apply.

**isothermal annealing,** *n*—**austenitizing** a steel object and then cooling it to, and holding it at, a temperature at which austenite transforms to a ferrite-carbide aggregate.

**isothermal transformation,** *n*—a change in phase at any constant temperature.

**killed steel,** *n*—a **steel** deoxidized to such a level that essentially no reaction occurred between carbon and oxygen during solidification.

**laser beam welding,** *n*—a welding process that uses a laser beam as the heat source.

**lot,** *n*—a definite quantity of product manufactured under conditions that are considered uniform.

**low-alloy steel,** *n*—a **steel**, other than a **carbon steel** or an **interstitial-free steel**, that conforms to a specification that requires the minimum content for each specified alloying element to be lower than the applicable limit in the definition for **alloy steel**.

$M_f$ , $M_s$**—**See **transformation temperature**.

**manufacturer,** *n*—the organization responsible for the conversion of materials into products meeting the requirements of a product specification.

**maraging,** *n*—a precipitation hardening treatment applied to a special group of **alloy steels** to precipitate one or more intermetallic compounds in a matrix of essentially carbon-free martensite.

**martempering,** *n*— **quenching** an austenitized steel object in a medium at a temperature in the upper part of, or slightly above, the **martensite range**, holding it in the medium until its temperature is substantially uniform throughout, and then cooling it in air through the **martensite range**.

**martensite range,** *n*—the temperature interval between $M_s$ and $M_f$.

**microalloyed steel,** *n*—a **low-alloy steel** that conforms to a specification that requires the presence of one or more carbide-, nitride-, or carbonitride-forming elements, generally in individual concentrations less than 0.15 mass percent, to enhance strength.

DISCUSSION—The most common microalloying elements are niobium (columbium), titanium, and vanadium.

**multiple heat,** *n*—two or more molten **primary heats**, in whole or in part, combined in a common ladle or in a common non-oscillating mold.

DISCUSSION—A **multiple heat** is identified by a single **heat number** representative of the **multiple heat**, or by the individual **heat numbers** of the **primary heats** contained in the **multiple heat**. The **heat analysis** of a **multiple heat** identified by a single **heat number** is the weighted average analysis of the individual **primary heats** contained in the **multiple heat**. Two or more molten **primary heats** sequentially strand cast (poured into an oscillating mold) constitute a series of individual **heats**, not a **multiple heat**.

**natural aging,** *n*—spontaneous aging of a super-saturated solid solution at room temperature.

**nickel alloy,** *n*—a material that conforms to a specification that requires by mass percent more nickel than any other element.

DISCUSSION—In castings, the nickel content requirement is not normally stated in the specification and is not normally determined by chemical analysis, but is taken to be 100 % minus the sum of the mean values permitted by the specification for all other elements having a specified range or a specified maximum.

**nitriding,** *n*—introducing nitrogen into a solid steel object by holding it at a suitable temperature in contact with a nitrogenous environment.

**nonferrous material,** *n*—metals and alloys that do not contain iron as the principal component.

**normalizing,** *v*—reheating a steel object to a temperature above the **transformation range** and then cooling it in air to a temperature substantially below the transformation range to achieve both grain refinement and improved homogenization.

**overaging,** *n*—**aging** under conditions of time and temperature greater than those required to obtain maximum change in a certain property, so that the property is altered away from the maximum.

**overheating,** *n*—heating a steel object to such a high temperature that excessive grain growth occurs.

DISCUSSION—Unlike burning, it may be possible to restore the original properties/microstructure by further heat treatment or mechanical working, or a combination thereof.

**patenting,** *n—in wire making,* heating a medium-carbon or high-carbon steel before wire drawing, or between drafts, to a temperature above the **transformation range**, and then cooling it in air, or a bath of molten lead or salt, to a temperature below $Ae_1$.

**plate-as-rolled,** *n*—the quantity of plate product rolled at one time, either from an individual slab or directly from an ingot.

DISCUSSION—This term does not refer to the surface condition or the heat-treatment state of the material; a **plate-as-rolled** may be in the as-rolled condition, or may have received one or more surface treatments or **heat treatments**, or both.

**post-weld heat treatment,** *n*—heating weldments immediately after welding, to provide **tempering**, **stress relieving**, or a controlled rate of cooling to prevent formation of a hard or brittle microstructure.

**precipitation hardening,** *n*—**hardening** caused by the precipitation of a constituent from a supersaturated solid solution.

**precipitation heat treatment,** *n*—**artificial aging** in which a constituent precipitates from a supersaturated solid solution.

**preheating,** *n*—heating before welding, a mechanical treatment, or some further thermal treatment.

**preheating,** *n—for tool steels*, heating to an intermediate temperature immediately before final **austenitizing**.

**primary heat,** *n*—the product of a single cycle of a batch melting process.

DISCUSSION—In the investment casting industry, the term *master heat* is used.

**process annealing,** *n*—*in the sheet and wire industries*, heating a steel object to a temperature close to, but below, $Ac_1$ and then cooling it, in order to soften it for further cold working.

**product analysis,** *n*—a chemical analysis of a specimen taken from the semi-finished product or the finished product.

**progressive aging,** *n*—**aging** by increasing the temperature in steps, or continuously, during the aging cycle.

**quench aging,** *n*—**aging** associated with **quenching** after **solution heat treatment**.

**quench hardening,** *n*—**hardening** a steel object by **austenitizing** it, and then cooling it rapidly enough that some or all of the austenite transforms to martensite.

DISCUSSION—The austenitizing temperature is usually above $Ac_3$ for hypoeutectoid steels and between $Ac_1$ and $Ac_{cm}$ for hypereutectoid steels.

**quenching,** *n*—rapid cooling in a fluid at a rate sufficient to preserve or produce desired material characteristics.

DISCUSSION—Where applicable, it is preferred that the following more specific terms be used: **fog quenching, hot quenching, interrupted quenching, selective quenching, spray quenching,** and **time quenching**. Quenching is often used in solution heat treatment of austenitic steels to retain certain constituents in solution. Quenching is also used for ferritic steels to develop desired characteristics (such as microstructure or toughness) in thicker sections that can otherwise only be achieved in thinner sections. Liquids and gasses are both fluids.

**recrystallization,** *n*—the formation of a new grain structure through a nucleation and growth process.

DISCUSSION—This is commonly produced by subjecting a steel object, which may be strained, to suitable conditions of time and temperature.

**recrystallization annealing,** *n*—**annealing** a cold-worked steel object to produce a new grain structure without a change in phase.

**recrystallization temperature,** *n*—the approximate minimum temperature at which recrystallization of a cold-worked steel object occurs within a specified time.

**remelted heat,** *n*—the product of the remelting of a **primary heat**, in whole or in part.

DISCUSSION—In the investment casting industry, the term *sub-heat* is used.

**residual element,** *n*—*in* ***steel***, a specified or unspecified element, not intentionally added, originating in the raw materials, refractories, or surrounding atmospheres used in steel making.

**rimmed steel,** *n*—a **steel** that contained sufficient oxygen to generate carbon monoxide at the boundary between the solid metal and the remaining molten metal during solidification, resulting in an outer layer low in carbon.

**secondary hardening,** *n*—the hardening phenomenon that occurs during high-temperature **tempering** of certain **steels** containing one or more carbide-forming alloying elements.

**selective heating,** *n*—intentionally heating only certain portions of a steel object.

**selective quenching,** *n*—**quenching** only certain portions of a steel object.

**semicontinuous-conveyance furnace,** *n*—a heating device through which steel objects are intentionally moved in accordance with a predetermined start-stop-start pattern during the thermal processing cycle.

**semikilled steel,** *n*—an incompletely deoxidized **steel** that contained sufficient oxygen to form enough entrapped carbon monoxide during solidification to offset solidification shrinkage.

**shell hardening,** *n*—a surface hardening process in which a suitable steel object, when heated through and quench hardened, develops a martensitic layer or shell that closely follows the contour of the piece and surrounds a **core** of essentially pearlitic transformation product.

DISCUSSION—This result is accomplished by a proper balance between section size, **hardenability**, and severity of quench.

**slack quenching,** *n*—the incomplete **hardening** of a steel object due to **quenching** from the austenitizing temperature at a rate slower than the **critical cooling rate** for the particular steel composition, resulting in the formation of one or more transformation products in addition to martensite.

**snap temper,** *n*—a precautionary interim stress-relieving treatment applied to a high-hardenability steel immediately after **quenching** to prevent cracking because of delay in **tempering** it at the prescribed higher temperature.

**soaking,** *n*—prolonged holding at a selected temperature.

**solution heat treatment,** *n*—heating a steel object to a suitable temperature, holding it at that temperature long enough to cause one or more constituents to enter into solid solution, and then cooling it rapidly enough to hold such constituents in solution.

**specified element,** *n*—*in* ***steel***, an element controlled to a specified minimum, maximum, or range, in accordance with the requirements of the applicable product specification.

**spheroidizing,** *n*—heating and cooling a steel object to produce a spheroidal or globular form of carbide in its microstructure.

DISCUSSION—Spheroidizing methods commonly used are the following: (1) prolonged holding at a temperature just below $Ae_1$; (2) heating and cooling alternately between temperatures that are just above, and just below, $Ae_1$; (3) heating to a temperature above $Ae_1$ or $Ae_3$ and then cooling very slowly in the furnace or holding at a temperature just below $Ae_1$; (4) cooling, from the minimum temperature at which all carbide is dissolved, at a rate suitable to prevent the reformation of a carbide network, and then reheating in accordance with Method (1) or (2) above. (Applicable to hypereutectoid steels containing a carbide network.)

**spray quenching,** *n*—**quenching** in a spray of liquid.

**stabilized stainless steel,** *n*—a **stainless steel** that conforms to a specification that prescribes limits (minimum or range) for niobium (columbium), tantalum, titanium, or a combination thereof.

DISCUSSION—Such limits are sometimes expressed as a function of the carbon and nitrogen contents. In an appropriately annealed condition, a **stabilized stainless steel** will resist sensitization to intergranular corrosion associated with the precipitation of chromium carbide at grain boundaries as a result of thermal exposure, such as **annealing, stress relieving** , welding, or high temperature service. Resistance to sensitization to intergranular corrosion is dependent upon the corrosivity of the environment. The condition of being stabilized with respect to sensitization is frequently demonstrated by passing one or more standard corrosion tests for sensitization.

**stabilizing treatment,** *n*—any treatment intended to stabilize the microstructure or dimensions of a steel object.

**stainless steel,** *n*—a **steel** that conforms to a specification that requires, by mass percent, a minimum chromium content of 10.5 or more, and a maximum carbon content of less than 1.20.

**steel,** *n*—a material that conforms to a specification that requires, by mass percent, more iron than any other element and a maximum carbon content of generally less than 2.

DISCUSSION—The iron content requirement is not normally stated in the specification and is not normally determined by chemical analysis, but is taken to be 100 % minus the sum of the mean values permitted by the specification for all other elements having a specified range or a specified maximum. For conformance purposes, this calculated value for iron is compared on an individual basis to the mean values permitted by the specification for each of the other elements having a specified range or a specified maximum. Some chromium-containing steels may contain more than 2 % carbon; however, 2 % carbon is generally considered to be the demarcation between **steel** and cast iron.

**strain aging,** *n*—**aging** induced by cold working.

**strain hardening,** *n*—an increase in hardness and strength of a metal caused by plastic deformation at temperatures below its **recrystallization temperature**. (Syn. *work hardening*)

**stress relieving,** *n*—heating a steel object to a suitable temperature, holding it long enough to reduce residual stresses, and then cooling it slowly enough to minimize the development of new residual stresses.

**subcritical annealing,** *n*—**annealing** at a temperature slightly below $Ac_1$.

**surface hardening,** *n*—a generic term covering any of several processes that, by **quench hardening** only, produce in a steel object a surface layer that is harder or more wear resistant than the **core**.

DISCUSSION—There is no significant alteration of the chemical composition of the surface layer. Where applicable, it is preferred that the following more specific terms be used: **induction hardening, flame hardening**, and **shell hardening**.

**temper brittleness,** *n*—brittleness that results when certain **steels** are held within, or are cooled slowly through, a certain range of temperature below the **transformation range**.

**tempering,** *n*—reheating a quench hardened or normalized steel object to a temperature below $Ac_1$, and then cooling it at any desired rate.

**test record,** *n*—a document or electronic record that contains the observations and derived data obtained by applying a given test method.

**test report,** *n*—a document that presents the applicable qualitative or quantitative results obtained by applying one or more given test methods.

DISCUSSION—A single document, containing test report information and certificate of compliance information, may be used.

**Thermal-Mechanical Control Process (TMCP),** *n*—a rolling process that produces a fine-grained ferritic steel by a particular combination of controls on the manufacturing process, from slab reheating to post-rolling cooling, thereby achieving enhanced mechanical properties.

DISCUSSION—(TMCP) requires appropriate selection of chemical composition and accurate control of steel temperature and rolling reduction.

**thermochemical treatment,** *n*—a **heat treatment** carried out in a medium suitably chosen to produce a change in the chemical composition of the steel object by exchange with the medium.

**time quenching,** *n*—interrupted **quenching** in which the duration of holding in the quenching medium is controlled.

**transformation ranges,** *n*—those ranges of temperature within which austenite forms during heating and transforms during cooling.

DISCUSSION—The two ranges are distinct, sometimes overlapping but never coinciding. The limiting temperatures of the ranges are dependent upon the steel composition and the rate of change of temperature, particularly during cooling.

**transformation temperature,** *n*—the temperature at which a change in phase occurs, with the limiting temperatures of the **transformation ranges** designated using the following symbols:

$Ac_{cm}$—the temperature at which the solution of cementite in austenite is completed during heating.

$Ac_1$—the temperature at which austenite begins to form during heating.

$Ac_3$—the temperature at which transformation of ferrite to austenite is completed during heating.

$Ac_4$—the temperature at which austenite transforms to delta ferrite during heating.

$Ae_1$, $Ae_3$, $Ae_{cm}$, $Ae_4$—the temperatures of phase change at equilibrium.

$Ar_{cm}$—the temperature at which precipitation of cementite starts during cooling.

$Ar_1$—the temperature at which transformation of austenite to ferrite or to ferrite plus cementite is completed during cooling.

$Ar_3$—the temperature at which austenite begins to transform to ferrite during cooling.

$Ar_4$—the temperature at which delta ferrite transforms to austenite during cooling.

$M_f$—the temperature at which transformation of austenite to martensite is substantially completed during cooling.

$M_s$—the temperature at which transformation of austenite to martensite starts during cooling.

DISCUSSION—All of the above changes, except the formation of martensite, occur at lower temperatures during cooling than during heating, and are dependent upon the rate of change of temperature.

**unspecified element,** *n—in* ***steel***, an element not controlled to a specified minimum, maximum, or range, in accordance with the requirements of the applicable product specification.

## SUMMARY OF CHANGES

Committee A01 has identified the location of selected changes to this standard since the last issue (A941–13b) that may impact the use of this standard. (Approved November 1, 2015.)

*(1)* Added the term *ferrous material* (3.1).

*(2)* Edited the term *annealing* (3.1).

*ASTM International takes no position respecting the validity of any patent rights asserted in connection with any item mentioned in this standard. Users of this standard are expressly advised that determination of the validity of any such patent rights, and the risk of infringement of such rights, are entirely their own responsibility.*

*This standard is subject to revision at any time by the responsible technical committee and must be reviewed every five years and if not revised, either reapproved or withdrawn. Your comments are invited either for revision of this standard or for additional standards and should be addressed to ASTM International Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee, which you may attend. If you feel that your comments have not received a fair hearing you should make your views known to the ASTM Committee on Standards, at the address shown below.*

*This standard is copyrighted by ASTM International, 100 Barr Harbor Drive, PO Box C700, West Conshohocken, PA 19428-2959, United States. Individual reprints (single or multiple copies) of this standard may be obtained by contacting ASTM at the above address or at 610-832-9585 (phone), 610-832-9555 (fax), or service@astm.org (e-mail); or through the ASTM website (www.astm.org). Permission rights to photocopy the standard may also be secured from the Copyright Clearance Center, 222 Rosewood Drive, Danvers, MA 01923, Tel: (978) 646-2600; http://www.copyright.com/*

# Appendix

# 8

## *ASTM E527-12 STANDARD PRACTICE FOR NUMBERING METALS AND ALLOYS IN THE UNIFIED NUMBERING SYSTEM (UNS)*

Designation: E527 – 12

# Standard Practice for Numbering Metals and Alloys in the Unified Numbering System (UNS)[1]

This standard is issued under the fixed designation E527; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

*This standard has been approved for use by agencies of the U.S. Department of Defense.*

## 1. Scope*

1.1 This practice (Note 1) covers a unified numbering system (UNS) for metals and alloys that have a "commercial standing" (see Note 2), and covers the procedure by which such numbers are assigned. Section 2 describes the system of alphanumeric designations or "numbers" established for each family of metals and alloys. Section 3 outlines the organization established for administering the system. Section 5 describes the procedure for requesting number assignment to metals and alloys for which UNS numbers have not previously been assigned.

NOTE 1—UNS designations are not to be used for metals and alloys that are not registered under the system described herein, or for any metal or alloy whose composition differs from those registered.

NOTE 2—The terms "commercial standing," "production usage," and other similar terms are intended to apply to metals and alloys in active commercial production and use, although the actual amount of such use will depend, among other things, upon the type of metals and alloys involved and their application.

The various standardizing organizations involved with the individual industries apply their own established criteria to define the status of a metal or alloy in terms of when a UNS designation number will be assigned. For instance, ASTM Committee A01 requires details of heat analysis, mechanical properties, and processing requirements for addition of a new grade or alloy to its specifications. The Copper Development Association requires that the material be "in commercial use (without tonnage limits);" the Aluminum Association requires that the alloy be "offered for sale (not necessarily in commercial use);" the SAE Aerospace Materials Division calls for "repetitive procurement by at least two users."

Thus, while no universal definition for usage criteria is established, the UNS numbers are intended to identify metals and alloys that are generally in regular production and use. A UNS number will not ordinarily be issued for a material that has just been conceived or that is still in only experimental trial.

## 2. Description of Numbers (or Codes) Established for Metals and Alloys

2.1 The UNS establishes 18 series of numbers for metals and alloys, as shown in Table 1. Each UNS number consists of a single letter-prefix followed by five digits. In most cases the letter is suggestive of the family of metals identified; for example, A for aluminum, P for precious metals, and S for stainless steels.

2.2 Whereas some of the digits in certain UNS number groups have special assigned meaning, each series is independent of the others in such significance; this practice permits greater flexibility and avoids complicated and lengthy UNS numbers.

NOTE 3—This arrangement of alphanumeric six-character numbers is a compromise between the thinking that identification numbers should indicate many characteristics of the material, and the belief that numbers should be short and uncomplicated to define only the chemical composition and leaving the other properties to the specifications involved.

2.3 Wherever feasible, identification "numbers" from previous systems are incorporated into the UNS numbers. For example: carbon steel, originally identified by "American Iron and Steel Institute (AISI) 1020," is covered by "UNS G10200," and free cutting brass, presently identified by "Copper Development Association (CDA) C36000," is covered by "UNS C36000." Table 2 shows the secondary division of some primary series of numbers.

[1] This practice is under the jurisdiction of ASTM Committee A01 on Steel, Stainless Steel and Related Alloys and is the direct responsibility of Subcommittee A01.91 on Editorial.

Current edition approved Oct. 15, 2012. Published November 2012. Originally approved in 1974. Last previous edition approved in 2007 as E527–07. DOI: 10.1520/E0527-12.

***A Summary of Changes section appears at the end of this standard**

Copyright © ASTM International, 100 Barr Harbor Drive, PO Box C700, West Conshohocken, PA 19428-2959. United States

**TABLE 1 Primary Series of Numbers**

| | |
|---|---|
| *Nonferrous Metals and Alloys* | |
| A00001–A99999 | aluminum and aluminum alloys |
| C00001–C99999 | copper and copper alloys |
| E00001–E99999 | rare earth and rare earth-like metals and alloys (18 items; see Table 2) |
| L00001–L99999 | low melting metals and alloys (15 items; see Table 2) |
| M00001–M99999 | miscellaneous nonferrous metals and alloys (12 items; see Table 2) |
| N00001–N99999 | nickel and nickel alloys |
| P00001–P99999 | precious metals and alloys (8 items; see Table 2) |
| R00001–R99999 | reactive and refractory metals and alloys (14 items; see Table 2) |
| Z00001–Z99999 | zinc and zinc alloys |
| *Ferrous Metals and Alloys* | |
| D00001–D99999 | specified mechanical properties steels |
| F00001–F99999 | cast irons |
| G00001–G99999 | carbon and alloy steels |
| H00001–H99999 | H-steels |
| J00001–J99999 | cast steels (except tool steels) |
| K00001–K99999 | miscellaneous steels and ferrous alloys |
| S00001–S99999 | heat and corrosion resistant (stainless) steels |
| T00001–T99999 | tool steels |
| W00001–W99999 | welding filler metals, covered and tubular electrodes, classified by weld deposit composition (see Table 2) |

**TABLE 2 Secondary Division of Some Series of Numbers**

| | |
|---|---|
| *E00001–E99999 Rare Earth and Rare Earth-Like Metals and Alloys* | |
| E00000–E00999 | actinium |
| E01000–E20999 | cerium |
| E21000–E45999 | mixed rare earths[A] |
| E46000–E47999 | dysprosium |
| E48000–E49999 | erbium |
| E50000–E51999 | europium |
| E52000–E55999 | gadolinium |
| E56000–E57999 | holmium |
| E58000–E67999 | lanthanum |
| E68000–E68999 | lutetium |
| E69000–E73999 | neodymium |
| E74000–E77999 | praseodymium |
| E78000–E78999 | promethium |
| E79000–E82999 | samarium |
| E83000–E84999 | scandium |
| E85000–E86999 | terbium |
| E87000–E87999 | thulium |
| E88000–E89999 | ytterbium |
| E90000–E99999 | yttrium |
| *L00001–L99999 Low-Melting Metals and Alloys* | |
| L00001–L00999 | bismuth |
| L01001–L01999 | cadmium |
| L02001–L02999 | cesium |
| L03001–L03999 | gallium |
| L04001–L04999 | indium |
| L06001–L06999 | lithium |
| L07001–L07999 | mercury |
| L08001–L08999 | potassium |
| L09001–L09999 | rubidium |
| L10001–L10999 | selenium |
| L11001–L11999 | sodium |
| L12001–L12999 | thallium |
| L13001–L13999 | tin |
| L50001–L59999 | lead |
| *M00001–M99999 Miscellaneous Nonferrous Metals and Alloys* | |
| M00001–M00999 | antimony |
| M01001–M01999 | arsenic |
| M02001–M02999 | barium |
| M03001–M03999 | calcium |
| M04001–M04999 | germanium |
| M05001–M05999 | plutonium |
| M06001–M06999 | stron ium |
| M07001–M07999 | tellurium |
| M08001–M08999 | uranium |

**TABLE 2** *Continued*

| | |
|---|---|
| M10001–M19999 | magnesium |
| M20001–M29999 | manganese |
| M30001–M39999 | silicon |
| *P00001–P99999 Precious Metals and Alloys* | |
| P00001–P00999 | gold |
| P01001–P01999 | iridium |
| P02001–P02999 | osmium |
| P03001–P03999 | palladium |
| P04001–P04999 | platinum |
| P05001–P05999 | rhodium |
| P06001–P06999 | ruthenium |
| P07001–P07999 | silver |
| *R00001–R99999 Reactive and Refractory Metals and Alloys* | |
| R01001–R01999 | boron |
| R02001–R02999 | hafnium |
| R03001–R03999 | molybdenum |
| R04001–R04999 | niobium (columbium) |
| R05001–R05999 | tantalum |
| R06001–R06999 | thorium |
| R07001–R07999 | tungsten |
| R08001–R08999 | vanadium |
| R10001–R19999 | beryllium |
| R20001–R29999 | chromium |
| R30001–R39999 | cobalt |
| R40001–R49999 | rhenium |
| R50001–R59999 | titanium |
| R60001–R69999 | zirconium |
| *W00001–W99999 Welding Filler Metals Classified by Weld Deposit Composition* | |
| W00001–W09999 | carbon steel with no significant alloying elements |
| W10000–W19999 | manganese-molybdenum low alloy steels |
| W20000–W29999 | nickel low alloy steels |
| W30000–W39999 | austenitic stainless steels |
| W40000–W49999 | ferritic stainless steels |
| W50000–W59999 | chromiun low alloy steels |
| W60000–W69999 | copper base alloys |
| W70000–W79999 | surfacing alloys |
| W80000–W89999 | nickel base alloys |

[A] Alloys in which the rare earths are used in the ratio of their natural occurrence (that is, unseparated rare earths). In this mixture, cerium is the most abundant of he rare ear h elements.

2.4 Welding filler metals fall into two general categories: those whose compositions are determined by the filler metal analysis (e.g. solid bare wire or rods and cast rods) and those whose composition is determined by the weld deposit analysis (e.g. covered electrodes, flux-cored and other composite wire electrodes). The latter are assigned to a primary series with the letter W as shown in Table 1. The solid bare wire and rods continue to be assigned in the established number series according to their composition.

NOTE 4—The assignment of UNS designations rests solely with the industry organizations listed herin. Readers are *not* to make their own assignments of numbers from such listings, as this may create a risk of duplication and conflict.

2.5 ASTM and SAE periodically publish up-to-date listings of all UNS numbers assigned to specific metals and alloys, with appropriate reference information on each.[2] Many trade associations also publish similar listings related to materials of primary interest to their organizations.

[2] Request the most recent version of ASTM DS 56 and SAE HS 1086, *Unified Numbering System for Metals and Alloys*, (a joint ASTM–SAE publication), PCN 05-056001-01.

## 3. Organization for Administering the UNS for Metals and Alloys

3.1 The organization for administering the UNS consists of the following:

3.1.1 *Advisory Board*—The Advisory Board has approximately 20 volunteer members who are affiliated with major producing and using industries, trade associations, government agencies, and standards societies, and who have extensive experience with identification, classification, and specification of materials. The Board is the administrative arm of SAE and ASTM on all matters pertaining to the UNS. It coordinates thinking on the format of each series of numbers and the administration of each by selected experts. It sets up ground rules for determining eligibility of any material for a UNS number, for requesting such numbers, and for appealing unfavorable rulings. It is the final referee on matters of disagreement between requesters and assigners.

3.1.2 *Several Number-Assigning Offices*— UNS number assigners for certain materials are set up at trade associations which have successfully administered their own numbering systems; for other materials, assigners are located at offices of

SAE. Each of these assigners has the responsibility for administering a specific series of numbers, as shown in Table 3. Each considers requests for assignment of new UNS numbers, and informs applicants of the action taken. Trade association UNS number assigners report immediately to SAE details of each number assignment. Assigners collaborate with designated consultants when considering requests for assignment of new numbers.

3.1.3 *Corps of Volunteer Consultants*— Consultants are selected by the Advisory Board to provide expert knowledge of a specific field of materials. Since they are utilized primarily by the Board and the SAE number assigners, they are not listed in this recommended practice. At the request of the SAE number assigner, a consultant considers a request for a new number in the light of the ground rules established for the material involved, decides whether a new number is justified, and informs the SAE number assigner accordingly. This utilization of experts (consultants and number assigners) is intended to ensure prompt and fair consideration of all requests. It permits each decision to be based on current knowledge of the needs of a specific industry of producers and users.

3.1.4 *Staff at SAE*—Staff members at SAE maintain master listings of all UNS numbers assigned.

3.1.5 In addition, established SAE and ASTM committees which normally deal with standards and specifications for the materials covered by the UNS, and other knowledgeable persons, are called upon by the Advisory Board for advice when considering appeals of unfavorable rulings in the matter of UNS number assignments.

## 4. Significance and Use

4.1 The UNS provides a means of correlating many nationally used numbering systems currently administered by societies, trade associations, and individual users and producers of metals and alloys, thereby avoiding confusion caused by use of more than one identification number for the same material; and by the opposite situation of having the same number assigned to two or more entirely different materials. It

**TABLE 3 Number Assigners and Areas of Responsibility**

| | |
|---|---|
| The Aluminum Associa ion, Inc.<br>1425 Wilson Boulevard, Suite 600<br>Arlington, VA 22209<br>Attention: Office for Unified Numbering System for Metals<br>Telephone: (703) 358-2960<br>www.aluminum.org | Aluminum and Aluminum Alloys<br>UNS Number Series: A00001–A99999 |
| American Welding Society<br>550 N. W. LeJeune Road<br>P.O. Box 351040<br>Miami, FL 33126<br>Attention: Office for Unified Numbering System for Metals<br>Telephone: (305) 443-9353<br>www.aws.org | Welding Filler Metals<br>UNS Number Series: W00001–W99999 |
| Copper Development Association<br>260 Madison Avenue, 16th Floor<br>New York, NY 10016<br>Attention: Office for Unified Numbering System for Metals<br>Telephone: (212) 251-7200<br>www.copper.org | Copper and Copper Alloys<br>UNS Number Series: C00001–C99999 |
| Society of Automotive Engineers<br>400 Commonwealth Drive<br>Warrendale, PA 15096<br>Attention: Office for Unified Numbering System for Metals<br>Telephone: (724) 776-4841<br>www.sae.org | Carbon and Alloy Steels<br>UNS Number Series: G00001–G99999<br>H-Steels<br>UNS Number Series: H00001–H99999<br>Tool Steels<br>UNS Number Series: T00001–T99999<br>Miscellaneous Nonferrous Metals and Alloys<br>UNS Number Series: M00001–M99999<br>Cast Steels<br>UNS Number Series: J00001–J99999<br>Heat and Corrosion Resistant (Stainless) Steels<br>UNS Number Series: S00001–S99999<br>Zinc and Zinc Alloys<br>UNS Number Series: Z00001–Z99999<br>Precious Metals and Alloys<br>UNS Number Series: P00001–P99999<br>Cast Irons<br>UNS Number Series: F00001–F99999<br><br>Nickel and Nickel Alloys<br>UNS Number Series: N00001–N99999<br>Steels Specified by Mechanical Properties<br>UNS Number Series: D00001–D99999<br>Reactive and Refractory Metals and Alloys<br>UNS Number Series: R00001–R99999 |

also provides the uniformity necessary for efficient indexing, record keeping, data storage and retrieval, and cross referencing.

4.2 A UNS number is not in itself a specification, since it establishes no requirements for form, condition, quality, etc. It is a unified identification of metals and alloys for which controlling limits have been established in specifications published elsewhere.

NOTE 5—Organizations that issue specifications should report to appropriate UNS number-assigning offices (3.1.2) any specification changes that affect descriptions shown in published UNS listings.

## 5. Procedure for Requesting Number Assignment to Metals and Alloys Not Already Covered by UNS Numbers (or Codes)

5.1 UNS numbers are assigned only to metals and alloys that have a commercial standing (as defined in Note 2).

5.2 The need for a new number should always be verified by determining from the latest complete listing of already assigned UNS numbers that a usable number is or is not available.

NOTE 6—In assigning UNS numbers, and consequently in searching complete listings of numbers, the predominant element of the metal or alloy usually determines the prefix letter of the series to which it is assigned. In certain instances where no one element predominates, arbitrary decisions are made as to what prefix letter to use, depending on the producing industry and other factors.

5.3 For a new UNS number to be assigned, the composition (or other properties, as applicable) must be significantly different from that of any metal or alloy which has already been assigned a UNS number.

5.3.1 In the case of metals or alloys that are normally identified or specified by chemical composition, the chemical composition limits must be reported.

5.3.2 In the case of metals or alloys that are normally identified or specified by mechanical (or other) properties, such properties and limits thereof must be reported. Only those chemical elements and limits, if any, which are significant in defining such materials need be reported.

5.4 Requests for new numbers shall be submitted on "Application for UNS Number Assignment" forms (see Fig. 1 and Fig. 2). Copies of these are available from any UNS number-assigning office (see Table 3) or facsimiles may be made of the one herein.

5.5 All instructions on the printed application form should be read carefully and all information provided as indicated.

NOTE 7—The application form is designed to serve also as a data input sheet to facilitate processing each request through to final print-out of the data on electronic data-processing equipment and to minimize transcription errors at number-assigning offices and data-processing centers.

5.6 To further assist in assigning UNS numbers, the requester is encouraged to suggest a possible UNS number in each request, giving appropriate consideration to any existing number presently used by a trade association, standards society, producer, or user.

5.7 Each completed application form shall be sent to the UNS number-assigning office having responsibility for the series of numbers that appears to most closely relate to the material described on the form (see Table 3).

## 6. Keywords

6.1 aluminum alloy numbering system; aluminum alloy UNS numbering; cast iron numbering system; cast iron UNS numbering; copper alloy numbering system; copper alloy UNS numbering; ferrous alloys numbering system; ferrous alloys UNS numbering; nickel alloy numbering system; nickel alloy UNS numbering; reactive metals and alloys numbering system; reactive metals and alloys UNS numbering; refractory metals and alloys numbering system; refractory metals and alloys UNS numbering; steel alloy numbering system; steel alloy UNS numbering; stainless steel alloy numbering system; stainless steel alloy UNS numbering; unified numbering system; UNS metal and alloy numbering system; weld filler metal numbering system; weld filler metal numbering; welding electrode numbering system; welding electrode UNS numbering

# E527 – 12

APPLICATION FOR UNS NUMBER ASSIGNMENT
and
Data Input Sheet for Entering a Specific Material in the
SAE-ASTM Unified Numbering System for Metals and Alloys
(See Reverse Side for Instructions for Completing This Form)

Material Description _____

_____

_____

_____

_____ Suggested UNS No. _____

* UNS Assigned Description _____

_____

_____

_____

_____ * UNS Assigned No. _____

* Chemical Composition

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Aluminum | Al | _____ | Indium | In | _____ | Selenium | Se | _____ |
| Antimony | Sb | _____ | Iridium | Ir | _____ | Silicon | Si | _____ |
| Arsenic | As | _____ | Iron | Fe | _____ | Silver | Ag | _____ |
| Beryllium | Be | _____ | Lead | Pb | _____ | Sulfur | S | _____ |
| Bismuth | Bi | _____ | Lithium | Li | _____ | Tantalum | Ta | _____ |
| Boron | B | _____ | Magnesium | Mg | _____ | Tellurium | Te | _____ |
| Cadmium | Cd | _____ | Manganese | Mn | _____ | Thorium | Th | _____ |
| Carbon | C | _____ | Mercury | Hg | _____ | Tin | Sn | _____ |
| Chromium | Cr | _____ | Molybdenum | Mo | _____ | Titanium | Ti | _____ |
| Cobalt | Co | _____ | Nickel | Ni | _____ | Tungsten | W | _____ |
| Columbium | Cb | _____ | Nitrogen | N | _____ | Uranium | U | _____ |
| Copper | Cu | _____ | Oxygen | O | _____ | Vanadium | V | _____ |
| Germanium | Ge | _____ | Phosphorus | P | _____ | Zinc | Zn | _____ |
| Gold | Au | _____ | Platinum | Pt | _____ | Zirconium | Zr | _____ |
| Hafnium | Hf | _____ | Rhenium | Re | _____ | Other | | _____ |
| Hydrogen | H | _____ | Rhodium | Rh | _____ | | | |

_____

_____

_____

* Cross References

AA _____
ACI _____
AISI _____
ANSI _____
AMS _____
ASME _____
ASTM _____
AWS _____
CDA _____
FED _____
MIL SPEC _____
SAE _____
OTHERS _____

Requesting Person and Organization (full address) _____

_____ Date of Request _____

* Assigning Org _____ * Date of UNS Assignment _____

Assigner's Name and Office_____

Applicant do not write in shaded areas. * These items for Computer Operator.

NOTE—Reverse side of Fig. 1 is located on the next page.

**FIG. 1 Sample Application Form.**

**General:**
Before attempting to complete this form, he applicant should be thoroughly familiar with the objectives of the UNS and the "ground rules" for assigning numbers, as stated in SAE J 1086 and ASTM E527, Section 5.

**Material Description:**
Identify the base element; the single alloying element that constitutes 50 % or more of the total alloy content; other distinguishing predominant characteristics (such as "casting"); and common or generic names if any (such as "ounce metal" or "Waspalloy"). When no single element makes up 50 % or more of the total alloy content, list in deceasing order of abundance the two alloying elements that together constitute the largest portion of the total alloy contents; except that if no two elements make up at least 50 % of the total alloy content, list the three most abundant, and so on. Instead of "iron," use "steel" to identify the base element of those iron-low-carbon alloys commonly known as steels.
When mechanical properties or physical characteristics are he primary defining criteria and chemical composition is secondary or nonsignificant, enter such properties and characteristics with the appropriate values or limits for each.

**Suggested UNS No.:**
While applicant's suggestion may or may not be the one finally assigned, it will assist proper iden ification of the material by he UNS Number Assigner.

**Chemical Composition:**
Enter limits such as 0.13–0.18 (*not* .13–.18 or 0.13 to 0.18) 1.5 max, 0.040 min, and balance. In space designated "other," enter information such as "Each 0.05 max, Total 0.15 max," and "Sn plus Pb 2.0 min."

**Cross References:**
Letter-symbols listed indicated widely known trade associations and standards-issuing organizations. Enter after appropriate symbols any known specification numbers or identification numbers issued by such groups to cover material equivalent to, similar to, or closely resembling the subject material.
Examples: SAE J 404 (50B44), AISI 415, ASTM A638 (660)
In space designated "other," enter any pertinent numbers issued by groups not listed above. In these instances, the full name and address of the issuing group shall be included.

| SUBMIT COMPLETED FORM TO APPROPRIATE UNS NUMBER ASSIGNER,<br>AS LISTED IN SAE J 1086 AND ASTM E527 |
|---|

**FIG. 2 Sample Application Form (Reverse Side).**

## SUMMARY OF CHANGES

Committee A01 has identified the location of selected changes to this practice since the last issue, E527 –07, that may impact the use of this practice. (Approved October 15, 2012)

(*1*) Added "EN" and "ISO" to list of cross reference organizations shown in Fig. 1.

*ASTM International takes no position respecting the validity of any patent rights asserted in connection with any item mentioned in this standard. Users of this standard are expressly advised that determination of the validity of any such patent rights, and the risk of infringement of such rights, are entirely their own responsibility.*

*This standard is subject to revision at any time by the responsible technical committee and must be reviewed every five years and if not revised, either reapproved or withdrawn. Your comments are invited either for revision of this standard or for additional standards and should be addressed to ASTM International Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee, which you may attend. If you feel that your comments have not received a fair hearing you should make your views known to the ASTM Committee on Standards, at the address shown below.*

*This standard is copyrighted by ASTM International, 100 Barr Harbor Drive, PO Box C700, West Conshohocken, PA 19428-2959, United States. Individual reprints (single or multiple copies) of this standard may be obtained by contacting ASTM at the above address or at 610-832-9585 (phone), 610-832-9555 (fax), or service@astm.org (e-mail); or through the ASTM website (www.astm.org). Permission rights to photocopy the standard may also be secured from the Copyright Clearance Center, 222 Rosewood Drive, Danvers, MA 01923, Tel: (978) 646-2600; http://www.copyright.com/*

# Appendix

# 9

## *SI QUICK REFERENCE GUIDE*

# SI QUICK REFERENCE GUIDE:
## International System of Units (SI)
## *The Modern Metric System**

## UNITS

The International System of Units (SI) is based on seven base units:

**Base Units**

| *Quantity* | *Name* | *Symbol* |
|---|---|---|
| length | metre | m |
| mass | kilogram | kg |
| time | second | s |
| electric current | ampere | A |
| thermodynamic temperature | kelvin | K |
| amount of substance | mole | mol |
| luminous intensity | candela | cd |

and a number of derived units which are combinations of base units and which may have special names and symbols:

**Examples of Derived Units**

| *Quantity* | *Expression* | *Name* | *Symbol* |
|---|---|---|---|
| acceleration | | | |
| angular | $rad/s^2$ | | |
| linear | $m/s^2$ | | |
| angle | | | |
| plane | dimensionless | radian | rad |
| solid | dimensionless | steradian | sr |
| area | $m^2$ | | |
| Celsius temperature | K | degree Celsius | °C |
| density | | | |
| heat flux | $W/m^2$ | | |
| mass | $kg/m^3$ | | |
| current | $A/m^2$ | | |
| energy, enthalpy | | | |
| work, heat | N·m | joule | J |
| specific | J/kg | | |
| entropy | | | |
| heat capacity | J/K | | |
| specific | J/(kg·K) | | |
| flow, mass | kg/s | | |
| flow, volume | $m^3/s$ | | |
| force | $kg·m/s^2$ | newton | N |
| frequency | | | |
| periodic | 1/s | hertz | Hz |
| rotating | rev/s | | |
| inductance | Wb/A | henry | H |
| magnetic flux | V·s | weber | Wb |
| mass flow | kg/s | | |
| moment of a force | N·m | | |
| potential, electric | W/A | volt | V |
| power, radiant flux | J/s | watt | W |
| pressure, stress | $N/m^2$ | pascal | Pa |
| resistance, electric | V/A | ohm | Ω |
| thermal conductivity | W/(m·K) | | |
| velocity | | | |
| angular | rad/s | | |
| linear | m/s | | |
| viscosity | | | |
| dynamic (absolute) (μ) | Pa·s | | |
| kinematic (ν) | $m^2/s$ | | |
| volume | $m^3$ | | |
| volume, specific | $m^3/kg$ | | |

* *For compete information see IEEE/ASTM SI-10.*

## SYMBOLS

| *Symbol* | *Name* | *Quantity* | *Formula* |
|---|---|---|---|
| A | ampere | electric current | base unit |
| Bq | becquerel | activity (of a radio nuclide) | 1/s |
| C | coulomb | electric charge | A·s |
| °C | degree Celsius | temperature interval | °C = K |
| cd | candela | luminous intensity | base unit |
| F | farad | electric capacitance | C/V |
| Gy | gray | absorbed dose | J/kg |
| g | gram | mass | kg/1000 |
| H | henry | inductance | Wb/A |
| Hz | hertz | frequency | 1/s |
| ha | hectare* | area | 10 000 $m^2$ |
| J | joule | energy, work, heat | N·m |
| K | kelvin | temperature | base unit |
| kg | kilogram | mass | base unit |
| L | litre | volume | $m^3$/1000 |
| lm | lumen | luminous flux | cd·sr |
| lx | lux | illuminance | lm/$m^2$ |
| m | metre | length | base unit |
| mol | mole | amount of substance | base unit |
| N | newton | force | kg·m/$s^2$ |
| Ω | ohm | electric resistance | V/A |
| Pa | pascal | pressure, stress | N/$m^2$ |
| rad | radian | plane angle | m/m (dimensionless) |
| S | siemens | electric conductance | A/V |
| Sv | sievert | dose equivalent | J/kg |
| s | second | time | base unit |
| sr | steradian | solid angle | $m^2/m^2$ (dimensionless) |
| T | tesla | magnetic flux density | Wb/$m^2$ |
| t | tonne, metric ton | mass | 1000 kg; Mg |
| V | volt | electric potential | W/A |
| W | watt | power, radiant flux | J/s |
| Wb | weber | magnetic flux | V·s |
| | * allowed with SI | | |

### Use of Symbols

The correct use of symbols is important because an incorrect symbol may change the meaning of a quantity. Some SI symbols are listed in the Symbol table.

SI has no abbreviations—only symbols. Therefore, no periods follow a symbol except at the end of a sentence.

*Examples:* A, *not* amp; s *not* sec; SI, *not* S.I.

Symbols appear in lower case unless the unit name has been taken from a proper name. In this case the first letter of the symbol is capitalized.

*Examples:* m, metre; Pa, pascal; W, watt

*Exception:* L, litre

Symbols and prefixes are printed in upright (roman) type regardless of the type style in surrounding text.

*Example:* . . . *a distance* of 73 km *between* . . .

Unit symbols are the same whether singular or plural.

*Examples:* 1 mm, 100 mm; 1 kg, 65 kg

Leave a space between the value and the symbol.

*Examples:* 115 W, *not* 115W; 0.75 L, *not* 0.75L
88 °C, *not* 88°C or 88° C

*Exception:* No space is left between the numerical value and symbol for degree of plane angle.

*Examples:* 73°, *not* 73 °

Note: Symbol for coulomb is C; for degree Celsius it is °C

Do not mix symbols and names in the same expression.

*Examples:* radians per second or rad/s,
*not* radians/second; *not* radians/s
m/s or metres per second,
*not* metres/second; *not* metres/s
J/kg or joules per kilogram,
*not* joules/kilogram; *not* joules/kg

Symbol for product—use the raised dot (·)

*Examples:* N·m; mPa·s; W/($m^2$·K)

Symbol for quotient—use one of the following forms:

*Examples:* m/s or $^m/_s$ or use the negative exponent

Note: Use only one solidus (/) per expression and parentheses to avoid any ambiguity.

## PREFIXES

Most prefixes indicate orders of magnitude in steps of 1000 and provide a convenient way to express large and small numbers and to eliminate nonsignificant digits and leading zeroes in decimal fractions.

*Examples:* 64 000 watts is the same as 64 kilowatts*
0.057 metre is the same as 57 millimetres
16 000 metres is the same as 16 kilometres*
*except for intended accuracy

| *Prefix* | *Symbol* | *Represents* |
|---|---|---|
| yotta | Y | $10^{24}$ |
| zetta | Z | $10^{21}$ |
| exa | E | $10^{18}$ |
| peta | P | $10^{15}$ |
| tera | T | $10^{12}$ |
| giga | G | $10^{9}$ |
| mega | M | $10^{6}$ |
| kilo | k | $10^{3}$ |
| hecto | h* | $10^{2}$ |
| deka | da* | $10^{1}$ |
| deci | d* | $10^{-1}$ |
| centi | c* | $10^{-2}$ |
| milli | m | $10^{-3}$ |
| micro | μ | $10^{-6}$ |
| nano | n | $10^{-9}$ |
| pico | p | $10^{-12}$ |
| femto | f | $10^{-15}$ |
| atto | a | $10^{-18}$ |
| zepto | z | $10^{-21}$ |
| yocto | y | $10^{-24}$ |
| | * allowed with SI | |

To realize the full benefit of the prefixes when expressing a quantity by numerical value, choose a prefix so that the number lies between 0.1 and 1000. For simplicity, give preference to prefixes representing 1000 raised to an integral power (i.e., mm, μm, km).

**Exceptions:* In expressing area and volume, the prefixes hecto, deka, deci, and centi may be required; for example, cubic decimetre (L), square hectometre (hectare), cubic centimetre.

Tables of values of the same quantity.

Comparison of values.

For certain quantities in particular applications. For example, the millimetre is used for linear dimensions in architectural and engineering drawings even when the values lie far outside the range of 0.1 mm to 1000 mm; the centimetre is usually used for anatomical measurements and clothing sizes.

**Compound Units**. A compound unit is a derived unit expressed with two or more units. The prefix is attached to a unit in the numerator.

*Examples:* V/m *not* mV/mm
MJ/kg *not* kJ/g

**Compound prefixes** formed by a combination of two or more prefixes are not used. Use only one prefix.

*Examples:* 2 nm *not* 2 mμm;
6 $m^3$*not* 6 kL;
6 mPa *not* 6 kkPA

**Exponential Powers**. An exponent attached to a symbol containing a prefix indicates that the multiple (of the unit with its prefix) is raised to the power of 10 expressed by the exponent.

*Examples:* 1 $mm^3 = (10^{-3}\ m)^3 = 10^{-9}\ m^3$
1 $ns^{-1} = (10^{-9}\ s)^{-1} = 10^{9}\ s^{-1}$
1 $mm^2/s = (10^{-3}\ m)^2/s = 10^{-6}\ m^2/s$

## NUMBERS

International practice separates the digits of large numbers into groups of three, counting from the decimal to the left and to the right, and inserts a space to separate the groups. In numbers of four digits, the space is not necessary except for the uniformity in tables.

*Examples:* 6.358 568; 85 365; 51 845 953; 88 000;
0.246 113 562; 7 258

**Small Numbers**. When writing a number between one and minus one, put a zero before the decimal marker.

Note: This applies to large numbers which have an exponent: as -0.1 × 10^6. This rule is given colloquially as "never use a naked decimal point."

**Decimal Marker**. The recommended decimal marker is a dot on the line (period). (In some countries, a comma is used as the decimal marker.)

Because **billion** means a million million in most countries but a thousand million in the United States, avoid using billion in technical writing.

## DO'S AND DON'TS

The units in the international system of units are called SI units—*not* Metric Units and *not* SI Metric Units.

Non-SI units include inch-pound units, old metric units and many other units. Inch=pound units (IP) refers to sets of units which contain inches and pounds. These include so-called customary units, US customary units, conventional units, imperial units, and English units.

Treat all spelled out names as nouns. Therefore, do not capitalize the first letter of a unit except at the beginning of a sentence or in capitalized material such as a title.

*Examples:* watt; pascal; ampere; volt; newton; kelvin
*Exception:* Always capitalize the first letter of Celsius.

Do not begin a sentence with a unit symbol—either rearrange the unit names or write the unit name in full.

Use plurals for spelled out unit names when required by the rules of grammar.

*Examples:* metre—metres; henry—henries;
kilogram—kilograms; kelvin—kelvins
*Irregular:* hertz—hertz; lux—lux; siemens—siemens

Do not put a space or hyphen between the prefix and unit name.

*Examples:* kilometre *not* kilo metre or kilo-metre;
milliwatt *not* milli watt or milli-watt

When a prefix ends with a vowel and the unit name begins with a vowel, retain and pronounce both vowels.

*Example:* kiloampere
*Exceptions:* hectare; kilohm; megohm

When a derived unit name is formed by multiplication, leave a space between units that are multiplied.

*Examples:* newton metre, *not* newton-metre;
volt ampere, *not* volt-ampere

Use the modifier squared or cubed after the unit name.

*Example:* metre per second squared
*Exception:* For area or volume the modifier may be placed before the units.
*Example:* square millimetre; cubic metre

When derived units are formed by division, use the word *per*, not a solidus (/).

*Examples:* metre per second, *not* metre/second; watt per square metre, *not* watt/square meter

## SELECTED CONVERSION FACTORS

*CAUTION:* These conversion values are rounded to three or four significant figures, which is sufficiently accurate for most applications. When making conversions, remember that a converted value is no more precise than the original value. Round off the final value to the same number of significant figures as those in the original value. See ANSI SI 10 for additional conversions with more significant figures.

| *Multiply* | *By* | *To Obtain* |
|---|---|---|
| acre | 0.4047 | ha |
| atmosphere, standard | *101.325 | kPa |
| bar | *100 | kPa |
| barrel (42 US gal, petroleum) | 159 | L |
| Btu, (International Table) | 1.055 | kJ |
| Btu/lb·°F (specific heat, $C^P$) | 4.184 | kJ/(kg·K) |
| bushel | 0.03524 | $m^3$ |
| calorie, kilogram (kilocalorie) | 4.187 | kJ |
| candle, candlepower | *1.0 | cd |
| centipoise, dynamic viscosity, μ | *1.00 | mPa·s |
| centistokes, kinematic viscosity, ν | *1.00 | $mm^2/s$ |
| ft | *0.3048 | m |
| ft | *304.8 | mm |
| ft/min, fpm | *0.00508 | m/s |
| ft/s, fps | *0.3048 | m/s |
| ft of water | 2.99 | kPa |
| $ft^2$ | 0.09290 | $m^2$ |
| $ft^2/s$, kinematic viscosity, ν | 92 900 | $mm^2/s$ |
| $ft^3$ | 28.32 | L |
| $ft^3$ | 0.02832 | $m^3$ |
| $ft^3/h$, cfh | 7.866 | mL/s |
| $ft^3/min$, cfm | 0.4719 | L/s |
| $ft^3/s$, cfs | 28.32 | L/s |
| footcandle | 10.76 | lx |
| ft·$lb_f$ (torque or moment) | 1.36 | N·m |
| ft·$lb_f$ (work) | 1.36 | J |
| ft·$lb_f$/lb (specific energy) | 2.99 | J/kg |
| ft·$lb_f$/min (power) | 0.0226 | W |
| gallon, US (*231 $in^3$) | 3.785 | L |
| gph | 1.05 | mL/s |
| gpm | 0.0631 | L/s |
| gpm/$ft^2$ | 0.6791 | L/(s·$m^2$) |
| gr/gal | 17.1 | g/$m^3$ |
| horsepower (550 ft·$lb_f$/s) | 0.746 | kW |
| inch | *25.4 | mm |
| in of mercury (60°F) | 3.377 | kPa |

| *Multiply* | *By* | *To Obtain* |
|---|---|---|
| in of water (60°F) | 248.8 | Pa |
| in·$lb_f$ (torque or moment) | 113 | mN·m |
| $in^2$ | 645 | $mm^2$ |
| $in^3$ (volume) | 16.4 | mL |
| $in^3$ (section modulus) | 16 400 | $mm^3$ |
| $in^4$ (section moment) | 416 200 | $mm^4$ |
| km/h | 0.278 | m/s |
| kWh | *3.60 | MJ |
| kip/$in^2$ (ksi) | 6.895 | MPa |
| litre | *0.001 | $m^3$ |
| micron (μm) of mercury (60°F) | 133 | mPa |
| mil (0.001 in.) | *25.4 | mm |
| mile | 1.61 | km |
| mile, nautical | 1.85 | km |
| mph | 1.61 | km/h |
| mph | 0.447 | m/s |
| millibar | *0.100 | kPa |
| mm of mercury (60°F) | 0.133 | kPa |
| mm of water (60°F) | 9.80 | Pa |
| ounce (mass, avoirdupois) | 28.35 | g |
| ounce (force of thrust) | 0.278 | N |
| ounce (liquid, US) | 29.6 | mL |
| ounce (avoirdupois) per gallon | 7.49 | kg/$m^3$ |
| pint (liquid, US) | 473 | mL |
| pound | | |
| $lb_m$ (mass) | 0.4536 | kg |
| $lb_m$ (mass) | 453.6 | g |
| $lb_f$ (force or thrust) | 4.45 | N |
| $lb_m$/ft (uniform load) | 1.49 | kg/m |
| $lb_m$/(ft·h) (dynamic viscosity, μ) | 0.413 | mPa·s |
| $lb_m$/(ft·s) (dynamic viscosity, μ) | 1490 | mPa·s |
| $lb_f$·s/$ft^2$ (dynamic viscosity, μ) | 47 880 | mPa·s |
| $lb_m$/min | 0.00756 | kg/s |
| $lb_m$/h | 0.126 | g/s |
| $lb_f$/$ft^2$ | 47.9 | Pa |
| $lb_m$/$ft^2$ | 4.88 | kg/$m^2$ |
| $lb_m$/$ft^3$ (density, ρ) | 16.0 | kg/$m^3$ |
| $lb_m$/gallon | 120 | kg/$m^3$ |
| ppm (by mass) | *1.00 | mg/kg |
| psi | 6.895 | kPa |
| quad ($10^{15}$ Btu) | 1.06 | EJ |
| quart (liquid, US) | 0.946 | L |
| rpm | 0.105 | rad/s |
| tablespoon (approx.) | 15 | mL |
| teaspoon (approx.) | 5 | mL |
| therm (100,000 Btu) | 105.5 | MJ |
| ton, short (2000 lb) | 0.907 | Mg; t (tonne) |
| yd | *0.9144 | m |
| $yd^2$ | 0.836 | $m^2$ |
| $yd^3$ | 0.7646 | $m^3$ |

* Conversion factor is exact.

Note: In this list the kelvin (K) expresses temperature intervals. The degree Celsius symbol (C) may be used for this purpose as well

# *STEEL GRADE/NAME INDEX*

| Designation | Specification | Page Number |
|---|---|---|
| 00Cr12 | GB 1220-92 | 534, 536 |
| | GB 1221-92 | 534, 536 |
| | GB 3280-92 | 438, 441 |
| | GB 4237-92 | 438, 441 |
| | GB 4238-92 | 438, 441 |
| | GB 4239-91 | 438, 441 |
| 00Cr12Ti | GB/T 12770-2002 | 227, 228 |
| 00Cr17 | GB 3280-92 | 160, 164, 446, 454 |
| | GB 4239-91 | 446, 454 |
| 00Cr17Mo | GB 3280-92 | 469, 498 |
| | GB 4237-92 | 469, 498 |
| | GB 4239-91 | 469, 498 |
| 00Cr17Ni13Mo2N | GB 1220-92 | 547, 580 |
| | GB 3280-92 | 168, 180, 467, 493 |
| | GB 4237-92 | 168, 180, 467, 493 |
| | GB 4239-91 | 467, 493 |
| | GB/T 14975-2002 | 233, 239 |
| 00Cr17Ni14Mo2 | GB 1220-92 | 547, 578 |
| | GB 3280-92 | 167, 178, 465, 489 |
| | GB 4226-84 | 547 |
| | GB 4237-92 | 167, 178, 465, 489 |
| | GB 4239-91 | 465, 489 |
| | GB/T 12770-2002 | 233, 238 |
| | GB/T 14975-2002 | 233, 238 |
| 00Cr18Mo2 | GB 3280-92 | 161, 164, 448, 456 |
| | GB 4237-92 | 161, 164, 448, 456 |
| | GB 4239-91 | 448, 456 |
| 00Cr18Ni10N | GB 1220-92 | 543, 561 |
| | GB 3280-92 | 166, 175, 462, 482 |
| | GB 4237-92 | 166, 175, 462, 482 |
| | GB 4239-91 | 462, 482 |
| | GB/T 14975-2002 | 233, 238 |
| 00Cr18Ni12Mo2Cu2 | GB 4237-92 | 465, 490 |
| 00Cr18Ni14Mo2Cu2 | GB 1220-92 | 547, 579 |
| | GB 4239-91 | 465, 490 |
| 00Cr18Ni5Mo3Si2 | GB 1220-92 | 600, 602 |
| | GB 3280-92 | 513, 515 |
| | GB 4237-92 | 513, 515 |
| | GB/T 14975-2002 | 243, 244 |
| 00Cr19Ni10 | GB 1220-92 | 542, 560 |
| | GB 3280-92 | 165, 173, 461, 479 |
| 00Cr19Ni10 (continued) | GB 4237-92 | 165, 173, 461, 480 |
| | GB 4239-91 | 461, 480 |
| | GB/T 12770-2002 | 232, 236 |
| | GB/T 14975-2002 | 232, 236 |
| 00Cr19Ni11 | GB 4226-84 | 542 |
| 00Cr19Ni13Mo3 | GB 1220-92 | 548, 581 |
| | GB 3280-92 | 165, 173, 461, 479 |
| | GB 4237-92 | 168, 181, 467, 494 |
| | GB 4239-91 | 467, 494 |
| 00Cr24Ni6Mo3N | GB 4239-91 | 513, 517 |
| 00Cr27Mo | GB 1220-92 | 535, 540 |
| | GB 3280-92 | 448, 457 |
| | GB 4237-92 | 448, 457 |
| | GB 4239-91 | 448, 457 |
| 00Cr30Mo2 | GB 1220-92 | 535, 540 |
| | GB 3280-92 | 449, 457 |
| | GB 4237-92 | 449, 457 |
| | GB 4239-91 | 449, 457 |
| 06Ni3MoDG | GB/T 18984-2003 | 251, 253 |
| 0Cr13 | GB 3280-92 | 438, 441 |
| | GB 4237-92 | 438, 441 |
| | GB 4239-91 | 438, 441 |
| | GB/T 12770-2002 | 227, 229 |
| | GB/T 14975-2002 | 227, 229 |
| 0Cr13Al | GB 1220-92 | 534, 536 |
| | GB 1221-92 | 534, 536 |
| | GB 3280-92 | 159, 162, 445, 450 |
| | GB 4237-92 | 159, 162, 445, 450 |
| | GB 4238-92 | 159, 162, 445, 450 |
| | GB 4239-91 | 445, 450 |
| 0Cr15Ni25Ti2MoAlVB | GB 1221-92 | 550, 590 |
| | GB 4238-92 | 471, 502 |
| 0Cr15Ni7Mo2Al | GB 1220-92 | 593, 599 |
| 0Cr17Ni12Mo2 | GB 1220-92 | 545, 571 |
| | GB 1221-92 | 545, 571 |
| | GB 3280-92 | 167, 177, 464, 488 |
| | GB 4226-84 | 545 |
| | GB 4237-92 | 167, 177, 464, 488 |
| | GB 4238-92 | 167, 177, 464, 488 |
| | GB 4239-91 | 464, 488 |
| | GB/T 12770-2002 | 233, 238 |

| Designation | Specification | Page Number |
|---|---|---|
| 0Cr17Ni12Mo2 (continued) | GB/T 14975-2002 | 233, 238 |
| 0Cr17Ni12Mo2N | GB 1220-92 | 547, 579 |
| | GB 3280-92 | 466, 492 |
| | GB 4237-92 | 466, 492 |
| | GB 4239-91 | 466, 492 |
| 0Cr17Ni4Cu4Nb | GB 1220-92 | 593, 596 |
| | GB 1221-92 | 593, 596 |
| 0Cr17Ni7Al | GB 1220-92 | 593, 598 |
| | GB 1221-92 | 593, 598 |
| | GB 4237-92 | 505, 512 |
| | GB 4238-92 | 505, 512 |
| | GB 4239-91 | 505, 512 |
| | GB/T 4231-93 | 621 |
| 0Cr18Ni10Ti | GB 1220-92 | 548, 584 |
| | GB 1221-92 | 548, 584 |
| | GB 3280-92 | 169, 182, 468, 496 |
| | GB 4237-92 | 169, 182, 468, 496 |
| | GB 4238-92 | 169, 182, 468, 496 |
| | GB 4239-91 | 468, 496 |
| | GB/T 12770-2002 | 234, 240 |
| | GB/T 14975-2002 | 234, 240 |
| 0Cr18Ni11Nb | GB 1220-92 | 549, 586 |
| | GB 3280-92 | 169, 183, 469, 498 |
| | GB 4226-84 | 549 |
| | GB 4237-92 | 169, 183, 469, 498 |
| | GB 4238-92 | 169, 183, 469, 498 |
| | GB 4239-91 | 469, 498 |
| | GB/T 12770-2002 | 234, 241 |
| | GB/T 14975-2002 | 234, 241 |
| 0Cr18Ni11Ti | GB 4226-84 | 548 |
| 0Cr18Ni12 | GB 4226-84 | 543 |
| 0Cr18Ni12Mo2Cu2 | GB 1220-92 | 546, 578 |
| | GB 3280-92 | 465, 490 |
| | GB 4237-92 | 465, 490 |
| | GB 4239-91 | 465, 490 |
| 0Cr18Ni12Mo2Ti | GB 3280-92 | 168, 179, 466, 491 |
| | GB 4237-92 | 168, 179, 466, 491 |
| | GB/T 14975-2002 | 234, 240 |
| 0Cr18Ni13Si4 | GB 1220-92 | 550, 589 |
| | GB 1221-92 | 550, 589 |
| | GB 3280-92 | 469, 499 |
| 0Cr18Ni13Si4 (continued) | GB 4237-92 | 469, 499 |
| | GB 4238-92 | 469, 499 |
| | GB 4239-91 | 469, 499 |
| 0Cr18Ni16Mo5 | GB 1220-92 | 548, 581 |
| | GB 3280-92 | 467, 494 |
| | GB 4237-92 | 467, 494 |
| | GB 4239-91 | 467, 494 |
| 0Cr18Ni9 | GB 1220-92 | 542, 557 |
| | GB 1221-92 | 542, 557 |
| | GB 3280-92 | 165, 171, 460, 478 |
| | GB 4237-92 | 165, 171, 460, 478 |
| | GB 4238-92 | 165, 172, 460, 478 |
| | GB 4239-91 | 460, 478 |
| | GB/T 12770-2002 | 233, 239 |
| | GB/T 14975-2002 | 233, 239 |
| 0Cr18Ni9Cu3 | GB 1220-92 | 550, 589 |
| 0Cr19Ni10NbN | GB 1220-92 | 543, 562 |
| | GB 3280-92 | 462, 481 |
| | GB 4237-92 | 462, 481 |
| | GB 4239-91 | 462, 481 |
| 0Cr19Ni13Mo3 | GB 1220-92 | 548, 581 |
| | GB 1221-92 | 548, 581 |
| | GB 3280-92 | 467, 494 |
| | GB 4237-92 | 467, 494 |
| | GB 4238-92 | 467, 494 |
| | GB 4239-91 | 467, 494 |
| | GB/T 14975-2002 | 233, 239 |
| 0Cr19Ni9 | GB 4226-84 | 542 |
| | GB/T 4231-93 | 621 |
| 0Cr19Ni9N | GB 1220-92 | 543, 561 |
| | GB 3280-92 | 166, 174, 461, 481 |
| | GB 4237-92 | 166, 174, 461, 481 |
| | GB 4239-91 | 461, 481 |
| | GB/T 14975-2002 | 234, 241 |
| 0Cr23Ni13 | GB 1220-92 | 544, 564 |
| | GB 1221-92 | 544, 564 |
| | GB 3280-92 | 463, 484 |
| | GB 4226-84 | 544 |
| | GB 4237-92 | 463, 484 |
| | GB 4238-92 | 463, 484 |
| | GB 4239-91 | 463, 484 |
| 0Cr25Ni20 | GB 1220-92 | 544, 565 |

| Designation | Specification | Page Number |
|---|---|---|
| 0Cr25Ni20 (conintued) | GB 1221-92 | 544, 565 |
| | GB 3280-92 | 463, 485 |
| | GB 4226-84 | 544 |
| | GB 4237-92 | 463, 485 |
| | GB 4238-92 | 463, 485 |
| | GB 4239-91 | 463, 485 |
| 0Cr26Ni5Mo2 | GB 1220-92 | 601, 605 |
| | GB 3280-92 | 514, 518 |
| | GB 4226-84 | 601 |
| | GB 4237-92 | 514, 518 |
| | GB 4239-91 | 514, 518 |
| 1 | ASME SA-266/SA-266M | 342, 345 |
| | ASME SA-333/SA-333M | 246, 249 |
| | ASME SA-334/SA-334M | 246, 249 |
| | ASME SA-508/SA-508M | 342, 345 |
| | ASME SA-537/SA-537M | 115, 124 |
| | ASME SA-541/SA-541M | 342, 345 |
| | ASTM A242/A242M-13 | 76, 81 |
| | ASTM A266/A266M-13 | 342, 345 |
| | ASTM A333/A333M-13 | 246, 249 |
| | ASTM A334/A334M-04a (2010) | 246, 249 |
| | ASTM A485-14 | 628 |
| | ASTM A508/A508M-14 | 343, 346 |
| | ASTM A537/A537M-13 | 115, 125 |
| | ASTM A541/A541M-05 (2015) | 342, 345 |
| 1A | ASME SA-508/SA-508M | 342, 345 |
| | ASME SA-541/SA-541M | 342, 345 |
| | ASTM A508/A508M-14 | 343, 346 |
| | ASTM A541/A541M-05 (2015) | 342, 345 |
| 1Cr12 | GB 1220-92 | 519, 522 |
| | GB 3280-92 | 438, 440 |
| | GB 4226-84 | 519 |
| | GB 4237-92 | 438, 440 |
| | GB 4238-92 | 438, 440 |
| | GB 4239-91 | 438, 440 |
| 1Cr13 | GB 1220-92 | 519, 525 |
| | GB 1221-92 | 519, 525 |
| | GB 3280-92 | 438, 440 |
| | GB 4226-84 | 519 |
| | GB 4237-92 | 438, 440 |
| | GB 4238-92 | 438, 440 |
| | GB 4239-91 | 438, 440 |
| | GB/T 12770-2002 | 227, 229 |
| 1Cr13 (continued) | GB/T 14975-2002 | 227, 229 |
| 1Cr13Mo | GB 1220-92 | 519, 525 |
| | GB 1221-92 | 519, 525 |
| 1Cr15 | GB 3280-92 | 446, 452 |
| | GB 4237-92 | 446, 452 |
| | GB 4239-91 | 446, 452 |
| 1Cr16Ni35 | GB 4238-92 | 468, 497 |
| 1Cr17 | GB 1220-92 | 534, 538 |
| | GB 1221-92 | 534, 538 |
| | GB 3280-92 | 446, 453 |
| | GB 4226-84 | 534 |
| | GB 4237-92 | 446, 453 |
| | GB 4238-92 | 446, 453 |
| | GB 4239-91 | 446, 453 |
| | GB/T 12770-2002 | 227, 230 |
| | GB/T 14975-2002 | 227, 230 |
| 1Cr17Mn6Ni5N | GB 1220-92 | 541, 551 |
| | GB 3280-92 | 458, 473 |
| | GB 4237-92 | 458, 473 |
| | GB 4239-91 | 458, 473 |
| 1Cr17Mo | GB 1220-92 | 535, 539 |
| | GB 3280-92 | 447, 454 |
| | GB 4237-92 | 447, 454 |
| | GB 4239-91 | 447, 454 |
| 1Cr17Ni7 | GB 1220-92 | 541, 552 |
| | GB 3280-92 | 459, 475 |
| | GB 4239-91 | 459, 475 |
| | GB/T 4231-93 | 621 |
| 1Cr17Ni8 | GB 3280-92 | 459, 475 |
| | GB 4239-91 | 459, 475 |
| 1Cr18Mn8Ni5N | GB 1220-92 | 541, 551 |
| | GB 3280-92 | 458, 474 |
| | GB 4237-92 | 458, 474 |
| | GB 4239-91 | 458, 474 |
| 1Cr18Ni9 | GB 1220-92 | 548, 584 |
| | GB 3280-92 | 468, 497 |
| | GB 4226-84 | 548 |
| | GB 4237-92 | 468, 497 |
| | GB 4239-91 | 468, 497 |
| | GB 5310-1995 | 289, 301 |
| | GB/T 12770-2002 | 233, 239 |
| | GB/T 14975-2002 | 233, 239 |
| | GB 1220-92 | 543, 562 |

| Designation | Specification | Page Number |
|---|---|---|
| 1Cr18Ni12 (continued) | GB 3280-92 | 462, 483 |
| | GB 4226-84 | 543 |
| | GB 4237-92 | 462, 483 |
| | GB 4239-91 | 462, 483 |
| 1Cr18Ni9Si3 | GB 3280-92 | 460, 478 |
| | GB 4237-92 | 460, 478 |
| | GB 4238-92 | 460, 478 |
| | GB 4239-91 | 460, 478 |
| 1Cr18Ni9Ti | GB 3280-92 | 470, 501 |
| | GB 4237-92 | 470, 501 |
| | GB 4238-92 | 470, 501 |
| | GB 4239-91 | 470, 501 |
| 1Cr19Al3 | GB 4238-92 | 448, 456 |
| 1Cr19Ni11Nb | GB 5310-1995 | 296, 314 |
| 1Cr25Ni20Si2 | GB 1221-92 | 545, 567 |
| | GB 4238-92 | 463, 485 |
| 1Cr5Mo | GB 6479-2000 | 280, 282 |
| 2 | ASME SA-266/SA-266M | 342, 345 |
| | ASME SA-537/SA-537M | 118, 127 |
| | ASTM A266/A266M-13 | 342, 346 |
| | ASTM A537/A537M-13 | 118, 127 |
| | ASTM A606/A606M-09a | 99, 104 |
| | ISO 4978:1983 | 112, 120 |
| 2, Class 1 | ASME SA-387/SA-387M | 140 |
| | ASME SA-508/SA-508M | 361 |
| | ASME SA-541/SA-541M | 361 |
| | ASTM A387/A387M-11 | 140 |
| | ASTM A508/A508M-14 | 361 |
| | ASTM A541/A541M-05 (2015) | 361 |
| 2, Class 2 | ASME SA-387/SA-387M | 140 |
| | ASME SA-508/SA-508M | 361 |
| | ASME SA-541/SA-541M | 361 |
| | ASTM A387/A387M-11 | 140 |
| | ASTM A508/A508M-14 | 361 |
| | ASTM A541/A541M-05 (2015) | 361 |
| 2Cr12MoVNbN | GB 1221-92 | 521, 532 |
| 2Cr12NiMoWV | GB 1221-92 | 521, 532 |
| 2Cr13 | GB 1220-92 | 520, 527 |
| | GB 1221-92 | 520, 527 |
| | GB 3280-92 | 439, 442 |
| | GB 4226-84 | 520 |
| | GB 4237-92 | 439, 442 |
| | GB 4239-91 | 439, 442 |
| 2Cr13 (continued) | GB/T 14975-2002 | 227, 230 |
| 2Cr21Ni12N | GB 1221-92 | 550, 589 |
| 2Cr23Ni13 | GB 1221-92 | 544, 564 |
| | GB 4238-92 | 462, 483 |
| 2Cr25N | GB 1221-92 | 535, 540 |
| | GB 4238-92 | 448, 456 |
| 2Cr25Ni20 | GB 1221-92 | 544, 564 |
| | GB 4238-92 | 463, 485 |
| 3 | ASME SA-333/SA-333M | 248, 250 |
| | ASME SA-334/SA-334M | 251, 253 |
| | ASME SA-537/SA-537M | 118, 127 |
| | ASTM A333/A333M-13 | 248, 250, 251, 253 |
| | ASTM A334/A334M-04a (2010) | 251, 253 |
| | ASTM A537/A537M-13 | 118, 127 |
| | ISO 4978:1983 | 113, 121 |
| 3, Class 1 | ASME SA-508/SA-508M | 362 |
| | ASME SA-541/SA-541M | 362 |
| | ASTM A508/A508M-14 | 362 |
| | ASTM A541/A541M-05 (2015) | 362 |
| 3, Class 2 | ASME SA-508/SA-508M | 362 |
| | ASME SA-541/SA-541M | 362 |
| | ASTM A508/A508M-14 | 362 |
| | ASTM A541/A541M-05 (2015) | 362 |
| 3Cr13 | GB 1220-92 | 520, 528 |
| | GB 3280-92 | 439, 443 |
| | GB 4226-84 | 520 |
| | GB 4237-92 | 439, 443 |
| | GB 4239-91 | 439, 443 |
| | GB/T 4231-93 | 621 |
| 3V | ASME SA-508/SA-508M | 354, 355 |
| | ASME SA-541/SA-541M | 354, 355 |
| | ASTM A508/A508M-14 | 354, 355 |
| | ASTM A541/A541M-05 (2015) | 354, 355 |
| 4 | ASME SA-266/SA-266M | 342, 345 |
| | ASTM A266/A266M-13 | 342, 346 |
| | ASTM A606/A606M-09a | 99, 104 |
| | ISO 4978:1983 | 116, 125 |
| 4Cr13 | GB 1220-92 | 521, 533 |
| | GB 3280-92 | 439, 444 |
| | GB 4237-92 | 439, 444 |
| | ASME SA-508/SA-508M | 363 |
| | ASME SA-541/SA-541M | 363 |
| | ASTM A508/A508M-14 | 363 |

| Designation | Specification | Page Number |
|---|---|---|
| 4N, Class 3 (continued) | ASTM A541/A541M-05 (2015) | 363 |
| 5, Class 1 | ASME SA-387/SA-387M | 145 |
| | ASTM A387/A387M-11 | 145 |
| 5, Class 2 | ASME SA-387/SA-387M | 145 |
| | ASTM A387/A387M-11 | 145 |
| 5Cr21Mn9Ni4N | GB 1221-92 | 549, 587 |
| 5Cr3Mn1SiMo1V | GB/T 1299-2000 | 627 |
| 5CrW2Si | GB/T 1299-2000 | 627 |
| 6 | ASME SA-333/SA-333M | 248, 250 |
| | ASME SA-334/SA-334M | 248, 250 |
| | ASTM A333/A333M-13 | 248, 250 |
| | ASTM A334/A334M-04a (2010) | 248, 250 |
| 6CrMnSi2Mo1 | GB/T 1299-2000 | 627 |
| 7Cr17 | GB 1220-92 | 520, 531 |
| | GB 3280-92 | 439, 444 |
| | GB 4237-92 | 439, 444 |
| | GB 4239-91 | 439, 444 |
| 8 | ASME SA-333/SA-333M | 248, 250 |
| | ASME SA-334/SA-334M | 251, 254 |
| | ASTM A333/A333M-13 | 248, 250, 251, 254 |
| | ASTM A334/A334M-04a (2010) | 251, 254 |
| | GB 711-88 | 51, 66 |
| | GB/T 699-1999 | 21 |
| 8, Class A | ASME SA-487/SA-487M | 406, 408 |
| | ASTM A487/A487M-14 | 406, 408 |
| 8, Class B | ASME SA-487/SA-487M | 406, 408 |
| | ASTM A487/A487M-14 | 406, 408 |
| 8, Class C | ASME SA-487/SA-487M | 406, 408 |
| | ASTM A487/A487M-14 | 406, 408 |
| 08F | GB 711-88 | 51, 66 |
| | GB/T 699-1999 | 21 |
| 8Cr17 | GB 1220-92 | 520, 531 |
| 8Cr20Si2Ni | GB 1221-92 | 521, 533 |
| 8 CrMo 4-5 | ISO 9329-2:1997 | 274, 275 |
| 8 CrMo 5-5 | ISO 9329-2:1997 | 276, 277 |
| 8MoB5-4 | EN 10216-2:2013 | 268, 270 |
| 09DG | GB/T 18984-2003 | 247, 249 |
| 9Cr18MoV | GB 1220-92 | 521, 533 |
| 9CrWMn | GB/T 1299-2000 | 626 |
| 9 NiMnMoNb 5-4-4 | ISO 9329-2:1997 | 273 |
| 9 S 20 | ISO 683-9:1988 | 613 |
| 10 | GB 13791-92 | 21 |
| 10 (continued) | GB 3087-1999 | 260, 264 |
| | GB 6479-2000 | 255, 258 |
| | GB 711-88 | 51, 66 |
| | GB/T 3078-94 | 21 |
| | GB/T 699-1999 | 21 |
| 10B18 | ASTM A29/A29M-12e1 | 44 |
| | SAE J403 JUN14 | 44 |
| 10B23 | ASTM A29/A29M-12e1 | 44 |
| | SAE J403 JUN14 | 44 |
| 10B29 | ASTM A29/A29M-12e1 | 44 |
| | SAE J403 JUN14 | 44 |
| 10B30 | ASTM A29/A29M-12e1 | 44 |
| | SAE J403 JUN14 | 44 |
| 10B38 | ASTM A29/A29M-12e1 | 44 |
| | SAE J403 JUN14 | 44 |
| 10B40 | ASTM A29/A29M-12e1 | 44 |
| | SAE J403 JUN14 | 44 |
| 10B45 | ASTM A29/A29M-12e1 | 44 |
| | SAE J403 JUN14 | 44 |
| 10B50 | ASTM A29/A29M-12e1 | 44 |
| | SAE J403 JUN14 | 44 |
| 10Cr9Mo1VNb | GB 5310-1995 | 283, 285 |
| 10CrMo5-5 | EN 10216-2:2013 | 276, 277 |
| 10CrMo9-10 | EN 10028-2:2009 | 143 |
| | EN 10216-2:2013 | 278, 279 |
| 10F | GB 711-88 | 51, 66 |
| | GB/T 3078-94 | 21 |
| | GB/T 699-1999 | 21 |
| 10MnDG | GB/T 18984-2003 | 248, 250 |
| 10S20 | EN 10087:1998 C2:2006 | 611 |
| | EN 10277-3:2008 | 611 |
| | ISO 683-9:1988 | 611 |
| 10SPb20 | EN 10087:1998 C2:2006 | 614 |
| | EN 10277-3:2008 | 614 |
| | ISO 683-9:1988 | 614 |
| 11, Class 1 | ASME SA-387/SA-387M | 142 |
| | ASTM A387/A387M-11 | 142 |
| 11, Class 2 | ASME SA-387/SA-387M | 142 |
| | ASTM A387/A387M-11 | 142 |
| 11Cr17 | GB 1220-92 | 521, 531 |
| | GB 4226-84 | 521 |
| 11CrMo9-10 | EN 10216-2:2013 | 278, 279 |
| | EN 10222-2:1999 | 352, 353 |

| Designation | Specification | Page Number |
|---|---|---|
| 11 CrMo 9-10 TA | ISO 9329-2:1997 | 278, 279 |
| 11 CrMo 9-10 TN+TT | ISO 9329-2:1997 | 278, 279 |
| 11MnNi5-3 | EN 10028-4:2009 | 147 |
| | EN 10216-4:2013 | 251, 252 |
| | ISO 9327-3:1999 | 359 |
| | ISO 9328-4:2004 | 147 |
| | ISO 9329-3:1997 | 251, 252 |
| | ISO 9330-3:1997 | 251, 252 |
| | ISO 9330-5:2000 | 251, 252 |
| 11 SMn 28 | ISO 683-9:1988 | 613 |
| 11SMn30 | EN 10087:1998 C2:2006 | 613 |
| | EN 10277-3:2008 | 613 |
| 11SMn37 | EN 10087:1998 C2:2006 | 614 |
| | EN 10277-3:2008 | 614 |
| 11 SMnPb 28 | ISO 683-9:1988 | 614 |
| 11SMnPb30 | EN 10087:1998 C2:2006 | 614 |
| | EN 10277-3:2008 | 614 |
| 11SMnPb37 | EN 10087:1998 C2:2006 | 614 |
| | EN 10277-3:2008 | 614 |
| 12, Class 1 | ASME SA-387/SA-387M | 141 |
| | ASTM A387/A387M-11 | 141 |
| 12, Class 2 | ASME SA-387/SA-387M | 141 |
| | ASTM A387/A387M-11 | 141 |
| 12Cr2Mo | GB 6479-2000 | 278, 279 |
| 12Cr2MoG | GB 5310-1995 | 278, 279 |
| 12CrMo | GB 6479-2000 | 271, 272 |
| 12CrMoG | GB 5310-1995 | 271, 272 |
| 12CrNi3 | GB/T 3077-1999 | 41 |
| 12L13 | ASME SA-29/SA-29M | 614 |
| | ASTM A29/A29M-12e1 | 614 |
| 12L14 | ASME SA-29/SA-29M | 614 |
| | ASTM A29/A29M-12e1 | 614 |
| | ASTM A576-90b (2012) | 614 |
| | SAE J403 JUN14 | 614 |
| 12L15 | ASME SA-29/SA-29M | 614 |
| | ASTM A29/A29M-12e1 | 614 |
| 12 MoCrV 6-2 | ISO 9329-2:1997 | 271, 272 |
| 12Ni14 | EN 10028-4:2009 | 151, 152 |
| | EN 10216-4:2013 | 251, 253 |
| | EN 10222-3:1998 | 357, 358 |
| | ISO 9329-3:1997 | 251, 253 |
| | ISO 9330-3:1997 | 251, 253 |
| | ISO 9330-5:2000 | 251, 253 |
| 12Ni14G1 | ISO 9327-3:1999 | 357, 358 |
| 12Ni14G2 | ISO 9327-3:1999 | 357, 358 |
| 12Ni19 | ISO 9327-3:1999 | 357, 358 |
| 12 SMn 35 | ISO 683-9:1988 | 614 |
| 12 SMnPb 35 | ISO 683-9:1988 | 614 |
| 13CrMo4-5 | EN 10028-2:2009 | 141 |
| | EN 10216-2:2013 | 274, 275 |
| | EN 10222-2:1999 | 350 |
| | ISO 9329-2:1997 | 274, 275 |
| 13CrMo9-10 | ISO 9327-2:1999 | 352, 353 |
| 13CrMoSi5-5 | EN 10028-2:2009 | 142 |
| 13MnNi6-3 | EN 10028-4:2009 | 147 |
| | EN 10216-4:2013 | 251, 252 |
| | EN 10222-3:1998 | 359 |
| | ISO 9327-3:1999 | 359 |
| | ISO 9328-4:2004 | 147 |
| | ISO 9329-3:1997 | 251, 252 |
| | ISO 9330-3:1997 | 251, 252 |
| | ISO 9330-5:2000 | 251, 252 |
| 13MnNiMoNbg | GB 713-1997 | 134, 138 |
| 13MnNiMoNbR | GB 6654-1996 | 157, 158 |
| 14CrMo4-5 | ISO 9327-2:1999 | 350 |
| 14MoV6-3 | EN 10216-2:2013 | 271, 272 |
| 14NiCrMo13-4 | EN 10084:2008 | 43 |
| 15 | GB 13791-92 | 22 |
| | GB 711-88 | 54, 67 |
| | GB/T 17107-1997 | 333, 339 |
| | GB/T 3078-94 | 22 |
| | GB/T 699-1999 | 22 |
| 15B22 | ASTM A29/A29M-12e1 | 44 |
| | SAE J403 JUN14 | 44 |
| 15Cr | GB 11251-89 | 85, 92 |
| | GB/T 3077-1999 | 36 |
| 15CrA | GB/T 3077-1999 | 36 |
| | GB/T 3078-94 | 36 |
| 15CrMo | GB 6479-2000 | 274, 275 |
| 15CrMog | GB 5310-1995 | 274, 275 |
| | GB 713-1997 | 141 |
| 15CrMoR | GB 6654-1996 | 141 |
| 15F | GB 711-88 | 54, 67 |
| | GB/T 3078-94 | 22 |
| | GB/T 699-1999 | 22 |
| 15Mn | GB/T 3078-94 | 22 |

| Designation | Specification | Page Number |
|---|---|---|
| 15 Mn (continued) | GB/T 699-1999 | 22 |
| 15MnNiDR | GB 3531-1996 | 147 |
| 15MnVR | GB 6654-1996 | 118, 126 |
| 15MoG | GB 5310-1995 | 267 |
| 15NiCr13 | EN 10084:2008 | 41 |
| | ISO 683-11:1987 | 41 |
| 15NiCuMoNb5-6-4 | EN 10028-2:2009 | 157, 158 |
| | EN 10216-2:2013 | 273 |
| 15NiMn6 | EN 10028-4:2009 | 148 |
| | EN 10222-3:1998 | 357, 358 |
| | ISO 9327-3:1999 | 357, 358 |
| | ISO 9328-4:2004 | 148 |
| 15SMn13 | EN 10087:1998 C2:2006 | 611 |
| | EN 10277-3:2008 | 611 |
| 16MnDG | GB/T 18984-2003 | 248, 250 |
| 16MnDR | GB 3531-1996 | 116, 125 |
| 16Mng | GB 713-1997 | 117, 126 |
| 16MnR | GB 6654-1996 | 117, 126 |
| 16Mo3 | EN 10028-2:2009 | 134, 138 |
| | EN 10216-2:2013 | 267 |
| | EN 10217-2:2002 A1:2005 | 267 |
| | EN 10217-5:2002 A1:2005 | 267 |
| | EN 10222-2:1999 | 348 |
| | ISO 9327-2:1999 | 348 |
| | ISO 9328-2:2004 | 134, 138 |
| | ISO 9329-2:1997 | 267 |
| 17B2 | EN 10263-4:2001 C2:2003 | 44 |
| 17Cr3 | EN 10084:2008 | 36 |
| 17CrS3 | EN 10084:2008 | 36 |
| 17 NiCrMo 6 | ISO 683-11:1987 | 42 |
| 17 SMn 20 | ISO 683-9:1988 | 611 |
| 18B2 | EN 10263-3:2001 C1:2001 | 44 |
| 18CrMo4 | EN 10084:2008 | 39 |
| | ISO 683-11:1987 | 39 |
| 18CrMoS4 | EN 10084:2008 | 39 |
| | ISO 683-11:1987 | 39 |
| 18MnMo4-5 | EN 10028-2:2009 | 134, 138 |
| 18MnMoNbR | GB 6654-1996 | 137, 139 |
| 19Mng | GB 713-1997 | 117, 126 |
| 20 | GB 13791-92 | 23 |
| | GB 3087-1999 | 261, 265 |
| | GB 6479-2000 | 256, 259 |
| | GB 711-88 | 58, 69 |
| 20 (continued) | GB/T 17107-1997 | 333, 339 |
| | GB/T 17396-1998 | 203, 217 |
| | GB/T 3078-94 | 23 |
| | GB/T 699-1999 | 23 |
| 20Cr | GB 11251-89 | 85, 92 |
| | GB 13791-92 | 36 |
| | GB/T 3077-1999 | 36 |
| | GB/T 3078-94 | 36 |
| 20 Cr 4 | ISO 683-11:1987 | 36 |
| 20 CrS 4 | ISO 683-11:1987 | 36 |
| 20CrH | GB 5216-85 | 36 |
| 20CrMnMo | GB/T 3077-1999 | 39 |
| | GB/T 3078-94 | 39 |
| 20CrMnMoH | GB 5216-85 | 39 |
| 20CrMnSiA | GB 11251-89 | 85, 92 |
| 20CrMo | GB/T 3077-1999 | 39 |
| | GB/T 3078-94 | 39 |
| 20CrMo(A) | GB 13791-92 | 39 |
| 20CrNiMo | GB/T 3077-1999 | 42 |
| 20CrNiMoH | GB 5216-85 | 42 |
| 20F | GB 711-88 | 55, 67 |
| | GB/T 3078-94 | 23 |
| 20g | GB 5310-1995 | 261, 265 |
| | GB 713-1997 | 113, 120 |
| 20Mn | GB 711-88 | 60, 70 |
| | GB/T 3078-94 | 23 |
| | GB/T 699-1999 | 23 |
| 20Mn2 | GB/T 3077-1999 | 34 |
| | GB/T 3078-94 | 34 |
| 20MnB5 | EN 10083-3:2006 C1:2008 | 44 |
| 20MnG | GB 5310-1995 | 261, 265 |
| 20MnMoNi4-5 | EN 10028-2:2009 | 155, 156 |
| 20MoCr3 | EN 10084:2008 | 39 |
| 20MoCr4 | EN 10084:2008 | 39 |
| 20MoCrS3 | EN 10084:2008 | 39 |
| 20MoCrS4 | EN 10084:2008 | 39 |
| 20MoG | GB 5310-1995 | 268, 270 |
| 20 NiCrMo 2 | ISO 683-11:1987 | 42 |
| 20NiCrMo2-2 | EN 10084:2008 | 42 |
| 20 NiCrMoS 2 | ISO 683-11:1987 | 42 |
| 20NiCrMoS2-2 | EN 10084:2008 | 42 |
| 20NiCrMoS6-4 | EN 10084:2008 | 42 |
| 20R | GB 6654-1996 | 113, 120 |

| Designation | Specification | Page Number |
|---|---|---|
| 21, Class 1 | ASME SA-387/SA-387M | 144 |
| | ASTM A387/A387M-11 | 144 |
| 21, Class 2 | ASME SA-387/SA-387M | 144 |
| | ASTM A387/A387M-11 | 144 |
| 21L, Class 1 | ASME SA-387/SA-387M | 144 |
| | ASTM A387/A387M-11 | 144 |
| 22, Class 1 | ASME SA-387/SA-387M | 143 |
| | ASTM A387/A387M-11 | 143 |
| 22, Class 2 | ASME SA-387/SA-387M | 143 |
| | ASTM A387/A387M-11 | 143 |
| 22, Class 3 | ASME SA-508/SA-508M | 352, 353 |
| | ASME SA-541/SA-541M | 352, 353 |
| | ASTM A508/A508M-14 | 352, 353 |
| | ASTM A541/A541M-05 (2015) | 352, 353 |
| 22L, Class 1 | ASME SA-387/SA-387M | 143 |
| | ASTM A387/A387M-11 | 143 |
| 22 Mn 6 | ISO 683-1:1987 | 34 |
| 22CrMoS3-5 | EN 10084:2008 | 39 |
| 22Mng | GB 713-1997 | 117, 126 |
| 22V | ASME SA-541/SA-541M | 352, 353 |
| | ASTM A541/A541M-05 (2015) | 352, 353 |
| 23B2 | EN 10263-4:2001 C2:2003 | 44 |
| 25 | GB 13791-92 | 24 |
| | GB 711-88 | 60, 70 |
| | GB/T 17107-1997 | 334, 339 |
| | GB/T 3078-94 | 24 |
| | GB/T 699-1999 | 24 |
| 25CrMnSiA | GB 11251-89 | 86, 92 |
| 25CrMo4 | EN 10083-3:2006 C1:2008 | 40 |
| | EN 10250-3:1999 | 347 |
| | EN 10297-1:2003 | 224, 225 |
| | EN 10305-1:2010 | 224, 225 |
| | ISO 683-1:1987 | 40 |
| 25CrMoS4 | EN 10083-3:2006 C1:2008 | 40 |
| | ISO 683-1:1987 | 40 |
| 25Mn | GB 711-88 | 60, 70 |
| | GB/T 3078-94 | 24 |
| | GB/T 699-1999 | 24 |
| 25MnG | GB 5310-1995 | 263, 266 |
| 26 CrMo 4 | ISO 9329-3:1997 | 251, 254 |
| 26CrMo4-2 | EN 10216-4:2013 | 251, 254 |
| 26Mn5 | EN 10305-1:2010 | 211, 212, 223, 224 |
| 26Mo2 | EN 10305-1:2010 | 224, 225 |
| 27SiMn | GB 11251-89 | 87, 93 |
| 28 Mn 6 | ISO 683-1:1987 | 34 |
| 28B2 | EN 10263-4:2001 C2:2003 | 44 |
| 28Cr4 | EN 10084:2008 | 36 |
| 28CrS4 | EN 10084:2008 | 36 |
| 28Mn6 | EN 10083-2:2006 | 34 |
| 30 | GB 13791-92 | 25 |
| | GB 711-88 | 60, 70 |
| | GB/T 17107-1997 | 335, 339 |
| | GB/T 3078-94 | 25 |
| | GB/T 699-1999 | 25 |
| 30 [205], SS | ASME SA-1011/SA-1011M | 52, 66 |
| | ASTM A1011/A1011M-14 | 52, 66 |
| 30Cr | GB 11251-89 | 86, 92 |
| | GB/T 3077-1999 | 36 |
| | GB/T 3078-94 | 36 |
| 30CrMnSiA | GB 11251-89 | 87, 93 |
| 30CrMo | GB/T 3077-1999 | 40 |
| | GB/T 3078-94 | 40 |
| 30CrMo4 | EN 10297-1:2003 | 224, 225 |
| 30CrMoA | GB/T 3077-1999 | 40 |
| 30CrNi3 | GB/T 3077-1999 | 41 |
| 30Mn | GB 711-88 | 64, 72 |
| | GB/T 3078-94 | 25 |
| | GB/T 699-1999 | 25 |
| 30Mn2 | GB/T 3077-1999 | 34 |
| 32CrAlMo7-10 | EN 10085:2001 | 43 |
| 32CrMoV12-28 | ISO 4957:1999 | 626 |
| 33 [230], SS | ASME SA-1011/SA-1011M | 54, 67 |
| | ASTM A1011/A1011M-14 | 54, 67 |
| 33B2 | EN 10263-4:2001 C2:2003 | 44 |
| 34Cr4 | ISO 683-1:1987 | 37 |
| | EN 10083-3:2006 C1:2008 | 37 |
| 34CrMo4 | ISO 683-1:1987 | 40 |
| 34CrMoS4 | ISO 683-1:1987 | 40 |
| 34CrS4 | ISO 683-1:1987 | 37 |
| 34CrAlMo5-10 | EN 10085:2001 | 43 |
| 34CrAlNi7-10 | EN 10085:2001 | 43 |
| 34CrMo4 | EN 10083-3:2006 C1:2008 | 40 |
| | EN 10250-3:1999 | 347 |
| | EN 10297-1:2003 | 224, 226 |
| 34CrMoS4 | EN 10083-3:2006 C1:2008 | 40 |
| 34CrS4 | EN 10083-3:2006 C1:2008 | 37 |

| Designation | Specification | Page Number |
|---|---|---|
| 35 | GB 13791-92 | 26 |
| | GB 711-88 | 64, 72 |
| | GB/T 17107-1997 | 335, 339 |
| | GB/T 17396-1998 | 208, 221 |
| | GB/T 3078-94 | 26 |
| | GB/T 699-1999 | 26 |
| 35B2 | EN 10269:2013 | 44 |
| 35Cr | GB 11251-89 | 87, 93 |
| | GB/T 3077-1999 | 37 |
| | GB/T 3078-94 | 37 |
| 35CrMnSiA | GB 11251-89 | 88, 94 |
| 35CrMo | GB/T 3077-1999 | 40 |
| | GB/T 3078-94 | 40 |
| 35CrMo(A) | GB 13791-92 | 40 |
| 35Mn | GB/T 3078-94 | 26 |
| | GB/T 699-1999 | 26 |
| 35Mn2 | GB/T 3077-1999 | 34 |
| | GB/T 3078-94 | 34 |
| 35S20 | EN 10087:1998 C2:2006 | 612 |
| | EN 10277-3:2008 | 612 |
| | ISO 683-9:1988 | 612 |
| 35 SMn 20 | ISO 683-9:1988 | 612 |
| 36 [250] | ASTM A709/A709M-13a | 57, 68 |
| 36 [250], 1, SS | ASME SA-1011/SA-1011M | 54, 67 |
| | ASTM A1011/A1011M-14 | 54, 67 |
| 36 [250], 2, SS | ASME SA-1011/SA-1011M | 57, 68 |
| | ASTM A1011/A1011M-14 | 57, 68 |
| 36 Mn 6 | ISO 683-1:1987 | 35 |
| 36CrB4 | EN 10263-4:2001 C2:2003 | 45 |
| 36SMn14 | EN 10087:1998 C2:2006 | 612 |
| | EN 10277-3:2008 | 612 |
| 37Cr4 | EN 10083-3:2006 C1:2008 | 37 |
| | ISO 683-1:1987 | 37 |
| 37CrS4 | EN 10083-3:2006 C1:2008 | 37 |
| | ISO 683-1:1987 | 37 |
| 37Mn | GB 18248-2000 | 212, 224 |
| 38B2 | EN 10263-4:2001 C2:2003 | 44 |
| 38CrCoWV18-17-17 | ISO 4957:1999 | 627 |
| 38CrMoAl | GB/T 3077-1999 | 43 |
| 38CrMoAlA | GB/T 3078-94 | 43 |
| 38Mn6 | EN 10297-1:2003 | 211, 223 |
| 38SMn28 | EN 10087:1998 C2:2006 | 612 |
| | EN 10277-3:2008 | 612 |
| 40 | GB 13791-92 | 27 |
| | GB 3522-83 | 616 |
| | GB 711-88 | 64, 73 |
| | GB/T 17107-1997 | 336, 339 |
| | GB/T 3078-94 | 27 |
| | GB/T 699-1999 | 27 |
| 40 [275], SS | ASME SA-1011/SA-1011M | 55, 67 |
| | ASTM A1011/A1011M-14 | 55, 67 |
| 40B | GB 11251-89 | 62, 71 |
| | GB/T 3077-1999 | 44 |
| | GB/T 3078-94 | 44 |
| 40Cr | GB 11251-89 | 87, 93 |
| | GB 13791-92 | 37 |
| | GB/T 3077-1999 | 37 |
| | GB/T 3078-94 | 37 |
| 40CrH | GB 5216-85 | 37 |
| 40CrNiMoA | GB/T 3077-1999 | 42 |
| | GB/T 3078-94 | 42 |
| 40Mn | GB 711-88 | 64, 73 |
| | GB/T 3078-94 | 27 |
| | GB/T 699-1999 | 27 |
| 40Mn2 | GB/T 3077-1999 | 35 |
| | GB/T 3078-94 | 35 |
| 41Cr4 | EN 10083-3:2006 C1:2008 | 37 |
| | ISO 683-1:1987 | 37 |
| 41CrAlMo7-10 | EN 10085:2001 | 43 |
| 41CrAlMo74 | ISO 683-10:1987 | 43 |
| 41CrNiMo2 | ISO 683-1:1987 | 43 |
| 41CrNiMoS2 | ISO 683-1:1987 | 43 |
| 41CrS4 | EN 10083-3:2006 C1:2008 | 37 |
| | ISO 683-1:1987 | 37 |
| 42 [290], 1 | ASME SA-572/SA-572M | 74, 80 |
| | ASTM A572/A572M-15 | 74, 80 |
| 42 [290], 2 | ASME SA-572/SA-572M | 74, 80 |
| | ASTM A572/A572M-15 | 74, 80 |
| 42 [290], 3 | ASME SA-572/SA-572M | 74, 80 |
| | ASTM A572/A572M-15 | 74, 80 |
| 42 [290], 5 | ASME SA-572/SA-572M | 74, 80 |
| | ASTM A572/A572M-15 | 74, 80 |
| 42CrMo | GB/T 3077-1999 | 41 |
| | GB/T 3078-94 | 41 |
| 42CrMo4 | EN 10083-3:2006 C1:2008 | 41 |
| | EN 10250-3:1999 | 347 |

| Designation | Specification | Page Number |
|---|---|---|
| 42CrMo4 (continued) | EN 10297-1:2003 | 224, 226 |
| | EN 10305-1:2010 | 224, 226 |
| | ISO 683-1:1987 | 41 |
| 42CrMoS4 | EN 10083-3:2006 C1:2008 | 41 |
| | ISO 683-1:1987 | 41 |
| 42Mn6 | ISO 683-1:1987 | 35 |
| 44SMn28 | EN 10087:1998 C2:2006 | 612 |
| | EN 10277-3:2008 | 612 |
| | ISO 683-9:1988 | 612 |
| 45 | GB 13791-92 | 28 |
| | GB 711-88 | 64, 73 |
| | GB/T 17107-1997 | 337, 339 |
| | GB/T 17396-1998 | 210, 223 |
| | GB/T 3078-94 | 28 |
| | GB/T 699-1999 | 28 |
| 45 [310], 1, SS | ASTM A1011/A1011M-14 | 59, 69 |
| 45 [310], 2, SS | ASTM A1011/A1011M-14 | 59, 69 |
| 45 [310], Class 1, HSLAS | ASME SA-1011/SA-1011M | 74, 80 |
| | ASTM A1011/A1011M-14 | 74, 80 |
| 45 [310], SS | ASME SA-1011/SA-1011M | 59, 69 |
| 45B | GB 11251-89 | 64, 72 |
| | GB/T 3077-1999 | 44 |
| | GB/T 3078-94 | 44 |
| 45Cr | GB/T 3077-1999 | 38 |
| | GB/T 3078-94 | 38 |
| 45CrH | GB 5216-85 | 38 |
| 45Mn | GB/T 3078-94 | 28 |
| | GB/T 699-1999 | 28 |
| 45Mn2 | GB 11251-89 | 64, 72 |
| | GB/T 3077-1999 | 35 |
| | GB/T 3078-94 | 35 |
| 46S20 | EN 10087:1998 C2:2006 | 613 |
| | EN 10277-3:2008 | 613 |
| | ISO 683-9:1988 | 613 |
| 50 | GB 13791-92 | 29 |
| | GB 3522-83 | 616 |
| | GB 711-88 | 65, 73 |
| | GB/T 17107-1997 | 338, 340 |
| | GB/T 3078-94 | 29 |
| | GB/T 699-1999 | 29 |
| 50 [340], Class 1, HSLAS | ASME SA-1011/SA-1011M | 75, 80 |
| | ASTM A1011/A1011M-14 | 75, 80 |
| 50 [340], Class 2, HSLAS | ASME SA-1011/SA-1011M | 74, 80 |
| 50 [340], Class 2, HSLAS (continued) | ASTM A1011/A1011M-14 | 74, 80 |
| 50 [340], SS | ASME SA-1011/SA-1011M | 60, 70 |
| | ASTM A1011/A1011M-14 | 60, 70 |
| 50 [345] | ASTM A529/A529M-14 | 60, 70 |
| 50 [345], 1 | ASME SA-572/SA-572M | 75, 81 |
| | ASTM A572/A572M-15 | 75, 81 |
| | ASTM A709/A709M-13a | 75, 81 |
| 50 [345], 2 | ASME SA-572/SA-572M | 75, 81 |
| | ASTM A572/A572M-15 | 75, 81 |
| | ASTM A709/A709M-13a | 75, 81 |
| 50 [345], 3 | ASME SA-572/SA-572M | 75, 81 |
| | ASTM A572/A572M-15 | 75, 81 |
| | ASTM A656/A656M-13 | 74, 80 |
| | ASTM A709/A709M-13a | 75, 81 |
| 50 [345], 5 | ASME SA-572/SA-572M | 75, 81 |
| | ASTM A572/A572M-15 | 75, 81 |
| | ASTM A709/A709M-13a | 75, 81 |
| 50 [345], 7 | ASTM A656/A656M-13 | 74, 80 |
| 50 [345], 8 | ASTM A656/A656M-13 | 74, 80 |
| 50B | GB 11251-89 | 64, 72 |
| | GB 13791-92 | 44 |
| | GB/T 3077-1999 | 44 |
| | GB/T 3078-94 | 44 |
| 50B44 | ASME SA-29/SA-29M | 45 |
| | ASTM A29/A29M-12e1 | 45 |
| | ASTM A322-13 | 45 |
| 50B46 | ASME SA-29/SA-29M | 45 |
| | ASTM A29/A29M-12e1 | 45 |
| | ASTM A322-13 | 45 |
| 50B50 | ASME SA-29/SA-29M | 45 |
| | ASTM A29/A29M-12e1 | 45 |
| | ASTM A322-13 | 45 |
| 50B60 | ASME SA-29/SA-29M | 45 |
| | ASTM A29/A29M-12e1 | 45 |
| | ASTM A322-13 | 45 |
| 50Cr | GB/T 3077-1999 | 38 |
| 50CrMo4 | EN 10083-3:2006 C1:2008 | 41 |
| | EN 10250-3:1999 | 347 |
| | ISO 683-1:1987 | 41 |
| | JIS G 7105:2000 | 41 |
| 50CrMoV13-15 | ISO 4957:1999 | 627 |
| 50CrVA | GB/T 3077-1999 | 45 |
| 50Mn | GB 13791-92 | 29 |

| Designation | Specification | Page Number |
|---|---|---|
| 50Mn (continued) | GB 711-88 | 65, 73 |
| | GB/T 3078-94 | 29 |
| | GB/T 699-1999 | 29 |
| 50Mn2 | GB/T 3077-1999 | 35 |
| | GB/T 3078-94 | 35 |
| 50W [345W], A | ASTM A709/A709M-13a | 85, 92 |
| 50W [345W], B | ASTM A709/A709M-13a | 85, 92 |
| 55 | GB 3522-83 | 616 |
| | GB 711-88 | 65, 73 |
| | GB/T 17107-1997 | 338, 340 |
| | GB/T 3078-94 | 30 |
| | GB/T 699-1999 | 30 |
| 51B35 | ASTM A29/A29M-12e1 | 45 |
| 51B60 | ASME SA-29/SA-29M | 45 |
| | ASTM A29/A29M-12e1 | 45 |
| | ASTM A322-13 | 45 |
| | SAE J404 JAN09 | 45 |
| 51CrV4 | EN 10083-3:2006 C1:2008 | 45 |
| | EN 10089:2002 | 620 |
| | EN 10132-4:2000 | 620 |
| | ISO 683-1:1987 | 45 |
| | ISO 683-14:2004 | 620 |
| 54SiCr6 | EN 10089:2002 | 619 |
| 54SiCrV6 | EN 10089:2002 | 620 |
| 55 [380] | ASTM A529/A529M-14 | 60, 70 |
| 55 [380], 1 | ASME SA-572/SA-572M | 77, 82 |
| | ASTM A572/A572M-15 | 77, 82 |
| 55 [380], 2 | ASME SA-572/SA-572M | 77, 82 |
| | ASTM A572/A572M-15 | 77, 82 |
| 55 [380], 3 | ASME SA-572/SA-572M | 77, 82 |
| | ASTM A572/A572M-15 | 77, 82 |
| 55 [380], 5 | ASME SA-572/SA-572M | 77, 82 |
| | ASTM A572/A572M-15 | 77, 82 |
| 55 [380], Class 1, HSLAS | ASME SA-1011/SA-1011M | 76, 82 |
| | ASTM A1011/A1011M-14 | 77, 82 |
| 55 [380], Class 2, HSLAS | ASME SA-1011/SA-1011M | 75, 81 |
| | ASTM A1011/A1011M-14 | 75, 81 |
| 55 [380], SS | ASME SA-1011/SA-1011M | 60, 70 |
| | ASTM A1011/A1011M-14 | 60, 70 |
| 55Cr3 | EN 10089:2002 | 618 |
| | ISO 683-14:2004 | 618 |
| 55NiCrMoV7 | ISO 4957:1999 | 627 |
| 55SiCr6-3 | ISO 683-14:2004 | 619 |
| 58 [400] | ASTM A573/A573M-13 | 56, 67 |
| 60 | ASME SA-181/SA-181M | 342, 345 |
| | ASTM A181/A181M-14 | 342, 345 |
| | GB 13791-92 | 31 |
| | GB 3522-83 | 616 |
| | GB 711-88 | 65, 73 |
| | GB/T 3078-94 | 31 |
| | GB/T 699-1999 | 31 |
| 60 [410], Class 1, HSLAS | ASME SA-1011/SA-1011M | 78, 83 |
| | ASTM A1011/A1011M-14 | 78, 83 |
| 60 [410], Class 2 | ASTM A1011/A1011M-14 | 77 |
| 60 [410], Class 2, HSLAS | ASME SA-1011/SA-1011M | 76, 82 |
| | ASTM A1011/A1011M-14 | 82 |
| 60 [415] | ASME SA-515/SA-515M | 114, 121 |
| | ASME SA-516/SA-516M | 114, 122 |
| | ASTM A515/A515M-10 | 114, 122 |
| | ASTM A516/A516M-10 | 114, 122 |
| 60 [415], 1 | ASME SA-572/SA-572M | 78, 83 |
| | ASTM A572/A572M-15 | 78, 83 |
| 60 [415], 2 | ASME SA-572/SA-572M | 78, 83 |
| | ASTM A572/A572M-15 | 78, 83 |
| 60 [415], 3 | ASME SA-572/SA-572M | 78, 83 |
| | ASTM A572/A572M-15 | 78, 83 |
| | ASTM A656/A656M-13 | 77, 82 |
| 60 [415], 5 | ASME SA-572/SA-572M | 78, 83 |
| | ASTM A572/A572M-15 | 78, 83 |
| 60 [415], 7 | ASTM A656/A656M-13 | 77, 82 |
| 60 [415], 8 | ASTM A656/A656M-13 | 77, 82 |
| 60 [420] | ASTM A955/A955M-15 | 600, 602 |
| 60 [420], 304 | ASTM A955/A955M-15 | 542, 556 |
| 60 [420], 316L | ASTM A955/A955M-15 | 546, 572 |
| 60, I | ASTM A871/A871M-14 | 101, 105 |
| 60, II | ASTM A871/A871M-14 | 101, 105 |
| 60, IV | ASTM A871/A871M-14 | 101, 105 |
| 60-30 [415-205] | ASTM A27/A27M-13 | 389, 393 |
| 60Cr3 | EN 10089:2002 | 618 |
| 60CrMnBA | GB/T 1222-84 | 621 |
| 60CrMo3-1 | EN 10089:2002 | 619 |
| 60CrMo3-2 | EN 10089:2002 | 619 |
| 60CrMo3-3 | EN 10089:2002 | 619 |
| | ISO 683-14:2004 | 619 |
| 60Mn | GB 711-88 | 65, 73 |
| | GB/T 3078-94 | 31 |

| Designation | Specification | Page Number |
|---|---|---|
| 60 Mn (continued) | GB/T 699-1999 | 31 |
| 65 | GB 3522-83 | 617 |
| | GB 711-88 | 65, 73 |
| | GB/T 3078-94 | 32 |
| | GB/T 699-1999 | 32 |
| 65 [450] | ASME SA-515/SA-515M | 114, 122 |
| | ASME SA-516/SA-516M | 114, 123 |
| | ASTM A515/A515M-10 | 114, 123 |
| | ASTM A516/A516M-10 | 114, 123 |
| | ASTM A573/A573M-13 | 60, 70 |
| 65 [450], 1 | ASME SA-572/SA-572M | 79, 84 |
| | ASTM A572/A572M-15 | 79, 84 |
| 65 [450], 2 | ASME SA-572/SA-572M | 79, 84 |
| | ASTM A572/A572M-15 | 79, 84 |
| 65 [450], 3 | ASME SA-572/SA-572M | 79, 84 |
| | ASTM A572/A572M-15 | 79, 84 |
| 65 [450], 5 | ASME SA-572/SA-572M | 79, 84 |
| | ASTM A572/A572M-15 | 79, 84 |
| 65 [450], Class 1, HSLAS | ASME SA-1011/SA-1011M | 79, 84 |
| | ASTM A1011/A1011M-14 | 79, 84 |
| 65 [450], Class 2, HSLAS | ASME SA-1011/SA-1011M | 78, 83 |
| | ASTM A1011/A1011M-14 | 78, 83 |
| 65, I | ASTM A871/A871M-14 | 102, 106 |
| 65, II | ASTM A871/A871M-14 | 102, 106 |
| 65, IV | ASTM A871/A871M-14 | 102, 106 |
| 65-35 [450-240] | ASTM A27/A27M-13 | 389, 393 |
| 65Mn | GB/T 3078-94 | 32 |
| | GB/T 4358-1995 | 615 |
| | GB/T 699-1999 | 32 |
| 70 | ASME SA-181/SA-181M | 342, 345 |
| | ASTM A181/A181M-14 | 342, 346 |
| | GB 3522-83 | 617 |
| | GB/T 4358-1995 | 615 |
| | GB/T 699-1999 | 32 |
| 70 [480], Class 1, HSLAS | ASME SA-1011/SA-1011M | 79, 84 |
| | ASTM A1011/A1011M-14 | 79, 84 |
| 70 [485] | ASME SA-515/SA-515M | 115, 124 |
| | ASME SA-516/SA-516M | 115, 124 |
| | ASTM A515/A515M-10 | 115, 125 |
| | ASTM A516/A516M-10 | 115, 125 |
| | ASTM A573/A573M-13 | 60, 70 |
| 70 [485], 3 | ASTM A656/A656M-13 | 79, 84 |
| 70 [485], 7 | ASTM A656/A656M-13 | 79, 84 |
| 70 [485], 8 | ASTM A656/A656M-13 | 79, 84 |
| 70-36 [485-250] | ASTM A27/A27M-13 | 390, 393 |
| 70-40 [485-275] | ASTM A27/A27M-13 | 390, 393 |
| 70Mn | GB/T 699-1999 | 32 |
| 70MnMoCr8 | ISO 4957:1999 | 626 |
| 75 | GB/T 699-1999 | 33 |
| 75 [520] | ASTM A955/A955M-15 | 600, 602 |
| 75 [520], 304 | ASTM A955/A955M-15 | 542, 556 |
| 75 [520], 316L | ASTM A955/A955M-15 | 546, 572 |
| 80 | GB/T 699-1999 | 33 |
| 80-40 [550-275] | ASTM A148/A148 M-14 | 390, 394 |
| 80-50 [550-345] | ASTM A148/A148 M-14 | 390, 394 |
| 85 | GB/T 699-1999 | 33 |
| 90-60 [620-415] | ASTM A148/A148 M-14 | 391, 394 |
| 91, Class 2 | ASME SA-387/SA-387M | 146 |
| | ASTM A387/A387M-11 | 146 |
| 95MnWCr5 | ISO 4957:1999 | 626 |
| 100Cr6 | ISO 683-17:1999 | 628 |
| 100CrMnMoSi8-4-6 | ISO 683-17:1999 | 628 |
| 100CrMnSi4-4 | ISO 683-17:1999 | 628 |
| 100CrMnSi6-4 | ISO 683-17:1999 | 628 |
| 100CrMnSi6-6 | ISO 683-17:1999 | 628 |
| 100CrMo7 | ISO 683-17:1999 | 628 |
| 100CrMo7-3 | ISO 683-17:1999 | 628 |
| 100CrMo7-4 | ISO 683-17:1999 | 628 |
| 102Cr6 | ISO 4957:1999 | 627 |
| 105-85 [725-585] | ASTM A148/A148 M-14 | 392, 395 |
| 105V | ISO 4957:1999 | 622 |
| 115-95 [795-655] | ASTM A148/A148 M-14 | 392, 395 |
| 130-115 [895-795] | ASTM A148/A148 M-14 | 392, 395 |
| 150-135 [1035-930] | ASTM A148/A148 M-14 | 392, 395 |
| 200-400 | ISO 3755:1991 | 389, 392 |
| 200-400W | ISO 3755:1991 | 389, 392 |
| 201-1 | ASME SA-240/SA-240M | 458, 473 |
| | ASME SA-666 | 458, 473 |
| | ASTM A240/A240M-15a | 458, 473 |
| | ASTM A666-15 | 458, 473 |
| 201-2 | ASME SA-240/SA-240M | 458, 473 |
| | ASME SA-666 | 458, 473 |
| | ASTM A240/A240M-15a | 458, 473 |
| | ASTM A666-15 | 458, 473 |
| 201L | ASME SA-240/SA-240M | 458, 474 |
| | ASME SA-666 | 458, 474 |

| Designation | Specification | Page Number |
|---|---|---|
| 201L (continued) | ASTM A240/A240M-15a | 458, 474 |
| | ASTM A666-15 | 458, 474 |
| 201LN | ASME SA-240/SA-240M | 458, 474 |
| | ASME SA-666 | 458, 474 |
| | ASTM A240/A240M-15a | 458, 474 |
| | ASTM A666-15 | 458, 474 |
| 201 | ASME SA-276 | 541, 551 |
| | ASTM A276/A276M-15 | 541, 551 |
| | SAE J405 JUN98 | 458 |
| 202 | ASME SA-240/SA-240M | 458, 474 |
| | ASME SA-276 | 541, 551 |
| | ASME SA-666 | 458, 474 |
| | ASTM A240/A240M-15a | 458, 474 |
| | ASTM A276/A276M-15 | 541, 551 |
| | ASTM A666-15 | 458, 474 |
| | SAE J405 JUN98 | 458 |
| 230-450 | ISO 3755:1991 | 389, 393 |
| 230-450W | ISO 3755:1991 | 389, 393 |
| 241 - Category 1 | CSA Z245.1-14 | 316, 318 |
| 241 - Category 2 | CSA Z245.1-14 | 321, 324 |
| 241 - Category 3 | CSA Z245.1-14 | 321, 324 |
| 260W (38W) | CSA G40.21-13 | 74, 80 |
| 260WT (38WT) | CSA G40.21-13 | 74, 80 |
| 270-480 | ISO 3755:1991 | 390, 393 |
| 270-480W | ISO 3755:1991 | 390, 393 |
| 290 - Category 1 | CSA Z245.1-14 | 316, 318 |
| 290 - Category 2 | CSA Z245.1-14 | 321, 325 |
| 290 - Category 3 | CSA Z245.1-14 | 321, 325 |
| 300W (44W) | CSA G40.21-13 | 75, 80 |
| 300WT (44WT) | CSA G40.21-13 | 75, 80 |
| 301 | ASME SA-240/SA-240M | 459, 475 |
| | ASME SA-666 | 459, 475 |
| | ASTM A240/A240M-15a | 459, 475 |
| | ASTM A666-15 | 459, 475 |
| | SAE J405 JUN98 | 459 |
| 301L | ASME SA-240/SA-240M | 459, 476 |
| | ASME SA-666 | 459, 476 |
| | ASTM A240/A240M-15a | 459, 476 |
| | ASTM A666-15 | 459, 476 |
| 301LN | ASME SA-240/SA-240M | 165, 171, 459, 477 |
| | ASME SA-666 | 165, 171, 459, 477 |
| | ASTM A240/A240M-15a | 165, 171, 459, 477 |
| 301LN (continued) | ASTM A666-15 | 165, 171, 459, 477 |
| 302 | ASME SA-240/SA-240M | 459, 477 |
| | ASME SA-276 | 541, 553 |
| | ASME SA-479/SA-479M | 541, 553 |
| | ASME SA-666 | 459, 477 |
| | ASTM A240/A240M-15a | 459, 477 |
| | ASTM A276/A276M-15 | 541, 553 |
| | ASTM A479/A479M-14 | 541, 553 |
| | ASTM A666-15 | 459, 477 |
| | SAE J405 JUN98 | 459 |
| 302, Class 1 | ASTM A313/A313M-13 | 621 |
| 302, Class 2 | ASTM A313/A313M-13 | 621 |
| 303 | ASTM A581/A581M-95b (2014) | 615 |
| | ASTM A582/A582M-12e1 | 541, 554, 615 |
| | ASTM A895-89 (2009) | 615 |
| 303Se | ASTM A581/A581M-95b (2014) | 615 |
| | ASTM A582/A582M-12e1 | 541, 554 |
| 304 | ASME SA-240/SA-240M | 165, 171, 460, 478 |
| | ASME SA-276 | 542, 555 |
| | ASME SA-358/SA-358M | 288, 298 |
| | ASME SA-479/SA-479M | 542, 555 |
| | ASME SA-666 | 165, 171, 460, 478, 542, 555 |
| | ASTM A240/A240M-15a | 165, 171, 460, 478 |
| | ASTM A276/A276M-15 | 542, 555 |
| | ASTM A313/A313M-13 | 621 |
| | ASTM A314-13a | 542 |
| | ASTM A358/A358M-14a | 288, 298 |
| | ASTM A473-15 | 367, 373 |
| | ASTM A479/A479M-14 | 542, 555 |
| | ASTM A666-15 | 165, 171, 460, 478, 542, 555 |
| | ASTM A908-03 (2013) | 232, 235, 288, 298 |
| | SAE J405 JUN98 | 460 |
| 304H | ASME SA-240/SA-240M | 165, 172, 461, 480 |
| | ASME SA-358/SA-358M | 289, 301 |
| | ASME SA-479/SA-479M | 543, 562 |
| | ASTM A240/A240M-15a | 165, 172, 461, 480 |
| | ASTM A358/A358M-14a | 289, 301 |
| | ASTM A479/A479M-14 | 543, 562 |
| | SAE J405 JUN98 | 461 |
| 304L | ASME SA-240/SA-240M | 165, 173, 461, 479 |

| Designation | Specification | Page Number |
|---|---|---|
| 304L (continued) | ASME SA-276 | 542, 558 |
| | ASME SA-358/SA-358M | 288, 299 |
| | ASME SA-479/SA-479M | 542, 558 |
| | ASME SA-666 | 165, 173, 461, 479, 542, 558 |
| | ASTM A240/A240M-15a | 165, 173, 461, 479 |
| | ASTM A276/A276M-15 | 542, 558 |
| | ASTM A314-13a | 542 |
| | ASTM A358/A358M-14a | 289, 299 |
| | ASTM A473-15 | 367, 373 |
| | ASTM A479/A479M-14 | 542, 558 |
| | ASTM A666-15 | 165, 173, 461, 479, 542, 558 |
| | SAE J405 JUN98 | 461 |
| 304LN | ASME SA-240/SA-240M | 166, 175, 462, 482 |
| | ASME SA-276 | 543, 561 |
| | ASME SA-479/SA-479M | 543, 561 |
| | ASME SA-666 | 166, 175, 462, 482, 543, 561 |
| | ASTM A240/A240M-15a | 166, 175, 462, 482 |
| | ASTM A276/A276M-15 | 543, 561 |
| | ASTM A479/A479M-14 | 543, 561 |
| | ASTM A666-15 | 166, 175, 462, 482, 543, 561 |
| | SAE J405 JUN98 | 462 |
| 304N | ASME SA-240/SA-240M | 166, 174, 461, 481 |
| | ASME SA-276 | 543, 560 |
| | ASME SA-479/SA-479M | 543, 560 |
| | ASME SA-666 | 166, 174, 461, 481, 543, 560 |
| | ASTM A240/A240M-15a | 166, 174, 461, 481 |
| | ASTM A276/A276M-15 | 543, 561 |
| | ASTM A479/A479M-14 | 543, 561 |
| | ASTM A666-15 | 166, 174, 461, 481, 543, 561 |
| | SAE J405 JUN98 | 461 |
| 305 | ASME SA-240/SA-240M | 462, 483 |
| | ASME SA-276 | 543, 562 |
| | ASTM A240/A240M-15a | 462, 483 |
| | ASTM A276/A276M-15 | 543, 562 |
| | SAE J405 JUN98 | 462 |
| 309 | ASME SA-276 | 544, 564 |
| | ASTM A276/A276M-15 | 544, 564 |
| 309H | ASME SA-240/SA-240M | 166, 176, 463, 484 |
| | ASTM A240/A240M-15a | 166, 176, 463, 484 |
| 309H (continued) | SAE J405 JUN98 | 463 |
| 309S | ASME SA-240/SA-240M | 463, 484 |
| | ASME SA-276 | 544, 564 |
| | ASME SA-358/SA-358M | 290, 302 |
| | ASME SA-479/SA-479M | 544, 564 |
| | ASTM A240/A240M-15a | 463, 484 |
| | ASTM A276/A276M-15 | 544, 564 |
| | ASTM A358/A358M-14a | 290, 302 |
| | ASTM A479/A479M-14 | 544, 564 |
| | SAE J405 JUN98 | 463 |
| 310 | ASME SA-276 | 544, 564 |
| | ASTM A276/A276M-15 | 544, 564 |
| | ASTM A473-15 | 368, 375 |
| 310H | ASME SA-240/SA-240M | 166, 176, 463, 486 |
| | ASTM A240/A240M-15a | 166, 176, 463, 486 |
| | SAE J405 JUN98 | 463 |
| 310 MoLN | ASME SA-240/SA-240M | 464, 486 |
| | ASTM A240/A240M-15a | 464, 486 |
| | SAE J405 JUN98 | 464 |
| 310S | ASME SA-240/SA-240M | 463, 485 |
| | ASME SA-276 | 544, 565 |
| | ASME SA-358/SA-358M | 290, 303 |
| | ASME SA-479/SA-479M | 544, 565 |
| | ASTM A240/A240M-15a | 463, 485 |
| | ASTM A276/A276M-15 | 544, 565 |
| | ASTM A358/A358M-14a | 290, 303 |
| | ASTM A479/A479M-14 | 544, 565 |
| | SAE J405 JUN98 | 463 |
| 314 | ASME SA-276 | 545, 567 |
| | ASTM A276/A276M-15 | 545, 567 |
| 316 | ASME SA-240/SA-240M | 167, 177, 464, 487 |
| | ASME SA-276 | 545, 568 |
| | ASME SA-358/SA-358M | 291, 305 |
| | ASME SA-479/SA-479M | 545, 568 |
| | ASME SA-666 | 167, 177, 464, 487, 545, 568 |
| | ASTM A240/A240M-15a | 167, 177, 464, 487 |
| | ASTM A276/A276M-15 | 545, 568 |
| | ASTM A313/A313M-13 | 621 |
| | ASTM A358/A358M-14a | 291, 305 |
| | ASTM A473-15 | 369, 375 |
| | ASTM A479/A479M-14 | 545, 568 |
| | ASTM A666-15 | 167, 177, 464, 487, 545, 568 |

| Designation | Specification | Page Number |
|---|---|---|
| 316 (continued) | SAE J405 JUN98 | 464 |
| 316Cb | ASME SA-240/SA-240M | 168, 180, 466, 491 |
| | ASME SA-276 | 546, 578 |
| | ASME SA-479/SA-479M | 546, 578 |
| | ASTM A240/A240M-15a | 168, 180, 466, 491 |
| | ASTM A276/A276M-15 | 546, 578 |
| | ASTM A479/A479M-14 | 546, 578 |
| | SAE J405 JUN98 | 466 |
| 316H | ASME SA-358/SA-358M | 293, 308 |
| | ASTM A358/A358M-14a | 293, 308 |
| 316L | ASME SA-240/SA-240M | 167, 178, 465, 489 |
| | ASME SA-276 | 546, 572 |
| | ASME SA-358/SA-358M | 292, 306 |
| | ASME SA-479/SA-479M | 546, 572 |
| | ASME SA-666 | 167, 178, 465, 489, 546, 572 |
| | ASTM A240/A240M-15a | 167, 178, 465, 489 |
| | ASTM A276/A276M-15 | 546, 572 |
| | ASTM A358/A358M-14a | 292, 306 |
| | ASTM A473-15 | 369, 376 |
| | ASTM A479/A479M-14 | 546, 572 |
| | ASTM A666-15 | 167, 178, 465, 489, 546, 572 |
| | SAE J405 JUN98 | 465 |
| 316LN | ASME SA-240/SA-240M | 467, 493 |
| | ASME SA-276 | 547, 580 |
| | ASME SA-479/SA-479M | 168, 180, 547, 580 |
| | ASTM A240/A240M-15a | 467, 493 |
| | ASTM A276/A276M-15 | 547, 580 |
| | ASTM A479/A479M-14 | 168, 180, 547, 580 |
| | SAE J405 JUN98 | 467 |
| 316N | ASME SA-240/SA-240M | 466, 492 |
| | ASME SA-276 | 547, 579 |
| | ASME SA-479/SA-479M | 547, 579 |
| | ASME SA-666 | 466, 492, 547, 579 |
| | ASTM A240/A240M-15a | 466, 492 |
| | ASTM A276/A276M-15 | 547, 579 |
| | ASTM A479/A479M-14 | 547, 579 |
| | ASTM A666-15 | 466, 492, 547, 579 |
| | SAE J405 JUN98 | 466 |
| 316Ti | ASME SA-240/SA-240M | 168, 179, 466, 491 |
| | ASME SA-276 | 546, 576 |
| 316 Ti (continued) | ASME SA-479/SA-479M | 546, 576 |
| | ASTM A240/A240M-15a | 168, 179, 466, 491 |
| | ASTM A276/A276M-15 | 546, 576 |
| | ASTM A314-13a | 546 |
| | ASTM A479/A479M-14 | 546, 576 |
| | SAE J405 JUN98 | 466 |
| 317 | ASME SA-240/SA-240M | 467, 494 |
| | ASME SA-276 | 548, 581 |
| | ASME SA-479/SA-479M | 548, 581 |
| | ASTM A240/A240M-15a | 467, 494 |
| | ASTM A276/A276M-15 | 548, 581 |
| | ASTM A473-15 | 370, 377 |
| | ASTM A479/A479M-14 | 548, 581 |
| | SAE J405 JUN98 | 467 |
| 317L | ASME SA-240/SA-240M | 168, 181, 467, 494 |
| | ASTM A240/A240M-15a | 168, 181, 467, 494 |
| | SAE J405 JUN98 | 467 |
| 317LMN | ASME SA-240/SA-240M | 169, 182, 468, 495 |
| | ASTM A240/A240M-15a | 169, 182, 468, 495 |
| 317LN | ASME SA-240/SA-240M | 169, 181, 468, 495 |
| | ASTM A240/A240M-15a | 169, 181, 468, 495 |
| | SAE J405 JUN98 | 468 |
| 321 | ASME SA-240/SA-240M | 169, 182, 468, 496 |
| | ASME SA-276 | 548, 582 |
| | ASME SA-358/SA-358M | 295, 311 |
| | ASME SA-479/SA-479M | 548, 582 |
| | ASTM A240/A240M-15a | 169, 182, 468, 496 |
| | ASTM A276/A276M-15 | 548, 582 |
| | ASTM A358/A358M-14a | 295, 311 |
| | ASTM A473-15 | 371, 378 |
| | ASTM A479/A479M-14 | 548, 582 |
| | SAE J405 JUN98 | 468 |
| 321H | ASME SA-240/SA-240M | 468, 497 |
| | ASME SA-479/SA-479M | 548, 582 |
| | ASTM A240/A240M-15a | 468, 497 |
| | ASTM A479/A479M-14 | 548, 582 |
| | SAE J405 JUN98 | 468 |
| 329 | ASME SA-240/SA-240M | 514, 518 |
| | ASTM A240/A240M-15a | 514, 518 |
| | SAE J405 JUN98 | 514 |
| 340-550 | ISO 3755:1991 | 390, 394 |

| Designation | Specification | Page Number |
|---|---|---|
| 340-550W | ISO 3755:1991 | 390, 394 |
| 347 | ASME SA-240/SA-240M | 169, 183, 469, 498 |
| | ASME SA-276 | 549, 586 |
| | ASME SA-358/SA-358M | 296, 313 |
| | ASME SA-479/SA-479M | 549, 586 |
| | ASTM A240/A240M-15a | 169, 183, 469, 498 |
| | ASTM A276/A276M-15 | 549, 586 |
| | ASTM A358/A358M-14a | 296, 313 |
| | ASTM A473-15 | 372, 379 |
| | ASTM A479/A479M-14 | 549, 586 |
| | SAE J405 JUN98 | 469 |
| 347H | ASME SA-240/SA-240M | 470, 501 |
| | ASME SA-479/SA-479M | 549, 586 |
| | ASTM A240/A240M-15a | 470, 501 |
| | ASTM A479/A479M-14 | 549, 586 |
| | SAE J405 JUN98 | 470 |
| 348 | ASME SA-276 | 549, 586 |
| | ASTM A276/A276M-15 | 549, 586 |
| 350A (50A) | CSA G40.21-13 | 99, 104 |
| 350AT (50AT) | CSA G40.21-13 | 99, 104 |
| 350R (50R) | CSA G40.21-13 | 99, 104 |
| 350W (50W) | CSA G40.21-13 | 75, 81 |
| 350WT (50WT) | CSA G40.21-13 | 76, 82 |
| 359 - Category 1 | CSA Z245.1-14 | 316, 319 |
| 359 - Category 2 | CSA Z245.1-14 | 322, 326 |
| 359 - Category 3 | CSA Z245.1-14 | 322, 326 |
| 380W (55W) | CSA G40.21-13 | 76, 82 |
| 386 - Category 1 | CSA Z245.1-14 | 317, 319 |
| 386 - Category 2 | CSA Z245.1-14 | 322, 326 |
| 386 - Category 3 | CSA Z245.1-14 | 322, 326 |
| 400A (60A) | CSA G40.21-13 | 101, 105 |
| 400AT (60AT) | CSA G40.21-13 | 101, 105 |
| 400W (60W) | CSA G40.21-13 | 78, 83 |
| 400WT (60WT) | CSA G40.21-13 | 78, 83 |
| 403 | ASME SA-276 | 519, 522 |
| | ASME SA-479/SA-479M | 519, 522 |
| | ASTM A240/A240M-15a | 438, 440 |
| | ASTM A276/A276M-15 | 519, 522 |
| | ASTM A479/A479M-14 | 519, 522 |
| 405 | ASME SA-240/SA-240M | 159, 162, 445, 450 |
| | ASME SA-276 | 534, 536 |
| | ASME SA-479/SA-479M | 534, 536 |
| 405 (continued) | ASTM A240/A240M-15a | 159, 162, 445, 450 |
| | ASTM A276/A276M-15 | 534, 536 |
| | ASTM A479/A479M-14 | 534, 536 |
| | SAE J405 JUN98 | 445 |
| 410 | ASME SA-240/SA-240M | 519, 523 |
| | ASME SA-276 | 519, 523 |
| | ASME SA-479/SA-479M | 519, 523 |
| | ASTM A240/A240M-15a | 519, 523 |
| | ASTM A276/A276M-15 | 519, 523 |
| | ASTM A473-15 | 364, 365 |
| | ASTM A479/A479M-14 | 519, 523 |
| | SAE J405 JUN98 | 438 |
| 410-620 | ISO 9477:1992 | 391, 394 |
| 410S | ASME SA-240/SA-240M | 438, 441 |
| | ASTM A240/A240M-15a | 438, 441 |
| | SAE J405 JUN98 | 438 |
| 414 - Category 1 | CSA Z245.1-14 | 317, 319 |
| 414 - Category 2 | CSA Z245.1-14 | 323, 327 |
| 414 - Category 3 | CSA Z245.1-14 | 323, 327 |
| 416 | ASTM A581/A581M-95b (2014) | 615 |
| | ASTM A582/A582M-12e1 | 519, 526 |
| 420 | ASME SA-276 | 520, 527 |
| | ASTM A240/A240M-15a | 439, 442 |
| | ASTM A276/A276M-15 | 520, 527 |
| 420F | ASTM A582/A582M-12e1 | 520, 528 |
| 429 | ASME SA-240/SA-240M | 446, 452 |
| | ASTM A240/A240M-15a | 446, 452 |
| | SAE J405 JUN98 | 446 |
| 430 | ASME SA-240/SA-240M | 446, 453 |
| | ASME SA-276 | 534, 538 |
| | ASME SA-479/SA-479M | 534, 538 |
| | ASTM A240/A240M-15a | 446, 453 |
| | ASTM A276/A276M-15 | 534, 538 |
| | ASTM A473-15 | 366 |
| | ASTM A479/A479M-14 | 534, 538 |
| | SAE J405 JUN98 | 446 |
| 430F | ASTM A581/A581M-95b (2014) | 615 |
| | ASTM A582/A582M-12e1 | 534, 538 |
| 431 | ASME SA-276 | 520, 529 |
| | ASME SA-479/SA-479M | 520, 529 |
| | ASTM A276/A276M-15 | 520, 529 |
| | ASTM A479/A479M-14 | 520, 529 |
| 434 | ASME SA-240/SA-240M | 447, 454 |

| Designation | Specification | Page Number |
|---|---|---|
| 434 (continued) | ASTM A240/A240M-15a | 447, 454 |
| 436 | ASME SA-240/SA-240M | 447, 455 |
| | ASTM A240/A240M-15a | 447, 455 |
| 439 | ASME SA-240/SA-240M | 160, 163, 447, 455 |
| | ASTM A240/A240M-15a | 160, 163, 447, 455 |
| 440A | ASME SA-276 | 520, 531 |
| | ASTM A276/A276M-15 | 520, 531 |
| 440B | ASME SA-276 | 520, 531 |
| | ASTM A276/A276M-15 | 520, 531 |
| 440C | ASME SA-276 | 521, 531 |
| | ASTM A276/A276M-15 | 521, 531 |
| 440F | ASTM A582/A582M-12e1 | 521, 533 |
| 444 | ASME SA-240/SA-240M | 161, 164, 448, 456 |
| | ASTM A240/A240M-15a | 161, 164, 448, 456 |
| | SAE J405 JUN98 | 448 |
| 446 | ASME SA-276 | 535, 540 |
| | ASTM A240/A240M-15a | 448, 456 |
| | ASTM A276/A276M-15 | 535, 540 |
| 447 | ASME SA-276 | 540 |
| | ASTM A276/A276M-15 | 540 |
| 448 - Category 1 | CSA Z245.1-14 | 317, 320 |
| 448 - Category 2 | CSA Z245.1-14 | 323, 327 |
| 448 - Category 3 | CSA Z245.1-14 | 323, 327 |
| 480A (70A) | CSA G40.21-13 | 102, 106 |
| 480AT (70AT) | CSA G40.21-13 | 102, 106 |
| 480WT (70WT) | CSA G40.21-13 | 88, 94 |
| 483 - Category 1 | CSA Z245.1-14 | 317, 320 |
| 483 - Category 2 | CSA Z245.1-14 | 323, 327 |
| 483 - Category 3 | CSA Z245.1-14 | 323, 327 |
| 540-720 | ISO 9477:1992 | 392, 395 |
| 550 - Category 2 | CSA Z245.1-14 | 323, 327 |
| 550 - Category 3 | CSA Z245.1-14 | 323, 327 |
| 550A (80A) | CSA G40.21-13 | 102, 106 |
| 550AT (80AT) | CSA G40.21-13 | 102, 106 |
| 550WT (80WT) | CSA G40.21-13 | 89, 94 |
| 616 | ASTM A565/A565M-10 | 521, 532 |
| 620 | BS 3604-2:1991 | 274, 275 |
| 620-820 | ISO 9477:1992 | 392, 395 |
| 621 | BS 3604-2:1991 | 276, 277 |
| 622 | BS 3604-2:1991 | 278, 279 |
| 630 | ASME SA-564/SA-564M | 593, 594 |
| | ASME SA-693 | 505, 506 |
| 630(continued) | ASME SA-705/SA-705M | 379, 380 |
| | ASTM A564/A564M-13 | 593, 595 |
| | ASTM A693-13 | 505, 507 |
| | ASTM A705/A705M-13 | 379, 380 |
| 631 | ASME SA-564/SA-564M | 593, 597 |
| | ASME SA-693 | 505, 510 |
| | ASTM A313/A313M-13 | 621 |
| | ASTM A564/A564M-13 | 593, 597 |
| | ASTM A693-13 | 505, 511 |
| 632 | ASME SA-564/SA-564M | 593, 599 |
| | ASTM A564/A564M-13 | 593, 599 |
| 660, Class A | ASME SA-453/SA-453M | 550, 590 |
| | ASTM A453/A453M-12 | 550, 590 |
| 700Q (100Q) | CSA G40.21-13 | 91, 96 |
| 700QT (100QT) | CSA G40.21-13 | 91, 96 |
| 800 | ASME SA-240/SA-240M | 471, 502 |
| | ASTM A240/A240M-15a | 297, 314, 471, 502 |
| 800H | ASME SA-240/SA-240M | 170, 184, 471, 503 |
| | ASTM A240/A240M-15a | 170, 184, 297, 314, 471, 503 |
| 840-1030 | ISO 9477:1992 | 392, 395 |
| 904L | ASME SA-240/SA-240M | 170, 183, 472, 504 |
| | ASTM A240/A240M-15a | 170, 183, 472, 504 |
| | SAE J405 JUN98 | 472 |
| 1005 | ASME SA-29/SA-29M | 21 |
| | ASTM A29/A29M-12e1 | 21 |
| | SAE J403 JUN14 | 21 |
| 1006 | ASME SA-29/SA-29M | 21 |
| | ASTM A29/A29M-12e1 | 21 |
| | SAE J403 JUN14 | 21 |
| 1008 | ASME SA-29/SA-29M | 21 |
| | ASME SA-513 | 198, 199, 200, 202, 204, 213, 214, 215, 217 |
| | ASTM A29/A29M-12e1 | 21 |
| | ASTM A513-15 | 198, 199, 200, 202, 204, 213, 214, 215, 218 |
| | ASTM A576-90b (2012) | 21 |
| | SAE J403 JUN14 | 21 |
| 1010 | ASME SA-29/SA-29M | 21 |
| | ASME SA-513 | 198, 199, 200, 202, 204, 213, 214, 215, 217 |
| | ASTM A29/A29M-12e1 | 21 |

| Designation | Specification | Page Number |
|---|---|---|
| 1010 (continued) | ASTM A513-15 | 198, 199, 200, 202, 204, 213, 214, 215, 218 |
| | ASTM A576-90b (2012) | 21 |
| | SAE J403 JUN14 | 21 |
| 1011 | ASTM A512-06 (2012) | 205, 219 |
| 1012 | ASME SA-29/SA-29M | 22 |
| | ASTM A29/A29M-12e1 | 22 |
| | ASTM A576-90b (2012) | 22 |
| | SAE J403 JUN14 | 22 |
| 1015 | ASME SA-29/SA-29M | 22 |
| | ASME SA-513 | 199, 200, 202, 204, 205, 214, 215, 217 |
| | ASTM A29/A29M-12e1 | 22 |
| | ASTM A513-15 | 199, 200, 202, 204, 205, 214, 215, 218 |
| | ASTM A576-90b (2012) | 22 |
| | SAE J403 JUN14 | 22 |
| 1016 | ASME SA-29/SA-29M | 22 |
| | ASTM A29/A29M-12e1 | 22 |
| | ASTM A512-06 (2012) | 206, 220 |
| | ASTM A576-90b (2012) | 22 |
| | SAE J403 JUN14 | 22 |
| 1017 | ASME SA-29/SA-29M | 23 |
| | ASTM A29/A29M-12e1 | 23 |
| | ASTM A576-90b (2012) | 23 |
| | SAE J403 JUN14 | 23 |
| 1018 | ASME SA-29/SA-29M | 23 |
| | ASTM A29/A29M-12e1 | 23 |
| | ASTM A512-06 (2012) | 206, 220 |
| | ASTM A576-90b (2012) | 23 |
| | SAE J403 JUN14 | 23 |
| 1019 | ASME SA-29/SA-29M | 23 |
| | ASTM A29/A29M-12e1 | 23 |
| | ASTM A576-90b (2012) | 23 |
| 1020 | ASME SA-29/SA-29M | 23 |
| | ASME SA-513 | 200, 201, 204, 205, 207, 214, 215, 217, 220 |
| | ASTM A29/A29M-12e1 | 23 |
| | ASTM A513-15 | 200, 201, 204, 205, 207, 214, 215, 218, 220 |
| | ASTM A519-06 (2012) | 200, 201, 205, 207, 214, 215, 219, 220 |
| | ASTM A576-90b (2012) | 23 |
| | SAE J403 JUN14 | 24 |
| 1021 | ASME SA-29/SA-29M | 23 |
| | ASME SA-513 | 200, 201, 204, 206, 207, 214, 215, 219, 220, 221 |
| | ASTM A29/A29M-12e1 | 23 |
| | ASTM A513-15 | 200, 201, 204, 206, 207, 214, 215, 219, 220, 221 |
| | ASTM A576-90b (2012) | 23 |
| | SAE J403 JUN14 | 24 |
| 1022 | ASME SA-29/SA-29M | 23 |
| | ASTM A29/A29M-12e1 | 23 |
| | ASTM A576-90b (2012) | 23 |
| | SAE J403 JUN14 | 24 |
| 1023 | ASME SA-29/SA-29M | 24 |
| | ASTM A29/A29M-12e1 | 24 |
| | ASTM A576-90b (2012) | 24 |
| | SAE J403 JUN14 | 24 |
| 1025 | ASME SA-29/SA-29M | 24 |
| | ASME SA-513 | 202, 205, 207, 208, 215, 219, 220, 221 |
| | ASTM A29/A29M-12e1 | 24 |
| | ASTM A512-06 (2012) | 207, 221 |
| | ASTM A513-15 | 202, 205, 207, 208, 215, 219, 220, 221 |
| | ASTM A519-06 (2012) | 201, 207, 208, 215, 220, 221 |
| | ASTM A576-90b (2012) | 24 |
| | SAE J403 JUN14 | 24 |
| 1026 | ASME SA-29/SA-29M | 24 |
| | ASME SA-513 | 204, 207, 208, 209, 217, 220, 221, 222 |
| | ASTM A29/A29M-12e1 | 24 |
| | ASTM A513-15 | 204, 207, 208, 209, 218, 220, 221, 222 |
| | ASTM A576-90b (2012) | 24 |
| | SAE J403 JUN14 | 24 |
| 1029 | ASME SA-29/SA-29M | 25 |
| | ASTM A29/A29M-12e1 | 25 |
| | ASTM A576-90b (2012) | 25 |
| | SAE J403 JUN14 | 25 |
| 1030 | ASME SA-29/SA-29M | 25 |
| | ASME SA-513 | 204, 207, 209, 210, 217, 220, 222, 223 |
| | ASTM A29/A29M-12e1 | 25 |

| Designation | Specification | Page Number |
|---|---|---|
| 1030 (continued) | ASTM A512-06 (2012) | 209, 222 |
| | ASTM A513-15 | 204, 207, 209, 210, 218, 220, 222 |
| | ASTM A576-90b (2012) | 25 |
| | SAE J403 JUN14 | 25 |
| 1034 | ASME SA-29/SA-29M | 26 |
| | ASTM A29/A29M-12e1 | 26 |
| 1035 | ASME SA-29/SA-29M | 26 |
| | ASME SA-513 | 205, 206, 209, 210, 211, 219, 220, 222, 223 |
| | ASTM A29/A29M-12e1 | 26 |
| | ASTM A513-15 | 205, 206, 209, 210, 219, 220, 222, 223 |
| | ASTM A519-06 (2012) | 204, 205, 208, 210, 217, 219, 221, 223 |
| | ASTM A576-90b (2012) | 26 |
| | SAE J403 JUN14 | 26 |
| 1037 | ASME SA-29/SA-29M | 26 |
| | ASTM A29/A29M-12e1 | 26 |
| | ASTM A576-90b (2012) | 26 |
| 1038 | ASME SA-29/SA-29M | 26 |
| | ASTM A29/A29M-12e1 | 26 |
| | ASTM A576-90b (2012) | 26 |
| | SAE J403 JUN14 | 26 |
| 1039 | ASME SA-29/SA-29M | 27 |
| | ASTM A29/A29M-12e1 | 27 |
| | ASTM A576-90b (2012) | 27 |
| | SAE J403 JUN14 | 27 |
| 1040 | ASME SA-29/SA-29M | 27 |
| | ASME SA-513 | 205, 206, 210, 211, 219, 220, 223 |
| | ASTM A29/A29M-12e1 | 27 |
| | ASTM A513-15 | 205, 206, 210, 219, 220, 222, 223 |
| | ASTM A576-90b (2012) | 27 |
| | SAE J403 JUN14 | 27 |
| 1040, 1, Limit H | ASTM A684/A684M-14 | 616 |
| 1040, 1, Limit L | ASTM A684/A684M-14 | 616 |
| 1040, 2, Limit H | ASTM A684/A684M-14 | 616 |
| 1040, 2, Limit L | ASTM A684/A684M-14 | 616 |
| 1042 | ASME SA-29/SA-29M | 27 |
| | ASTM A29/A29M-12e1 | 27 |
| | ASTM A576-90b (2012) | 27 |
| | SAE J403 JUN14 | 27 |
| 1043 | ASME SA-29/SA-29M | 27 |
| | ASTM A29/A29M-12e1 | 27 |
| | ASTM A576-90b (2012) | 27 |
| | SAE J403 JUN14 | 27 |
| 1044 | ASME SA-29/SA-29M | 28 |
| | ASTM A29/A29M-12e1 | 28 |
| | ASTM A576-90b (2012) | 28 |
| | SAE J403 JUN14 | 28 |
| 1045 | ASME SA-29/SA-29M | 28 |
| | ASTM A29/A29M-12e1 | 28 |
| | ASTM A519-06 (2012) | 205, 208, 209, 210, 219, 221, 222, 223 |
| | ASTM A576-90b (2012) | 28 |
| | SAE J403 JUN14 | 28 |
| 1046 | ASME SA-29/SA-29M | 28 |
| | ASTM A29/A29M-12e1 | 28 |
| | ASTM A576-90b (2012) | 28 |
| | SAE J403 JUN14 | 28 |
| 1049 | ASME SA-29/SA-29M | 29 |
| | ASTM A29/A29M-12e1 | 29 |
| | ASTM A576-90b (2012) | 29 |
| | SAE J403 JUN14 | 29 |
| 1050 | ASME SA-29/SA-29M | 29 |
| | ASTM A29/A29M-12e1 | 29 |
| | ASTM A519-06 (2012) | 206, 208, 209, 220, 222 |
| | ASTM A576-90b (2012) | 29 |
| | SAE J403 JUN14 | 29 |
| 1050, 1, Limit H | ASTM A684/A684M-14 | 616 |
| 1050, 1, Limit L | ASTM A684/A684M-14 | 616 |
| 1050, 2, Limit H | ASTM A684/A684M-14 | 616 |
| 1050, 2, Limit L | ASTM A684/A684M-14 | 616 |
| 1053 | ASME SA-29/SA-29M | 29 |
| | ASTM A29/A29M-12e1 | 29 |
| | ASTM A576-90b (2012) | 29 |
| | SAE J403 JUN14 | 29 |
| 1055 | ASME SA-29/SA-29M | 30 |
| | ASTM A29/A29M-12e1 | 30 |
| | ASTM A576-90b (2012) | 30 |
| | SAE J403 JUN14 | 30 |
| 1055, 1, Limit H | ASTM A684/A684M-14 | 616 |
| 1055, 1, Limit L | ASTM A684/A684M-14 | 616 |
| 1055, 2, Limit H | ASTM A684/A684M-14 | 616 |
| 1055, 2, Limit L | ASTM A684/A684M-14 | 616 |

| Designation | Specification | Page Number |
|---|---|---|
| 1059(continued) | ASME SA-29/SA-29M | 31 |
| | ASTM A29/A29M-12e1 | 31 |
| 1060 | ASME SA-29/SA-29M | 31 |
| 1060 | ASTM A29/A29M-12e1 | 31 |
| | ASTM A576-90b (2012) | 31 |
| | SAE J403 JUN14 | 31 |
| 1060, 1, Limit H | ASTM A684/A684M-14 | 616 |
| 1060, 1, Limit L | ASTM A684/A684M-14 | 616 |
| 1060, 2, Limit H | ASTM A684/A684M-14 | 616 |
| 1060, 2, Limit L | ASTM A684/A684M-14 | 616 |
| 1064 | ASME SA-29/SA-29M | 32 |
| | ASTM A29/A29M-12e1 | 32 |
| | ASTM A713-04 (2010) | 615 |
| 1064, 1, Limit H | ASTM A684/A684M-14 | 617 |
| 1064, 1, Limit L | ASTM A684/A684M-14 | 617 |
| 1064, 2, Limit H | ASTM A684/A684M-14 | 617 |
| 1064, 2, Limit L | ASTM A684/A684M-14 | 617 |
| 1065 | ASME SA-29/SA-29M | 32 |
| | ASTM A29/A29M-12e1 | 32 |
| | ASTM A713-04 (2010) | 615 |
| | SAE J403 JUN14 | 32 |
| 1065, 1, Limit H | ASTM A684/A684M-14 | 617 |
| 1065, 1, Limit L | ASTM A684/A684M-14 | 617 |
| 1065, 2, Limit H | ASTM A684/A684M-14 | 617 |
| 1065, 2, Limit L | ASTM A684/A684M-14 | 617 |
| 1069 | ASME SA-29/SA-29M | 32 |
| | ASTM A29/A29M-12e1 | 32 |
| 1070 | ASME SA-29/SA-29M | 32 |
| | ASTM A29/A29M-12e1 | 32 |
| | ASTM A576-90b (2012) | 32 |
| | ASTM A713-04 (2010) | 615 |
| | SAE J403 JUN14 | 32 |
| 1070, 1, Limit H | ASTM A684/A684M-14 | 617 |
| 1070, 1, Limit L | ASTM A684/A684M-14 | 617 |
| 1070, 2, Limit H | ASTM A684/A684M-14 | 617 |
| 1070, 2, Limit L | ASTM A684/A684M-14 | 617 |
| 1071 | ASME SA-29/SA-29M | 32 |
| | ASTM A29/A29M-12e1 | 32 |
| 1074 | ASME SA-29/SA-29M | 33 |
| | ASTM A29/A29M-12e1 | 33 |
| | SAE J403 JUN14 | 33 |
| 1074, 1, Limit H | ASTM A684/A684M-14 | 617 |
| 1074, 1, Limit L | ASTM A684/A684M-14 | 617 |
| 1074, 2, Limit H | ASTM A684/A684M-14 | 617 |
| 1074, 2, Limit L | ASTM A684/A684M-14 | 617 |
| 1075 | ASME SA-29/SA-29M | 33 |
| | ASTM A29/A29M-12e1 | 33 |
| | SAE J403 JUN14 | 33 |
| 1078 | ASME SA-29/SA-29M | 33 |
| | ASTM A29/A29M-12e1 | 33 |
| | ASTM A576-90b (2012) | 33 |
| | SAE J403 JUN14 | 33 |
| 1080 | ASME SA-29/SA-29M | 33 |
| | ASTM A29/A29M-12e1 | 33 |
| | ASTM A576-90b (2012) | 33 |
| | SAE J403 JUN14 | 33 |
| 1080, 1, Limit H | ASTM A684/A684M-14 | 617 |
| 1080, 1, Limit L | ASTM A684/A684M-14 | 617 |
| 1080, 2, Limit H | ASTM A684/A684M-14 | 617 |
| 1080, 2, Limit L | ASTM A684/A684M-14 | 617 |
| 1084 | ASME SA-29/SA-29M | 33 |
| | ASTM A29/A29M-12e1 | 33 |
| | ASTM A576-90b (2012) | 33 |
| | ASTM A713-04 (2010) | 616 |
| | SAE J403 JUN14 | 33 |
| 1085, 1, Limit H | ASTM A684/A684M-14 | 617 |
| 1085, 1, Limit L | ASTM A684/A684M-14 | 617 |
| 1085, 2, Limit H | ASTM A684/A684M-14 | 617 |
| 1085, 2, Limit L | ASTM A684/A684M-14 | 617 |
| 1086 | ASME SA-29/SA-29M | 33 |
| | ASTM A29/A29M-12e1 | 33 |
| | ASTM A713-04 (2010) | 616 |
| | SAE J403 JUN14 | 33 |
| 1086, 1, Limit H | ASTM A684/A684M-14 | 618 |
| 1086, 1, Limit L | ASTM A684/A684M-14 | 618 |
| 1086, 2, Limit H | ASTM A684/A684M-14 | 618 |
| 1086, 2, Limit L | ASTM A684/A684M-14 | 618 |
| 1090 | ASME SA-29/SA-29M | 34 |
| | ASTM A29/A29M-12e1 | 34 |
| | ASTM A576-90b (2012) | 34 |
| | SAE J403 JUN14 | 34 |
| 1095 | ASME SA-29/SA-29M | 34 |
| | ASTM A29/A29M-12e1 | 34 |
| | ASTM A576-90b (2012) | 34 |
| | SAE J403 JUN14 | 34 |
| 1095, 1, Limit H | ASTM A684/A684M-14 | 618 |

| Designation | Specification | Page Number |
|---|---|---|
| 1095, 1, Limit L | ASTM A684/A684M-14 | 618 |
| 1095, 2, Limit H | ASTM A684/A684M-14 | 618 |
| 1095, 2, Limit L | ASTM A684/A684M-14 | 618 |
| 1109 | ASME SA-29/SA-29M | 611 |
| | ASTM A29/A29M-12e1 | 611 |
| | ASTM A576-90b (2012) | 611 |
| 1110 | ASME SA-29/SA-29M | 611 |
| | ASTM A29/A29M-12e1 | 611 |
| | ASTM A512-06 (2012) | 205, 219 |
| | ASTM A576-90b (2012) | 611 |
| 1117 | ASME SA-29/SA-29M | 611 |
| | ASTM A29/A29M-12e1 | 611 |
| | ASTM A576-90b (2012) | 611 |
| | SAE J403 JUN14 | 611 |
| 1118 | ASME SA-29/SA-29M | 611 |
| | ASTM A29/A29M-12e1 | 611 |
| | ASTM A576-90b (2012) | 611 |
| | SAE J403 JUN14 | 611 |
| 1132 | ASME SA-29/SA-29M | 611 |
| | ASTM A29/A29M-12e1 | 611 |
| | ASTM A576-90b (2012) | 611 |
| | SAE J403 JUN14 | 611 |
| 1137 | ASME SA-29/SA-29M | 612 |
| | ASTM A29/A29M-12e1 | 612 |
| | ASTM A576-90b (2012) | 612 |
| | SAE J403 JUN14 | 612 |
| 1138 | SAE J403 JUN14 | 612 |
| 1139 | ASME SA-29/SA-29M | 612 |
| | ASTM A29/A29M-12e1 | 612 |
| | ASTM A576-90b (2012) | 612 |
| 1140 | ASME SA-29/SA-29M | 612 |
| | ASTM A29/A29M-12e1 | 612 |
| | ASTM A576-90b (2012) | 612 |
| | SAE J403 JUN14 | 612 |
| 1141 | ASME SA-29/SA-29M | 612 |
| | ASTM A29/A29M-12e1 | 612 |
| | ASTM A576-90b (2012) | 612 |
| | SAE J403 JUN14 | 612 |
| 1144 | ASME SA-29/SA-29M | 612 |
| | ASTM A29/A29M-12e1 | 612 |
| | ASTM A576-90b (2012) | 612 |
| | SAE J403 JUN14 | 612 |
| 1146 | ASME SA-29/SA-29M | 613 |
| 1146 (continued) | ASTM A29/A29M-12e1 | 613 |
| | ASTM A576-90b (2012) | 613 |
| | SAE J403 JUN14 | 613 |
| 1151 | ASME SA-29/SA-29M | 613 |
| | ASTM A29/A29M-12e1 | 613 |
| | ASTM A576-90b (2012) | 613 |
| | SAE J403 JUN14 | 613 |
| 1212 | ASME SA-29/SA-29M | 613 |
| | ASTM A29/A29M-12e1 | 613 |
| | ASTM A576-90b (2012) | 613 |
| | SAE J403 JUN14 | 613 |
| 1213 | ASME SA-29/SA-29M | 613 |
| | ASTM A29/A29M-12e1 | 613 |
| | ASTM A576-90b (2012) | 613 |
| | SAE J403 JUN14 | 613 |
| 1215 | ASME SA-29/SA-29M | 613 |
| | ASTM A29/A29M-12e1 | 613 |
| | ASTM A576-90b (2012) | 613 |
| | SAE J403 JUN14 | 613 |
| 1522 | ASME SA-29/SA-29M | 34 |
| | ASTM A29/A29M-12e1 | 34 |
| | ASTM A576-90b (2012) | 34 |
| | SAE J403 JUN14 | 34 |
| 1524 | ASME SA-513 | 206, 210, 211, 220, 223 |
| | ASTM A29/A29M-12e1 | 34 |
| | ASTM A513-15 | 206, 210, 220, 222, 223 |
| | ASTM A576-90b (2012) | 34 |
| | SAE J403 JUN14 | 34 |
| 1536 | ASME SA-29/SA-29M | 34 |
| | ASTM A29/A29M-12e1 | 34 |
| | ASTM A576-90b (2012) | 34 |
| | SAE J403 JUN14 | 34 |
| 1541 | ASME SA-29/SA-29M | 35 |
| | ASTM A29/A29M-12e1 | 35 |
| | ASTM A576-90b (2012) | 35 |
| | SAE J403 JUN14 | 35 |
| 1547 | ASTM A29/A29M-12e1 | 35 |
| | ASTM A576-90b (2012) | 35 |
| | SAE J403 JUN14 | 35 |
| 1552 | ASTM A29/A29M-12e1 | 35 |
| | ASTM A576-90b (2012) | 35 |
| | SAE J403 JUN14 | 35 |
| 2205 | ASME SA-240/SA-240M | 185, 186, 513, 515 |

| Designation | Specification | Page Number |
|---|---|---|
| 2205 (continued) | ASTM A240/A240M-15a | 185, 186, 513, 515 |
| | ASTM A270/A270M-15 | 243, 244 |
| 2304 | ASME SA-240/SA-240M | 185, 186, 513, 516 |
| | ASTM A240/A240M-15a | 185, 186, 513, 516 |
| 2507 | ASME SA-240/SA-240M | 185, 187, 514, 517 |
| | ASTM A240/A240M-15a | 185, 187, 514, 517 |
| | ASTM A270/A270M-15 | 243, 245 |
| 4028 | ASTM A519-06 (2012) | 224, 225 |
| 4118 | ASME SA-29/SA-29M | 39 |
| | ASTM A29/A29M-12e1 | 39 |
| | ASTM A322-13 | 39 |
| | SAE J404 JAN09 | 39 |
| 4120 | ASME SA-29/SA-29M | 39 |
| | ASTM A29/A29M-12e1 | 39 |
| | ASTM A322-13 | 39 |
| | SAE J404 JAN09 | 39 |
| 4121 | ASME SA-29/SA-29M | 39 |
| | ASTM A29/A29M-12e1 | 39 |
| | ASTM A322-13 | 39 |
| 4130 | ASME SA-29/SA-29M | 40 |
| | ASME SA-513 | 224, 225 |
| | ASTM A29/A29M-12e1 | 40 |
| | ASTM A322-13 | 40 |
| | ASTM A513-15 | 224, 225 |
| | ASTM A519-06 (2012) | 224, 225 |
| | SAE J404 JAN09 | 40 |
| 4135 | ASTM A519-06 (2012) | 224, 226 |
| 4137 | ASME SA-29/SA-29M | 40 |
| | ASTM A29/A29M-12e1 | 40 |
| | ASTM A322-13 | 40 |
| | ASTM A519-06 (2012) | 224, 226 |
| | SAE J404 JAN09 | 40 |
| 4140 | ASME SA-29/SA-29M | 41 |
| | ASME SA-513 | 224, 226 |
| | ASTM A29/A29M-12e1 | 41 |
| | ASTM A322-13 | 41 |
| | ASTM A513-15 | 224, 226 |
| | ASTM A519-06 (2012) | 224, 226 |
| | SAE J404 JAN09 | 41 |
| 4142 | ASTM A519-06 (2012) | 224, 226 |
| 4145 | ASME SA-29/SA-29M | 41 |
| | ASTM A29/A29M-12e1 | 41 |
| 4145 (continued) | ASTM A322-13 | 41 |
| | SAE J404 JAN09 | 41 |
| 4150 | ASME SA-29/SA-29M | 41 |
| | ASTM A29/A29M-12e1 | 41 |
| | ASTM A322-13 | 41 |
| | SAE J404 JAN09 | 41 |
| 4320 | ASME SA-29/SA-29M | 42 |
| | ASTM A29/A29M-12e1 | 42 |
| | ASTM A322-13 | 42 |
| | SAE J404 JAN09 | 42 |
| 4340 | ASME SA-29/SA-29M | 42 |
| | ASTM A29/A29M-12e1 | 42 |
| | ASTM A322-13 | 42 |
| | SAE J404 JAN09 | 42 |
| 5120 | ASME SA-29/SA-29M | 36 |
| | ASTM A29/A29M-12e1 | 36 |
| | ASTM A322-13 | 36 |
| | SAE J404 JAN09 | 36 |
| 5130 | ASME SA-29/SA-29M | 36 |
| | ASTM A29/A29M-12e1 | 36 |
| | ASTM A322-13 | 36 |
| | SAE J404 JAN09 | 36 |
| 5132 | ASME SA-29/SA-29M | 37 |
| | ASTM A29/A29M-12e1 | 37 |
| | ASTM A322-13 | 37 |
| | SAE J404 JAN09 | 37 |
| 5135 | ASME SA-29/SA-29M | 37 |
| | ASTM A29/A29M-12e1 | 37 |
| | ASTM A322-13 | 37 |
| 5140 | ASME SA-29/SA-29M | 37 |
| | ASTM A29/A29M-12e1 | 37 |
| | ASTM A322-13 | 37 |
| | SAE J404 JAN09 | 37 |
| 5145 | ASME SA-29/SA-29M | 38 |
| | ASTM A29/A29M-12e1 | 38 |
| 5150 | ASTM A29/A29M-12e1 | 38 |
| | ASTM A322-13 | 38 |
| | SAE J404 JAN09 | 38 |
| 6150 | ASME SA-29/SA-29M | 45 |
| | ASTM A29/A29M-12e1 | 45 |
| | ASTM A322-13 | 45 |
| | SAE J404 JAN09 | 45 |
| 8620 | ASME SA-29/SA-29M | 42 |

| Designation | Specification | Page Number |
|---|---|---|
| 8620 (continued) | ASTM A29/A29M-12e1 | 42 |
| | ASTM A322-13 | 42 |
| | SAE J404 JAN09 | 42 |
| 8640 | ASME SA-29/SA-29M | 43 |
| | ASTM A29/A29M-12e1 | 43 |
| | ASTM A322-13 | 43 |
| | SAE J404 JAN09 | 43 |
| 52100 | ASTM A295/A295M-14 | 628 |
| A | ASME SA-106 | 260, 264 |
| | ASME SA-135 | 255, 258 |
| | ASME SA-178/SA-178M | 260, 264 |
| | ASME SA-203/SA-203M | 149, 150 |
| | ASME SA-204/SA-204M | 134, 138 |
| | ASME SA-283/SA-283M | 51, 66 |
| | ASME SA-302/SA-302M | 136, 139 |
| | ASME SA-662/SA-662M | 128, 131 |
| | ASME SA-738/SA-738M | 118, 126 |
| | ASTM A1000/A1000M-11 | 619 |
| | ASTM A106/A106M-14 | 260, 264 |
| | ASTM A128/A128M-93 (2012) | 400, 401 |
| | ASTM A135/A135M-09 (2014) | 255, 258 |
| | ASTM A139/A139M-04 (2010) | 255, 258 |
| | ASTM A178/A178M-02 (2012) | 260, 264 |
| | ASTM A203/A203M-12 | 149, 150 |
| | ASTM A204/A204M-12 | 134, 138 |
| | ASTM A302/A302M-12 | 136, 139 |
| | ASTM A355-89 (2012) | 43 |
| | ASTM A500-13 | 199, 214 |
| | ASTM A501-14 | 203, 217 |
| | ASTM A514/A514M-14 | 90, 95 |
| | ASTM A588/A588M-15 | 77, 82 |
| | ASTM A595/A595M-14 | 206, 220 |
| | ASTM A633/A633M-13 | 74, 80 |
| | ASTM A662/A662M-12 | 128, 131 |
| | ASTM A738/A738M-12a | 118, 126 |
| | GB 712-2000 | 56, 67 |
| A (AH) | ASTM A668/A668M-15 | 333, 339 |
| A E | ASME SA-53/SA-53M | 255, 258 |
| A F | ASME SA-53/SA-53M | 255, 258 |
| A S | ASME SA-53/SA-53M | 255, 258 |
| A, Class 1 | ASME SA-533/SA-533M | 137, 139 |
| | ASME SA-841/SA-841M | 129, 132 |
| | ASTM A1021-05 (2015) | 364, 365 |

| Designation | Specification | Page Number |
|---|---|---|
| A, Class 1 (continued) | ASTM A533/A533M-09 (2014) | 137, 139 |
| | ASTM A710/A710M-02 (2013) | 89, 94 |
| | ASTM A841/A841M-13 | 129, 132 |
| A, Class 2 | ASME SA-533/SA-533M | 137, 139 |
| | ASME SA-841/SA-841M | 130, 133 |
| | ASTM A1021-05 (2015) | 364, 365 |
| | ASTM A533/A533M-09 (2014) | 137, 139 |
| | ASTM A710/A710M-02 (2013) | 86, 92 |
| | ASTM A841/A841M-13 | 130, 133 |
| A, Class 3 | ASME SA-533/SA-533M | 137, 139 |
| | ASTM A533/A533M-09 (2014) | 137, 139 |
| | ASTM A710/A710M-02 (2013) | 88, 94 |
| A-1 | ASME SA-210/SA-210M | 262, 265 |
| | ASTM A210/A210M-02 (2012) | 262, 265 |
| A1Q | ASTM A757/A757M-15 | 398, 399 |
| A2 | ASME SA-556/SA-556M | 260, 264 |
| | ASTM A556/A556M-96 (2012) | 260, 264 |
| | ASTM A681-08 | 625 |
| | SAE J438b MAY70 | 625 |
| A2Q | ASTM A757/A757M-15 | 398, 399 |
| A6 | ASTM A681-08 | 626 |
| A32 | GB 712-2000 | 60, 69 |
| A36 | GB 712-2000 | 62, 71 |
| A40 | GB 712-2000 | 63, 72 |
| alloy steel | ISO 4706:1989 | 116, 125 |
| B | ASME SA-106 | 262, 265 |
| | ASME SA-135 | 257, 259 |
| | ASME SA-203/SA-203M | 149, 150 |
| | ASME SA-204/SA-204M | 134, 138 |
| | ASME SA-283/SA-283M | 53, 66 |
| | ASME SA-302/SA-302M | 137, 139 |
| | ASME SA-662/SA-662M | 129, 132 |
| | ASME SA-737/SA-737M | 115, 124 |
| | ASME SA-738/SA-738M | 119, 127 |
| | ASTM A106/A106M-14 | 262, 265 |
| | ASTM A135/A135M-09 (2014) | 257, 259 |
| | ASTM A139/A139M-04 (2010) | 257, 259 |
| | ASTM A203/A203M-12 | 149, 150 |
| | ASTM A204/A204M-12 | 135, 138 |
| | ASTM A302/A302M-12 | 137, 139 |
| | ASTM A500-13 | 203, 217 |
| | ASTM A514/A514M-14 | 90, 95 |
| | ASTM A588/A588M-15 | 77, 82 |

| Designation | Specification | Page Number |
|---|---|---|
| B (continued) | ASTM A595/A595M-14 | 206, 220 |
| | ASTM A662/A662M-12 | 129, 132 |
| | ASTM A737/A737M-09 (2013) | 115, 125 |
| | ASTM A738/A738M-12a | 119, 127 |
| | GB 712-2000 | 56, 67 |
| B (BH) | ASTM A668/A668M-15 | 334, 339 |
| B E | ASME SA-53/SA-53M | 257, 259 |
| B S | ASME SA-53/SA-53M | 257, 259 |
| B, Class 1 | ASME SA-533/SA-533M | 155, 156 |
| | ASME SA-841/SA-841M | 129, 132 |
| | ASTM A1021-05 (2015) | 364, 365 |
| | ASTM A533/A533M- 09 (2014) | 155 |
| | ASTM A533/A533M-09 (2014) | 156 |
| | ASTM A841/A841M-13 | 129, 132 |
| B, Class 2 | ASME SA-533/SA-533M | 155, 156 |
| | ASME SA-841/SA-841M | 130, 133 |
| | ASTM A533/A533M- 09 (2014) | 155 |
| | ASTM A533/A533M-09 (2014) | 156 |
| | ASTM A841/A841M-13 | 130, 133 |
| B, Class 3 | ASME SA-533/SA-533M | 155, 156 |
| | ASTM A533/A533M- 09 (2014) | 155 |
| | ASTM A533/A533M-09 (2014) | 156 |
| B-1 | ASTM A128/A128M-93 (2012) | 400, 401 |
| B2 | ASME SA-556/SA-556M | 261, 265 |
| | ASTM A556/A556M-96 (2012) | 261, 265 |
| B-2 | ASTM A128/A128M-93 (2012) | 400, 401 |
| B2, 100CrMnSi4–4 | ASTM A485-14 | 628 |
| B2N | ASTM A757/A757M-15 | 409, 411 |
| B2Q | ASTM A757/A757M-15 | 409, 411 |
| B-3 | ASTM A128/A128M-93 (2012) | 400, 401 |
| B3, 100CrMnSi6–4 | ASTM A485-14 | 628 |
| B3N | ASTM A757/A757M-15 | 409, 411 |
| B3Q | ASTM A757/A757M-15 | 409, 411 |
| B-4 | ASTM A128/A128M-93 (2012) | 400, 401 |
| B4, 100CrMnSi6–6 | ASTM A485-14 | 628 |
| B5, 100CrMo7 | ASTM A485-14 | 628 |
| B6, 100CrMo7–3 | ASTM A485-14 | 628 |
| B7, 100CrMo7–4 | ASTM A485-14 | 628 |
| B8, 100CrMnMoSi8-4-6 | ASTM A485-14 | 628 |
| BL2 | GB 715-89 | 22 |
| BL3 | GB 715-89 | 23 |
| C | ASME SA-106 | 263, 266 |
| | ASME SA-178/SA-178M | 262, 265 |

| Designation | Specification | Page Number |
|---|---|---|
| C (continued) | ASME SA-204/SA-204M | 134, 138 |
| | ASME SA-210/SA-210M | 263, 266 |
| | ASME SA-283/SA-283M | 55, 67 |
| | ASME SA-302/SA-302M | 155, 156 |
| | ASME SA-414/SA-414M | 112, 120 |
| | ASME SA-662/SA-662M | 129, 132 |
| | ASME SA-737/SA-737M | 119, 127 |
| | ASME SA-738/SA-738M | 119, 127 |
| | ASTM A1000/A1000M-11 | 620 |
| | ASTM A106/A106M-14 | 263, 266 |
| | ASTM A128/A128M-93 (2012) | 400, 401 |
| | ASTM A139/A139M-04 (2010) | 257, 259 |
| | ASTM A178/A178M-02 (2012) | 262, 265 |
| | ASTM A204/A204M-12 | 135, 138 |
| | ASTM A210/A210M-02 (2012) | 263, 266 |
| | ASTM A283/A283M-13 | 55, 67 |
| | ASTM A302/A302M-12 | 155, 156 |
| | ASTM A414/A414M-14 | 112, 120 |
| | ASTM A500-13 | 204, 219 |
| | ASTM A633/A633M-13 | 77, 82 |
| | ASTM A662/A662M-12 | 129, 132 |
| | ASTM A737/A737M-09 (2013) | 119, 127 |
| | ASTM A738/A738M-12a | 119, 127 |
| C (CH) | ASTM A668/A668M-15 | 335, 339 |
| C, Class 1 | ASME SA-533/SA-533M | 157, 158 |
| | ASME SA-841/SA-841M | 129, 132 |
| | ASTM A533/A533M-09 (2014) | 157, 158 |
| | ASTM A841/A841M-13 | 129, 132 |
| C, Class 2 | ASME SA-533/SA-533M | 157, 158 |
| | ASME SA-841/SA-841M | 130, 133 |
| | ASTM A533/A533M-09 (2014) | 157, 158 |
| | ASTM A841/A841M-13 | 130, 133 |
| C, Class 3 | ASME SA-533/SA-533M | 157, 158 |
| | ASTM A533/A533M-09 (2014) | 157, 158 |
| C1Q | ASTM A757/A757M-15 | 410, 412 |
| C2 | ASME SA-556/SA-556M | 263, 266 |
| | ASTM A556/A556M-96 (2012) | 263, 266 |
| C5 | ASME SA-217/SA-217M | 407, 408 |
| | ASTM A217/A217M-14 | 407, 408 |
| C9D | EN ISO 16120-2:2011 | 21 |
| C 10 | ISO 683-11:1987 | 21 |
| C10D | EN ISO 16120-2:2011 | 21 |
| C10D2 | EN ISO 16120-4:2011 | 21 |

| Designation | Specification | Page Number |
|---|---|---|
| C10E | EN 10084:2008 | 21 |
| C10R | EN 10084:2008 | 21 |
| C12 | ASME SA-217/SA-217M | 407, 408 |
| | ASTM A217/A217M-14 | 407, 408 |
| C12D | EN ISO 16120-2:2011 | 22 |
| C12D2 | EN ISO 16120-4:2011 | 22 |
| C15D | EN ISO 16120-2:2011 | 22 |
| C15D2 | EN ISO 16120-4:2011 | 22 |
| C15E | EN 10084:2008 | 22 |
| C 15 E4 | ISO 683-11:1987 | 22 |
| C 15 M2 | ISO 683-11:1987 | 22 |
| C15R | EN 10084:2008 | 22 |
| C16E | EN 10084:2008 | 22 |
| C 16 E4 | ISO 683-11:1987 | 22 |
| C 16 M2 | ISO 683-11:1987 | 22 |
| C16R | EN 10084:2008 | 22 |
| C18D | EN ISO 16120-2:2011 | 23 |
| C18D2 | EN ISO 16120-4:2011 | 23 |
| C20D | EN ISO 16120-2:2011 | 23 |
| C20D2 | EN ISO 16120-4:2011 | 23 |
| C22 | EN 10250-2:1999 C1:2000 | 23, 334, 339 |
| C22E | EN 10083-2:2006 | 23 |
| | EN 10297-1:2003 | 204, 208, 219, 221 |
| C22R | EN 10083-2:2006 | 23 |
| C23-45A | ISO 4991:1994 | 396, 397 |
| C23-45AH | ISO 4991:1994 | 396, 397 |
| C23-45B | ISO 4991:1994 | 396, 397 |
| C23-45BH | ISO 4991:1994 | 396, 397 |
| C23-45BL | ISO 4991:1994 | 398, 399 |
| C24 | ASTM A389/A389M-13 | 406, 408 |
| C25 | EN 10250-2:1999 C1:2000 | 334, 339 |
| | ISO 683-1:1987 | 24 |
| C25E | EN 10250-2:1999 C1:2000 | 334, 339 |
| C 25 E4 | ISO 683-1:1987 | 24 |
| C 25 M2 | ISO 683-1:1987 | 24 |
| C26-52 | ISO 4991:1994 | 396, 397 |
| C26-52H | ISO 4991:1994 | 396, 397 |
| C26-52L | ISO 4991:1994 | 398, 399 |
| C26D | EN ISO 16120-2:2011 | 24 |
| C26D2 | EN ISO 16120-4:2011 | 24 |
| C28H | ISO 4991:1994 | 406, 407 |
| C30 | EN 10250-2:1999 C1:2000 | 335, 339 |
| | ISO 683-1:1987 | 25 |
| C 30 E4 | ISO 683-1:1987 | 25 |
| C 30 M2 | ISO 683-1:1987 | 25 |
| C31L | ISO 4991:1994 | 410, 412 |
| C32D | EN ISO 16120-2:2011 | 25 |
| C32D2 | EN ISO 16120-4:2011 | 25 |
| C32H | ISO 4991:1994 | 406, 408 |
| C33H | ISO 4991:1994 | 407, 408 |
| C34AH | ISO 4991:1994 | 407, 408 |
| C34BH | ISO 4991:1994 | 407, 408 |
| C34BL | ISO 4991:1994 | 410, 412 |
| C35 | EN 10083-2:2006 | 26 |
| | EN 10250-2:1999 C1:2000 | 336, 339 |
| | ISO 683-1:1987 | 26 |
| | ISO 2937:1974 | 209, 222 |
| C35BH | ISO 4991:1994 | 406, 408 |
| C35E | EN 10083-2:2006 | 26 |
| | EN 10250-2:1999 C1:2000 | 336, 339 |
| | EN 10297-1:2003 | 209, 211, 222, 223 |
| | EN 10305-1:2010 | 205, 206, 208, 210, 219, 220, 222, 223 |
| C 35 E4 | ISO 683-1:1987 | 26 |
| C 35 M2 | ISO 683-1:1987 | 26 |
| C35R | EN 10083-2:2006 | 26 |
| C36D2 | EN ISO 16120-4:2011 | 26 |
| C37H | ISO 4991:1994 | 407, 408 |
| C38D | EN ISO 16120-2:2011 | 26 |
| C38D2 | EN ISO 16120-4:2011 | 26 |
| C38H | ISO 4991:1994 | 407, 408 |
| C39CH | ISO 4991:1994 | 419, 421 |
| C39CNiH | ISO 4991:1994 | 420, 421 |
| C39NiH | ISO 4991:1994 | 419, 421 |
| C39NiL | ISO 4991:1994 | 419, 421 |
| C3D2 | EN ISO 16120-4:2011 | 21 |
| C40 | EN 10083-2:2006 | 27 |
| | EN 10250-2:1999 C1:2000 | 336, 339 |
| | ISO 683-1:1987 | 27 |
| C40D2 | EN ISO 16120-4:2011 | 27 |
| C40E | EN 10083-2:2006 | 27 |
| C 40 E4 | ISO 683-1:1987 | 27 |
| C 40 M2 | ISO 683-1:1987 | 27 |
| C40H | ISO 4991:1994 | 420, 421 |
| C40R | EN 10083-2:2006 | 27 |
| C42D | EN ISO 16120-2:2011 | 27 |

| Designation | Specification | Page Number |
|---|---|---|
| C42D2 | EN ISO 16120-4:2011 | 27 |
| C43C1L | ISO 4991:1994 | 410, 412 |
| C43E2aL | ISO 4991:1994 | 410, 412 |
| C43E2bL | ISO 4991:1994 | 410, 412 |
| C43L | ISO 4991:1994 | 409, 411 |
| C45 | EN 10083-2:2006 | 28 |
| | EN 10250-2:1999 C1:2000 | 337, 339 |
| | ISO 683-1:1987 | 28 |
| C45E | EN 10083-2:2006 | 28 |
| | EN 10250-2:1999 C1:2000 | 338, 340 |
| | EN 10297-1:2003 | 210, 212, 223, 224 |
| | EN 10305-1:2010 | 208, 209, 211, 212, 221, 223 |
| C 45 E4 | ISO 683-1:1987 | 28 |
| C 45 M2 | ISO 683-1:1987 | 28 |
| C45R | EN 10083-2:2006 | 28 |
| C46 | ISO 4991:1994 | 422, 424 |
| C46D2 | EN ISO 16120-4:2011 | 28 |
| C47 | ISO 4991:1994 | 422, 424 |
| C47H | ISO 4991:1994 | 423, 425 |
| C47L | ISO 4991:1994 | 423, 425 |
| C48D | EN ISO 16120-2:2011 | 28 |
| C48D2 | EN ISO 16120-4:2011 | 28 |
| C4D | EN ISO 16120-2:2011 | 21 |
| C50 | EN 10250-2:1999 C1:2000 | 338, 340 |
| | ISO 683-1:1987 | 29 |
| | ISO 4991:1994 | 422, 424 |
| C50D | EN ISO 16120-2:2011 | 29 |
| C50D2 | EN ISO 16120-4:2011 | 29 |
| C50E | EN 10083-2:2006 | 29 |
| C 50 E4 | ISO 683-1:1987 | 29 |
| C 50 M2 | ISO 683-1:1987 | 29 |
| C50R | EN 10083-2:2006 | 29 |
| C52D | EN ISO 16120-2:2011 | 29 |
| C52D2 | EN ISO 16120-4:2011 | 29 |
| C55 | EN 10083-2:2006 | 30 |
| | EN 10250-2:1999 C1:2000 | 338, 340 |
| | ISO 683-1:1987 | 30 |
| C55E | EN 10083-2:2006 | 30 |
| C 55 E4 | ISO 683-1:1987 | 30 |
| C 55 M2 | ISO 683-1:1987 | 30 |
| C55R | EN 10083-2:2006 | 30 |
| C55S | EN 10132-4:2000 | 616 |
| C56D | EN ISO 16120-2:2011 | 30 |
| C56D2 | EN ISO 16120-4:2011 | 30 |
| C57 | ISO 4991:1994 | 423, 425 |
| C58D | EN ISO 16120-2:2011 | 31 |
| C58D2 | EN ISO 16120-4:2011 | 31 |
| C5D2 | EN ISO 16120-4:2011 | 21 |
| C60 | EN 10083-2:2006 | 31 |
| | ISO 683-1:1987 | 31 |
| | ISO 4991:1994 | 422, 424 |
| C60D | EN ISO 16120-2:2011 | 31 |
| C60D2 | EN ISO 16120-4:2011 | 31 |
| C60E | EN 10083-2:2006 | 31 |
| C 60 E4 | ISO 683-1:1987 | 31 |
| C60H | ISO 4991:1994 | 423, 425 |
| C 60 M2 | ISO 683-1:1987 | 31 |
| C60Nb | ISO 4991:1994 | 422, 424 |
| C60R | EN 10083-2:2006 | 31 |
| C60S | EN 10132-4:2000 | 616 |
| C61 | ISO 4991:1994 | 422, 424 |
| C61LC | ISO 4991:1994 | 423, 425 |
| C62D | EN ISO 16120-2:2011 | 32 |
| C62D2 | EN ISO 16120-4:2011 | 32 |
| C66D | EN ISO 16120-2:2011 | 32 |
| C66D2 | EN ISO 16120-4:2011 | 32 |
| C67S | EN 10132-4:2000 | 617 |
| C68D | EN ISO 16120-2:2011 | 32 |
| C68D2 | EN ISO 16120-4:2011 | 32 |
| C70D | EN ISO 16120-2:2011 | 32 |
| C70D2 | EN ISO 16120-4:2011 | 32 |
| C70U | ISO 4957:1999 | 622 |
| C72D | EN ISO 16120-2:2011 | 32 |
| C72D2 | EN ISO 16120-4:2011 | 32 |
| C75S | EN 10132-4:2000 | 617 |
| C76D | EN ISO 16120-2:2011 | 33 |
| C76D2 | EN ISO 16120-4:2011 | 33 |
| C78D | EN ISO 16120-2:2011 | 33 |
| C78D2 | EN ISO 16120-4:2011 | 33 |
| C7D | EN ISO 16120-2:2011 | 21 |
| C80D | EN ISO 16120-2:2011 | 33 |
| C80D2 | EN ISO 16120-4:2011 | 33 |
| C80U | ISO 4957:1999 | 622 |
| C82D | EN ISO 16120-2:2011 | 33 |
| C82D2 | EN ISO 16120-4:2011 | 33 |
| C85S | EN 10132-4:2000 | 617 |

| Designation | Specification | Page Number |
|---|---|---|
| C86D | EN ISO 16120-2:2011 | 33 |
| C86D2 | EN ISO 16120-4:2011 | 33 |
| C88D | EN ISO 16120-2:2011 | 33 |
| C88D2 | EN ISO 16120-4:2011 | 33 |
| C8D2 | EN ISO 16120-4:2011 | 21 |
| C90S | EN 10132-4:2000 | 618 |
| C90U | ISO 4957:1999 | 622 |
| C92D | EN ISO 16120-2:2011 | 34 |
| C92D2 | EN ISO 16120-4:2011 | 34 |
| C98D2 | EN ISO 16120-4:2011 | 34 |
| C100S | EN 10132-4:2000 | 618 |
| C105U | ISO 4957:1999 | 622 |
| C120U | ISO 4957:1999 | 622 |
| CA6NM | ASME SA-352/SA-352M | 419, 421 |
| | ASTM A352/A352M-06 (2012) | 419, 421 |
| | ASTM A743/A743M-13ae1 | 413, 414 |
| CA6NM, Class A | ASME SA-487/SA-487M | 419, 421 |
| | ASTM A487/A487M-14 | 419, 421 |
| CA6NM, Class B | ASME SA-487/SA-487M | 419, 421 |
| | ASTM A487/A487M-14 | 419, 421 |
| CA15 | ASME SA-217/SA-217M | 419, 421 |
| | ASTM A217/A217M-14 | 419, 421 |
| | ASTM A743/A743M-13ae1 | 413, 414 |
| CA15, Class A | ASME SA-487/SA-487M | 419, 421 |
| | ASTM A487/A487M-14 | 419, 421 |
| CA15, Class B | ASME SA-487/SA-487M | 419, 421 |
| | ASTM A487/A487M-14 | 419, 421 |
| CA15, Class C | ASME SA-487/SA-487M | 419, 421 |
| | ASTM A487/A487M-14 | 419, 421 |
| CA15, Class D | ASME SA-487/SA-487M | 419, 421 |
| | ASTM A487/A487M-14 | 419, 421 |
| CA15M | ASTM A743/A743M-13ae1 | 413, 414 |
| CA40 | ASTM A743/A743M-13ae1 | 413, 414 |
| carbon steel | ISO 4706:1989 | 116, 125 |
| CF3 | ASME SA-351/SA-351M | 422, 424 |
| | ASTM A351/A351M-14 | 422, 424 |
| | ASTM A743/A743M-13ae1 | 415, 417 |
| | ASTM A744/A744M-13 | 415, 417 |
| CF3A | ASME SA-351/SA-351M | 422, 424 |
| | ASTM A351/A351M-14 | 422, 424 |
| CF3M | ASME SA-351/SA-351M | 423, 425 |
| | ASTM A351/A351M-14 | 423, 425 |
| | ASTM A743/A743M-13ae1 | 415, 417 |
| CF3M (continued) | ASTM A744/A744M-13 | 415, 417 |
| CF3MA | ASME SA-351/SA-351M | 423, 425 |
| | ASTM A351/A351M-14 | 423, 425 |
| CF3MN | ASTM A743/A743M-13ae1 | 416, 418 |
| CF8 | ASME SA-351/SA-351M | 422, 424 |
| | ASTM A351/A351M-14 | 422, 424 |
| | ASTM A743/A743M-13ae1 | 415, 417 |
| | ASTM A744/A744M-13 | 415, 417 |
| CF8A | ASME SA-351/SA-351M | 422, 424 |
| | ASTM A351/A351M-14 | 422, 424 |
| CF8C | ASME SA-351/SA-351M | 422, 424 |
| | ASTM A351/A351M-14 | 422, 424 |
| | ASTM A743/A743M-13ae1 | 415, 417 |
| | ASTM A744/A744M-13 | 415, 417 |
| CF8M | ASME SA-351/SA-351M | 422, 424 |
| | ASTM A351/A351M-14 | 422, 424 |
| | ASTM A743/A743M-13ae1 | 415, 417 |
| | ASTM A744/A744M-13 | 415, 417 |
| CF10M | ASME SA-351/SA-351M | 423, 425 |
| | ASTM A351/A351M-14 | 423, 425 |
| CF20 | ASTM A743/A743M-13ae1 | 415, 417 |
| CG3M | ASTM A743/A743M-13ae1 | 416, 418 |
| | ASTM A744/A744M-13 | 416, 418 |
| CG8M | ASTM A743/A743M-13ae1 | 416, 418 |
| | ASTM A744/A744M-13 | 416, 418 |
| CH20 | ASTM A743/A743M-13ae1 | 416, 418 |
| CK3MCuN | ASTM A743/A743M-13ae1 | 416, 418 |
| | ASTM A744/A744M-13 | 416, 418 |
| CN3M | ASTM A743/A743M-13ae1 | 416, 418 |
| CN3MN | ASTM A743/A743M-13ae1 | 416, 418 |
| | ASTM A744/A744M-13 | 416, 418 |
| CN7M | ASME SA-351/SA-351M | 423, 425 |
| | ASTM A351/A351M-14 | 423, 425 |
| | ASTM A743/A743M-13ae1 | 416, 418 |
| | ASTM A744/A744M-13 | 416, 418 |
| Cr2 | GB/T 1299-2000 | 627 |
| Cr5Mo1V | GB/T 1299-2000 | 625 |
| Cr12 | GB/T 1299-2000 | 625 |
| Cr12Mo1V1 | GB/T 1299-2000 | 625 |
| CR304 | ASME SA-403/SA-403M | 367, 373 |
| | ASTM A403/A403M-15 | 367, 373 |
| CR304L | ASME SA-403/SA-403M | 367, 373 |

| Designation | Specification | Page Number |
|---|---|---|
| CR304L (continued) | ASTM A403/A403M-15 | 373 |
| CR304LN | ASME SA-403/SA-403M | 368 |
| | ASTM A403/A403M-15 | 368 |
| CR310S | ASME SA-403/SA-403M | 368, 375 |
| | ASTM A403/A403M-15 | 368, 375 |
| CR316 | ASME SA-403/SA-403M | 369, 375 |
| | ASTM A403/A403M-15 | 369, 375 |
| CR316L | ASME SA-403/SA-403M | 369, 376 |
| | ASTM A403/A403M-15 | 369, 376 |
| CR317 | ASME SA-403/SA-403M | 370, 377 |
| | ASTM A403/A403M-15 | 370, 377 |
| CR317L | ASME SA-403/SA-403M | 370, 377 |
| | ASTM A403/A403M-15 | 370, 377 |
| CR321 | ASME SA-403/SA-403M | 371, 378 |
| | ASTM A403/A403M-15 | 371, 378 |
| CR347 | ASME SA-403/SA-403M | 372, 379 |
| | ASTM A403/A403M-15 | 372, 379 |
| CR403L | ASTM A403/A403M-15 | 367 |
| CRS31803 | ASME SA-815/SA-815M | 381, 383 |
| | ASTM A815/A815M-14 | 381, 383 |
| CRS32205 | ASME SA-815/SA-815M | 381, 383 |
| | ASTM A815/A815M-14 | 381, 383 |
| CRS32750 | ASME SA-815/SA-815M | 381, 383 |
| | ASTM A815/A815M-14 | 381, 383 |
| CRS32760 | ASME SA-815/SA-815M | 382, 384 |
| | ASTM A815/A815M-14 | 382, 384 |
| CrWMn | GB/T 1299-2000 | 626 |
| D | ASME SA-178/SA-178M | 263, 266 |
| | ASME SA-203/SA-203M | 151, 152 |
| | ASME SA-283/SA-283M | 59, 69 |
| | ASME SA-302/SA-302M | 157, 158 |
| | ASME SA-414/SA-414M | 114, 122 |
| | ASTM A1000/A1000M-11 | 619 |
| | ASTM A128/A128M-93 (2012) | 400, 401 |
| | ASTM A139/A139M-04 (2010) | 257, 259 |
| | ASTM A178/A178M-02 (2012) | 263, 266 |
| | ASTM A203/A203M-12 | 151, 152 |
| | ASTM A283/A283M-13 | 59, 69 |
| | ASTM A302/A302M-12 | 157, 158 |
| | ASTM A414/A414M-14 | 114, 122 |
| | ASTM A500-13 | 203, 217 |
| | ASTM A633/A633M-13 | 77, 82 |
| | GB 712-2000 | 56, 67 |

| Designation | Specification | Page Number |
|---|---|---|
| D (DH) | ASTM A668/A668M-15 | 335, 339 |
| D1N1 | ASTM A757/A757M-15 | 410, 412 |
| D1N2 | ASTM A757/A757M-15 | 410, 412 |
| D1N3 | ASTM A757/A757M-15 | 410, 412 |
| D1Q1 | ASTM A757/A757M-15 | 410, 412 |
| D1Q2 | ASTM A757/A757M-15 | 410, 412 |
| D1Q3 | ASTM A757/A757M-15 | 410, 412 |
| D2 | ASTM A681-08 | 625 |
| | SAE J438b MAY70 | 625 |
| D3 | ASTM A681-08 | 625 |
| | SAE J438b MAY70 | 625 |
| D32 | GB 712-2000 | 60, 69 |
| D36 | GB 712-2000 | 62, 71 |
| D40 | GB 712-2000 | 63, 72 |
| E | ASME SA-203/SA-203M | 151, 152 |
| | ASME SA-414/SA-414M | 114, 123 |
| | ASTM A139/A139M-04 (2010) | 257, 259 |
| | ASTM A203/A203M-12 | 151, 152 |
| | ASTM A414/A414M-14 | 114, 123 |
| | ASTM A514/A514M-14 | 90, 95 |
| | ASTM A633/A633M-13 | 79, 84 |
| | GB 712-2000 | 56, 67 |
| E (EH) | ASTM A668/A668M-15 | 337, 339 |
| E 185 (Fe 310), Quality 0 | ISO 630:1995 A1:2003 | 51, 66 |
| E 235 (Fe 360), Quality A | ISO 630:1995 A1:2003 | 52, 66 |
| E 235 (Fe 360), Quality B | ISO 630:1995 A1:2003 | 52, 66 |
| E 235 (Fe 360), Quality B NF | ISO 630:1995 A1:2003 | 52, 66 |
| E 235 (Fe 360), Quality C | ISO 630:1995 A1:2003 | 53, 66 |
| E 235 (Fe 360), Quality D | ISO 630:1995 A1:2003 | 53, 66 |
| E 275 (Fe 430), Quality A | ISO 630:1995 A1:2003 | 58, 69 |
| E 275 (Fe 430), Quality B | ISO 630:1995 A1:2003 | 58, 69 |
| E 275 (Fe 430), Quality C | ISO 630:1995 A1:2003 | 58, 69 |
| E 275 (Fe 430), Quality D | ISO 630:1995 A1:2003 | 59, 69 |
| E 355 (Fe 510), Quality C | ISO 630:1995 A1:2003 | 62, 71 |
| E 355 (Fe 510), Quality D | ISO 630:1995 A1:2003 | 62, 71 |
| E 355, Quality DD | ISO 4950-2:1995 A1:2003 | 85, 92 |
| E 355, Quality E | ISO 4950-2:1995 A1:2003 | 85, 92 |
| E 460, Quality DD | ISO 4950-3:1995 A1:2003 | 88, 93 |
| E 460, Quality E | ISO 4950-3:1995 A1:2003 | 88, 93 |
| E A | ASTM A53/A53M-12 | 255, 258 |

| Designation | Specification | Page Number |
|---|---|---|
| E B | ASTM A53/A53M-12 | 257, 259 |
| E-1 | ASTM A128/A128M-93 (2012) | 400, 401 |
| E1Q | ASTM A757/A757M-15 | 410, 412 |
| E-2 | ASTM A128/A128M-93 (2012) | 400, 401 |
| E2N1 | ASTM A757/A757M-15 | 410, 412 |
| E2N2 | ASTM A757/A757M-15 | 410, 412 |
| E2N3 | ASTM A757/A757M-15 | 410, 412 |
| E2Q1 | ASTM A757/A757M-15 | 410, 412 |
| E2Q2 | ASTM A757/A757M-15 | 410, 412 |
| E2Q3 | ASTM A757/A757M-15 | 410, 412 |
| E3N | ASTM A757/A757M-15 | 419, 421 |
| E32 | GB 712-2000 | 60, 69 |
| E36 | GB 712-2000 | 62, 71 |
| E40 | GB 712-2000 | 63, 72 |
| E155 | EN 10296-1:2003 | 198, 199, 213 |
| | EN 10305-2:2010 | 198, 201, 202, 213, 215, 217 |
| | EN 10305-3:2010 | 198, 213 |
| E190 | EN 10296-1:2003 | 198, 213 |
| | EN 10305-3:2010 | 198, 213 |
| E195 | EN 10296-1:2003 | 199, 200 |
| | EN 10305-2:2010 | 198, 199, 201, 204, 213, 215, 219 |
| | EN 10305-3:2010 | 198, 199, 200, 213, 214 |
| E215 | EN 10305-1:2010 | 198, 199, 202, 205, 213, 216, 219 |
| E220 | EN 10296-1:2003 | 199, 214 |
| | EN 10305-3:2010 | 199, 214 |
| E235 | EN 10296-1:2003 | 199, 200, 202, 214, 216 |
| | EN 10297-1:2003 | 201, 215 |
| | EN 10305-1:2010 | 199, 200, 204, 206, 214, 218, 220 |
| | EN 10305-2:2010 | 199, 200, 205, 207, 214, 219, 221 |
| | EN 10305-3:2010 | 199, 200, 202, 214, 216 |
| E255 | EN 10305-1:2010 | 202, 205, 208, 209, 216, 219, 221, 222 |
| E260 | EN 10296-1:2003 | 200, 214 |
| | EN 10305-3:2010 | 200, 214 |
| E275 | EN 10296-1:2003 | 202, 203, 205, 216, 217 |
| | EN 10297-1:2003 | 203, 217 |
| | EN 10305-2:2010 | 202, 203, 208, 209, 216, 217, 221, 222 |
| E275 (continued) | EN 10305-3:2010 | 202, 203, 205, 216, 217 |
| E275K2 | EN 10296-1:2003 | 201, 215 |
| | EN 10297-1:2003 | 203, 217 |
| E295 | EN 10025-2:2004 | 61, 70 |
| E315 | EN 10297-1:2003 | 206, 219 |
| E320 | EN 10296-1:2003 | 203, 217 |
| | EN 10305-3:2010 | 203, 217 |
| E335 | EN 10025-2:2004 | 64, 73 |
| E355 | EN 10296-1:2003 | 207, 209, 221, 222 |
| | EN 10297-1:2003 | 207, 221 |
| | EN 10305-1:2010 | 206, 207, 209, 211, 219, 222, 223 |
| | EN 10305-2:2010 | 206, 207, 210, 211, 219, 223 |
| | EN 10305-3:2010 | 206, 207, 209, 219, 222 |
| E360 | EN 10025-2:2004 | 65, 73 |
| E370 | EN 10296-1:2003 | 206, 220 |
| | EN 10305-3:2010 | 206, 219 |
| E410 | EN 10305-1:2010 | 208, 209, 210, 211, 212, 221, 222, 223 |
| E420 | EN 10305-3:2010 | 207, 221 |
| E420J2 | EN 10297-1:2003 | 210, 223 |
| E4340 | ASME SA-29/SA-29M | 42 |
| | ASTM A29/A29M-12e1 | 42 |
| | ASTM A322-13 | 42 |
| | SAE J404 JAN09 | 42 |
| E470 | EN 10297-1:2003 | 211, 223 |
| E590K2 | EN 10297-1:2003 | 212, 224 |
| E9310 | ASME SA-29/SA-29M | 43 |
| | ASTM A29/A29M-12e1 | 43 |
| F | ASME SA-203/SA-203M | 151, 152 |
| | ASME SA-414/SA-414M | 115, 125 |
| | ASTM A128/A128M-93 (2012) | 400, 401 |
| | ASTM A203/A203M-12 | 151, 152 |
| | ASTM A414/A414M-14 | 115, 125 |
| | ASTM A514/A514M-14 | 90, 95 |
| F (FH) | ASTM A668/A668M-15 | 338, 340 |
| F A | ASTM A53/A53M-12 | 255, 258 |
| F, Class 1 | ASTM A1028-03 (2015) | 593, 595 |
| F1 | ASME SA-182/SA-182M | 348 |
| | ASME SA-336/SA-336M | 348 |
| | ASTM A182/A182M-15 | 348 |

| Designation | Specification | Page Number |
|---|---|---|
| F1 (continued) | ASTM A336/A336M-10a | 348 |
| F2 | ASME SA-182/SA-182M | 349 |
| | ASTM A182/A182M-15 | 349 |
| | ASTM A681-08 | 627 |
| F3V | ASME SA-182/SA-182M | 354, 355 |
| | ASME SA-336/SA-336M | 354, 355 |
| | ASTM A182/A182M-15 | 354, 355 |
| | ASTM A336/A336M-10a | 354, 355 |
| F5 | ASME SA-182/SA-182M | 355, 356 |
| | ASME SA-336/SA-336M | 355, 356 |
| | ASTM A182/A182M-15 | 355, 356 |
| | ASTM A336/A336M-10a | 355, 356 |
| F5A | ASME SA-182/SA-182M | 355, 356 |
| | ASME SA-336/SA-336M | 355, 356 |
| | ASTM A182/A182M-15 | 355, 356 |
| | ASTM A336/A336M-10a | 355, 356 |
| F6a, Class 1 | ASME SA-182/SA-182M | 364, 365 |
| | ASTM A182/A182M-15 | 364, 365 |
| F6a, Class 2 | ASME SA-182/SA-182M | 364, 365 |
| | ASTM A182/A182M-15 | 364, 365 |
| F6a, Class 3 | ASME SA-182/SA-182M | 364, 365 |
| | ASTM A182/A182M-15 | 364, 365 |
| F6a, Class 4 | ASME SA-182/SA-182M | 364, 365 |
| | ASTM A182/A182M-15 | 364, 365 |
| F6b | ASME SA-182/SA-182M | 364, 365 |
| | ASTM A182/A182M-15 | 364, 365 |
| F6NM | ASME SA-182/SA-182M | 364, 365 |
| | ASTM A182/A182M-15 | 364, 365 |
| F9 | ASME SA-182/SA-182M | 356 |
| | ASME SA-336/SA-336M | 356 |
| | ASTM A182/A182M-15 | 356 |
| | ASTM A336/A336M-10a | 356 |
| F11, Class 2 | ASME SA-182/SA-182M | 351 |
| | ASME SA-336/SA-336M | 351 |
| | ASTM A182/A182M-15 | 351 |
| | ASTM A336/A336M-10a | 351 |
| F11, Class 3 | ASME SA-182/SA-182M | 351 |
| | ASME SA-336/SA-336M | 351 |
| | ASTM A182/A182M-15 | 351 |
| | ASTM A336/A336M-10a | 351 |
| F12, Class 2 | ASME SA-182/SA-182M | 350 |
| | ASTM A182/A182M-15 | 350 |
| F12 | ASME SA-336/SA-336M | 350 |
| F12 (continued) | ASTM A336/A336M-10a | 350 |
| F21 | ASME SA-182/SA-182M | 354 |
| | ASTM A182/A182M-15 | 354 |
| F21, Class 1 | ASME SA-336/SA-336M | 354 |
| | ASTM A336/A336M-10a | 354 |
| F21, Class 3 | ASME SA-336/SA-336M | 354 |
| | ASTM A336/A336M-10a | 354 |
| F22, Class 1 | ASME SA-182/SA-182M | 352, 353 |
| | ASME SA-336/SA-336M | 352, 353 |
| | ASTM A182/A182M-15 | 352, 353 |
| | ASTM A336/A336M-10a | 352, 353 |
| F22, Class 3 | ASME SA-182/SA-182M | 352, 353 |
| | ASME SA-336/SA-336M | 352, 353 |
| | ASTM A182/A182M-15 | 352, 353 |
| | ASTM A336/A336M-10a | 352, 353 |
| F22V | ASME SA-182/SA-182M | 352, 353 |
| | ASME SA-336/SA-336M | 352, 353 |
| | ASTM A182/A182M-15 | 352, 353 |
| | ASTM A336/A336M-10a | 352, 353 |
| F32 | GB 712-2000 | 60, 69 |
| F36 | GB 712-2000 | 62, 71 |
| F40 | GB 712-2000 | 63, 72 |
| F 50 | ASME SA-182/SA-182M | 381, 383 |
| | ASTM A182/A182M-15 | 381, 383 |
| F51 | ASME SA-182/SA-182M | 381, 383 |
| | ASTM A182/A182M-15 | 381, 383 |
| F53 | ASME SA-182/SA-182M | 381, 383 |
| | ASTM A182/A182M-15 | 381, 383 |
| F55 | ASME SA-182/SA-182M | 382, 384 |
| | ASTM A182/A182M-15 | 382, 384 |
| F59 | ASME SA-182/SA-182M | 382, 384 |
| | ASTM A182/A182M-15 | 382, 384 |
| F60 | ASME SA-182/SA-182M | 381, 383 |
| | ASTM A182/A182M-15 | 381, 383 |
| F304 | ASME SA-182/SA-182M | 367, 373 |
| | ASTM A182/A182M-15 | 367, 373 |
| | ASTM A965/A965M-14 | 367, 373 |
| F304H | ASME SA-182/SA-182M | 367, 374 |
| | ASTM A182/A182M-15 | 367, 374 |
| | ASTM A965/A965M-14 | 367, 374 |
| F304L | ASME SA-182/SA-182M | 367, 373 |
| | ASTM A182/A182M-15 | 367, 373 |
| | ASTM A965/A965M-14 | 367, 373 |

| Designation | Specification | Page Number |
|---|---|---|
| F304LN | ASME SA-182/SA-182M | 368, 374 |
| | ASTM A182/A182M-15 | 368, 374 |
| | ASTM A965/A965M-14 | 368, 374 |
| F304N | ASME SA-182/SA-182M | 368, 374 |
| | ASTM A182/A182M-15 | 368, 374 |
| | ASTM A965/A965M-14 | 368, 374 |
| F310 | ASME SA-182/SA-182M | 368, 375 |
| | ASTM A182/A182M-15 | 368, 375 |
| | ASTM A965/A965M-14 | 368, 375 |
| F310H | ASME SA-182/SA-182M | 368, 375 |
| | ASTM A182/A182M-15 | 368, 375 |
| | ASTM A965/A965M-14 | 368, 375 |
| F316 | ASME SA-182/SA-182M | 369, 375 |
| | ASTM A182/A182M-15 | 369, 375 |
| | ASTM A965/A965M-14 | 369, 375 |
| F316H | ASME SA-182/SA-182M | 370, 377 |
| | ASTM A182/A182M-15 | 370, 377 |
| | ASTM A965/A965M-14 | 370, 377 |
| F316L | ASME SA-182/SA-182M | 369, 376 |
| | ASTM A182/A182M-15 | 369, 376 |
| | ASTM A965/A965M-14 | 369, 376 |
| F316LN | ASME SA-182/SA-182M | 370, 376 |
| | ASTM A182/A182M-15 | 370, 376 |
| | ASTM A965/A965M-14 | 370, 376 |
| F316N | ASME SA-182/SA-182M | 367, 373 |
| | ASTM A182/A182M-15 | 367, 373 |
| | ASTM A965/A965M-14 | 367, 373 |
| F317 | ASME SA-182/SA-182M | 370, 377 |
| | ASTM A182/A182M-15 | 370, 377 |
| F317L | ASME SA-182/SA-182M | 370, 377 |
| | ASTM A182/A182M-15 | 370, 377 |
| F321 | ASME SA-182/SA-182M | 371, 378 |
| | ASTM A182/A182M-15 | 371, 378 |
| | ASTM A965/A965M-14 | 371, 378 |
| F321H | ASME SA-182/SA-182M | 371, 378 |
| | ASTM A182/A182M-15 | 371, 378 |
| | ASTM A965/A965M-14 | 371, 378 |
| F347 | ASME SA-182/SA-182M | 372, 379 |
| | ASTM A182/A182M-15 | 372, 379 |
| | ASTM A965/A965M-14 | 372, 379 |
| F347H | ASME SA-182/SA-182M | 372, 379 |
| | ASTM A182/A182M-15 | 372, 379 |
| F348 | ASME SA-182/SA-182M | 372, 379 |
| F348 (continued) | ASTM A182/A182M-15 | 372, 379 |
| | ASTM A965/A965M-14 | 372, 379 |
| F430 | ASME SA-182/SA-182M | 366 |
| | ASTM A182/A182M-15 | 366 |
| FDC | EN 10270-2:2011 | 615 |
| | GB/T 18983-2003 | 615 |
| | ISO 8458-3:2002 | 615 |
| FDCrSi | GB/T 18983-2003 | 619 |
| FDCrV | EN 10270-2:2011 | 620 |
| FDCrV-A | GB/T 18983-2003 | 620 |
| | ISO 8458-3:2002 | 620 |
| FDCrV-B | GB/T 18983-2003 | 620 |
| | ISO 8458-3:2002 | 620 |
| FDSiCr | EN 10270-2:2011 | 619 |
| | ISO 8458-3:2002 | 619 |
| FDSiMn | GB/T 18983-2003 | 618 |
| G | ASME SA-414/SA-414M | 117, 126 |
| | ASTM A414/A414M-14 | 118, 126 |
| G9Ni10 | EN 10213:2007 C1:2008 | 409, 411 |
| G9Ni14 | EN 10213:2007 C1:2008 | 409, 411 |
| G12MoCrV5-2 | EN 10213:2007 C1:2008 | 407, 408 |
| G17CrMo5-5 | EN 10213:2007 C1:2008 | 406, 408 |
| G17CrMo9-10 | EN 10213:2007 C1:2008 | 407, 408 |
| G17CrMoV5-10 | EN 10213:2007 C1:2008 | 406, 408 |
| G17Mn5 | EN 10213:2007 C1:2008 | 398, 399 |
| | EN 10293:2015 | 389, 393 |
| G17NiCrMo13-6 | EN 10213:2007 C1:2008 | 410, 412 |
| G18Mo5 | EN 10213:2007 C1:2008 | 409, 411 |
| G20Mn5 | EN 10213:2007 C1:2008 | 398, 399 |
| | EN 10293:2015 | 390, 393 |
| G20Mo5 | EN 10213:2007 C1:2008 | 406, 407 |
| G24Mn6 | EN 10293:2015 | 391, 395 |
| G25CrMo4 | ISO 14737:2003 | 402, 403 |
| G26CrMo4 | EN 10293:2015 | 402, 403 |
| G28Mn6 | EN 10293:2015 | 391, 395 |
| G32CrMo4 | ISO 14737:2003 | 402, 404 |
| G32NiCrMo8-5-4 | EN 10293:2015 | 403, 405 |
| | ISO 14737:2003 | 403, 405 |
| G42CrMo4 | EN 10293:2015 | 402, 404 |
| | ISO 14737:2003 | 402, 404 |
| G-CoCr28 | EN 10295:2002 | 429, 432 |
| GCr15 | GB/T 18254-2002 | 628 |
| GCr15SiMn | GB/T 18254-2002 | 628 |

| Designation | Specification | Page Number |
|---|---|---|
| GCr18Mo | GB/T 18254-2002 | 628 |
| GE200 | EN 10293:2015 | 389, 392 |
| GE240 | EN 10293:2015 | 389, 393 |
| GE300 | EN 10293:2015 | 391, 394 |
| G-NiCr15 | EN 10295:2002 | 429, 432 |
| G-NiCr28W | EN 10295:2002 | 429, 432 |
| G-NiCr50Nb | EN 10295:2002 | 428, 432 |
| GP240GH | EN 10213:2007 C1:2008 | 396, 397 |
| GP280GH | EN 10213:2007 C1:2008 | 396, 397 |
| GS200 | EN 10293:2015 | 389, 392 |
| GS240 | EN 10293:2015 | 389, 393 |
| GX 2 CrNi 18 10 | ISO 11972:1998 | 415, 417 |
| GX2CrNi19-11 | EN 10213:2007 C1:2008 | 422, 424 |
| | EN 10283:2010 | 415, 417 |
| GX 2 CrNiCuMoN 26 5 3 3 | ISO 11972:1998 | 416, 418 |
| GX2CrNiMo19-11-2 | EN 10213:2007 C1:2008 | 423, 425 |
| | EN 10283:2010 | 415, 417 |
| | ISO 11972:1998 | 415, 417 |
| GX 2 CrNiMo 19 11 3 | ISO 11972:1998 | 416, 418 |
| GX2CrNiMoCuN20-18-6 | EN 10283:2010 | 416, 418 |
| GX2CrNiMoCuN25-6-3-3 | EN 10283:2010 | 416, 418 |
| GX2CrNiMoN17-13-4 | EN 10283:2010 | 416, 418 |
| GX 2 CrNiMoN 19 11 2 | ISO 11972:1998 | 416, 418 |
| GX 2 CrNiMoN 19 11 3 | ISO 11972:1998 | 416, 418 |
| GX2CrNiMoN25-6-3 | EN 10283:2010 | 416, 418 |
| GX 2 CrNiMoN 26 5 3 | ISO 11972:1998 | 416, 418 |
| GX2NiCrMo28-20-2 | EN 10213:2007 C1:2008 | 423, 425 |
| | EN 10283:2010 | 416, 418 |
| GX2NiCrMoCuN25-20-6 | EN 10283:2010 | 416, 418 |
| GX2NiCrMoN25-20-5 | EN 10283:2010 | 416, 418 |
| GX3CrNi13-4 | EN 10213:2007 C1:2008 | 419, 421 |
| GX 4 CrNi 12 4 (QT1) | ISO 11972:1998 | 413, 414 |
| GX 4 CrNi 12 4 (QT2) | ISO 11972:1998 | 413, 414 |
| GX4CrNi13-4 | EN 10213:2007 C1:2008 | 419, 421 |
| | EN 10283:2010 | 413, 414 |
| GX 4 CrNiMo 16 5 1 | ISO 11972:1998 | 413, 414 |
| GX4CrNiMo16-5-1 | EN 10283:2010 | 413, 414 |
| GX4NiCrCuMo30-20-4 | EN 10283:2010 | 416, 418 |
| GX 5 CrNi 19 9 | ISO 11972:1998 | 415, 417 |
| GX5CrNi19-10 | EN 10213:2007 C1:2008 | 422, 424 |
| | EN 10283:2010 | 415, 417 |
| GX5CrNiMo19-11-2 | EN 10213:2007 C1:2008 | 422, 424 |
| | EN 10283:2010 | 415, 417 |
| | ISO 11972:1998 | 415, 417 |
| GX5CrNiMo19-11-3 | EN 10283:2010 | 416, 418 |
| | ISO 11972:1998 | 415, 417 |
| GX5CrNiMoNb19-11-2 | EN 10213:2007 C1:2008 | 422, 424 |
| | EN 10283:2010 | 415, 417 |
| GX5CrNiNb19-11 | EN 10213:2007 C1:2008 | 422, 424 |
| | EN 10283:2010 | 415, 417 |
| GX 6 CrNiMoNb 19 11 2 | ISO 11972:1998 | 415, 417 |
| GX 6 CrNiNb 19 10 | ISO 11972:1998 | 415, 417 |
| GX7CrNiMo12-1 | EN 10283:2010 | 413, 414 |
| GX8CrNi12 | EN 10213:2007 C1:2008 | 420, 421 |
| GX 8 CrNiMo 12 1 | ISO 11972:1998 | 413, 414 |
| GX10NiCrNb50-50 | ISO 11973:1999 | 428, 432 |
| GX12Cr12 | EN 10283:2010 | 413, 414 |
| | ISO 11972:1998 | 413, 414 |
| GX15CrMo5 | EN 10213:2007 C1:2008 | 407, 408 |
| GX23CrMoV12-1 | EN 10213:2007 C1:2008 | 420, 421 |
| GX25 CrNiSi 20-14 | ISO 11973:1999 | 426, 430 |
| GX25CrNiSi18-9 | EN 10295:2002 | 426, 430 |
| | ISO 11973:1999 | 426, 430 |
| GX25CrNiSi20-14 | EN 10295:2002 | 426, 430 |
| GX30CoCr50-28 | ISO 11973:1999 | 429, 432 |
| GX30CrSi7 | EN 10295:2002 | 407, 408 |
| | ISO 11973:1999 | 407, 408 |
| GX35NiCrSi25-21 | EN 10295:2002 | 428, 432 |
| GX40CrNiSi22-10 | EN 10295:2002 | 426, 430 |
| | ISO 11973:1999 | 426, 430 |
| GX40CrNiSi25-12 | EN 10295:2002 | 427, 431 |
| | ISO 11973:1999 | 427, 431 |
| GX40CrNiSi25-20 | EN 10295:2002 | 427, 431 |
| | ISO 11973:1999 | 427, 431 |
| GX40CrNiSi27-4 | EN 10295:2002 | 426, 430 |
| | ISO 11973:1999 | 426, 430 |
| GX40CrNiSiNb24-24 | EN 10295:2002 | 428, 432 |
| | ISO 11973:1999 | 428, 432 |
| GX40CrSi13 | EN 10295:2002 | 426, 430 |
| | ISO 11973:1999 | 426, 430 |
| GX40CrSi17 | EN 10295:2002 | 426, 430 |
| | ISO 11973:1999 | 426, 430 |
| GX40CrSi24 | EN 10295:2002 | 426, 430 |
| | ISO 11973:1999 | 426, 430 |

| Designation | Specification | Page Number |
|---|---|---|
| GX40CrSi28 | EN 10295:2002 | 426, 430 |
| | ISO 11973:1999 | 426, 430 |
| GX40NiCrCo20-20-20 | ISO 11973:1999 | 429, 432 |
| GX40NiCrSi35-17 | EN 10295:2002 | 428, 432 |
| | ISO 11973:1999 | 428, 432 |
| GX40NiCrSi35-26 | EN 10295:2002 | 428, 432 |
| | ISO 11973:1999 | 428, 432 |
| GX40NiCrSi38-19 | EN 10295:2002 | 428, 432 |
| | ISO 11973:1999 | 428, 432 |
| GX40NiCrSiNb35-18 | EN 10295:2002 | 428, 432 |
| GX40NiCrSiNb35-26 | EN 10295:2002 | 428, 432 |
| | ISO 11973:1999 | 428, 432 |
| GX40NiCrSiNb38-19 | EN 10295:2002 | 428, 432 |
| | ISO 11973:1999 | 428, 432 |
| GX45NiCrWSi48-28-5 | ISO 11973:1999 | 429, 432 |
| GX50NiCr65-15 | ISO 11973:1999 | 429, 432 |
| GX50NiCrCo20-20-20 | EN 10295:2002 | 429, 432 |
| GX90MnMo14 | ISO 13521:1999 | 400, 401 |
| GX100Mn13 | ISO 13521:1999 | 400, 401 |
| GX110MnMo13-1 | ISO 13521:1999 | 400, 401 |
| GX120Mn13 | ISO 13521:1999 | 400, 401 |
| GX120MnCr13-2 | ISO 13521:1999 | 400, 401 |
| GX120MnCr17-2 | ISO 13521:1999 | 400, 401 |
| GX120MnMo7-1 | ISO 13521:1999 | 400, 401 |
| GX120MnNi13-3 | ISO 13521:1999 | 400, 401 |
| GX130CrSi29 | EN 10295:2002 | 426, 430 |
| | ISO 11973:1999 | 426, 430 |
| H | ASTM A514/A514M-14 | 90, 95 |
| H10 | ASTM A681-08 | 626 |
| H11 | ASTM A681-08 | 626 |
| | SAE J438b MAY70 | 626 |
| H12 | ASTM A681-08 | 626 |
| | SAE J438b MAY70 | 626 |
| H13 | ASTM A681-08 | 626 |
| | SAE J438b MAY70 | 626 |
| H19 | ASTM A681-08 | 627 |
| H21 | ASTM A681-08 | 627 |
| | SAE J438b MAY70 | 627 |
| HC | ASTM A297/A297M-14 | 426, 430 |
| HC30 | ASTM A608/A608M-14 | 426, 430 |
| HD | ASTM A297/A297M-14 | 426, 430 |
| HD50 | ASTM A608/A608M-14 | 426, 430 |
| HE | ASTM A297/A297M-14 | 426, 430 |
| HE35 | ASTM A608/A608M-14 | 426 |
| HF | ASTM A297/A297M-14 | 426, 430 |
| HF30 | ASTM A608/A608M-14 | 426, 430 |
| HH | ASTM A297/A297M-14 | 427, 431 |
| HH30 | ASTM A608/A608M-14 | 427, 431 |
| HH33 | ASTM A608/A608M-14 | 427, 431 |
| HI | ASTM A297/A297M-14 | 427, 431 |
| HI35 | ASTM A608/A608M-14 | 427, 431 |
| HK | ASTM A297/A297M-14 | 427, 431 |
| HK30 | ASME SA-351/SA-351M | 427, 431 |
| | ASTM A351/A351M-14 | 427, 431 |
| | ASTM A608/A608M-14 | 427, 431 |
| HK40 | ASME SA-351/SA-351M | 427, 431 |
| | ASTM A351/A351M-14 | 427, 431 |
| | ASTM A608/A608M-14 | 427, 431 |
| HL | ASTM A297/A297M-14 | 427, 431 |
| HL30 | ASTM A608/A608M-14 | 427 |
| HL40 | ASTM A608/A608M-14 | 427 |
| HN | ASTM A297/A297M-14 | 428, 432 |
| HN40 | ASTM A608/A608M-14 | 428 |
| HP | ASTM A297/A297M-14 | 428, 432 |
| HP245 | GB 6653-94 | 112, 120 |
| HP265 | GB 6653-94 | 113, 121 |
| HP295 | GB 6653-94 | 114, 122 |
| HP325 | GB 6653-94 | 116, 125 |
| HP345 | GB 6653-94 | 117, 126 |
| HP365 | GB 6653-94 | 118, 126 |
| HPS 100W [HPS 690W] | ASTM A709/A709M-13a | 91, 95 |
| HPS 70W [HPS 485W] | ASTM A709/A709M-13a | 88 |
| HPS 70W [HPS 485W] | ASTM A709/A709M-13a | 93 |
| HS10-4-3-10 | ISO 4957:1999 | 625 |
| HS18-0-1 | ISO 4957:1999 | 623 |
| HS1-8-1 | ISO 4957:1999 | 623 |
| HS2-9-1-8 | ISO 4957:1999 | 625 |
| HS2-9-2 | ISO 4957:1999 | 624 |
| HS6-5-2 | ISO 4957:1999 | 624 |
| HS6-5-2-5 | ISO 4957:1999 | 625 |
| HS6-5-3 | ISO 4957:1999 | 624 |
| HS6-5-4 | ISO 4957:1999 | 624 |
| HS6-6-2 | ISO 4957:1999 | 624 |
| HSA 235W, Class B | ISO 5952:2005 | 97, 103 |
| HSA 235W, Class D | ISO 5952:2005 | 97, 103 |
| HSA 245W, Class B | ISO 5952:2005 | 98, 103 |

| Designation | Specification | Page Number |
|---|---|---|
| HSA 245W, Class D | ISO 5952:2005 | 98, 103 |
| HSA 355W1, Class A | ISO 5952:2005 | 101, 105 |
| HSA 355W1, Class D | ISO 5952:2005 | 101, 105 |
| HSA 355W2, Class C | ISO 5952:2005 | 101, 105 |
| HSA 355W2, Class D | ISO 5952:2005 | 101, 105 |
| HSA 365W, Class B | ISO 5952:2005 | 104 |
| HSA 365W, Class D | ISO 5952:2005 | 104 |
| HSA 365W, Class B | ISO 5952:2005 | 99 |
| HSA 365W, Class D | ISO 5952:2005 | 99 |
| HT | ASTM A297/A297M-14 | 428, 432 |
| HT30 | ASME SA-351/SA-351M | 428, 432 |
| | ASTM A351/A351M-14 | 428, 432 |
| HT50 | ASTM A608/A608M-14 | 428 |
| HU | ASTM A297/A297M-14 | 428, 432 |
| HU50 | ASTM A608/A608M-14 | 428 |
| HW | ASTM A297/A297M-14 | 429, 432 |
| HW50 | ASTM A608/A608M-14 | 429 |
| HX | ASTM A297/A297M-14 | 429, 432 |
| HX50 | ASTM A608/A608M-14 | 429 |
| I | ASME SA-553/SA-553M | 153, 154 |
| | ASTM A447/A447M-11 | 427, 431 |
| | ASTM A553/A553M-14 | 153, 154 |
| II | ASME SA-553/SA-553M | 153, 154 |
| | ASTM A447/A447M-11 | 427, 431 |
| | ASTM A553/A553M-14 | 153, 154 |
| K | ASTM A588/A588M-15 | 77, 82 |
| L3 | ASTM A681-08 | 627 |
| L6 | ASTM A681-08 | 627 |
| | SAE J438b MAY70 | 627 |
| L7 | SAE J438b MAY70 | 627 |
| L175 or A25 | API 5L - 2012 | 316, 321 |
| | EN ISO 3183:2012 | 316, 321 |
| L175 or A25 Seamless | API 5L - 2012 | 318, 324 |
| | EN ISO 3183:2012 | 318, 324 |
| L175 or A25 Welded | API 5L - 2012 | 318, 324 |
| | EN ISO 3183:2012 | 318, 324 |
| L175P or A25P | API 5L - 2012 | 316, 321 |
| | EN ISO 3183:2012 | 316, 321 |
| L175P or A25P Seamless | API 5L - 2012 | 318, 324 |
| | EN ISO 3183:2012 | 318, 324 |
| L175P or A25P Welded | API 5L - 2012 | 318, 324 |
| | EN ISO 3183:2012 | 318, 324 |
| L210 or A | API 5L - 2012 | 316 |
| | EN ISO 3183:2012 | 316 |
| L210 or A Seamless | API 5L - 2012 | 318 |
| | EN ISO 3183:2012 | 318 |
| L210 or A Welded | API 5L - 2012 | 318 |
| | EN ISO 3183:2012 | 318 |
| L245 or B | API 5L - 2012 | 316 |
| | EN ISO 3183:2012 | 316 |
| L245 or B Seamless | API 5L - 2012 | 318 |
| | EN ISO 3183:2012 | 318 |
| L245 or B Welded | API 5L - 2012 | 318 |
| | EN ISO 3183:2012 | 318 |
| L245M or BM | API 5L - 2012 | 321, 324 |
| | EN ISO 3183:2012 | 321, 324 |
| L245N or BN | API 5L - 2012 | 321, 324 |
| | EN ISO 3183:2012 | 321, 324 |
| L245Q or BQ | API 5L - 2012 | 321, 324 |
| | EN ISO 3183:2012 | 321, 324 |
| L245R or BR | API 5L - 2012 | 321, 324 |
| | EN ISO 3183:2012 | 321, 324 |
| L290 or X42 | API 5L - 2012 | 316 |
| | EN ISO 3183:2012 | 316 |
| L290 or X42 Seamless | API 5L - 2012 | 318 |
| | EN ISO 3183:2012 | 318 |
| L290 or X42 Welded | API 5L - 2012 | 318 |
| | EN ISO 3183:2012 | 318 |
| L290M or X42M | API 5L - 2012 | 321, 325 |
| | EN ISO 3183:2012 | 321, 325 |
| L290N or X42N | API 5L - 2012 | 321, 325 |
| | EN ISO 3183:2012 | 321, 325 |
| L290Q or X42Q | API 5L - 2012 | 321, 325 |
| | EN ISO 3183:2012 | 321, 325 |
| L290R or X42R | API 5L - 2012 | 321, 325 |
| | EN ISO 3183:2012 | 321, 325 |
| L320 or X46 | API 5L - 2012 | 316 |
| | EN ISO 3183:2012 | 316 |
| L320 or X46 Seamless | API 5L - 2012 | 319 |
| | EN ISO 3183:2012 | 319 |
| L320 or X46 Welded | API 5L - 2012 | 319 |
| | EN ISO 3183:2012 | 319 |
| L320M or X46M | API 5L - 2012 | 322, 325 |
| | EN ISO 3183:2012 | 322, 325 |
| L320N or X46N | API 5L - 2012 | 322, 325 |
| | EN ISO 3183:2012 | 322, 325 |

| Designation | Specification | Page Number |
|---|---|---|
| L320Q or X46Q | API 5L - 2012 | 322, 325 |
| | EN ISO 3183:2012 | 322, 325 |
| L360 or X52 | API 5L - 2012 | 316 |
| | EN ISO 3183:2012 | 316 |
| L360 or X52 Seamless | API 5L - 2012 | 319 |
| | EN ISO 3183:2012 | 319 |
| L360 or X52 Welded | API 5L - 2012 | 319 |
| | EN ISO 3183:2012 | 319 |
| L360M or X52M | API 5L - 2012 | 322, 326 |
| | EN ISO 3183:2012 | 322, 326 |
| L360N or X52N | API 5L - 2012 | 322, 326 |
| | EN ISO 3183:2012 | 322, 326 |
| L360Q or X52Q | API 5L - 2012 | 322, 326 |
| | EN ISO 3183:2012 | 322, 326 |
| L390 or X56 | API 5L - 2012 | 317 |
| | EN ISO 3183:2012 | 317 |
| L390 or X56 Seamless | API 5L - 2012 | 319 |
| | EN ISO 3183:2012 | 319 |
| L390 or X56 Welded | API 5L - 2012 | 319 |
| | EN ISO 3183:2012 | 319 |
| L390M or X56M | API 5L - 2012 | 322, 326 |
| | EN ISO 3183:2012 | 322, 326 |
| L390N or X56N | API 5L - 2012 | 322, 326 |
| | EN ISO 3183:2012 | 322, 326 |
| L390Q or X56Q | API 5L - 2012 | 322, 326 |
| | EN ISO 3183:2012 | 322, 326 |
| L415 or X60 | API 5L - 2012 | 317 |
| | EN ISO 3183:2012 | 317 |
| L415 or X60 Seamless | API 5L - 2012 | 319 |
| | EN ISO 3183:2012 | 319 |
| L415 or X60 Welded | API 5L - 2012 | 319 |
| | EN ISO 3183:2012 | 319 |
| L415M or X60M | API 5L - 2012 | 323, 327 |
| | EN ISO 3183:2012 | 323, 327 |
| L415N or X60N | API 5L - 2012 | 323, 327 |
| | EN ISO 3183:2012 | 323, 327 |
| L415Q or X60Q | API 5L - 2012 | 323, 327 |
| | EN ISO 3183:2012 | 323, 327 |
| L450 or X65 | API 5L - 2012 | 317 |
| | EN ISO 3183:2012 | 317 |
| L450 or X65 Seamless | API 5L - 2012 | 320 |
| | EN ISO 3183:2012 | 320 |
| L450 or X65 Welded | API 5L - 2012 | 320 |
| | EN ISO 3183:2012 | 320 |
| L450M or X65M | API 5L - 2012 | 323, 327 |
| | EN ISO 3183:2012 | 323, 327 |
| L450Q or X65Q | API 5L - 2012 | 323, 327 |
| | EN ISO 3183:2012 | 323, 327 |
| L485 or X70 | API 5L - 2012 | 317 |
| | EN ISO 3183:2012 | 317 |
| L485 or X70 Seamless | API 5L - 2012 | 320 |
| | EN ISO 3183:2012 | 320 |
| L485 or X70 Welded | API 5L - 2012 | 320 |
| | EN ISO 3183:2012 | 320 |
| L485M or X70M | API 5L - 2012 | 323, 327 |
| | EN ISO 3183:2012 | 323, 327 |
| L485Q or X70Q | API 5L - 2012 | 323, 327 |
| | EN ISO 3183:2012 | 323, 327 |
| L555M or X80M | API 5L - 2012 | 323, 327 |
| | EN ISO 3183:2012 | 323, 327 |
| L555Q or X80Q | API 5L - 2012 | 323, 327 |
| | EN ISO 3183:2012 | 323, 327 |
| LC1 | ASME SA-352/SA-352M | 409, 411 |
| | ASTM A352/A352M-06 (2012) | 409, 411 |
| LC2 | ASME SA-352/SA-352M | 409, 411 |
| | ASTM A352/A352M-06 (2012) | 409, 411 |
| LC2-1 | ASME SA-352/SA-352M | 410, 412 |
| | ASTM A352/A352M-06 (2012) | 410, 412 |
| LC3 | ASME SA-352/SA-352M | 409, 411 |
| | ASTM A352/A352M-06 (2012) | 409, 411 |
| LCA | ASME SA-352/SA-352M | 398, 399 |
| | ASTM A352/A352M-06 (2012) | 398, 399 |
| LCB | ASME SA-352/SA-352M | 398, 399 |
| | ASTM A352/A352M-06 (2012) | 398, 399 |
| LCC | ASME SA-352/SA-352M | 398, 399 |
| | ASTM A352/A352M-06 (2012) | 398, 399 |
| LF1, Class 1 | ASME SA-350/SA-350M | 342, 345 |
| | ASTM A350/A350M-15 | 342, 345 |
| LF2, Class 1 | ASME SA-350/SA-350M | 342, 345 |
| | ASTM A350/A350M-15 | 343, 346 |
| LF2, Class 2 | ASME SA-350/SA-350M | 342, 345 |
| | ASTM A350/A350M-15 | 343, 346 |
| LF3, Class 1 | ASME SA-350/SA-350M | 357, 358 |
| | ASTM A350/A350M-15 | 357, 358 |
| LF3, Class 2 | ASME SA-350/SA-350M | 357, 358 |

| Designation | Specification | Page Number |
|---|---|---|
| LF3, Class 2 (continued) | ASTM A350/A350M-15 | 357, 358 |
| M1 | ASTM A600-92a (2010) | 623 |
| M2 | SAE J438b MAY70 | 624 |
| M2 (high C) | ASTM A600-92a (2010) | 624 |
| M2 (regular C) | ASTM A600-92a (2010) | 624 |
| M3 | SAE J438b MAY70 | 624 |
| M3, Class 1 | ASTM A600-92a (2010) | 624 |
| M3, Class 2 | ASTM A600-92a (2010) | 624 |
| M4 | ASTM A600-92a (2010) | 624 |
| | SAE J438b MAY70 | 624 |
| M7 | ASTM A600-92a (2010) | 624 |
| M36 | ASTM A600-92a (2010) | 624 |
| M42 | ASTM A600-92a (2010) | 625 |
| MT 302 | ASTM A511/A511M-15a | 233, 239 |
| | ASTM A554-15 | 233, 239 |
| MT 304 | ASTM A511/A511M-15a | 232, 235 |
| | ASTM A554-15 | 232, 235 |
| MT 304L | ASTM A511/A511M-15a | 232, 236 |
| | ASTM A554-15 | 232, 236 |
| MT 316 | ASTM A511/A511M-15a | 232, 237 |
| | ASTM A554-15 | 232, 237 |
| MT 316L | ASTM A511/A511M-15a | 232, 238 |
| | ASTM A554-15 | 232, 238 |
| MT 317 | ASTM A511/A511M-15a | 233, 239 |
| | ASTM A554-15 | 233, 239 |
| MT 321 | ASTM A511/A511M-15a | 234, 240 |
| | ASTM A554-15 | 234, 240 |
| MT 347 | ASTM A511/A511M-15a | 234, 241 |
| | ASTM A554-15 | 234, 241 |
| MT 405 | ASTM A511/A511M-15a | 227, 228 |
| MT 410 | ASTM A511/A511M-15a | 227, 229 |
| MT 430 | ASTM A511/A511M-15a | 227, 230 |
| | ASTM A554-15 | 227, 230 |
| MT 1010 | ASTM A512-06 (2012) | 198, 205, 213, 219 |
| MT 1015 | ASTM A512-06 (2012) | 199, 206, 213, 220 |
| MT 1017 | ASTM A512-06 (2012) | 206, 220 |
| MT 1020 | ASTM A512-06 (2012) | 200, 207, 214, 221 |
| MT 1025 | ASTM A512-06 (2012) | 201, 215 |
| MT 1030 | ASTM A512-06 (2012) | 205, 219 |
| NCF800HTF | JIS G 3467:2013 | 297, 314 |
| NCF800TF | JIS G 3467:2013 | 297, 314 |
| O1 | ASTM A681-08 | 626 |
| O2 | ASTM A681-08 | 626 |
| | SAE J438b MAY70 | 626 |
| P | ASTM A514/A514M-14 | 90, 95 |
| P1 | ASME SA-335/SA-335M | 268, 269 |
| | ASTM A335/A335M-15 | 268, 269 |
| P2 | ASME SA-335/SA-335M | 271, 272 |
| | ASTM A335/A335M-15 | 271, 272 |
| P5 | ASME SA-335/SA-335M | 280, 281 |
| | ASTM A335/A335M-15 | 280, 281 |
| P9 | ASME SA-335/SA-335M | 283, 284 |
| | ASTM A335/A335M-15 | 283, 284 |
| P11 | ASME SA-335/SA-335M | 276, 277 |
| | ASTM A335/A335M-15 | 276, 277 |
| P12 | ASME SA-335/SA-335M | 274, 275 |
| | ASTM A335/A335M-15 | 274, 275 |
| P22 | ASME SA-335/SA-335M | 278, 279 |
| | ASTM A335/A335M-15 | 278, 279 |
| P28 | ISO 9327-4:1999 | 341, 344 |
| P35 | ISO 9327-4:1999 | 343, 346 |
| P42 | ISO 9327-4:1999 | 359, 360 |
| P91 | ASME SA-335/SA-335M | 283, 285 |
| | ASTM A335/A335M-15 | 283, 285 |
| P92 | ASME SA-335/SA-335M | 283, 285 |
| | ASTM A335/A335M-15 | 283, 285 |
| P195GH | EN 10216-2:2013 | 260, 264 |
| | EN 10217-2:2002 A1:2005 | 260, 264 |
| P195TR1 | EN 10216-1:2013 | 255, 258 |
| | EN 10217-1:2002 A1:2005 | 255, 258 |
| P195TR2 | EN 10216-1:2013 | 255, 258 |
| | EN 10217-1:2002 A1:2005 | 255, 258 |
| P215NL | EN 10216-4:2013 | 246, 249 |
| | EN 10217-4:2002 A1:2005 | 246, 249 |
| | EN 10217-6:2002 A1:2005 | 246, 249 |
| P235GH | EN 10028-2:2009 | 112, 120 |
| | EN 10216-2:2013 | 261, 264 |
| | EN 10217-2:2002 A1:2005 | 261, 264 |
| | EN 10217-5:2002 A1:2005 | 261, 264 |
| | ISO 9328-2:2004 | 112, 120 |
| P235TR1 | EN 10216-1:2013 | 256, 258 |
| | EN 10217-1:2002 A1:2005 | 256, 258 |
| P235TR2 | EN 10216-1:2013 | 256, 258 |
| | EN 10217-1:2002 A1:2005 | 256, 258 |
| P245GH | EN 10222-2:1999 | 342, 345 |

| Designation | Specification | Page Number |
|---|---|---|
| P245NB | EN 10120:2008 | 112, 120 |
| P255QL | EN 10216-4:2013 | 246, 249 |
| P265GH | EN 10028-2:2009 | 113, 121 |
| | EN 10216-2:2013 | 262, 265 |
| | EN 10217-2:2002 A1:2005 | 262, 265 |
| | EN 10217-5:2002 A1:2005 | 262, 265 |
| | ISO 9328-2:2004 | 113, 121 |
| P265NB | EN 10120:2008 | 113, 121 |
| P265NL | EN 10216-4:2013 | 248, 250 |
| | EN 10217-4:2002 A1:2005 | 248, 250 |
| | EN 10217-6:2002 A1:2005 | 248, 250 |
| P265TR1 | EN 10216-1:2013 | 256, 259 |
| | EN 10217-1:2002 A1:2005 | 256, 259 |
| P265TR2 | EN 10216-1:2013 | 256, 259 |
| | EN 10217-1:2002 A1:2005 | 256, 259 |
| P275NH | EN 10028-3:2009 | 112, 120 |
| P275NL1 | EN 10028-3:2009 | 128, 131 |
| P275NL2 | EN 10028-3:2009 | 128, 131 |
| | EN 10216-3:2013 | 247, 249 |
| P280GH | EN 10222-2:1999 | 342, 345 |
| P285NH | EN 10222-4:1998 A1:2001 | 341, 344 |
| P285QH | EN 10222-4:1998 A1:2001 | 341, 344 |
| P295GH | EN 10028-2:2009 | 115, 124 |
| P305GH | EN 10222-2:1999 | 343, 346 |
| P310NB | EN 10120:2008 | 115, 124 |
| P355GH | EN 10028-2:2009 | 117, 126 |
| P355N | EN 10028-3:2009 | 116, 125 |
| P355NB | EN 10120:2008 | 117, 126 |
| P355NH | EN 10028-3:2009 | 116, 125 |
| | EN 10222-4:1998 A1:2001 | 343, 346 |
| P355NL1 | EN 10028-3:2009 | 129, 132 |
| P355NL2 | EN 10028-3:2009 | 129, 132 |
| P355QH | EN 10222-4:1998 A1:2001 | 342, 345 |
| P420NH | EN 10222-4:1998 A1:2001 | 359, 360 |
| P420QH | EN 10222-4:1998 A1:2001 | 359, 360 |
| P911 | ASME SA-335/SA-335M | 273 |
| | ASTM A335/A335M-15 | 273 |
| PH 26 | ISO 9327-2:1999 | 334, 339 |
| PH 28 | ISO 9327-4:1999 | 341, 344 |
| PH 29 | ISO 9327-2:1999 | 335, 339 |
| PH 31 | ISO 9327-2:1999 | 335, 339 |
| PH 35 | ISO 9327-4:1999 | 343, 346 |
| PH 42 | ISO 9327-4:1999 | 359, 360 |
| PL 21 | ISO 9329-3:1997 | 246, 249 |
| | ISO 9330-3:1997 | 246, 249 |
| | ISO 9330-5:2000 | 246, 249 |
| PL 23 | ISO 9329-3:1997 | 248, 250 |
| | ISO 9330-3:1997 | 248, 250 |
| | ISO 9330-5:2000 | 248, 250 |
| PL 25 | ISO 9329-3:1997 | 246, 249 |
| | ISO 9330-3:1997 | 246, 249 |
| | ISO 9330-5:2000 | 246, 249 |
| PL 28 | ISO 9327-4:1999 | 341, 344 |
| PL 35 | ISO 9327-4:1999 | 343, 346 |
| PL 42 | ISO 9327-4:1999 | 359, 360 |
| PLH 35 | ISO 9327-4:1999 | 344, 346 |
| PLH 42 | ISO 9327-4:1999 | 359, 360 |
| Q | ASTM A514/A514M-14 | 90, 95 |
| Q195 | GB 700-88 | 51, 66 |
| | GB/T 3524-92 | 51, 66 |
| Q215A | GB 700-88 | 52, 66 |
| | GB/T 3524-92 | 52, 66 |
| Q215B | GB 700-88 | 52, 66 |
| | GB/T 3524-92 | 52, 66 |
| Q235 | GB/T 17107-1997 | 333, 339 |
| Q235A | GB 700-88 | 55, 67 |
| | GB/T 3524-92 | 55, 67 |
| Q235B | GB 700-88 | 55, 67 |
| | GB/T 3524-92 | 55, 67 |
| Q235C | GB 700-88 | 55, 67 |
| Q235D | GB 700-88 | 55, 67 |
| Q245NHYJ | GB/T 18982-2003 | 98, 103 |
| Q255A | GB 700-88 | 58, 69 |
| | GB/T 3524-92 | 58, 69 |
| Q255B | GB 700-88 | 58, 69 |
| | GB/T 3524-92 | 58, 69 |
| Q275 | GB 700-88 | 60, 70 |
| | GB/T 3524-92 | 60, 70 |
| Q295A | GB/T 1591-94 | 74, 80 |
| Q295B | GB/T 1591-94 | 74, 80 |
| Q295GNHJ | GB/T 18982-2003 | 97, 103 |
| Q310GNHJ | GB/T 18982-2003 | 98, 103 |
| Q310GNHLJ | GB/T 18982-2003 | 98, 103 |
| Q325NHYJ | GB/T 18982-2003 | 99, 104 |
| Q345A | GB/T 1591-94 | 76, 81 |
| Q345B | GB/T 1591-94 | 76, 81 |

| Designation | Specification | Page Number |
|---|---|---|
| Q345C | GB/T 1591-94 | 76, 81 |
| Q345D | GB/T 1591-94 | 76, 81 |
| Q345E | GB/T 1591-94 | 76, 81 |
| Q345GNHJ | GB/T 18982-2003 | 99, 104 |
| Q345GNHLJ | GB/T 18982-2003 | 99, 104 |
| Q390A | GB/T 1591-94 | 86, 92 |
| Q390B | GB/T 1591-94 | 86, 92 |
| Q390C | GB/T 1591-94 | 86, 92 |
| Q390D | GB/T 1591-94 | 86, 92 |
| Q390E | GB/T 1591-94 | 86, 92 |
| Q420A | GB/T 1591-94 | 78, 83 |
| Q420B | GB/T 1591-94 | 78, 83 |
| Q420C | GB/T 1591-94 | 78, 83 |
| | GB/T 16270-1996 | 79, 83 |
| Q420D | GB/T 1591-94 | 79, 83 |
| | GB/T 16270-1996 | 79, 83 |
| Q420E | GB/T 1591-94 | 79, 83 |
| | GB/T 16270-1996 | 79, 83 |
| Q460C | GB/T 1591-94 | 87, 93 |
| | GB/T 16270-1996 | 87, 93 |
| Q460D | GB/T 1591-94 | 87, 93 |
| | GB/T 16270-1996 | 87, 93 |
| Q460E | GB/T 1591-94 | 87, 93 |
| | GB/T 16270-1996 | 87, 93 |
| Q500D | GB/T 16270-1996 | 89, 94 |
| Q500E | GB/T 16270-1996 | 89, 94 |
| Q550D | GB/T 16270-1996 | 90, 95 |
| Q550E | GB/T 16270-1996 | 90, 95 |
| Q620D | GB/T 16270-1996 | 90, 95 |
| Q620E | GB/T 16270-1996 | 90, 95 |
| Q690D | GB/T 16270-1996 | 91, 96 |
| Q690E | GB/T 16270-1996 | 91, 96 |
| R28 | ISO 3304:1985 | 198, 201, 202, 213, 215, 217 |
| | ISO 3305:1985 | 198, 201, 202, 213, 215, 217 |
| | ISO 3306:1985 | 198, 199, 213, 214 |
| R33 | ISO 3304:1985 | 199, 201, 204, 214, 215, 218 |
| | ISO 3305:1985 | 199, 201, 204, 214, 215, 218 |
| | ISO 3306:1985 | 199, 200, 214 |
| R37 | ISO 3304:1985 | 200, 201, 202, 205, 214, 215, 217, 219 |
| | ISO 3305:1985 | 200, 201, 202, 205, 214, 215, 217, 219 |
| R37 (continued) | ISO 3306:1985 | 200, 201, 202, 214, 215, 217 |
| R44 | ISO 3304:1985 | 202, 204, 205, 208, 217, 219, 221 |
| | ISO 3305:1985 | 202, 204, 205, 208, 217, 219, 221 |
| | ISO 3306:1985 | 202, 204, 205, 217 |
| R50 | ISO 3304:1985 | 206, 207, 209, 210, 220, 222, 223 |
| | ISO 3305:1985 | 206, 207, 209, 210, 220, 222, 223 |
| | ISO 3306:1985 | 206, 207, 208, 220, 222 |
| S | ASTM A514/A514M-14 | 90, 95 |
| S A | ASTM A53/A53M-12 | 255, 258 |
| S B | ASTM A53/A53M-12 | 257, 259 |
| S09CK | JIS G 4051:2009 | 21 |
| S1 | ASTM A681-08 | 627 |
| S5 | ASTM A681-08 | 627 |
| | SAE J438b MAY70 | 627 |
| S7 | ASTM A681-08 | 627 |
| S10C | JIS G 4051:2009 | 21 |
| S12C | JIS G 4051:2009 | 22 |
| S15C | JIS G 4051:2009 | 22 |
| S15CK | JIS G 4051:2009 | 22 |
| S17C | JIS G 4051:2009 | 23 |
| S20C | JIS G 4051:2009 | 24 |
| S20CK | JIS G 4051:2009 | 24 |
| S22C | JIS G 4051:2009 | 24 |
| S25C | JIS G 4051:2009 | 24 |
| S28C | JIS G 4051:2009 | 25 |
| S30C | JIS G 4051:2009 | 25 |
| S33C | JIS G 4051:2009 | 25 |
| S35C | JIS G 4051:2009 | 26 |
| S38C | JIS G 4051:2009 | 26 |
| S40C | JIS G 4051:2009 | 27 |
| S43C | JIS G 4051:2009 | 27 |
| S45C | JIS G 4051:2009 | 28 |
| S48C | JIS G 4051:2009 | 28 |
| S50C | JIS G 4051:2009 | 29 |
| S50C-CSP | JIS G 4802:2011 | 616 |
| S53C | JIS G 4051:2009 | 29 |
| S55C | JIS G 4051:2009 | 30 |
| S55C-CSP | JIS G 4802:2011 | 616 |
| S58C | JIS G 4051:2009 | 31 |

| Designation | Specification | Page Number |
|---|---|---|
| S60C-CSP | JIS G 4802:2011 | 616 |
| S65C-CSP | JIS G 4802:2011 | 617 |
| S70C-CSP | JIS G 4802:2011 | 617 |
| S175 I - PSL1 | GB/T 14164-2005 | 321, 324 |
| S175 II - PSL1 | GB/T 14164-2005 | 321, 324 |
| S185 | EN 10025-2:2004 | 51, 66 |
| S210 - PSL1 | GB/T 14164-2005 | 316, 318 |
| S235J0 | EN 10025-2:2004 | 54, 67 |
| S235J2G3 | EN 10250-2:1999 C1:2000 | 333, 339 |
| S235JR | EN 10025-2:2004 | 54, 67 |
| S235JRG2 | EN 10250-2:1999 C1:2000 | 333, 339 |
| S235W, Quality B | ISO 4952:2006 | 97, 103 |
| S235W, Quality C | ISO 4952:2006 | 97, 103 |
| S235W, Quality D | ISO 4952:2006 | 97, 103 |
| S245 - PSL1 | GB/T 14164-2005 | 316, 318 |
| S245 - PSL2 | GB/T 14164-2005 | 321, 324 |
| S275J0 | EN 10025-2:2004 | 59, 69 |
| S275JR | EN 10025-2:2004 | 59, 69 |
| S290 - PSL1 | GB/T 14164-2005 | 316, 318 |
| S290 - PSL2 | GB/T 14164-2005 | 321, 325 |
| S320 - PSL1 | GB/T 14164-2005 | 316, 319 |
| S320 - PSL2 | GB/T 14164-2005 | 322, 325 |
| S355J0 | EN 10025-2:2004 | 63, 72 |
| S355JR | EN 10025-2:2004 | 63, 72 |
| S355W, Quality B | ISO 4952:2006 | 104 |
| S355W, Quality C | ISO 4952:2006 | 104 |
| S355W, Quality D | ISO 4952:2006 | 104 |
| S355W, Quality B | ISO 4952:2006 | 99 |
| S355W, Quality C | ISO 4952:2006 | 99 |
| S355W, Quality D | ISO 4952:2006 | 99 |
| S355WP, Quality A | ISO 4952:2006 | 104 |
| S355WP, Quality D | ISO 4952:2006 | 104 |
| S355WP, Quality A | ISO 4952:2006 | 99 |
| S355WP, Quality D | ISO 4952:2006 | 99 |
| S360 - PSL1 | GB/T 14164-2005 | 316, 319 |
| S360 - PSL2 | GB/T 14164-2005 | 322, 326 |
| S390 - PSL1 | GB/T 14164-2005 | 317, 319 |
| S390 - PSL2 | GB/T 14164-2005 | 322, 326 |
| S415 - PSL1 | GB/T 14164-2005 | 317, 319 |
| S415 - PSL2 | GB/T 14164-2005 | 323, 327 |
| S450 - PSL1 | GB/T 14164-2005 | 317, 320 |
| S450 - PSL2 | GB/T 14164-2005 | 323, 327 |
| S485 - PSL1 | GB/T 14164-2005 | 317, 320 |
| S485 - PSL2 | GB/T 14164-2005 | 323, 327 |
| S555 - PSL2 | GB/T 14164-2005 | 323, 327 |
| SACM645 | JIS G 4053:2008 | 43 |
| SB410 | JIS G 3103:2012 | 113, 121 |
| SB450 | JIS G 3103:2012 | 114, 123 |
| SB450M | JIS G 3103:2012 | 135, 138 |
| SB480 | JIS G 3103:2012 | 115, 124 |
| SB480M | JIS G 3103:2012 | 135, 138 |
| SBV1A | JIS G 3119:2013 | 136, 139 |
| SBV1B | JIS G 3119:2013 | 137, 139 |
| SBV2 | JIS G 3119:2013 | 155, 156 |
| SBV3 | JIS G 3119:2013 | 157, 158 |
| SC 360 | JIS G 5101:1991 | 389, 392 |
| SC 410 | JIS G 5101:1991 | 389, 393 |
| SC 450 | JIS G 5101:1991 | 389, 393 |
| SC 480 | JIS G 5101:1991 | 390, 393 |
| SC 1020, Class 65/35 | ASTM A958/A958M-14 | 389, 393 |
| SC 1020, Class 70/36 | ASTM A958/A958M-14 | 390, 393 |
| SC 1025, Class 65/35 | ASTM A958/A958M-14 | 389, 393 |
| SC 1025, Class 70/36 | ASTM A958/A958M-14 | 390, 393 |
| SC 1030, Class 65/35 | ASTM A958/A958M-14 | 389, 393 |
| SC 1030, Class 70/36 | ASTM A958/A958M-14 | 390, 393 |
| SC 1030, Class 80/40 | ASTM A958/A958M-14 | 390, 394 |
| SC 1030, Class 80/50 | ASTM A958/A958M-14 | 390, 394 |
| SC 1040, Class 70/36 | ASTM A958/A958M-14 | 390, 393 |
| SC 1040, Class 80/40 | ASTM A958/A958M-14 | 390, 394 |
| SC 1040, Class 80/50 | ASTM A958/A958M-14 | 390, 394 |
| SC 1040, Class 90/60 | ASTM A958/A958M-14 | 391, 394 |
| SC 1045, Class 105/85 | ASTM A958/A958M-14 | 392, 395 |
| SC 1045, Class 80/40 | ASTM A958/A958M-14 | 390, 394 |
| SC 1045, Class 80/50 | ASTM A958/A958M-14 | 390, 394 |
| SC 1045, Class 90/60 | ASTM A958/A958M-14 | 391, 394 |
| SC 4130, Class 105/85 | ASTM A958/A958M-14 | 402, 404 |
| SC 4130, Class 115/95 | ASTM A958/A958M-14 | 402, 404 |
| SC 4130, Class 130/115 | ASTM A958/A958M-14 | 402, 404 |
| SC 4130, Class 135/125 | ASTM A958/A958M-14 | 402, 404 |
| SC 4130, Class 150/135 | ASTM A958/A958M-14 | 402, 404 |
| SC 4130, Class 65/35 | ASTM A958/A958M-14 | 402, 404 |
| SC 4130, Class 70/36 | ASTM A958/A958M-14 | 402, 404 |
| SC 4130, Class 80/40 | ASTM A958/A958M-14 | 402, 404 |
| SC 4130, Class 80/50 | ASTM A958/A958M-14 | 402, 404 |
| SC 4130, Class 90/60 | ASTM A958/A958M-14 | 402, 404 |

| Designation | Specification | Page Number |
|---|---|---|
| SC 4140, Class 105/85 | ASTM A958/A958M-14 | 402, 404 |
| SC 4140, Class 115/95 | ASTM A958/A958M-14 | 402, 404 |
| SC 4140, Class 130/115 | ASTM A958/A958M-14 | 402, 404 |
| SC 4140, Class 135/125 | ASTM A958/A958M-14 | 402, 404 |
| SC 4140, Class 150/135 | ASTM A958/A958M-14 | 402, 404 |
| SC 4140, Class 160/145 | ASTM A958/A958M-14 | 402, 404 |
| SC 4140, Class 165/150 | ASTM A958/A958M-14 | 402, 404 |
| SC 4140, Class 65/35 | ASTM A958/A958M-14 | 402, 404 |
| SC 4140, Class 70/36 | ASTM A958/A958M-14 | 402, 404 |
| SC 4140, Class 80/40 | ASTM A958/A958M-14 | 402, 404 |
| SC 4140, Class 80/50 | ASTM A958/A958M-14 | 402, 404 |
| SC 4140, Class 90/60 | ASTM A958/A958M-14 | 402, 404 |
| SC 4330, Class 105/85 | ASTM A958/A958M-14 | 403, 405 |
| SC 4330, Class 115/95 | ASTM A958/A958M-14 | 403, 405 |
| SC 4330, Class 130/115 | ASTM A958/A958M-14 | 403, 405 |
| SC 4330, Class 135/125 | ASTM A958/A958M-14 | 403, 405 |
| SC 4330, Class 150/135 | ASTM A958/A958M-14 | 403, 405 |
| SC 4330, Class 160/145 | ASTM A958/A958M-14 | 403, 405 |
| SC 4330, Class 165/150 | ASTM A958/A958M-14 | 403, 405 |
| SC 4330, Class 210/180 | ASTM A958/A958M-14 | 403, 405 |
| SC 4330, Class 65/35 | ASTM A958/A958M-14 | 403, 405 |
| SC 4330, Class 70/36 | ASTM A958/A958M-14 | 403, 405 |
| SC 4330, Class 80/40 | ASTM A958/A958M-14 | 403, 405 |
| SC 4330, Class 80/50 | ASTM A958/A958M-14 | 403, 405 |
| SC 4330, Class 90/60 | ASTM A958/A958M-14 | 403, 405 |
| SCC 3A | JIS G 5111:1991 | 390, 394 |
| SCC 3B | JIS G 5111:1991 | 391, 394 |
| SCC 5A | JIS G 5111:1991 | 391, 394 |
| SCC 5B | JIS G 5111:1991 | 391, 395 |
| SCCrM 1A | JIS G 5111:1991 | 402, 403 |
| SCCrM 3A | JIS G 5111:1991 | 402, 404 |
| SCH 1 | JIS G 5122:2003 | 426, 430 |
| SCH 2 | JIS G 5122:2003 | 426, 430 |
| SCH 3 | JIS G 5122:2003 | 426, 430 |
| SCH 11 | JIS G 5122:2003 | 426, 430 |
| SCH 12 | JIS G 5122:2003 | 426, 430 |
| SCH 13 | JIS G 5122:2003 | 427, 431 |
| SCH 13A | JIS G 5122:2003 | 427, 431 |
| SCH 15 | JIS G 5122:2003 | 428, 432 |
| SCH 16 | JIS G 5122:2003 | 428, 432 |
| SCH 17 | JIS G 5122:2003 | 426, 430 |
| SCH 18 | JIS G 5122:2003 | 427, 431 |
| SCH 19 | JIS G 5122:2003 | 428, 432 |
| SCH 20 | JIS G 5122:2003 | 428, 432 |
| SCH 21 | JIS G 5122:2003 | 427, 431 |
| SCH 22 | JIS G 5122:2003 | 427, 431 |
| SCH 23 | JIS G 5122:2003 | 427, 431 |
| SCH 24 | JIS G 5122:2003 | 428, 432 |
| SCM418 | JIS G 4053:2008 | 39 |
| SCM418TK | JIS G 3441:2012 | 224, 225 |
| SCM420 | JIS G 4053:2008 | 39 |
| SCM420TK | JIS G 3441:2012 | 224, 225 |
| SCM421 | JIS G 4053:2008 | 39 |
| SCM425 | JIS G 4053:2008 | 40 |
| SCM430 | JIS G 4053:2008 | 40 |
| SCM430TK | JIS G 3441:2012 | 224, 225 |
| SCM432 | JIS G 4053:2008 | 40 |
| SCM435 | JIS G 4053:2008 | 40 |
| SCM435TK | JIS G 3441:2012 | 224, 226 |
| SCM440 | JIS G 4053:2008 | 41 |
| SCM440TK | JIS G 3441:2012 | 224, 226 |
| SCM445 | JIS G 4053:2008 | 41 |
| SCM822 | JIS G 4053:2008 | 39 |
| SCMn 1A | JIS G 5111:1991 | 390, 394 |
| SCMn 1B | JIS G 5111:1991 | 391, 394 |
| SCMn 2A | JIS G 5111:1991 | 391, 394 |
| SCMn 2B | JIS G 5111:1991 | 391, 394 |
| SCMn 3A | JIS G 5111:1991 | 391, 394 |
| SCMn 3B | JIS G 5111:1991 | 391, 395 |
| SCMn 5A | JIS G 5111:1991 | 391, 395 |
| SCMn 5B | JIS G 5111:1991 | 392, 395 |
| SCMnH 1 | JIS G 5131:2008 | 400, 401 |
| SCMnH 2 | JIS G 5131:2008 | 400, 401 |
| SCMnH 3 | JIS G 5131:2008 | 400, 401 |
| SCMnH 11 | JIS G 5131:2008 | 400, 401 |
| SCMQ4E | JIS G 4110:2008 | 143 |
| SCMV1-1 | JIS G 4109:2013 | 140 |
| SCMV1-2 | JIS G 4109:2013 | 140 |
| SCMV2-1 | JIS G 4109:2013 | 141 |
| SCMV2-2 | JIS G 4109:2013 | 141 |
| SCMV3-1 | JIS G 4109:2013 | 142 |
| SCMV3-2 | JIS G 4109:2013 | 142 |

| Designation | Specification | Page Number |
|---|---|---|
| SCMV4-1 | JIS G 4109:2013 | 143 |
| SCMV4-2 | JIS G 4109:2013 | 143 |
| SCMV5-1 | JIS G 4109:2013 | 144 |
| SCMV5-2 | JIS G 4109:2013 | 144 |
| SCMV6-1 | JIS G 4109:2013 | 145 |
| SCMV6-2 | JIS G 4109:2013 | 145 |
| SCNCrM 2A | JIS G 5111:1991 | 403, 405 |
| SCPH 1 | JIS G 5151:1991 | 396, 397 |
| SCPH 2 | JIS G 5151:1991 | 396, 397 |
| SCPH 11 | JIS G 5151:1991 | 406, 407 |
| SCPH 21 | JIS G 5151:1991 | 406, 408 |
| SCPH 23 | JIS G 5151:1991 | 406, 408 |
| SCPH 32 | JIS G 5151:1991 | 407, 408 |
| SCPH 61 | JIS G 5151:1991 | 407, 408 |
| SCPL 1 | JIS G 5152:1991 | 398, 399 |
| SCPL 11 | JIS G 5152:1991 | 409, 411 |
| SCPL 21 | JIS G 5152:1991 | 409, 411 |
| SCPL 31 | JIS G 5152:1991 | 409, 411 |
| SCr415 | JIS G 4053:2008 | 36 |
| SCr420 | JIS G 4053:2008 | 36 |
| SCr430 | JIS G 4053:2008 | 36 |
| SCr435 | JIS G 4053:2008 | 37 |
| SCr440 | JIS G 4053:2008 | 37 |
| SCr445 | JIS G 4053:2008 | 38 |
| SCS 1 | JIS G 5121:2003 | 413, 414 |
| SCS 2 | JIS G 5121:2003 | 413, 414 |
| SCS 2A | JIS G 5121:2003 | 413, 414 |
| SCS 3 | JIS G 5121:2003 | 413, 414 |
| SCS 5 | JIS G 5121:2003 | 413, 414 |
| SCS 6 | JIS G 5121:2003 | 413, 414 |
| SCS 10 | JIS G 5121:2003 | 416, 418 |
| SCS 12 | JIS G 5121:2003 | 415, 417 |
| SCS 13 | JIS G 5121:2003 | 415, 417 |
| SCS 13A | JIS G 5121:2003 | 415, 417 |
| SCS 14 | JIS G 5121:2003 | 415, 417 |
| SCS 14A | JIS G 5121:2003 | 415, 417 |
| SCS 16A | JIS G 5121:2003 | 415, 417 |
| SCS 17 | JIS G 5121:2003 | 416, 418 |
| SCS 19 | JIS G 5121:2003 | 415, 417 |
| SCS 19A | JIS G 5121:2003 | 415, 417 |
| SCS 21 | JIS G 5121:2003 | 415, 417 |
| SCS 22 | JIS G 5121:2003 | 415, 417 |
| SCS 23 | JIS G 5121:2003 | 416, 418 |
| SCS 32 | JIS G 5121:2003 | 416, 418 |
| SCS 33 | JIS G 5121:2003 | 416, 418 |
| SCSiMn 2A | JIS G 5111:1991 | 391, 394 |
| SCSiMn 2B | JIS G 5111:1991 | 391, 394 |
| SCW 410 | JIS G 5102:1991 | 389, 393 |
| SCW 450 | JIS G 5102:1991 | 389, 393 |
| SCW 480 | JIS G 5102:1991 | 390, 393 |
| SCW 550 | JIS G 5102:1991 | 390, 394 |
| SCW 620 | JIS G 5102:1991 | 391, 394 |
| SEV245 | JIS G 3124:2009 | 117, 126 |
| SEV295 | JIS G 3124:2009 | 136, 139 |
| SEV345 | JIS G 3124:2009 | 137, 139 |
| SF 340 A | JIS G 3201:1988 A1:2008 | 333, 339 |
| SF 390 A | JIS G 3201:1988 A1:2008 | 333, 339 |
| SF 440 A | JIS G 3201:1988 A1:2008 | 334, 339 |
| SF 490 A | JIS G 3201:1988 A1:2008 | 335, 339 |
| SF 540 A | JIS G 3201:1988 A1:2008 | 336, 339 |
| SF 540 B | JIS G 3201:1988 A1:2008 | 336, 339 |
| SF 590 A | JIS G 3201:1988 A1:2008 | 337, 339 |
| SF 590 B | JIS G 3201:1988 A1:2008 | 337, 339 |
| SF 640 B | JIS G 3201:1988 A1:2008 | 338, 340 |
| SFCM 690 S | JIS G 3221:1988 A1:2008 | 347 |
| SFCM 740 S | JIS G 3221:1988 A1:2008 | 347 |
| SFCM 780 S | JIS G 3221:1988 A1:2008 | 347 |
| SFL 1 | JIS G 3205:1988 A1:2008 | 342, 345 |
| SFL 2 | JIS G 3205:1988 A1:2008 | 343, 346 |
| SFL 3 | JIS G 3205:1988 A1:2008 | 357, 358 |
| SFVA F 1 | JIS G 3203:1988 A1:2008 | 348 |
| SFVA F 2 | JIS G 3203:1988 A1:2008 | 349 |
| SFVA F 5 A | JIS G 3203:1988 A1:2008 | 355, 356 |
| SFVA F 5 B | JIS G 3203:1988 A1:2008 | 355, 356 |
| SFVA F 5 C | JIS G 3203:1988 A1:2008 | 355, 356 |
| SFVA F 5 D | JIS G 3203:1988 A1:2008 | 355, 356 |
| SFVA F 9 | JIS G 3203:1988 A1:2008 | 356 |
| SFVA F 11 A | JIS G 3203:1988 A1:2008 | 351 |
| SFVA F 11 B | JIS G 3203:1988 A1:2008 | 351 |
| SFVA F 12 | JIS G 3203:1988 A1:2008 | 350 |
| SFVA F 21 A | JIS G 3203:1988 A1:2008 | 354 |
| SFVA F 21 B | JIS G 3203:1988 A1:2008 | 354 |
| SFVA F 22 A | JIS G 3203:1988 A1:2008 | 352, 353 |
| SFVA F 22 B | JIS G 3203:1988 A1:2008 | 352, 353 |
| SFVC 1 | JIS G 3202:1988 A1:2008 | 342, 345 |
| SFVC 2 A | JIS G 3202:1988 A1:2008 | 343, 346 |

| Designation | Specification | Page Number |
|---|---|---|
| SFVC 2 B | JIS G 3202:1988 A1:2008 | 343, 346 |
| SFVCM F22B | JIS G 3206:1993 A1:2008 | 352, 353 |
| SFVCM F22V | JIS G 3206:1993 A1:2008 | 352, 353 |
| SFVCM F3V | JIS G 3206:1993 A1:2008 | 354, 355 |
| SFVQ 1 A | JIS G 3204:1988 A1:2008 | 362 |
| SFVQ 1 B | JIS G 3204:1988 A1:2008 | 362 |
| SFVQ 2 A | JIS G 3204:1988 A1:2008 | 361 |
| SFVQ 2 B | JIS G 3204:1988 A1:2008 | 361 |
| SFVQ 3 | JIS G 3204:1988 A1:2008 | 363 |
| SG255 | JIS G 3116:2013 | 112, 120 |
| SG295 | JIS G 3116:2013 | 114, 122 |
| SG325 | JIS G 3116:2013 | 116, 125 |
| SG365 | JIS G 3116:2013 | 118, 126 |
| SGP | JIS G 3452:2014 | 198, 213 |
| SGV410 | JIS G 3118:2010 | 114, 121 |
| SGV450 | JIS G 3118:2010 | 114, 123 |
| SGV480 | JIS G 3118:2010 | 115, 124 |
| SHY685 | JIS G 3128:2009 | 91, 96 |
| SHY685N | JIS G 3128:2009 | 91, 96 |
| SHY685NS | JIS G 3128:2009 | 91, 96 |
| SK105 | JIS G 4401:2009 | 622 |
| SK120 | JIS G 4401:2009 | 622 |
| SK65 | JIS G 4401:2009 | 622 |
| SK75 | JIS G 4401:2009 | 622 |
| SK85 | JIS G 4401:2009 | 622 |
| SK85-CSP | JIS G 4802:2011 | 617 |
| SK95 | JIS G 4401:2009 | 622 |
| SK95-CSP | JIS G 4802:2011 | 618 |
| SKD 1 | JIS G 4404:2006 | 625 |
| SKD 5 | JIS G 4404:2006 | 627 |
| SKD 6 | JIS G 4404:2006 | 626 |
| SKD 7 | JIS G 4404:2006 | 626 |
| SKD 8 | JIS G 4404:2006 | 627 |
| SKD 11 | JIS G 4404:2006 | 625 |
| SKD 12 | JIS G 4404:2006 | 625 |
| SKD 61 | JIS G 4404:2006 | 626 |
| SKD 62 | JIS G 4404:2006 | 626 |
| SKH2 | JIS G 4403:2006 | 623 |
| SKH3 | JIS G 4403:2006 | 623 |
| SKH4 | JIS G 4403:2006 | 623 |
| SKH10 | JIS G 4403:2006 | 623 |
| SKH50 | JIS G 4403:2006 | 623 |
| SKH51 | JIS G 4403:2006 | 624 |
| SKH52 | JIS G 4403:2006 | 624 |
| SKH53 | JIS G 4403:2006 | 624 |
| SKH54 | JIS G 4403:2006 | 624 |
| SKH55 | JIS G 4403:2006 | 625 |
| SKH56 | JIS G 4403:2006 | 624 |
| SKH57 | JIS G 4403:2006 | 625 |
| SKH58 | JIS G 4403:2006 | 624 |
| SKH59 | JIS G 4403:2006 | 625 |
| SKS 3 | JIS G 4404:2006 | 626 |
| SKS 11 | JIS G 4404:2006 | 627 |
| SKS 31 | JIS G 4404:2006 | 626 |
| SKS 43 | JIS G 4404:2006 | 622 |
| SKS 44 | JIS G 4404:2006 | 622 |
| SKS 51 | JIS G 4404:2006 | 627 |
| SKT 4 | JIS G 4404:2006 | 627 |
| SL2N255 | JIS G 3127:2013 | 149, 150 |
| SL3N255 | JIS G 3127:2013 | 151, 152 |
| SL3N275 | JIS G 3127:2013 | 151, 152 |
| SL3N440 | JIS G 3127:2013 | 151, 152 |
| SL5N590 | JIS G 3127:2013 | 153 |
| SL9N520 | JIS G 3127:2013 | 153, 154 |
| SL9N590 | JIS G 3127:2013 | 153, 154 |
| SLA235A | JIS G 3126:2009 | 128, 131 |
| SLA235B | JIS G 3126:2009 | 128, 131 |
| SLA325A | JIS G 3126:2009 | 128, 131 |
| SLA325B | JIS G 3126:2009 | 128, 131 |
| SLA365 | JIS G 3126:2009 | 129, 132 |
| SLA410 | JIS G 3126:2009 | 130, 133 |
| SM-27 | SAE J405 JUN98 | 448 |
| SM400A | JIS G 3106:2008 | 56, 68 |
| SM400B | JIS G 3106:2008 | 56, 68 |
| SM400C | JIS G 3106:2008 | 56, 68 |
| SM490A | JIS G 3106:2008 | 61, 70 |
| SM490B | JIS G 3106:2008 | 61, 70 |
| SM490C | JIS G 3106:2008 | 61, 70 |
| SM490YA | JIS G 3106:2008 | 62, 71 |
| SM490YB | JIS G 3106:2008 | 62, 71 |
| SM520B | JIS G 3106:2008 | 63, 72 |
| SM520C | JIS G 3106:2008 | 63, 72 |
| SM570 | JIS G 3106:2008 | 64, 73 |
| SMA400AP | JIS G 3114:2008 | 98, 103 |
| SMA400AW | JIS G 3114:2008 | 98, 103 |
| SMA400BP | JIS G 3114:2008 | 98, 103 |

| Designation | Specification | Page Number |
|---|---|---|
| SMA400BW | JIS G 3114:2008 | 98, 103 |
| SMA400CP | JIS G 3114:2008 | 98, 103 |
| SMA400CW | JIS G 3114:2008 | 98, 103 |
| SMA490AP | JIS G 3114:2008 | 100, 105 |
| SMA490AW | JIS G 3114:2008 | 100, 105 |
| SMA490BP | JIS G 3114:2008 | 100, 105 |
| SMA490BW | JIS G 3114:2008 | 100, 105 |
| SMA490CP | JIS G 3114:2008 | 100, 105 |
| SMA490CW | JIS G 3114:2008 | 100, 105 |
| SMA570P | JIS G 3114:2008 | 102, 106 |
| SMA570W | JIS G 3114:2008 | 102, 106 |
| SMn420 | JIS G 4053:2008 | 34 |
| SMn433 | JIS G 4053:2008 | 34 |
| SMn438 | JIS G 4053:2008 | 35 |
| SMn443 | JIS G 4053:2008 | 35 |
| SMnC420 | JIS G 4053:2008 | 34 |
| SN400A | JIS G 3136:2012 | 56, 68 |
| SN400B | JIS G 3136:2012 | 56, 68 |
| SN400C | JIS G 3136:2012 | 56, 68 |
| SN490B | JIS G 3136:2012 | 61, 70 |
| SN490C | JIS G 3136:2012 | 60, 70 |
| SNC631 | JIS G 4053:2008 | 41 |
| SNC815 | JIS G 4053:2008 | 41 |
| SNCM220 | JIS G 4053:2008 | 42 |
| SNCM240 | JIS G 4053:2008 | 43 |
| SNCM415 | JIS G 4053:2008 | 42 |
| SNCM420 | JIS G 4053:2008 | 42 |
| SNCM439 | JIS G 4053:2008 | 42 |
| SPA-C | JIS G 3125:2010 | 99, 104 |
| SPA-H | JIS G 3125:2010 | 100, 105 |
| SPV235 | JIS G 3115:2010 | 113, 120 |
| SPV315 | JIS G 3115:2010 | 116, 125 |
| SPV355 | JIS G 3115:2010 | 118, 126 |
| SPV410 | JIS G 3115:2010 | 119, 127 |
| SPV450 | JIS G 3115:2010 | 119, 127 |
| SQV1A | JIS G 3120:2014 | 137, 139 |
| SQV1B | JIS G 3120:2014 | 137, 139 |
| SQV2A | JIS G 3120:2014 | 155, 156 |
| SQV2B | JIS G 3120:2014 | 155, 156 |
| SQV3A | JIS G 3120:2014 | 157, 158 |
| SQV3B | JIS G 3120:2014 | 157, 158 |
| SS330 | JIS G 3101:2010 | 51, 66 |
| SS400 | JIS G 3101:2010 | 56, 68 |
| SS490 | JIS G 3101:2010 | 61, 70 |
| SS540 | JIS G 3101:2010 | 64, 72 |
| STAM290GA | JIS G 3472:2013 | 199, 213 |
| STAM290GB | JIS G 3472:2013 | 199, 213 |
| STAM340G | JIS G 3472:2013 | 200, 214 |
| STAM390G | JIS G 3472:2013 | 202, 216 |
| STAM440G | JIS G 3472:2013 | 205, 219 |
| STAM440H | JIS G 3472:2013 | 205, 219 |
| STAM470G | JIS G 3472:2013 | 206, 220 |
| STAM470H | JIS G 3472:2013 | 206, 220 |
| STAM500G | JIS G 3472:2013 | 208, 221 |
| STAM500H | JIS G 3472:2013 | 208, 221 |
| STAM540H | JIS G 3472:2013 | 209, 222 |
| STB340 | JIS G 3461:2012 | 260, 264 |
| STB410 | JIS G 3461:2012 | 261, 265 |
| STB510 | JIS G 3461:2012 | 263, 266 |
| STBA12 | JIS G 3462:2014 | 268, 270 |
| STBA13 | JIS G 3462:2014 | 268, 270 |
| STBA20 | JIS G 3462:2014 | 271, 272 |
| STBA22 | JIS G 3462:2014 | 274, 275 |
| STBA23 | JIS G 3462:2014 | 276, 277 |
| STBA24 | JIS G 3462:2014 | 278, 279 |
| STBA25 | JIS G 3462:2014 | 280, 282 |
| STBA26 | JIS G 3462:2014 | 283, 284 |
| STBL380 | JIS G 3464:2013 | 247, 249 |
| STBL450 | JIS G 3464:2013 | 251, 253 |
| STBL690 | JIS G 3464:2013 | 251, 254 |
| STC370 | JIS G 3473:2013 | 201, 215 |
| STC440 | JIS G 3473:2013 | 205, 219 |
| STC510A | JIS G 3473:2013 | 208, 221 |
| STC510B | JIS G 3473:2013 | 208, 221 |
| STC540 | JIS G 3473:2013 | 209, 222 |
| STC590A | JIS G 3473:2013 | 210, 223 |
| STC590B | JIS G 3473:2013 | 210, 223 |
| STF410 | JIS G 3467:2013 | 261, 265 |
| STFA12 | JIS G 3467:2013 | 268, 270 |
| STFA22 | JIS G 3467:2013 | 274, 275 |
| STFA23 | JIS G 3467:2013 | 276, 277 |
| STFA24 | JIS G 3467:2013 | 278, 279 |
| STFA25 | JIS G 3467:2013 | 280, 282 |
| STFA26 | JIS G 3467:2013 | 283, 284 |
| STK290 | JIS G 3444:2010 | 198, 213 |
| STK400 | JIS G 3444:2010 | 202, 217 |

| Designation | Specification | Page Number |
|---|---|---|
| STK490 | JIS G 3444:2010 | 207, 221 |
| STK500 | JIS G 3444:2010 | 208, 221 |
| STK540 | JIS G 3444:2010 | 209, 222 |
| STKM11A | JIS G 3445:2010 | 198, 213 |
| STKM12A | JIS G 3445:2010 | 200, 214 |
| STKM12B | JIS G 3445:2010 | 202, 216 |
| STKM12C | JIS G 3445:2010 | 206, 220 |
| STKM13A | JIS G 3445:2010 | 201, 215 |
| STKM13B | JIS G 3445:2010 | 205, 219 |
| STKM13C | JIS G 3445:2010 | 208, 221 |
| STKM14A | JIS G 3445:2010 | 204, 217 |
| STKM14B | JIS G 3445:2010 | 208, 221 |
| STKM14C | JIS G 3445:2010 | 209, 222 |
| STKM15A | JIS G 3445:2010 | 206, 220 |
| STKM15C | JIS G 3445:2010 | 209, 222 |
| STKM16A | JIS G 3445:2010 | 208, 221 |
| STKM16C | JIS G 3445:2010 | 210, 223 |
| STKM17A | JIS G 3445:2010 | 209, 222 |
| STKM17C | JIS G 3445:2010 | 211, 223 |
| STKM18A | JIS G 3445:2010 | 205, 219 |
| STKM18B | JIS G 3445:2010 | 207, 221 |
| STKM18C | JIS G 3445:2010 | 208, 221 |
| STKM19A | JIS G 3445:2010 | 207, 221 |
| STKM19C | JIS G 3445:2010 | 209, 222 |
| STKM20A | JIS G 3445:2010 | 209, 222 |
| STKT590 | JIS G 3474:2014 | 210, 223 |
| STPA12 | JIS G 3458:2013 | 268, 270 |
| STPA20 | JIS G 3458:2013 | 271, 272 |
| STPA22 | JIS G 3458:2013 | 274, 275 |
| STPA23 | JIS G 3458:2013 | 276, 277 |
| STPA24 | JIS G 3458:2013 | 278, 279 |
| STPA25 | JIS G 3458:2013 | 280, 282 |
| STPA26 | JIS G 3458:2013 | 283, 284 |
| STPG370 | JIS G 3454:2012 | 256, 258 |
| STPG410 | JIS G 3454:2012 | 257, 259 |
| STPL380 | JIS G 3460:2013 | 246, 249 |
| STPL450 | JIS G 3460:2013 | 248, 250, 251, 253 |
| STPL690 | JIS G 3460:2013 | 248, 250, 251, 254 |
| STPT370 | JIS G 3456:2014 | 261, 264 |
| STPT410 | JIS G 3456:2014 | 261, 265 |
| STPT480 | JIS G 3456:2014 | 263, 266 |
| STPY400 | JIS G 3457:2012 | 256, 259 |
| STS370 | JIS G 3455:2012 | 261, 264 |
| STS410 | JIS G 3455:2012 | 261, 265 |
| STS480 | JIS G 3455:2012 | 263, 266 |
| SUH4 | JIS G 4311:2011 | 521, 533 |
| SUH21 | JIS G 4312:2011 | 448, 456 |
| SUH35 | JIS G 4311:2011 | 549, 587 |
| SUH37 | JIS G 4311:2011 | 550, 589 |
| SUH309 | JIS G 4311:2011 | 544, 564 |
| | JIS G 4312:2011 | 462, 483 |
| SUH310 | JIS G 4311:2011 | 544, 564 |
| | JIS G 4312:2011 | 463, 485 |
| SUH330 | JIS G 4312:2011 | 468, 497 |
| SUH409 | JIS G 4312:2011 | 445, 452 |
| SUH409L | JIS G 4312:2011 | 159, 162, 445, 451 |
| SUH446 | JIS G 4311:2011 | 535, 540 |
| | JIS G 4312:2011 | 448, 456 |
| SUH600 | JIS G 4311:2011 | 521, 532 |
| SUH616 | JIS G 4311:2011 | 521, 532 |
| SUH660 | JIS G 4311:2011 | 550, 590 |
| | JIS G 4312:2011 | 471, 502 |
| SUH661 | JIS G 4312:2011 | 471, 502 |
| SUJ2 | JIS G 4805:2008 | 628 |
| SUJ3 | JIS G 4805:2008 | 628 |
| SUM 21 | JIS G 4804:2008 | 613 |
| SUM 22 | JIS G 4804:2008 | 613 |
| SUM 22 L | JIS G 4804:2008 | 614 |
| SUM 23 | JIS G 4804:2008 | 613 |
| SUM 23 L | JIS G 4804:2008 | 614 |
| SUM 24 L | JIS G 4804:2008 | 614 |
| SUM 25 | JIS G 4804:2008 | 614 |
| SUM 31 | JIS G 4804:2008 | 611 |
| SUM 32 | JIS G 4804:2008 | 611 |
| SUM 41 | JIS G 4804:2008 | 612 |
| SUM 42 | JIS G 4804:2008 | 612 |
| SUM 43 | JIS G 4804:2008 | 612 |
| SUP6 | JIS G 4801:2011 | 618 |
| SUP9 | JIS G 4801:2011 | 618 |
| SUP9A | JIS G 4801:2011 | 618 |
| SUP10 | JIS G 4801:2011 | 620 |
| SUP10-CSP | JIS G 4802:2011 | 620 |
| SUP11A | JIS G 4801:2011 | 621 |
| SUP12 | JIS G 4801:2011 | 619 |
| SUP13 | JIS G 4801:2011 | 619 |
| SUS F 6B | JIS G 3214:1991 A1:2009 | 364, 365 |

| Designation | Specification | Page Number |
|---|---|---|
| SUS F 6NM | JIS G 3214:1991 A1:2009 | 364, 365 |
| SUS F 304 | JIS G 3214:1991 A1:2009 | 367, 373 |
| SUS F 304H | JIS G 3214:1991 A1:2009 | 367, 374 |
| SUS F 304L | JIS G 3214:1991 A1:2009 | 367, 373 |
| SUS F 304LN | JIS G 3214:1991 A1:2009 | 368, 374 |
| SUS F 304N | JIS G 3214:1991 A1:2009 | 368, 374 |
| SUS F 310 | JIS G 3214:1991 A1:2009 | 368, 375 |
| SUS F 316 | JIS G 3214:1991 A1:2009 | 369, 375 |
| SUS F 316H | JIS G 3214:1991 A1:2009 | 370, 377 |
| SUS F 316L | JIS G 3214:1991 A1:2009 | 369, 376 |
| SUS F 316LN | JIS G 3214:1991 A1:2009 | 370, 376 |
| SUS F 316N | JIS G 3214:1991 A1:2009 | 367, 373 |
| SUS F 317 | JIS G 3214:1991 A1:2009 | 370, 377 |
| SUS F 317L | JIS G 3214:1991 A1:2009 | 370, 377 |
| SUS F 321 | JIS G 3214:1991 A1:2009 | 371, 378 |
| SUS F 321H | JIS G 3214:1991 A1:2009 | 371, 378 |
| SUS F 347 | JIS G 3214:1991 A1:2009 | 372, 379 |
| SUS F 347H | JIS G 3214:1991 A1:2009 | 372, 379 |
| SUS F 410-A | JIS G 3214:1991 A1:2009 | 364, 365 |
| SUS F 410-B | JIS G 3214:1991 A1:2009 | 364, 365 |
| SUS F 410-C | JIS G 3214:1991 A1:2009 | 364, 365 |
| SUS F 410-D | JIS G 3214:1991 A1:2009 | 364, 365 |
| SUS F 630 | JIS G 3214:1991 A1:2009 | 379, 380 |
| SUS201 | JIS G 4303:2012 | 541, 551 |
| SUS202 | JIS G 4303:2012 | 541, 551 |
| SUS301 | JIS G 4303:2012 | 541, 552 |
| | JIS G 4304:2012 | 459, 476 |
| | JIS G 4305:2012 | 459, 476 |
| SUS301-CSP | JIS G 4313:2011 | 621 |
| SUS301J1 | JIS G 4304:2012 | 459, 476 |
| | JIS G 4305:2012 | 459, 476 |
| SUS301L | JIS G 4304:2012 | 459, 476 |
| | JIS G 4305:2012 | 459, 477 |
| SUS302 | JIS G 4303:2012 | 541, 553 |
| | JIS G 4318:1998 A1:2007 | 541 |
| SUS302B | JIS G 4304:2012 | 460, 478 |
| | JIS G 4305:2012 | 460, 478 |
| SUS303 | JIS G 4303:2012 | 541, 554 |
| | JIS G 4304:2012 | 459, 477 |
| | JIS G 4308:2013 | 615 |
| | JIS G 4318:1998 A1:2007 | 541 |
| | JIS G 4303:2012 | 541, 554 |
| | JIS G 4308:2013 | 615 |
| SUS303Se (continued) | JIS G 4318:1998 A1:2007 | 541 |
| SUS304 | JIS G 4303:2012 | 542, 557 |
| | JIS G 4304:2012 | 165, 172, 460, 479 |
| | JIS G 4305:2012 | 165, 172, 460, 479 |
| | JIS G 4318:1998 A1:2007 | 542 |
| SUS304-CSP | JIS G 4313:2011 | 621 |
| SUS304HTB | JIS G 3463:2012 | 289, 301 |
| SUS304HTF | JIS G 3467:2013 | 289, 301 |
| SUS304HTP | JIS G 3459:2012 | 289, 301 |
| SUS304J1 | JIS G 4304:2012 | 460, 479 |
| | JIS G 4305:2012 | 460, 479 |
| SUS304L | JIS G 4303:2012 | 542, 560 |
| | JIS G 4304:2012 | 165, 173, 461, 480 |
| | JIS G 4305:2012 | 165, 173, 461, 480 |
| | JIS G 4318:1998 A1:2007 | 542 |
| SUS304LN | JIS G 4303:2012 | 543, 562 |
| | JIS G 4304:2012 | 166, 175, 462, 482 |
| | JIS G 4305:2012 | 166, 175, 462, 482 |
| SUS304LTB | JIS G 3463:2012 | 289, 299 |
| SUS304LTP | JIS G 3459:2012 | 289, 299 |
| SUS304LTPY | JIS G 3468:2011 | 289, 299 |
| SUS304N1 | JIS G 4303:2012 | 543, 561 |
| | JIS G 4304:2012 | 166, 174, 461, 481 |
| | JIS G 4305:2012 | 166, 174, 461, 481 |
| SUS304N2 | JIS G 4303:2012 | 543, 562 |
| | JIS G 4304:2012 | 462, 481 |
| | JIS G 4305:2012 | 462, 481 |
| SUS304N2-X | JIS G 4304:2012 | 462, 481 |
| SUS304TB | JIS G 3463:2012 | 288, 298 |
| SUS304TF | JIS G 3467:2013 | 288, 298 |
| SUS304TKA | JIS G 3446:2012 | 232, 235 |
| SUS304TKC | JIS G 3446:2012 | 232, 235 |
| SUS304TP | JIS G 3459:2012 | 288, 298 |
| SUS304TPY | JIS G 3468:2011 | 288, 298 |
| SUS305 | JIS G 4303:2012 | 543, 562 |
| | JIS G 4304:2012 | 462, 483 |
| | JIS G 4305:2012 | 462, 483 |
| | JIS G 4318:1998 A1:2007 | 543 |
| SUS305J1 | JIS G 4318:1998 A1:2007 | 543 |
| SUS309S | JIS G 4303:2012 | 544, 564 |
| | JIS G 4304:2012 | 463, 484 |

| Designation | Specification | Page Number |
|---|---|---|
| SUS309S (continued) | JIS G 4305:2012 | 463, 484 |
| | JIS G 4318:1998 A1:2007 | 544 |
| SUS309STB | JIS G 3463:2012 | 290, 302 |
| SUS309STP | JIS G 3459:2012 | 290, 302 |
| SUS309STPY | JIS G 3468:2011 | 290, 302 |
| SUS309TB | JIS G 3463:2012 | 290, 303 |
| SUS309TP | JIS G 3459:2012 | 290, 303 |
| SUS310S | JIS G 4303:2012 | 544, 565 |
| | JIS G 4304:2012 | 463, 485 |
| | JIS G 4305:2012 | 463, 485 |
| | JIS G 4318:1998 A1:2007 | 544 |
| SUS310STB | JIS G 3463:2012 | 290, 303 |
| SUS310STP | JIS G 3459:2012 | 290, 303 |
| SUS310STPY | JIS G 3468:2011 | 290, 303 |
| SUS310TB | JIS G 3463:2012 | 290, 304 |
| SUS310TF | JIS G 3467:2013 | 290, 304 |
| SUS312L | JIS G 4303:2012 | 545, 566 |
| | JIS G 4304:2012 | 464, 487 |
| | JIS G 4305:2012 | 464, 487 |
| SUS316 | JIS G 4303:2012 | 545, 571 |
| | JIS G 4304:2012 | 167, 177, 464, 488 |
| | JIS G 4305:2012 | 167, 177, 464, 488 |
| | JIS G 4318:1998 A1:2007 | 545 |
| SUS316HTB | JIS G 3463:2012 | 293, 308 |
| SUS316HTF | JIS G 3467:2013 | 293, 308 |
| SUS316HTP | JIS G 3459:2012 | 293, 308 |
| SUS316J1 | JIS G 4303:2012 | 546, 578 |
| | JIS G 4304:2012 | 465, 491 |
| | JIS G 4305:2012 | 465, 491 |
| SUS316J1L | JIS G 4303:2012 | 547, 579 |
| | JIS G 4304:2012 | 465, 490 |
| | JIS G 4305:2012 | 465, 490 |
| SUS316L | JIS G 4303:2012 | 547, 578 |
| | JIS G 4304:2012 | 167, 179, 465, 490 |
| | JIS G 4305:2012 | 167, 179, 465, 490 |
| | JIS G 4318:1998 A1:2007 | 547 |
| SUS316LN | JIS G 4303:2012 | 547, 580 |
| | JIS G 4304:2012 | 168, 180, 467, 493 |
| | JIS G 4305:2012 | 168, 180, 467, 493 |
| SUS316LTB | JIS G 3463:2012 | 292, 307 |
| SUS316LTP | JIS G 3459:2012 | 292, 307 |
| SUS316LTPY | JIS G 3468:2011 | 292, 307 |
| SUS316N | JIS G 4303:2012 | 547, 580 |
| | JIS G 4304:2012 | 466, 492 |
| | JIS G 4305:2012 | 466, 492 |
| SUS316TB | JIS G 3463:2012 | 291, 305 |
| SUS316TF | JIS G 3467:2013 | 291, 305 |
| SUS316Ti | JIS G 4303:2012 | 546, 578 |
| | JIS G 4304:2012 | 168, 179, 466, 491 |
| | JIS G 4305:2012 | 168, 179, 466, 491 |
| SUS316TiTB | JIS G 3463:2012 | 293, 308 |
| SUS316TiTP | JIS G 3459:2012 | 293, 308 |
| SUS316TKA | JIS G 3446:2012 | 232, 237 |
| SUS316TKC | JIS G 3446:2012 | 232, 237 |
| SUS316TP | JIS G 3459:2012 | 291, 305 |
| SUS316TPY | JIS G 3468:2011 | 291, 305 |
| SUS317 | JIS G 4303:2012 | 548, 581 |
| | JIS G 4304:2012 | 467, 494 |
| | JIS G 4305:2012 | 467, 494 |
| SUS317J1 | JIS G 4303:2012 | 548, 581 |
| | JIS G 4304:2012 | 467, 494 |
| | JIS G 4305:2012 | 467, 494 |
| SUS317L | JIS G 4303:2012 | 548, 581 |
| | JIS G 4304:2012 | 168, 181, 467, 495 |
| | JIS G 4305:2012 | 168, 181, 467, 495 |
| SUS317LN | JIS G 4304:2012 | 169, 181, 468, 496 |
| | JIS G 4305:2012 | 169, 181, 468, 496 |
| SUS317LTB | JIS G 3463:2012 | 294, 309 |
| SUS317LTP | JIS G 3459:2012 | 294, 309 |
| SUS317LTPY | JIS G 3468:2011 | 294, 309 |
| SUS317TB | JIS G 3463:2012 | 293, 309 |
| SUS317TP | JIS G 3459:2012 | 293, 309 |
| SUS317TPY | JIS G 3468:2011 | 293, 309 |
| SUS321 | JIS G 4303:2012 | 548, 584 |
| | JIS G 4304:2012 | 169, 182, 468, 496 |
| | JIS G 4305:2012 | 169, 182, 468, 496 |
| | JIS G 4318:1998 A1:2007 | 548 |
| SUS321HTB | JIS G 3463:2012 | 295, 312 |
| SUS321HTF | JIS G 3467:2013 | 295, 312 |
| SUS321HTP | JIS G 3459:2012 | 295, 312 |
| SUS321TB | JIS G 3463:2012 | 295, 311 |
| SUS321TF | JIS G 3467:2013 | 295, 311 |
| SUS321TKA | JIS G 3446:2012 | 234, 240 |

| Designation | Specification | Page Number |
|---|---|---|
| SUS321TP | JIS G 3459:2012 | 295, 311 |
| SUS321TPY | JIS G 3468:2011 | 295, 311 |
| SUS329J1 | JIS G 4303:2012 | 601, 605 |
| | JIS G 4304:2012 | 514, 518 |
| | JIS G 4305:2012 | 514, 518 |
| | JIS G 4318:1998 A1:2007 | 601 |
| SUS329J3L | JIS G 4303:2012 | 600, 603 |
| | JIS G 4304:2012 | 185, 186, 513, 515 |
| | JIS G 4305:2012 | 185, 186, 513, 515 |
| SUS329J4L | JIS G 4303:2012 | 600, 603 |
| | JIS G 4304:2012 | 513, 517 |
| | JIS G 4305:2012 | 513, 517 |
| SUS347 | JIS G 4303:2012 | 549, 586 |
| | JIS G 4304:2012 | 169, 183, 469, 498 |
| | JIS G 4305:2012 | 169, 183, 469, 498 |
| | JIS G 4318:1998 A1:2007 | 549 |
| SUS347HTB | JIS G 3463:2012 | 296, 314 |
| SUS347HTF | JIS G 3467:2013 | 296, 314 |
| SUS347HTP | JIS G 3459:2012 | 296, 314 |
| SUS347TB | JIS G 3463:2012 | 296, 313 |
| SUS347TF | JIS G 3467:2013 | 296, 313 |
| SUS347TKA | JIS G 3446:2012 | 234, 241 |
| SUS347TP | JIS G 3459:2012 | 296, 313 |
| SUS347TPY | JIS G 3468:2011 | 296, 313 |
| SUS403 | JIS G 4303:2012 | 519, 522 |
| | JIS G 4304:2012 | 438, 440 |
| | JIS G 4305:2012 | 438, 440 |
| | JIS G 4318:1998 A1:2007 | 519 |
| SUS405 | JIS G 4303:2012 | 534, 536 |
| | JIS G 4304:2012 | 159, 162, 445, 450 |
| | JIS G 4305:2012 | 159, 162, 445, 450 |
| SUS409TB | JIS G 3463:2012 | 286, 287 |
| SUS410 | JIS G 4303:2012 | 519, 525 |
| | JIS G 4304:2012 | 438, 440 |
| | JIS G 4305:2012 | 438, 440 |
| | JIS G 4318:1998 A1:2007 | 519 |
| SUS410J1 | JIS G 4303:2012 | 519, 525 |
| SUS410L | JIS G 4303:2012 | 534, 536 |
| | JIS G 4304:2012 | 438, 441 |
| | JIS G 4305:2012 | 438, 441 |
| SUS410S | JIS G 4304:2012 | 438, 441 |
| | JIS G 4305:2012 | 438, 441 |
| SUS410TB | JIS G 3463:2012 | 286, 287 |
| SUS410TKA | JIS G 3446:2012 | 227, 229 |
| SUS410TKC | JIS G 3446:2012 | 227, 229 |
| SUS416 | JIS G 4303:2012 | 519, 526 |
| | JIS G 4308:2013 | 615 |
| | JIS G 4318:1998 A1:2007 | 519 |
| SUS420F | JIS G 4303:2012 | 520, 529 |
| | JIS G 4318:1998 A1:2007 | 520 |
| SUS420J1 | JIS G 4303:2012 | 520, 528 |
| | JIS G 4304:2012 | 439, 442 |
| | JIS G 4305:2012 | 439, 442 |
| | JIS G 4318:1998 A1:2007 | 520 |
| SUS420J1TKA | JIS G 3446:2012 | 227, 230 |
| SUS420J2 | JIS G 4303:2012 | 520, 529 |
| | JIS G 4304:2012 | 439, 443 |
| | JIS G 4305:2012 | 439, 443 |
| | JIS G 4318:1998 A1:2007 | 520 |
| SUS420J2-CSP | JIS G 4313:2011 | 621 |
| SUS429 | JIS G 4304:2012 | 446, 452 |
| | JIS G 4305:2012 | 446, 452 |
| SUS430 | JIS G 4303:2012 | 534, 538 |
| | JIS G 4304:2012 | 446, 453 |
| | JIS G 4305:2012 | 446, 453 |
| | JIS G 4318:1998 A1:2007 | 534 |
| SUS430F | JIS G 4303:2012 | 534, 538 |
| | JIS G 4308:2013 | 615 |
| | JIS G 4318:1998 A1:2007 | 534 |
| SUS430LX | JIS G 4304:2012 | 160, 164, 446, 454 |
| | JIS G 4305:2012 | 160, 164, 446, 454 |
| SUS430LXTB | JIS G 3463:2012 | 286, 287 |
| SUS430TB | JIS G 3463:2012 | 286, 287 |
| SUS430TKA | JIS G 3446:2012 | 227, 231 |
| SUS430TKC | JIS G 3446:2012 | 227, 231 |
| SUS431 | JIS G 4303:2012 | 520, 530 |
| SUS434 | JIS G 4303:2012 | 535, 539 |
| | JIS G 4304:2012 | 447, 454 |
| | JIS G 4305:2012 | 447, 454 |
| SUS436L | JIS G 4304:2012 | 469, 498 |
| | JIS G 4305:2012 | 469, 498 |
| SUS440A | JIS G 4303:2012 | 520, 531 |
| | JIS G 4304:2012 | 439, 444 |
| | JIS G 4305:2012 | 439, 444 |
| SUS440B | JIS G 4303:2012 | 520, 531 |

| Designation | Specification | Page Number |
|---|---|---|
| SUS440C | JIS G 4303:2012 | 521, 531 |
| | JIS G 4318:1998 A1:2007 | 521 |
| SUS440F | JIS G 4303:2012 | 521, 533 |
| SUS444 | JIS G 4304:2012 | 161, 164, 448, 456 |
| | JIS G 4305:2012 | 161, 164, 448, 456 |
| SUS447J1 | JIS G 4303:2012 | 535, 540 |
| | JIS G 4304:2012 | 449, 457 |
| | JIS G 4305:2012 | 449, 457 |
| SUS630 | JIS G 4303:2012 | 593, 597 |
| | JIS G 4304:2012 | 505, 508 |
| | JIS G 4305:2012 | 505, 509 |
| SUS631 | JIS G 4303:2012 | 593, 598 |
| | JIS G 4304:2012 | 505, 512 |
| | JIS G 4305:2012 | 505, 512 |
| SUS631-CSP | JIS G 4313:2011 | 621 |
| SUS836L | JIS G 4303:2012 | 550, 590 |
| | JIS G 4304:2012 | 170, 184, 472, 504 |
| | JIS G 4305:2012 | 170, 184, 472, 504 |
| SUS836LTB | JIS G 3463:2012 | 297, 315 |
| SUS890L | JIS G 4303:2012 | 550, 591 |
| | JIS G 4304:2012 | 170, 183, 472, 504 |
| | JIS G 4305:2012 | 170, 183, 472, 504 |
| SUS890LTB | JIS G 3463:2012 | 297, 315 |
| SUS890LTP | JIS G 3459:2012 | 297, 315 |
| SUSXM15J1 | JIS G 4303:2012 | 550, 589 |
| | JIS G 4304:2012 | 469, 499 |
| | JIS G 4305:2012 | 469, 499 |
| SUSXM27 | JIS G 4303:2012 | 535, 540 |
| | JIS G 4304:2012 | 448, 457 |
| | JIS G 4305:2012 | 448, 457 |
| SUSXM27TB | JIS G 3463:2012 | 286, 287 |
| SUSXM7 | JIS G 4303:2012 | 550, 589 |
| T1 | ASME SA-209/SA-209M | 268, 269 |
| | ASME SA-250/SA-250M | 268, 269 |
| | ASTM A209/A209M-03 (2012) | 268, 269 |
| | ASTM A250/A250M-05 (2014) | 268, 269 |
| | ASTM A600-92a (2010) | 623 |
| | SAE J438b MAY70 | 623 |
| T1a | ASME SA-209/SA-209M | 268, 269 |
| | ASME SA-250/SA-250M | 268, 269 |
| | ASTM A209/A209M-03 (2012) | 268, 269 |
| | ASTM A250/A250M-05 (2014) | 268, 269 |
| T1b | ASME SA-209/SA-209M | 268, 269 |
| | ASME SA-250/SA-250M | 268, 269 |
| | ASTM A209/A209M-03 (2012) | 268, 269 |
| | ASTM A250/A250M-05 (2014) | 268, 269 |
| T2 | ASME SA-213/SA-213M | 271, 272 |
| | ASME SA-250/SA-250M | 271, 272 |
| | ASTM A213/A213M-15a | 271, 272 |
| | ASTM A250/A250M-05 (2014) | 271, 272 |
| T4 | ASTM A600-92a (2010) | 623 |
| | SAE J438b MAY70 | 623 |
| T5 | ASME SA-213/SA-213M | 280, 281 |
| | ASTM A213/A213M-15a | 280, 281 |
| | ASTM A600-92a (2010) | 623 |
| | SAE J438b MAY70 | 623 |
| T5b | ASME SA-213/SA-213M | 280, 281 |
| | ASTM A213/A213M-15a | 280, 281 |
| T7 | GB 1298-86 | 622 |
| T8 | GB 1298-86 | 622 |
| T8Mn | GB 1298-86 | 622 |
| T8MnA | GB/T 4358-1995 | 616 |
| T9 | ASME SA-213/SA-213M | 283, 284 |
| | ASTM A213/A213M-15a | 283, 284 |
| | GB 1298-86 | 622 |
| T9A | GB/T 4358-1995 | 616 |
| T10 | GB 1298-86 | 622 |
| T11 | ASME SA-213/SA-213M | 276, 277 |
| | ASME SA-250/SA-250M | 276, 277 |
| | ASTM A213/A213M-15a | 276, 277 |
| | ASTM A250/A250M-05 (2014) | 276, 277 |
| | GB 1298-86 | 625 |
| T12 | ASME SA-213/SA-213M | 274, 275 |
| | ASME SA-250/SA-250M | 274, 275 |
| | ASTM A213/A213M-15a | 274, 275 |
| | ASTM A250/A250M-05 (2014) | 274, 275 |
| | GB 1298-86 | 622 |
| T15 | ASTM A600-92a (2010) | 623 |
| T22 | ASME SA-213/SA-213M | 278, 279 |
| | ASME SA-250/SA-250M | 278, 279 |
| | ASTM A213/A213M-15a | 278, 279 |
| | ASTM A250/A250M-05 (2014) | 278, 279 |
| T36 Class 1 | ASTM A213/A213M-15a | 273 |
| T36 Class 2 | ASTM A213/A213M-15a | 273 |
| T91 | ASME SA-213/SA-213M | 283, 285 |

| Designation | Specification | Page Number |
|---|---|---|
| T91 (continued) | ASTM A213/A213M-15a | 283, 285 |
| TDC | EN 10270-2:2011 | 615 |
| | GB/T 18983-2003 | 615 |
| | ISO 8458-3:2002 | 615 |
| TDCrSi | GB/T 18983-2003 | 619 |
| TDCrV | EN 10270-2:2011 | 620 |
| TDCrV-A | GB/T 18983-2003 | 620 |
| | ISO 8458-3:2002 | 620 |
| TDCrV-B | GB/T 18983-2003 | 620 |
| | ISO 8458-3:2002 | 620 |
| TDSiCr | EN 10270-2:2011 | 619 |
| | ISO 8458-3:2002 | 619 |
| TDSiMn | GB/T 18983-2003 | 618 |
| TP XM-27 | ASME SA-803/SA-803M | 286, 287 |
| | ASTM A803/A803M-12 | 286, 287 |
| TP304 | ASME SA-213/SA-213M | 288, 298 |
| | ASME SA-249/SA-249M | 232, 235, 288, 298 |
| | ASME SA-312/SA-312M | 288, 298 |
| | ASME SA-376/SA-376M | 288, 298 |
| | ASME SA-409/SA-409M | 232, 235, 288, 298 |
| | ASME SA-688/SA-688M | 232, 235, 288, 298 |
| | ASTM A213/A213M-15a | 288, 298 |
| | ASTM A249/A249M-14a | 288, 298 |
| | ASTM A269/A269M-14e1 | 232, 235 |
| | ASTM A270/A270M-15 | 288, 298 |
| | ASTM A312/A312M-15 | 288, 298 |
| | ASTM A376/A376M-14 | 288, 298 |
| | ASTM A409/A409M-15 | 288, 298 |
| | ASTM A632-04 (2014) | 232, 235 |
| | ASTM A688/A688M-15 | 288, 298 |
| TP304H | ASME SA-213/SA-213M | 289, 301 |
| | ASME SA-249/SA-249M | 289, 301 |
| | ASME SA-312/SA-312M | 289, 301 |
| | ASME SA-376/SA-376M | 289, 301 |
| | ASTM A213/A213M-15a | 289, 301 |
| | ASTM A249/A249M-14a | 289, 301 |
| | ASTM A312/A312M-15 | 289, 301 |
| | ASTM A376/A376M-14 | 289, 301 |
| TP304L | ASME SA-213/SA-213M | 288, 299 |
| | ASME SA-249/SA-249M | 288, 299 |
| | ASME SA-312/SA-312M | 288, 299 |
| | ASME SA-409/SA-409M | 288, 299 |
| | ASME SA-688/SA-688M | 288, 299 |

| Designation | Specification | Page Number |
|---|---|---|
| TP304L (continued) | ASTM A213/A213M-15a | 288, 299 |
| | ASTM A249/A249M-14 | 288 |
| | ASTM A249/A249M-14a | 299 |
| | ASTM A269/A269M-14e1 | 232, 236 |
| | ASTM A312/A312M-15 | 288, 299 |
| | ASTM A409/A409M-15 | 289, 299 |
| | ASTM A632-04 (2014) | 232, 236 |
| | ASTM A688/A688M-15 | 289, 299 |
| | ASTM A778-01 (2009)e1 | 232, 236 |
| TP304LN | ASME SA-213/SA-213M | 289, 300 |
| | ASME SA-249/SA-249M | 289, 300 |
| | ASME SA-376/SA-376M | 289, 300 |
| | ASME SA-688/SA-688M | 289, 300 |
| | ASTM A213/A213M-15a | 289, 300 |
| | ASTM A249/A249M-14a | 289, 300 |
| | ASTM A269/A269M-14e1 | 233, 238 |
| | ASTM A376/A376M-14 | 289, 300 |
| | ASTM A688/A688M-15 | 289, 300 |
| TP304N | ASME SA-249/SA-249M | 288, 299 |
| | ASTM A249/A249M-14 | 288 |
| | ASTM A249/A249M-14a | 299 |
| TP309H | ASME SA-213/SA-213M | 290, 303 |
| | ASME SA-249/SA-249M | 290, 303 |
| | ASTM A213/A213M-15a | 290, 303 |
| | ASTM A249/A249M-14a | 290, 303 |
| TP309S | ASME SA-213/SA-213M | 290, 302 |
| | ASME SA-249/SA-249M | 290, 302 |
| | ASME SA-312/SA-312M | 290, 302 |
| | ASTM A213/A213M-15a | 290, 302 |
| | ASTM A249/A249M-14a | 290, 302 |
| | ASTM A312/A312M-15 | 290, 302 |
| TP310H | ASME SA-213/SA-213M | 290, 304 |
| | ASTM A213/A213M-15a | 290, 304 |
| TP310S | ASME SA-213/SA-213M | 290, 303 |
| | ASME SA-249/SA-249M | 290, 303 |
| | ASME SA-312/SA-312M | 290, 303 |
| | ASTM A213/A213M-15a | 290, 303 |
| | ASTM A249/A249M-14a | 290, 303 |
| | ASTM A312/A312M-15 | 290, 303 |
| TP316 | ASME SA-213/SA-213M | 291, 305 |
| | ASME SA-249/SA-249M | 291, 305 |
| | ASME SA-312/SA-312M | 291, 305 |
| | ASME SA-376/SA-376M | 291, 305 |

| Designation | Specification | Page Number |
|---|---|---|
| TP316 (continued) | ASME SA-409/SA-409M | 291, 305 |
| | ASME SA-688/SA-688M | 291, 305 |
| | ASTM A213/A213M-15a | 291, 305 |
| | ASTM A249/A249M-14a | 291, 305 |
| | ASTM A269/A269M-14e1 | 232, 237 |
| | ASTM A312/A312M-15 | 291, 305 |
| | ASTM A376/A376M-14 | 291, 305 |
| | ASTM A409/A409M-15 | 291, 305 |
| | ASTM A632-04 (2014) | 232, 237 |
| | ASTM A688/A688M-15 | 291, 305 |
| TP316H | ASME SA-213/SA-213M | 293, 308 |
| | ASME SA-249/SA-249M | 293, 308 |
| | ASME SA-312/SA-312M | 293, 308 |
| | ASME SA-376/SA-376M | 293, 308 |
| | ASTM A213/A213M-15a | 293, 308 |
| | ASTM A249/A249M-14a | 293, 308 |
| | ASTM A312/A312M-15 | 293, 308 |
| | ASTM A376/A376M-14 | 293, 308 |
| TP316L | ASME SA-213/SA-213M | 292, 306 |
| | ASME SA-249/SA-249M | 292, 306 |
| | ASME SA-312/SA-312M | 292, 306 |
| | ASME SA-409/SA-409M | 292, 306 |
| | ASME SA-688/SA-688M | 292, 306 |
| | ASTM A213/A213M-15a | 292, 306 |
| | ASTM A249/A249M-14a | 292, 306 |
| | ASTM A269/A269M-14e1 | 232, 238 |
| | ASTM A312/A312M-15 | 292, 306 |
| | ASTM A409/A409M-15 | 292, 306 |
| | ASTM A632-04 (2014) | 232, 238 |
| | ASTM A688/A688M-15 | 292, 306 |
| | ASTM A778-01 (2009)e1 | 232, 238 |
| TP316LN | ASME SA-213/SA-213M | 292, 307 |
| | ASME SA-249/SA-249M | 292, 307 |
| | ASME SA-376/SA-376M | 292, 307 |
| | ASME SA-688/SA-688M | 292, 307 |
| | ASTM A213/A213M-15a | 292, 307 |
| | ASTM A249/A249M-14a | 292, 307 |
| | ASTM A269/A269M-14e1 | 233, 239 |
| | ASTM A376/A376M-14 | 292, 307 |
| | ASTM A688/A688M-15 | 292, 307 |
| TP317 | ASME SA-213/SA-213M | 293, 309 |
| | ASME SA-249/SA-249M | 293, 309 |
| | ASME SA-312/SA-312M | 293, 309 |

| Designation | Specification | Page Number |
|---|---|---|
| TP317 (continued) | ASME SA-409/SA-409M | 293, 309 |
| | ASTM A213/A213M-15a | 293, 309 |
| | ASTM A249/A249M-14a | 293, 309 |
| | ASTM A312/A312M-15 | 293, 309 |
| | ASTM A409/A409M-15 | 293, 309 |
| | ASTM A632-04 (2014) | 233, 239 |
| TP317L | ASME SA-213/SA-213M | 294, 309 |
| | ASME SA-249/SA-249M | 294, 309 |
| | ASME SA-312/SA-312M | 294, 309 |
| | ASTM A213/A213M-15a | 294, 309 |
| | ASTM A249/A249M-14a | 294, 309 |
| | ASTM A312/A312M-15 | 294, 309 |
| | ASTM A774/A774M-14 | 370, 377 |
| TP317LM | ASME SA-213/SA-213M | 234, 242, 294, 310 |
| | ASTM A213/A213M-15a | 234, 242, 294, 310 |
| TP321 | ASME SA-213/SA-213M | 233, 240, 295, 311 |
| | ASME SA-249/SA-249M | 233, 240, 295, 311 |
| | ASME SA-312/SA-312M | 295, 311 |
| | ASME SA-376/SA-376M | 295, 311 |
| | ASME SA-409/SA-409M | 295, 311 |
| | ASTM A213/A213M-15a | 295, 311 |
| | ASTM A249/A249M-14a | 234, 240, 295, 311 |
| | ASTM A269/A269M-14e1 | 234, 240 |
| | ASTM A312/A312M-15 | 295, 311 |
| | ASTM A376/A376M-14 | 295, 311 |
| | ASTM A409/A409M-15 | 295, 311 |
| | ASTM A632-04 (2014) | 234, 240 |
| | ASTM A774/A774M-14 | 371, 378 |
| | ASTM A778-01 (2009)e1 | 234, 240 |
| TP321H | ASME SA-213/SA-213M | 295, 312 |
| | ASME SA-249/SA-249M | 295, 312 |
| | ASME SA-312/SA-312M | 295, 312 |
| | ASME SA-376/SA-376M | 295, 312 |
| | ASTM A213/A213M-15a | 295, 312 |
| | ASTM A249/A249M-14a | 295, 312 |
| | ASTM A312/A312M-15 | 295, 312 |
| | ASTM A376/A376M-14 | 295, 312 |
| TP347 | ASME SA-213/SA-213M | 296, 313 |
| | ASME SA-249/SA-249M | 296, 313 |
| | ASME SA-312/SA-312M | 296, 313 |
| | ASME SA-376/SA-376M | 296, 313 |

| Designation | Specification | Page Number |
|---|---|---|
| TP347 (continued) | ASME SA-409/SA-409M | 296, 313 |
| | ASTM A213/A213M-15a | 296, 313 |
| | ASTM A249/A249M-14a | 296, 313 |
| | ASTM A269/A269M-14e1 | 234, 241 |
| | ASTM A312/A312M-15 | 296, 313 |
| | ASTM A376/A376M-14 | 296, 313 |
| | ASTM A409/A409M-15 | 296, 313 |
| | ASTM A632-04 (2014) | 234, 241 |
| | ASTM A778-01 (2009)e1 | 234, 241 |
| TP347H | ASME SA-213/SA-213M | 296, 314 |
| | ASME SA-249/SA-249M | 296, 314 |
| | ASME SA-312/SA-312M | 296, 314 |
| | ASME SA-376/SA-376M | 296, 314 |
| | ASTM A213/A213M-15a | 296, 314 |
| | ASTM A249/A249M-14a | 296, 314 |
| | ASTM A312/A312M-15 | 296, 314 |
| | ASTM A376/A376M-14 | 296, 314 |
| TP347HFG | ASME SA-213/SA-213M | 296, 314 |
| | ASTM A213/A213M-15a | 296, 314 |
| TP405 | ASME SA-268/SA-268M | 227, 228 |
| | ASTM A268/A268M-10 | 227, 228 |
| TP409 | ASME SA-268/SA-268M | 227, 228, 286, 287 |
| | ASME SA-803/SA-803M | 286, 287 |
| | ASTM A268/A268M-10 | 227, 228, 286, 287 |
| | ASTM A803/A803M-12 | 286, 287 |
| TP410 | ASME SA-268/SA-268M | 227, 229, 286, 287 |
| | ASTM A268/A268M-10 | 227, 229, 286, 287 |
| TP430 | ASME SA-268/SA-268M | 227, 230, 286, 287 |
| | ASTM A268/A268M-10 | 227, 230, 286, 287 |
| TP439 | ASME SA-268/SA-268M | 227, 231 |
| | ASTM A268/A268M-10 | 227, 231 |
| TS 1 | ISO 2937:1974 | 199, 214 |
| TS 4 | ISO 2937:1974 | 201, 215 |
| TS 9 | ISO 2937:1974 | 204, 217 |
| TS 18 | ISO 2937:1974 | 207, 221 |
| TS Z 2 CN 18-10 | AFNOR NF A 49-647:1979 | 232, 236 |
| TS Z 6 CN 18-09 | AFNOR NF A 49-647:1979 | 232, 235 |
| TS Z 6 CND 17-11 | AFNOR NF A 49-647:1979 | 232, 237 |
| TS Z 8 C 17 | AFNOR NF A 49-647:1979 | 227, 230 |
| TU 10 CD 5-05 | AFNOR NF A 49-220:1990 | 276, 277 |
| TU 10 CD 9-10 | AFNOR NF A 49-220:1990 | 278, 279 |
| TU 13 CD 4-04 | AFNOR NF A 49-220:1990 | 274, 275 |
| TU 15 CD 2-05 | AFNOR NF A 49-220:1990 | 271, 272 |
| TU 15 D 3 | AFNOR NF A 49-220:1990 | 267 |
| TU 37 C | AFNOR NF A 49-220:1990 | 261, 264 |
| TU 42 C | AFNOR NF A 49-220:1990 | 261, 265 |
| TU 48 C | AFNOR NF A 49-220:1990 | 263, 266 |
| TU 52 C | AFNOR NF A 49-220:1990 | 263, 266 |
| U-60-30 [415-205] | ASTM A27/A27M-13 | 389, 393 |
| VDC | EN 10270-2:2011 | 615 |
| | GB/T 18983-2003 | 615 |
| | ISO 8458-3:2002 | 615 |
| VDCrSi | GB/T 18983-2003 | 619 |
| VDCrV | EN 10270-2:2011 | 620 |
| VDCrV-A | GB/T 18983-2003 | 620 |
| | ISO 8458-3:2002 | 620 |
| VDCrV-B | GB/T 18983-2003 | 620 |
| | ISO 8458-3:2002 | 620 |
| VDSiCr | EN 10270-2:2011 | 619 |
| | ISO 8458-3:2002 | 619 |
| W1, A-8 | ASTM A686-92 (2010) | 622 |
| W1, A-8.5 | ASTM A686-92 (2010) | 622 |
| W1, A-9 | ASTM A686-92 (2010) | 622 |
| W1, A-10 | ASTM A686-92 (2010) | 622 |
| W1, A-10.5 | ASTM A686-92 (2010) | 625 |
| W1, A-11.5 | ASTM A686-92 (2010) | 622 |
| W2, A-8.5 | ASTM A686-92 (2010) | 622 |
| W2, A-9.5 | ASTM A686-92 (2010) | 622 |
| W6Mo5Cr4V2 | GB/T 3080-2001 | 623 |
| W18Cr4V | GB/T 3080-2001 | 623 |
| W108 | SAE J438b MAY70 | 622 |
| W109 | SAE J438b MAY70 | 622 |
| W110 | SAE J438b MAY70 | 622 |
| W112 | SAE J438b MAY70 | 622 |
| WC1 | ASME SA-217/SA-217M | 406, 407 |
| | ASTM A217/A217M-14 | 406, 407 |
| WC6 | ASME SA-217/SA-217M | 406, 407 |
| | ASTM A217/A217M-14 | 406, 407 |
| WC9 | ASME SA-217/SA-217M | 406, 408 |
| | ASTM A217/A217M-14 | 406, 408 |
| WCA | ASME SA-216/SA-216M | 396, 397 |
| | ASTM A216/A216M-14e1 | 396, 397 |
| WCB | ASME SA-216/SA-216M | 396, 397 |
| | ASTM A216/A216M-14e1 | 396, 397 |
| WCC | ASME SA-216/SA-216M | 396, 397 |

| Designation | Specification | Page Number |
|---|---|---|
| WCC (continued) | ASTM A216/A216M-14e1 | 396, 397 |
| WP304 | ASME SA-403/SA-403M | 367, 373 |
| | ASTM A403/A403M-15 | 367, 373 |
| WP304L | ASME SA-403/SA-403M | 367, 373 |
| | ASTM A403/A403M-15 | 373 |
| WP304LN | ASME SA-403/SA-403M | 368 |
| | ASTM A403/A403M-15 | 368 |
| WP310S | ASME SA-403/SA-403M | 368, 375 |
| | ASTM A403/A403M-15 | 368, 375 |
| WP316 | ASME SA-403/SA-403M | 369, 375 |
| | ASTM A403/A403M-15 | 369, 375 |
| WP316L | ASME SA-403/SA-403M | 369, 376 |
| | ASTM A403/A403M-15 | 369, 376 |
| WP317 | ASME SA-403/SA-403M | 370, 377 |
| | ASTM A403/A403M-15 | 370, 377 |
| WP317L | ASME SA-403/SA-403M | 370, 377 |
| | ASTM A403/A403M-15 | 370, 377 |
| WP321 | ASME SA-403/SA-403M | 371, 378 |
| | ASTM A403/A403M-15 | 371, 378 |
| WP347 | ASME SA-403/SA-403M | 372, 379 |
| | ASTM A403/A403M-15 | 372, 379 |
| WP403L | ASTM A403/A403M-15 | 367 |
| WPS31803 | ASME SA-815/SA-815M | 381, 383 |
| | ASTM A815/A815M-14 | 381, 383 |
| WPS32205 | ASME SA-815/SA-815M | 381, 383 |
| | ASTM A815/A815M-14 | 381, 383 |
| WPS32750 | ASME SA-815/SA-815M | 381, 383 |
| | ASTM A815/A815M-14 | 381, 383 |
| WPS32760 | ASME SA-815/SA-815M | 382, 384 |
| | ASTM A815/A815M-14 | 382, 384 |
| X1CrNi25-21 | EN 10028-7:2007 | 470, 500 |
| | EN 10088-2:2014 | 470, 500 |
| | ISO 16143-1:2004 | 470, 500 |
| | ISO 9328-7:2004 | 470, 500 |
| X1CrNiMoCuN20-18-7 | EN 10028-7:2007 | 464, 487 |
| | EN 10088-2:2014 | 464, 487 |
| | EN 10088-3:2014 | 545, 566 |
| | ISO 9328-7:2004 | 464, 487 |
| X1CrNiMoCuN24-22-8 | EN 10088-2:2014 | 470, 500 |
| | EN 10088-3:2014 | 545, 566 |
| | ISO 16143-1:2004 | 470, 500 |
| | ISO 16143-2:2004 | 545, 566 |
| X1CrNiMoCuN25-25-5 | EN 10028-7:2007 | 472, 503 |
| X1CrNiMoCuN25-25-5 (continued) | EN 10088-2:2014 | 472, 503 |
| | ISO 9328-7:2004 | 472, 503 |
| X1CrNiMoCuNW24-22-6 | EN 10088-2:2014 | 470, 500 |
| | EN 10088-3:2014 | 545, 566 |
| | ISO 16143-2:2004 | 545, 566 |
| X1CrNiMoN25-22-2 | EN 10028-7:2007 | 464, 486 |
| | EN 10088-2:2014 | 464, 486 |
| | ISO 16143-1:2004 | 464, 486 |
| | ISO 9328-7:2004 | 464, 486 |
| X1CrNiSi18-15-4 | EN 10088-2:2014 | 462, 483 |
| X1NiCrMoCu25-20-5 | EN 10028-7:2007 | 170, 183, 472, 504 |
| | EN 10088-2:2014 | 170, 183, 472, 504 |
| | EN 10088-3:2014 | 550, 591 |
| | EN 10216-5:2013 | 297, 315 |
| | EN 10217-7:2014 | 297, 315 |
| | EN 10250-4:1999 | 372, 379 |
| | ISO 16143-1:2004 | 472, 504 |
| | ISO 9328-7:2004 | 170, 183, 472, 504 |
| X1NiCrMoCu31-27-4 | EN 10028-7:2007 | 472, 504 |
| | EN 10088-2:2014 | 472, 504 |
| | EN 10088-3:2014 | 550, 592 |
| | EN 10272:2007 | 550, 592 |
| | ISO 16143-1:2004 | 472, 504 |
| | ISO 16143-2:2004 | 550, 592 |
| | ISO 9328-7:2004 | 472, 504 |
| X1NiCrMoCuN25-20-7 | EN 10028-7:2007 | 170, 184, 472, 503 |
| | EN 10088-2:2014 | 170, 184, 472, 503 |
| | EN 10216-5:2013 | 297, 315 |
| | EN 10217-7:2014 | 297, 315 |
| | ISO 9328-7:2004 | 170, 184, 472, 503 |
| X2CrMnNiN17-7-5 | EN 10088-2:2014 | 458, 474 |
| X2CrMoTi17-1 | EN 10088-2:2014 | 469, 498 |
| X2CrMoTi18-2 | EN 10028-7:2007 | 161, 164, 448, 456 |
| | EN 10088-2:2014 | 161, 164, 448, 456 |
| | ISO 9328-7:2004 | 161, 164, 448, 456 |
| X2CrMoTi29-4 | EN 10088-2:2014 | 449, 457 |
| X2CrMoTiS18-2 | EN 10088-3:2014 | 534, 538 |
| X2CrNi12 | EN 10028-7:2007 | 159, 162, 445, 451 |
| | EN 10088-2:2014 | 159, 162, 445, 451 |

| Designation | Specification | Page Number |
|---|---|---|
| X2CrNi12 (continued) | EN 10088-3:2014 | 534, 536 |
| | ISO 16143-1:2004 | 445, 451 |
| | ISO 9328-7:2004 | 159, 162, 445, 451 |
| X2CrNi18-9 | EN 10028-7:2007 | 165, 173, 461, 479 |
| | EN 10088-2:2014 | 165, 173, 461, 479 |
| | EN 10088-3:2014 | 542, 559 |
| | EN 10216-5:2013 | 289, 299 |
| | EN 10217-7:2014 | 289, 299 |
| | EN 10222-5:1999 | 367, 373 |
| | EN 10250-4:1999 | 367, 373 |
| | EN 10263-5:2001 | 542, 560 |
| | EN 10294-2:2012 | 542, 560 |
| | ISO 16143-1:2004 | 461, 480 |
| | ISO 9328-7:2004 | 165, 173, 461, 480 |
| X2CrNi18-10 | ISO 9327-5:1999 | 367, 373 |
| X 2 CrNi 18 10 E | ISO 4954:1993 | 542, 560 |
| X2CrNi19-11 | EN 10028-7:2007 | 165, 173, 461, 479 |
| | EN 10088-2:2014 | 165, 173, 461, 479 |
| | EN 10216-5:2013 | 289, 299 |
| | EN 10217-7:2014 | 289, 299 |
| | EN 10250-4:1999 | 367, 373 |
| | EN 10294-2:2012 | 542, 560 |
| | EN 10296-2:2005 C2:2007 | 232, 236 |
| | EN 10297-2:2005 C1:2007 | 232, 236 |
| | ISO 16143-1:2004 | 461, 480 |
| | ISO 9328-7:2004 | 165, 173, 461, 480 |
| X2CrNiMnMoN25-18-6-5 | EN 10088-2:2014 | 470, 500 |
| | EN 10088-3:2014 | 547, 579 |
| | ISO 16143-1:2004 | 470, 500 |
| | ISO 16143-2:2004 | 547, 579 |
| X2CrNiMo17-12 | ISO 9327-5:1999 | 369, 376 |
| X2CrNiMo17-12-2 | EN 10028-7:2007 | 167, 178, 465, 489 |
| | EN 10088-2:2014 | 167, 178, 465, 489 |
| | EN 10088-3:2014 | 546, 573 |
| | EN 10216-5:2013 | 292, 307 |
| | EN 10217-7:2014 | 292, 307 |
| | EN 10222-5:1999 | 369, 376 |
| | EN 10250-4:1999 | 369, 376 |
| | EN 10263-5:2001 | 546, 576 |
| | EN 10294-2:2012 | 546, 576 |
| | EN 10296-2:2005 C2:2007 | 233, 238 |
| X2CrNiMo17-12-2 (continued) | EN 10297-2:2005 C1:2007 | 233, 238 |
| | ISO 16143-1:2004 | 465, 490 |
| | ISO 9328-7:2004 | 167, 179, 465, 490 |
| X2CrNiMo17-12-3 | EN 10028-7:2007 | 167, 178, 465, 489 |
| | EN 10088-2:2014 | 167, 178, 465, 489 |
| | EN 10088-3:2014 | 546, 574 |
| | EN 10217-7:2014 | 292, 307 |
| | EN 10222-5:1999 | 369, 376 |
| | EN 10263-5:2001 | 546, 576 |
| | EN 10296-2:2005 C2:2007 | 233, 238 |
| | ISO 16143-1:2004 | 465, 490 |
| | ISO 9328-7:2004 | 167, 179, 465, 490 |
| X2CrNiMo17-13 | ISO 9327-5:1999 | 369, 376 |
| X 2 CrNiMo 17 13 3 E | ISO 4954:1993 | 546, 576 |
| X2CrNiMo18-14-3 | EN 10028-7:2007 | 167, 178, 465, 489 |
| | EN 10088-2:2014 | 167, 178, 465, 489 |
| | EN 10088-3:2014 | 546, 575 |
| | EN 10216-5:2013 | 292, 307 |
| | EN 10217-7:2014 | 292, 307 |
| | EN 10222-5:1999 | 369, 376 |
| | EN 10250-4:1999 | 369, 376 |
| | EN 10294-2:2012 | 546, 576 |
| | EN 10296-2:2005 C2:2007 | 233, 238 |
| | EN 10297-2:2005 C1:2007 | 233, 238 |
| | ISO 16143-1:2004 | 465, 490 |
| | ISO 9328-7:2004 | 167, 179, 465, 490 |
| X2CrNiMo18-15-4 | EN 10028-7:2007 | 168, 181, 467, 494 |
| | EN 10088-2:2014 | 168, 181, 467, 494 |
| | EN 10088-3:2014 | 548, 581 |
| | EN 10217-7:2014 | 294, 309 |
| | ISO 9328-7:2004 | 168, 181, 467, 495 |
| X2CrNiMo25-7-4 | EN 10088-3:2014 | 604 |
| X2CrNiMoCuN25-6-3 | EN 10028-7:2007 | 185, 187, 513, 516 |
| | EN 10088-2:2014 | 185, 187, 513, 516 |
| | EN 10088-3:2014 | 601, 605 |
| | EN 10250-4:1999 | 382, 384 |
| | ISO 16143-1:2004 | 513, 516 |
| | ISO 16143-2:2004 | 601, 605 |
| | ISO 9328-7:2004 | 185, 187, 513, 516 |

| Designation | Specification | Page Number |
|---|---|---|
| X2CrNiMoCuWN25-7-4 | EN 10028-7:2007 | 185, 187, 514, 517 |
| | EN 10088-2:2014 | 185, 187, 514, 517 |
| | EN 10088-3:2014 | 600, 604 |
| | EN 10250-4:1999 | 382, 384 |
| | EN 10297-2:2005 C1:2007 | 243, 244 |
| | ISO 16143-1:2004 | 514, 517 |
| | ISO 16143-2:2004 | 600, 604 |
| | ISO 9328-7:2004 | 185, 187, 514, 517 |
| X2CrNiMoN17-11-2 | EN 10028-7:2007 | 168, 180, 467, 493 |
| | EN 10088-2:2014 | 467, 493 |
| | EN 10088-3:2014 | 168, 180, 547, 580 |
| | EN 10222-5:1999 | 370, 376 |
| | EN 10250-4:1999 | 370, 376 |
| | ISO 9328-7:2004 | 168, 180, 467, 493 |
| X2CrNiMoN17-12 | ISO 9327-5:1999 | 370, 376 |
| X2CrNiMoN17-12-3 | ISO 16143-1:2004 | 467, 493 |
| X2CrNiMoN17-13 | ISO 9327-5:1999 | 370, 376 |
| X2CrNiMoN17-13-3 | EN 10028-7:2007 | 168, 180, 467, 493 |
| | EN 10088-2:2014 | 467, 493 |
| | EN 10088-3:2014 | 168, 547, 580 |
| | EN 10216-5:2013 | 292, 307 |
| | EN 10217-7:2014 | 292, 307 |
| | EN 10222-5:1999 | 370, 376 |
| | EN 10250-4:1999 | 370, 376 |
| | EN 10263-5:2001 | 547, 580 |
| | EN 10296-2:2005 C2:2007 | 233, 239 |
| | EN 10297-2:2005 C1:2007 | 233, 239 |
| | ISO 9328-7:2004 | 168, 180, 467, 493 |
| X 2 CrNiMoN 17 13 3 E | ISO 4954:1993 | 547, 580 |
| X2CrNiMoN17-13-5 | EN 10028-7:2007 | 169, 182, 468, 495 |
| | EN 10088-2:2014 | 169, 182, 468, 495 |
| | EN 10088-3:2014 | 548, 581 |
| | EN 10216-5:2013 | 294, 310 |
| | EN 10217-7:2014 | 294, 310 |
| | EN 10296-2:2005 C2:2007 | 234, 242 |
| | EN 10297-2:2005 C1:2007 | 234, 242 |
| | ISO 9328-7:2004 | 169, 182, 468, 495 |
| X2CrNiMoN18-12-4 | EN 10028-7:2007 | 169, 181, 468, 495 |
| | EN 10088-2:2014 | 169, 181, 468, 495 |
| | ISO 9328-7:2004 | 169, 181, 468, 495 |
| X2CrNiMoN22-5-3 | EN 10028-7:2007 | 185, 186, 513, 515 |
| | EN 10088-2:2014 | 185, 186, 513, 515 |
| | EN 10088-3:2014 | 600, 603 |
| | EN 10222-5:1999 | 381, 383 |
| | EN 10250-4:1999 | 381, 383 |
| | EN 10263-5:2001 | 600, 603 |
| | EN 10294-2:2012 | 600, 603 |
| | EN 10296-2:2005 C2:2007 | 243, 244 |
| | EN 10297-2:2005 C1:2007 | 243, 244 |
| | ISO 16143-1:2004 | 513, 515 |
| | ISO 9327-5:1999 | 381, 383 |
| | ISO 9328-7:2004 | 185, 186, 513, 515 |
| X2CrNiMoN25-7-4 | EN 10028-7:2007 | 185, 187, 514, 517 |
| | EN 10088-2:2014 | 185, 187, 514, 517 |
| | EN 10088-3:2014 | 600 |
| | EN 10222-5:1999 | 381, 383 |
| | EN 10250-4:1999 | 381, 383 |
| | EN 10296-2:2005 C2:2007 | 243, 245 |
| | EN 10297-2:2005 C1:2007 | 243, 245 |
| | ISO 16143-1:2004 | 514, 517 |
| | ISO 16143-2:2004 | 600, 604 |
| | ISO 9328-7:2004 | 185, 187, 514, 517 |
| X2CrNiMoN29-7-2 | EN 10088-2:2014 | 514, 518 |
| | EN 10088-3:2014 | 601, 605 |
| | EN 10297-2:2005 C1:2007 | 243, 245 |
| X2CrNiMoSi18-5-3 | EN 10088-2:2014 | 513, 515 |
| | EN 10088-3:2014 | 600, 602 |
| | EN 10297-2:2005 C1:2007 | 243, 244 |
| X2CrNiN18-7 | EN 10028-7:2007 | 165, 171, 459, 477 |
| | EN 10088-2:2014 | 165, 171, 459, 477 |
| | ISO 9328-7:2004 | 165, 171, 459, 477 |
| X2CrNiN18-9 | ISO 16143-1:2004 | 462, 482 |
| X2CrNiN18-10 | EN 10028-7:2007 | 166, 175, 462, 482 |
| | EN 10088-2:2014 | 166, 175, 462, 482 |
| | EN 10088-3:2014 | 543, 561 |
| | EN 10216-5:2013 | 289, 300 |
| | EN 10217-7:2014 | 289, 300 |
| | EN 10222-5:1999 | 368, 374 |
| | EN 10250-4:1999 | 368, 374 |

| Designation | Specification | Page Number |
|---|---|---|
| X2CrNiN18-10 (continued) | EN 10296-2:2005 C2:2007 | 233, 238 |
| | EN 10297-2:2005 C1:2007 | 233, 238 |
| | ISO 9327-5:1999 | 368, 374 |
| | ISO 9328-7:2004 | 166, 175, 462, 482 |
| X2CrNiN23-4 | EN 10028-7:2007 | 185, 186, 513, 516 |
| | EN 10088-2:2014 | 185, 186, 513, 516 |
| | EN 10088-3:2014 | 600, 602 |
| | EN 10250-4:1999 | 382, 384 |
| | EN 10296-2:2005 C2:2007 | 243, 244 |
| | EN 10297-2:2005 C1:2007 | 243, 244 |
| | ISO 16143-1:2004 | 513, 516 |
| | ISO 16143-2:2004 | 600, 602 |
| | ISO 9327-5:1999 | 382, 384 |
| | ISO 9328-7:2004 | 185, 186, 513, 516 |
| X2CrTi12 | EN 10088-2:2014 | 445, 451 |
| | EN 10296-2:2005 C2:2007 | 227, 228 |
| | EN 10297-2:2005 C1:2007 | 227, 228 |
| | ISO 16143-1:2004 | 445, 451 |
| | ISO 4955:2005 | 445, 451 |
| X2CrTi17 | EN 10028-7:2007 | 160, 164, 446, 454 |
| | EN 10088-2:2014 | 160, 164, 446, 454 |
| | ISO 9328-7:2004 | 160, 164, 446, 454 |
| X2CrTiNb18 | EN 10028-7:2007 | 160, 163, 447, 455 |
| | EN 10088-2:2014 | 160, 163, 447, 455 |
| | ISO 4955:2005 | 447, 455 |
| | ISO 9328-7:2004 | 160, 163, 447, 455 |
| X2NiCrMoCu25-20-5 | ISO 9327-5:1999 | 372, 379 |
| X4CrNi18-12 | EN 10088-2:2014 | 462, 483 |
| | EN 10088-3:2014 | 543, 563 |
| | EN 10263-5:2001 | 543, 563 |
| | EN 10269:2013 | 543, 563 |
| X4CrNiMo16-5-1 | EN 10028-7:2007 | 439, 444 |
| | EN 10088-2:2014 | 439, 444 |
| | ISO 9328-7:2004 | 439, 444 |
| X3CrNb17 | EN 10088-2:2014 | 160, 164, 446, 454 |
| | ISO 16143-1:2004 | 446, 454 |
| X 3 CrNiCu 18 9 3 E | ISO 4954:1993 | 550, 589 |
| X3CrNiCu18-9-4 | EN 10088-3:2014 | 550, 588 |
| | EN 10263-5:2001 | 550, 589 |
| | EN 10269:2013 | 550, 589 |
| X3CrNiCu18-9-4 (continued) | ISO 16143-2:2004 | 550, 589 |
| X3CrNiMo13-4 | EN 10028-7:2007 | 159, 163, 439, 443 |
| | EN 10088-3:2014 | 521, 532 |
| | EN 10222-5:1999 | 364, 365 |
| | EN 10250-4:1999 | 364, 365 |
| | ISO 16143-2:2004 | 521, 532 |
| | ISO 9328-7:2004 | 159, 163, 439, 443 |
| X3CrNiMo17-12-3 | ISO 16143-1:2004 | 464, 488 |
| | ISO 9328-7:2004 | 167, 177, 464, 488 |
| X3CrNiMo17-13-3 | EN 10028-7:2007 | 167, 177, 464, 487 |
| | EN 10088-2:2014 | 167, 177, 464, 488 |
| | EN 10088-3:2014 | 545 |
| | EN 10216-5:2013 | 291, 305 |
| | EN 10217-7:2014 | 291, 305 |
| | EN 10222-5:1999 | 369, 375 |
| | EN 10250-4:1999 | 369, 375 |
| | EN 10263-5:2001 | 545, 571 |
| | EN 10296-2:2005 C2:2007 | 233, 238 |
| | EN 10297-2:2005 C1:2007 | 233, 238 |
| X3CrNiMoBN17-13-3 | EN 10028-7:2007 | 470, 501 |
| | EN 10302:2008 | 470, 501 |
| | ISO 9328-7:2004 | 470, 501 |
| X3CrNiMoN27-5-2 | EN 10250-4:1999 | 381, 383 |
| | EN 10294-2:2012 | 601, 605 |
| X3CrTi17 | EN 10028-7:2007 | 160, 164, 446, 454 |
| | EN 10088-2:2014 | 160, 164, 446, 454 |
| | EN 10296-2:2005 C2:2007 | 227, 231 |
| | EN 10297-2:2005 C1:2007 | 227, 231 |
| | ISO 16143-1:2004 | 446, 454 |
| | ISO 4955:2005 | 446, 454 |
| | ISO 9328-7:2004 | 160, 164, 446, 454 |
| X3NiCrMo17-13-3 | EN 10088-3:2014 | 570 |
| X5CrNi17-7 | EN 10088-2:2014 | 459, 475 |
| X5CrNi18-9 | ISO 16143-1:2004 | 460, 478 |
| | ISO 9327-5:1999 | 367, 373 |
| | ISO 9328-7:2004 | 165, 172, 460, 478 |
| X 5 CrNi 18 9 E | ISO 4954:1993 | 542, 557 |
| X5CrNi18-10 | EN 10028-7:2007 | 165, 171, 460, 478 |
| | EN 10088-2:2014 | 165, 171, 460, 478 |
| | EN 10088-3:2014 | 542, 556 |

| Designation | Specification | Page Number |
|---|---|---|
| X5CrNi18-10 (continued) | EN 10151:2002 | 621 |
| | EN 10216-5:2013 | 288, 298 |
| | EN 10217-7:2014 | 288, 298 |
| | EN 10222-5:1999 | 367, 373 |
| | EN 10250-4:1999 | 367, 373 |
| | EN 10263-5:2001 | 542, 557 |
| | EN 10294-2:2012 | 542, 557 |
| | EN 10296-2:2005 C2:2007 | 233, 239 |
| | EN 10297-2:2005 C1:2007 | 233, 239 |
| X 5 CrNi 18 12 E | ISO 4954:1993 | 543, 563 |
| X5CrNiCuNb16-4 | EN 10088-2:2014 | 505, 508 |
| | EN 10088-3:2014 | 593, 596 |
| | EN 10250-4:1999 | 379, 380 |
| X5CrNiMo17-12 | ISO 9327-5:1999 | 369, 375 |
| X5CrNiMo17-12-2 | EN 10028-7:2007 | 167, 177, 464, 487 |
| | EN 10088-2:2014 | 167, 177, 464, 488 |
| | EN 10088-3:2014 | 545, 569 |
| | EN 10151:2002 | 621 |
| | EN 10216-5:2013 | 291, 305 |
| | EN 10217-7:2014 | 291, 305 |
| | EN 10222-5:1999 | 369, 375 |
| | EN 10250-4:1999 | 369, 375 |
| | EN 10263-5:2001 | 545, 571 |
| | EN 10270-3:2011 | 621 |
| | EN 10294-2:2012 | 545, 571 |
| | EN 10296-2:2005 C2:2007 | 233, 238 |
| | EN 10297-2:2005 C1:2007 | 233, 238 |
| | ISO 16143-1:2004 | 464, 488 |
| | ISO 9328-7:2004 | 167, 177, 464, 488 |
| X 5 CrNiMo 17 12 2 E | ISO 4954:1993 | 545, 571 |
| X5CrNiMo17-13 | ISO 9327-5:1999 | 369, 375 |
| X5CrNiMoTi15-2 | DIN 5512-3:2004 | 445, 452 |
| | EN 10088-2:2014 | 159, 163, 445, 452 |
| X5CrNiN18-8 | ISO 9328-7:2004 | 166, 174, 461, 481 |
| X5CrNiN19-9 | EN 10028-7:2007 | 166, 174, 461, 481 |
| | EN 10088-2:2014 | 166, 174, 461, 481 |
| | EN 10088-3:2014 | 543, 561 |
| X5NiCrAlTi31-20 | EN 10028-7:2007 | 471, 502 |
| | EN 10302:2008 | 471, 502 |
| | ISO 9328-7:2004 | 471, 502 |
| X6Cr13 | EN 10088-2:2014 | 438, 441 |
| X6Cr13 (continued) | EN 10088-3:2014 | 534, 536 |
| | ISO 4955:2005 | 438, 441, 534, 536 |
| X6Cr17 | EN 10088-2:2014 | 446, 453 |
| | EN 10088-3:2014 | 534, 537 |
| | EN 10250-4:1999 | 366 |
| | EN 10263-5:2001 | 534, 537 |
| | EN 10296-2:2005 C2:2007 | 227, 230 |
| | EN 10297-2:2005 C1:2007 | 227, 230 |
| | ISO 16143-1:2004 | 446, 453 |
| | ISO 4955:2005 | 534, 537 |
| X 6 Cr 17 E | ISO 4954:1993 | 534, 537 |
| X6CrAl13 | EN 10088-2:2014 | 159, 162, 445, 450 |
| | EN 10297-2:2005 C1:2007 | 227, 228 |
| X6CrMo17-1 | EN 10088-2:2014 | 447, 454 |
| | EN 10088-3:2014 | 535, 539 |
| | EN 10263-5:2001 | 535, 539 |
| X 6 CrMo 17 1 E | ISO 4954:1993 | 535, 539 |
| X6CrMoNb17-1 | EN 10088-2:2014 | 447, 455 |
| X6CrMoS17 | EN 10088-3:2014 | 534, 538 |
| X6CrNi18-10 | EN 10028-7:2007 | 165, 172, 461, 480 |
| | EN 10216-5:2013 | 289, 301 |
| | EN 10222-5:1999 | 367, 374 |
| | ISO 9328-7:2004 | 165, 172, 461, 480 |
| X6CrNi23-13 | EN 10028-7:2007 | 166, 176, 463, 484 |
| | ISO 9328-7:2004 | 166, 176, 463, 484 |
| X6CrNi25-20 | EN 10028-7:2007 | 166, 176, 463, 486 |
| | ISO 9328-7:2004 | 166, 176, 463, 486 |
| X6CrNi25-21 | ISO 9327-5:1999 | 368, 375 |
| X6CrNiCu17-8-2 | ISO 16143-1:2004 | 460, 479 |
| X6CrNiCuS18-9-2 | EN 10088-3:2014 | 549, 587 |
| | ISO 16143-2:2004 | 549, 587 |
| X6CrNiMo17-13-2 | EN 10216-5:2013 | 293, 308 |
| X6CrNiMoNb17-12-2 | EN 10028-7:2007 | 168, 180, 466, 491 |
| | EN 10088-2:2014 | 168, 180, 466, 491 |
| | EN 10088-3:2014 | 546, 578 |
| | ISO 9328-7:2004 | 168, 180, 466, 491 |
| X6CrNiMoTi17-12 | ISO 9327-5:1999 | 370, 377 |
| X6CrNiMoTi17-12-2 | EN 10028-7:2007 | 168, 179, 466, 491 |
| | EN 10088-2:2014 | 168, 179, 466, 491 |
| | EN 10088-3:2014 | 546, 577 |

| Designation | Specification | Page Number |
|---|---|---|
| X6CrNiMoTi17-12-2 (continued) | EN 10216-5:2013 | 293, 308 |
| | EN 10217-7:2014 | 293, 308 |
| | EN 10250-4:1999 | 370, 377 |
| | EN 10263-5:2001 | 546, 578 |
| | EN 10294-2:2012 | 546, 578 |
| | EN 10296-2:2005 C2:2007 | 234, 240 |
| | EN 10297-2:2005 C1:2007 | 234, 240 |
| | ISO 16143-1:2004 | 466, 491 |
| | ISO 16143-2:2004 | 546 |
| | ISO 9328-7:2004 | 168, 179, 466, 491 |
| X 6 CrNiMoTi 17 12 2 E | ISO 4954:1993 | 546, 578 |
| X6CrNiMoTiB17-13 | EN 10302:2008 | 470, 499 |
| X6CrNiNb18-10 | EN 10028-7:2007 | 169, 183, 469, 498 |
| | EN 10088-2:2014 | 169, 183, 469, 498 |
| | EN 10088-3:2014 | 549, 586 |
| | EN 10216-5:2013 | 296, 313 |
| | EN 10217-7:2014 | 296, 313 |
| | EN 10222-5:1999 | 372, 379 |
| | EN 10296-2:2005 C2:2007 | 234, 241 |
| | EN 10297-2:2005 C1:2007 | 234, 241 |
| | ISO 16143-1:2004 | 469, 498 |
| | ISO 9327-5:1999 | 372, 379 |
| | ISO 9328-7:2004 | 169, 183, 469, 498 |
| X6CrNiSiNCe19-10 | EN 10296-2:2005 C2:2007 | 234, 241 |
| X6CrNiTi12 | EN 10028-7:2007 | 159, 163, 445, 452 |
| | EN 10088-2:2014 | 159, 163, 445, 452 |
| | ISO 9328-7:2004 | 159, 163, 445, 452 |
| X6CrNiTi18-10 | EN 10028-7:2007 | 169, 182, 468, 496 |
| | EN 10088-2:2014 | 169, 182, 468, 496 |
| | EN 10088-3:2014 | 548, 583 |
| | EN 10216-5:2013 | 295, 311 |
| | EN 10217-7:2014 | 295, 311 |
| | EN 10222-5:1999 | 371, 378 |
| | EN 10250-4:1999 | 371, 378 |
| | EN 10263-5:2001 | 548, 584 |
| | EN 10296-2:2005 C2:2007 | 234, 240 |
| | EN 10297-2:2005 C1:2007 | 234, 240 |
| | ISO 16143-1:2004 | 468, 496 |
| | ISO 9327-5:1999 | 371, 378 |
| | ISO 9328-7:2004 | 169, 182, 468, 496 |
| X 6 CrNiTi 18 10 E | ISO 4954:1993 | 548, 584 |
| X6CrNiTiB18-10 | EN 10028-7:2007 | 469, 499 |
| | EN 10302:2008 | 469, 499 |
| | ISO 9328-7:2004 | 469, 499 |
| X6NiCrSiNCe35-25 | EN 10095:1999 | 550, 588 |
| | ISO 4955:2005 | 550, 588 |
| X6NiCrTiMoVB25-15-2 | EN 10302:2008 | 471, 502, 550, 590 |
| X7CrNi18-9 | ISO 4955:2005 | 461, 480, 543, 562 |
| | ISO 9327-5:1999 | 367, 374 |
| X7CrNiAl17-7 | EN 10088-2:2014 | 505, 511 |
| | EN 10088-3:2014 | 593, 598 |
| | EN 10151:2002 | 621 |
| | EN 10270-3:2011 | 621 |
| | ISO 16143-1:2004 | 505, 512 |
| X7CrNiMo17-12 | ISO 9327-5:1999 | 370, 377 |
| X7CrNiNb18-10 | EN 10216-5:2013 | 296, 314 |
| | EN 10222-5:1999 | 372, 379 |
| | ISO 4955:2005 | 470, 501 |
| | ISO 9327-5:1999 | 372, 379 |
| X7CrNiSiNCe21-11 | ISO 4955:2005 | 549, 586 |
| X7CrNiTi18-10 | EN 10216-5:2013 | 295, 312 |
| | ISO 4955:2005 | 468, 497 |
| | ISO 9327-5:1999 | 371, 378 |
| X7CrS17 | ISO 16143-2:2004 | 534, 538 |
| X7Ni9 | EN 10028-4:2009 | 153, 154 |
| X8CrMnCuN17-8-3 | EN 10088-2:2014 | 470 |
| | EN 10088-3:2014 | 550 |
| | ISO 16143-1:2004 | 470, 499 |
| | ISO 16143-2:2004 | 550, 590 |
| X8CrMnCuNB17-8-3 | EN 10088-2:2014 | 499 |
| | EN 10088-3:2014 | 590 |
| X8CrMnNiN18-9-5 | EN 10088-3:2014 | 549, 585 |
| | ISO 16143-2:2004 | 549, 585 |
| X8CrNi25-21 | EN 10095:1999 | 463, 485 |
| | ISO 4955:2005 | 463, 485 |
| X8CrNiNb16-13 | EN 10028-7:2007 | 471, 501 |
| | EN 10302:2008 | 470, 499 |
| | ISO 9328-7:2004 | 471, 501 |
| X8CrNiS18-9 | EN 10088-3:2014 | 541, 554 |
| | EN 10294-2:2012 | 541, 554 |
| X8CrNiTi18-10 | EN 10095:1999 | 470, 501 |
| X8Ni9 | EN 10028-4:2009 | 153, 154 |
| | EN 10222-3:1998 | 357, 358 |

| Designation | Specification | Page Number |
|---|---|---|
| X8Ni9 (continued) | ISO 9327-3:1999 | 357, 358 |
| X8NiCrAlTi32-21 | EN 10028-7:2007 | 170, 184, 471, 503 |
| | ISO 4955:2005 | 471, 503 |
| | ISO 9328-7:2004 | 170, 184, 471, 503 |
| X9CrNi18-9 | EN 10088-3:2014 | 543, 562 |
| X10CrMoVNb9-1 | EN 10028-2:2009 | 146 |
| | EN 10216-2:2013 | 283, 285 |
| | EN 10222-2:1999 | 356 |
| | ISO 9329-2:1997 | 283, 285 |
| X10CrNi18-8 | EN 10088-2:2014 | 459, 475 |
| | EN 10088-3:2014 | 541, 552 |
| | EN 10151:2002 | 621 |
| | EN 10263-5:2001 | 541, 552 |
| | EN 10270-3:2011 | 621 |
| | ISO 16143-1:2004 | 459, 476 |
| X 10 CrNi 18 9 E | ISO 4954:1993 | 541, 553 |
| X10Ni9 | EN 10216-4:2013 | 251, 254 |
| | ISO 9329-3:1997 | 251, 254 |
| | ISO 9330-5:2000 | 251, 254 |
| X10NiCrAlTi32-21 | EN 10095:1999 | 471, 502 |
| X11 CrMo 5 TA | ISO 9329-2:1997 | 280, 282 |
| X11 CrMo 5 TN+TT | ISO 9329-2:1997 | 280, 282 |
| X11 CrMo 9-1 TA | ISO 9329-2:1997 | 283, 284 |
| X11 CrMo 9-1 TN+TT | ISO 9329-2:1997 | 283, 284 |
| X11CrMo5+I | EN 10216-2:2013 | 280, 281 |
| X11CrMo5+NT1 | EN 10216-2:2013 | 280, 281 |
| X11CrMo5+NT2 | EN 10216-2:2013 | 280, 281 |
| X11CrMo9-1+I | EN 10216-2:2013 | 283, 284 |
| X11CrMo9-1+NT | EN 10216-2:2013 | 283, 284 |
| X11CrNiMnN19-8-6 | EN 10088-2:2014 | 469, 498 |
| | EN 10088-3:2014 | 549, 585 |
| | EN 10151:2002 | 469, 498 |
| | ISO 16143-1:2004 | 469, 498 |
| | ISO 16143-2:2004 | 549, 585 |
| X12Cr13 | EN 10088-2:2014 | 438, 440 |
| | EN 10088-3:2014 | 519, 524 |
| | EN 10250-4:1999 | 364, 365 |
| | EN 10263-5:2001 | 519, 525 |
| | EN 10297-2:2005 C1:2007 | 227, 229 |
| | ISO 16143-1:2004 | 438, 440 |
| X 12 Cr 13 E | ISO 4954:1993 | 519, 525 |
| X 12 Ni 5 | ISO 9329-3:1997 | 251, 253 |
| | ISO 9330-3:1997 | 251, 253 |

| Designation | Specification | Page Number |
|---|---|---|
| X 12 Ni 5 (continued) | ISO 9330-5:2000 | 251, 253 |
| X12CrCoNi21-20 | EN 10302:2008 | 471, 502 |
| X12CrMnNiN17-7-5 | EN 10088-2:2014 | 458, 473 |
| | EN 10088-3:2014 | 541, 551 |
| | ISO 16143-1:2004 | 458, 473 |
| X12CrMnNiN18-9-5 | EN 10088-2:2014 | 458, 474 |
| X12CrMo5 | EN 10028-2:2009 | 145 |
| X12CrMo5-1 | ISO 9327-2:1999 | 355, 356 |
| X12CrNi23-13 | EN 10095:1999 | 463, 484 |
| | ISO 4955:2005 | 463, 484 |
| X12CrNiMoV12-3 | EN 10269:2013 | 521, 531 |
| | EN 10302:2008 | 521, 531 |
| X12CrS13 | EN 10088-3:2014 | 519, 526, 615 |
| X12Ni5 | EN 10028-4:2009 | 153 |
| | EN 10216-4:2013 | 251, 253 |
| | EN 10222-3:1998 | 357, 358 |
| X12NiCrSi35-16 | EN 10095:1999 | 468, 497 |
| X15CrN26 | ISO 4955:2005 | 448, 456 |
| X15CrNiSi25-21 | EN 10095:1999 | 463, 485, 545, 567 |
| X16CrMo5-1 | EN 10222-2:1999 | 355, 356 |
| X17CrNi16-2 | EN 10088-3:2014 | 520, 530 |
| X18CrN28 | EN 10095:1999 | 535, 540 |
| X 19 CrNi 16 2 E | ISO 4954:1993 | 520, 530 |
| X19CrMoNbVN11-1 | EN 10269:2013 | 521, 532 |
| X20Cr13 | EN 10088-2:2014 | 439, 442 |
| | EN 10088-3:2014 | 520, 527 |
| | ISO 16143-1:2004 | 439, 442 |
| X20CrMoV11-1 | EN 10222-2:1999 | 357 |
| X20CrMoV12-1 | ISO 9327-2:1999 | 357 |
| X29CrS13 | EN 10088-3:2014 | 520, 529 |
| X30Cr13 | EN 10088-2:2014 | 439, 443 |
| | EN 10088-3:2014 | 520, 528 |
| | EN 10151:2002 | 621 |
| | ISO 16143-1:2004 | 439, 443 |
| X30WCrV9-3 | ISO 4957:1999 | 627 |
| X35CrWMoV5 | ISO 4957:1999 | 626 |
| X37CrMoV5-1 | ISO 4957:1999 | 626 |
| X39Cr13 | EN 10088-2:2014 | 439, 444 |
| | EN 10088-3:2014 | 521, 533 |
| | EN 10151:2002 | 621 |
| | ISO 16143-1:2004 | 439, 444 |
| X40CrMoV5-1 | ISO 4957:1999 | 626 |
| X53CrMnNiNbN21-9 | EN 10090:1998 | 549, 587 |

| Designation | Specification | Page Number |
|---|---|---|
| X70CrMo15 | EN 10088-3:2014 | 520, 531 |
| X90CrMoV18 | EN 10088-3:2014 | 521, 533 |
| X 53CrMnNiNbN21 9 | ISO 683-15:1992 | 549, 587 |
| X100CrMoV5 | ISO 4957:1999 | 625 |
| X105CrMo17 | EN 10088-3:2014 | 521, 531 |
| X210Cr12 | ISO 4957:1999 | 625 |
| XM-21 | ASME SA-276 | 543, 562 |
| | ASTM A276/A276M-15 | 543, 562 |
| XM-27 | ASME SA-240/SA-240M | 448, 457 |
| | ASME SA-276 | 535, 540 |
| | ASME SA-479/SA-479M | 535, 540 |
| | ASTM A240/A240M-15a | 448, 457 |
| | ASTM A276/A276M-15 | 535, 540 |
| | ASTM A479/A479M-14 | 535, 540 |
| XM-32 | ASTM A565/A565M-10 | 521, 531 |
| Y1Cr13 | GB 1220-92 | 519, 526 |
| | GB 4226-84 | 519 |
| Y1Cr17 | GB 1220-92 | 534, 538 |
| | GB 4226-84 | 534 |
| Y1Cr18Ni9 | GB 1220-92 | 541, 554 |
| | GB 4226-84 | 541 |
| Y1Cr18Ni9Se | GB 1220-92 | 541, 554 |
| | GB 4226-84 | 541 |
| Y3Cr13 | GB 1220-92 | 520, 529 |
| | GB 4226-84 | 520 |
| Y11Cr17 | GB 1220-92 | 521, 533 |
| Y12 | GB 8731-88 | 611 |
| Y12Pb | GB 8731-88 | 614 |
| Y15 | GB 8731-88 | 613 |
| Y15Pb | GB 8731-88 | 614 |
| Y20 | GB 8731-88 | 611 |
| Y30 | GB 8731-88 | 611 |
| Y35 | GB 8731-88 | 612 |
| Y40Mn | GB 8731-88 | 612 |
| Y45Ca | GB 8731-88 | 613 |
| YF35V | GB/T 15712-1995 | 337, 339 |
| YF40V | GB/T 15712-1995 | 338, 340 |
| Z 100 MD 6 1-M | AFNOR NF A 32-058:1984 | 400, 401 |
| Z 100 MN 13 4-M | AFNOR NF A 32-058:1984 | 400, 401 |
| Z 110 MD 12 1-M | AFNOR NF A 32-058:1984 | 400, 401 |
| Z 120 M 12-M | AFNOR NF A 32-058:1984 | 400, 401 |
| Z 120 MC 12-M | AFNOR NF A 32-058:1984 | 400, 401 |
| Z 120MC 17 2-M | AFNOR NF A 32-058:1984 | 400, 401 |
| ZG 200-400 | GB 11352-89 | 389, 392 |
| ZG 230-450 | GB 11352-89 | 389, 393 |
| ZG 270-500 | GB 11352-89 | 390, 394 |
| ZG 310-570 | GB 11352-89 | 391, 394 |
| ZG 340-640 | GB 11352-89 | 391, 394 |
| ZG03Cr18Ni10 | GB/T 16253-1996 | 422, 424 |
| ZG03Cr19Ni11Mo2 | GB/T 16253-1996 | 423, 425 |
| ZG03Cr19Ni11Mo3 | GB/T 16253-1996 | 423, 425 |
| ZG03Cr26Ni5Cu3Mo3N | GB/T 2100-2002 | 416, 418 |
| ZG03Cr26Ni5Mo3N | GB/T 2100-2002 | 416, 418 |
| ZG07Cr18Ni10D | GB/T 16253-1996 | 423, 425 |
| ZG07Cr19Ni11Mo2 | GB/T 16253-1996 | 422, 424 |
| ZG07Cr19Ni11Mo2G | GB/T 16253-1996 | 423, 425 |
| ZG07Cr19Ni11Mo3 | GB/T 16253-1996 | 422, 424 |
| ZG07Cr20Ni10 | GB/T 16253-1996 | 422, 424 |
| ZG07Cr20Ni10G | GB/T 16253-1996 | 423, 425 |
| ZG08Cr12Ni1MoG | GB/T 16253-1996 | 420, 421 |
| ZG08Cr12Ni4Mo1D | GB/T 16253-1996 | 419, 421 |
| ZG08Cr12Ni4Mo1G | GB/T 16253-1996 | 419, 421 |
| ZG08Cr19Ni11Mo2Nb | GB/T 16253-1996 | 422, 424 |
| ZG08Cr20Ni10Nb | GB/T 16253-1996 | 422, 424 |
| ZG12Cr2Mo1G | GB/T 16253-1996 | 407, 408 |
| ZG14Cr12Ni1MoG | GB/T 16253-1996 | 419, 421 |
| ZG14Cr9Mo1G | GB/T 16253-1996 | 407, 408 |
| ZG14MoVG | GB/T 16253-1996 | 407, 408 |
| ZG14Ni4D | GB/T 16253-1996 | 409, 411 |
| ZG15Cr1MoG | GB/T 16253-1996 | 406, 408 |
| ZG16Cr2Mo1G | GB/T 16253-1996 | 407, 408 |
| ZG16Cr5MoG | GB/T 16253-1996 | 407, 408 |
| ZG17Cr1Mo1VG | GB/T 16253-1996 | 406, 408 |
| ZG19MoG | GB/T 16253-1996 | 406, 407 |
| ZG20Cr2Mo1D | GB/T 16253-1996 | 410, 412 |
| ZG22Ni3Cr2MoAD | GB/T 16253-1996 | 410, 412 |
| ZG22Ni3Cr2MoBD | GB/T 16253-1996 | 410, 412 |
| ZG23Cr12Mo1NiVG | GB/T 16253-1996 | 420, 421 |
| ZG24Ni2MoD | GB/T 16253-1996 | 410, 412 |
| ZG29Cr1MoD | GB/T 16253-1996 | 410, 412 |
| ZG200-400H | GB 7659-87 | 389, 392 |
| ZG230-450H | GB 7659-87 | 389, 393 |
| ZG240-450A | GB/T 16253-1996 | 396, 397 |
| ZG240-450AG | GB/T 16253-1996 | 396, 397 |
| ZG240-450B | GB/T 16253-1996 | 396, 397 |
| ZG240-450BD | GB/T 16253-1996 | 398, 399 |

| Designation | Specification | Page Number |
|---|---|---|
| ZG240-450BG | GB/T 16253-1996 | 396, 397 |
| ZG275-485H | GB 7659-87 | 390, 393 |
| ZG280-520 | GB/T 16253-1996 | 396, 397 |
| ZG280-520D | GB/T 16253-1996 | 398, 399 |
| ZG280-520G | GB/T 16253-1996 | 396, 397 |
| ZGD270-480 | GB/T 14408-93 | 390, 393 |
| ZGD290-510 | GB/T 14408-93 | 390, 394 |
| ZGD345-570 | GB/T 14408-93 | 390, 394 |
| ZGD410-620 | GB/T 14408-93 | 391, 394 |
| ZGD535-720 | GB/T 14408-93 | 392, 395 |
| ZGD650-830 | GB/T 14408-93 | 392, 395 |
| ZGD730-910 | GB/T 14408-93 | 392, 395 |
| ZGD840-1030 | GB/T 14408-93 | 392, 395 |
| ZGMn13-1 | GB/T 5680-1998 | 400, 401 |
| ZGMn13-2 | GB/T 5680-1998 | 400, 401 |
| ZGMn13-3 | GB/T 5680-1998 | 400, 401 |
| ZGMn13-4 | GB/T 5680-1998 | 400, 401 |
| ZGMn13-5 | GB/T 5680-1998 | 400 |

# *UNS NUMBER INDEX*

| UNS Number | Page Number |
|---|---|
| D50400 | 390, 394 |
| D50500 | 390, 394 |
| D50600 | 391, 394 |
| D50850 | 392, 395 |
| D50950 | 392, 395 |
| D51150 | 392, 395 |
| D51350 | 392, 395 |
| G10050 | 21 |
| G10060 | 21 |
| G10080 | 21, 198, 199, 200, 202, 204, 213, 214, 215, 217, 218 |
| G10100 | 21, 198, 199, 200, 202, 204, 205, 213, 214, 215, 217, 218, 219 |
| G10110 | 205, 219 |
| G10120 | 22 |
| G10150 | 22, 199, 200, 202, 204, 205, 206, 213, 214, 215, 217, 218, 220 |
| G10160 | 22, 206, 220 |
| G10170 | 23, 206, 220 |
| G10180 | 23, 206, 220 |
| G10181 | 44 |
| G10190 | 23 |
| G10200 | 23, 24, 200, 201, 204, 205, 207, 214, 215, 217, 218, 219, 220, 221 |
| G10210 | 23, 24, 200, 201, 204, 206, 207, 214, 215, 219, 220, 221 |
| G10220 | 23, 24 |
| G10230 | 24 |
| G10231 | 44 |
| G10250 | 24, 201, 202, 205, 207, 208, 215, 219, 220, 221 |
| G10260 | 24, 204, 207, 208, 209, 217, 218, 220, 221, 222 |
| G10290 | 25 |
| G10291 | 44 |
| G10300 | 25, 204, 205, 207, 209, 210, 217, 218, 219, 220, 222, 223 |
| G10301 | 44 |
| G10340 | 26 |
| G10350 | 26, 204, 205, 206, 208, 209, 210, 211, 217, 219, 220, 221, 222, 223 |
| G10370 | 26 |
| G10380 | 26 |
| G10381 | 44 |
| G10390 | 27 |
| G10400 | 27, 205, 206, 210, 211, 219, 220, 222, 223, 616 |
| G10401 | 44 |
| G10420 | 27 |
| G10430 | 27 |
| G10440 | 28 |
| G10450 | 28, 205, 208, 209, 210, 219, 221, 222, 223 |
| G10451 | 44 |
| G10460 | 28 |
| G10490 | 29 |
| G10500 | 29, 206, 208, 209, 220, 222, 616 |
| G10501 | 44 |
| G10530 | 29 |
| G10550 | 30, 616 |
| G10590 | 31 |
| G10600 | 31, 616 |
| G10640 | 32, 615, 617 |
| G10650 | 32, 615, 617 |
| G10690 | 32 |
| G10700 | 32, 615, 617 |
| G10740 | 33, 617 |
| G10750 | 33 |
| G10780 | 33 |
| G10800 | 33, 617 |
| G10840 | 33, 616 |
| G10850 | 617 |
| G10860 | 33, 616, 618 |
| G10900 | 34 |
| G10950 | 34, 618 |
| G11090 | 611 |
| G11100 | 205, 219, 611 |
| G11170 | 611 |
| G11180 | 611 |
| G11320 | 611 |
| G11370 | 612 |
| G11380 | 612 |
| G11390 | 612 |
| G11400 | 612 |
| G11410 | 612 |
| G11440 | 612 |
| G11460 | 613 |
| G11510 | 613 |
| G12120 | 613 |
| G12130 | 613 |
| G12134 | 614 |
| G12144 | 614 |
| G12150 | 613 |
| G15220 | 34 |
| G15221 | 44 |

| UNS Number | Page Number |
|---|---|
| G15240 | 34, 206, 210, 211, 220, 222, 223 |
| G15360 | 34 |
| G15410 | 35 |
| G15470 | 35 |
| G15520 | 35 |
| G40280 | 224, 225 |
| G41180 | 39 |
| G41200 | 39 |
| G41210 | 39 |
| G41300 | 40, 224, 225 |
| G41350 | 224, 226 |
| G41370 | 40, 224, 226 |
| G41400 | 41, 224, 226 |
| G41420 | 224, 226 |
| G41450 | 41 |
| G41500 | 41 |
| G43200 | 42 |
| G43400 | 42 |
| G43406 | 42 |
| G50441 | 45 |
| G50461 | 45 |
| G50501 | 45 |
| G50601 | 45 |
| G51200 | 36 |
| G51300 | 36 |
| G51320 | 37 |
| G51350 | 37 |
| G51351 | 45 |
| G51400 | 37 |
| G51450 | 38 |
| G51500 | 38 |
| G51601 | 45 |
| G52986 | 628 |
| G61500 | 45 |
| G86200 | 42 |
| G86400 | 43 |
| G93106 | 43 |
| J02003 | 389, 390, 393 |
| J02500 | 389, 393 |
| J02501 | 390, 393 |
| J02502 | 396, 397 |
| J02503 | 396, 397, 398, 399 |
| J02504 | 398, 399 |
| J02505 | 398, 399 |
| J02508 | 389, 390, 393 |
| J03000 | 389, 393 |
| J03001 | 389, 393 |
| J03002 | 396, 397, 398, 399 |
| J03003 | 398, 399 |
| J03012 | 389, 390, 393, 394 |
| J03501 | 390, 393 |
| J04003 | 390, 391, 393, 394 |
| J04502 | 390, 391, 392, 394, 395 |
| J12072 | 406, 407 |
| J12092 | 406, 408 |
| J12522 | 409, 411 |
| J12524 | 406, 407 |
| J12582 | 410, 412 |
| J13502 | 402, 404 |
| J14045 | 402, 404 |
| J21890 | 406, 408 |
| J22091 | 406, 408 |
| J22092 | 410, 412 |
| J22500 | 409, 411 |
| J22501 | 409, 411 |
| J23259 | 403, 405 |
| J31500 | 409, 411 |
| J31550 | 409, 411 |
| J42045 | 407, 408 |
| J42065 | 410, 412 |
| J42215 | 410, 412 |
| J42220 | 410, 412 |
| J82090 | 407, 408 |
| J91109 | 400, 401 |
| J91119 | 400, 401 |
| J91129 | 400, 401 |
| J91139 | 400, 401 |
| J91149 | 400, 401 |
| J91150 | 413, 414, 419, 421 |
| J91151 | 413, 414 |
| J91153 | 413, 414 |
| J91249 | 400, 401 |
| J91309 | 400, 401 |
| J91339 | 400, 401 |
| J91340 | 400, 401 |
| J91459 | 400, 401 |

| UNS Number | Page Number |
|---|---|
| J91540 | 413, 414, 419, 421 |
| J91550 | 419, 421 |
| J92500 | 415, 417 |
| J92600 | 415, 417, 422, 424 |
| J92602 | 415, 417 |
| J92603 | 426, 430 |
| J92605 | 426, 430 |
| J92613 | 426, 430 |
| J92700 | 422, 424 |
| J92710 | 415, 417, 422, 424 |
| J92800 | 415, 417, 423, 425 |
| J92803 | 426, 430 |
| J92804 | 416, 418 |
| J92900 | 415, 417, 422, 424 |
| J92901 | 423, 425 |
| J92999 | 416, 418 |
| J93000 | 416, 418 |
| J93005 | 426, 430 |
| J93015 | 426, 430 |
| J93254 | 416, 418 |
| J93303 | 427, 431 |
| J93402 | 416, 418 |
| J93403 | 426, 430 |
| J93413 | 426 |
| J93503 | 427, 431 |
| J93513 | 427, 431 |
| J93633 | 427, 431 |
| J94003 | 427, 431 |
| J94013 | 427, 431 |
| J94203 | 427, 431 |
| J94204 | 427, 431 |
| J94213 | 428, 432 |
| J94214 | 428 |
| J94224 | 427, 431 |
| J94651 | 416, 418 |
| J94652 | 416, 418 |
| K01200 | 260, 264 |
| K01201 | 260, 264 |
| K01400 | 51, 66 |
| K01701 | 128, 131 |
| K01702 | 53, 66 |
| K01802 | 74, 80 |
| K01807 | 260, 264 |
| K02004 | 206, 220 |
| K02005 | 206, 220 |
| K02007 | 129, 132 |
| K02008 | 119, 127 |
| K02010 | 129, 130, 132, 133 |
| K02100 | 114, 122 |
| K02203 | 129, 132 |
| K02301 | 56, 67 |
| K02401 | 55, 67, 114, 121, 122 |
| K02403 | 114, 123 |
| K02404 | 60, 70 |
| K02501 | 260, 264 |
| K02503 | 112, 120 |
| K02504 | 255, 258 |
| K02505 | 114, 122 |
| K02509 | 255, 258 |
| K02595 | 57, 68 |
| K02596 | 57, 68 |
| K02597 | 57, 68 |
| K02598 | 57, 68 |
| K02599 | 57, 68 |
| K02700 | 115, 124, 125 |
| K02701 | 60, 70 |
| K02702 | 59, 69 |
| K02703 | 60, 70 |
| K02704 | 114, 123 |
| K02705 | 204, 219 |
| K02707 | 261, 262, 265 |
| K02709 | 263, 266 |
| K02800 | 114, 122, 123 |
| K03000 | 199, 203, 214, 217 |
| K03003 | 257, 259 |
| K03004 | 257, 259 |
| K03005 | 257, 259 |
| K03006 | 248, 250, 262, 263, 265, 266 |
| K03008 | 246, 249 |
| K03009 | 342, 345 |
| K03010 | 257, 259 |
| K03011 | 342, 343, 345, 346 |
| K03012 | 257, 259 |
| K03017 | 342, 345, 346 |
| K03018 | 257, 259 |
| K03020 | 342, 345 |

| UNS Number | Page Number |
|---|---|
| K03101 | 115, 124, 125 |
| K03102 | 115, 125 |
| K03103 | 117, 118, 126 |
| K03501 | 263, 266 |
| K03503 | 262, 265 |
| K03504 | 342, 345, 346 |
| K03506 | 342, 345 |
| K11422 | 268, 269 |
| K11510 | 76, 81 |
| K11522 | 268, 269 |
| K11547 | 271, 272 |
| K11562 | 274, 275 |
| K11564 | 350 |
| K11572 | 351 |
| K11576 | 90, 95 |
| K11597 | 276, 277 |
| K11630 | 90, 95 |
| K11646 | 90, 95 |
| K11757 | 141 |
| K11789 | 142 |
| K11820 | 134, 138 |
| K11856 | 90, 95 |
| K11947 | 77, 82 |
| K12000 | 77, 82 |
| K12001 | 115, 124, 125 |
| K12020 | 134, 135, 138 |
| K12021 | 136, 139 |
| K12022 | 137, 139 |
| K12023 | 268, 269 |
| K12037 | 77, 82 |
| K12039 | 155, 156 |
| K12042 | 362 |
| K12043 | 77, 82 |
| K12045 | 362 |
| K12054 | 157, 158 |
| K12122 | 349 |
| K12202 | 79, 84, 119, 127 |
| K12320 | 134, 135, 138 |
| K12437 | 115, 118, 124, 125, 127 |
| K12447 | 118, 126 |
| K12520 | 348 |
| K12521 | 137, 139 |
| K12539 | 155, 156 |
| K12554 | 157, 158 |
| K12765 | 361 |
| K12766 | 361 |
| K12822 | 348 |
| K13502 | 342, 343, 345, 346 |
| K19667 | 628 |
| K20747 | 86, 88, 89, 92, 94 |
| K21001 | 273 |
| K21590 | 143, 278, 279, 352, 353 |
| K21604 | 90, 95 |
| K21650 | 90, 95 |
| K21703 | 149, 150 |
| K22103 | 149, 150 |
| K24065 | 43 |
| K31545 | 144, 354 |
| K31718 | 151, 152 |
| K31830 | 354, 355 |
| K31835 | 352, 353 |
| K31918 | 248, 250, 251, 253 |
| K32018 | 151, 152 |
| K32025 | 357, 358 |
| K41545 | 280, 281, 355, 356 |
| K42343 | 363 |
| K42544 | 355, 356 |
| K50400 | 284 |
| K51545 | 280, 281 |
| K71340 | 153, 154 |
| K81340 | 153, 154, 248, 250, 251, 254 |
| K90901 | 146, 283, 285 |
| K90941 | 283, 284, 356 |
| K91061 | 273 |
| K91560 | 146, 283, 285 |
| K92460 | 283, 285 |
| N06006 | 429, 432 |
| N06050 | 429 |
| N08001 | 429, 432 |
| N08004 | 428, 432 |
| N08005 | 428 |
| N08006 | 429 |
| N08007 | 416, 418, 423, 425 |
| N08030 | 428, 432 |
| N08050 | 428 |
| N08366 | 472, 503 |

| UNS Number | Page Number |
|---|---|
| N08367 | 170, 184, 297, 315, 472, 503, 550, 590 |
| N08604 | 427, 431 |
| N08605 | 428, 432 |
| N08613 | 427 |
| N08614 | 427 |
| N08705 | 428, 432 |
| N08800 | 297, 314, 471, 502 |
| N08810 | 170, 184, 297, 314, 471, 503 |
| N08811 | 471, 503 |
| N08904 | 170, 183, 297, 315, 472, 504 |
| N08925 | 297, 315 |
| N08926 | 170, 184, 297, 315, 472, 503 |
| S15700 | 593, 599 |
| S17400 | 379, 380, 505, 506, 507, 593, 594, 595 |
| S17700 | 505, 510, 511, 593, 597, 621 |
| S18235 | 534, 538 |
| S20100 | 458, 473, 541, 551 |
| S20103 | 458, 474 |
| S20153 | 458, 474 |
| S20200 | 458, 474, 541, 551 |
| S30100 | 459, 475 |
| S30103 | 459, 476 |
| S30153 | 165, 171, 459, 477 |
| S30200 | 233, 239, 459, 477, 541, 553, 621 |
| S30300 | 541, 554, 615 |
| S30323 | 541, 554, 615 |
| S30400 | 165, 171, 232, 235, 288, 298, 367, 373, 460, 478, 542, 555, 556, 621 |
| S30403 | 165, 173, 232, 236, 288, 289, 299, 367, 373, 461, 479, 542, 558 |
| S30409 | 165, 172, 289, 301, 367, 374, 461, 480, 543, 562 |
| S30415 | 234, 241 |
| S30451 | 166, 174, 288, 299, 368, 374, 461, 481, 543, 560, 561 |
| S30452 | 543, 562 |
| S30453 | 166, 175, 233, 238, 289, 300, 368, 374, 462, 482, 543, 561 |
| S30500 | 462, 483, 543, 562 |
| S30600 | 462, 483 |
| S30815 | 549, 586 |
| S30900 | 544, 564 |
| S30908 | 290, 302, 463, 484, 544, 564 |
| S30909 | 166, 176, 290, 303, 463, 484 |
| S31000 | 368, 375, 544, 564 |
| S31008 | 290, 303, 368, 375, 463, 485, 544, 565 |
| S31009 | 166, 176, 290, 304, 368, 375, 463, 486 |
| S31050 | 464, 486 |
| S31060 | 470, 499 |
| S31200 | 381, 383 |
| S31254 | 464, 487, 545, 566 |
| S31266 | 470, 500 |
| S31277 | 170, 184, 472, 503 |
| S31400 | 545, 567 |
| S31500 | 243, 244 |
| S31600 | 167, 177, 232, 237, 291, 305, 369, 375, 464, 487, 545, 568, 621 |
| S31603 | 167, 178, 232, 238, 292, 306, 369, 376, 465, 489, 546, 572 |
| S31609 | 293, 308, 370, 377 |
| S31635 | 168, 179, 466, 491, 546, 576 |
| S31640 | 168, 180, 466, 491, 546, 578 |
| S31651 | 367, 373, 466, 492, 547, 579 |
| S31653 | 168, 180, 233, 239, 292, 307, 370, 376, 467, 493, 547, 580 |
| S31700 | 233, 239, 293, 309, 370, 377, 467, 494, 548, 581 |
| S31703 | 168, 181, 294, 309, 370, 377, 467, 494 |
| S31725 | 234, 242, 294, 310 |
| S31726 | 169, 182, 468, 495 |
| S31753 | 169, 181, 468, 495 |
| S31803 | 185, 186, 243, 244, 381, 383, 513, 515, 600, 602 |
| S32100 | 169, 182, 233, 234, 240, 295, 311, 371, 378, 468, 496, 548, 582 |
| S32109 | 295, 312, 371, 378, 468, 497, 548, 582 |
| S32205 | 185, 186, 243, 244, 381, 383, 513, 515, 600, 602 |
| S32304 | 185, 186, 243, 244, 513, 516, 600, 602 |
| S32506 | 600, 603 |
| S32520 | 185, 187, 382, 384, 513, 516 |
| S32550 | 382, 384, 601, 605 |
| S32654 | 470, 500, 545, 566 |
| S32750 | 185, 187, 243, 245, 381, 383, 514, 517, 600, 604 |
| S32760 | 185, 187, 243, 244, 382, 384, 514, 517, 600, 604 |
| S32900 | 514, 518 |
| S32906 | 243, 245, 514, 518, 601, 605 |
| S34565 | 470, 500, 547, 579 |
| S34700 | 169, 183, 234, 241, 296, 313, 372, 379, 469, 498, 549, 586 |
| S34709 | 296, 314, 372, 379, 470, 501, 549, 586 |
| S34710 | 296, 314 |
| S34800 | 372, 379, 549, 586 |
| S35315 | 550, 588 |
| S40300 | 438, 440, 519, 522 |
| S40500 | 159, 162, 227, 228, 445, 450, 534, 536 |
| S40900 | 227, 228, 286, 287 |

| UNS Number | Page Number |
|---|---|
| S40945 | 445, 451 |
| S40975 | 445, 451 |
| S40977 | 159, 162, 445, 451 |
| S41000 | 227, 229, 286, 287, 364, 365, 438, 519, 523 |
| S41005 | 364, 365 |
| S41008 | 438, 441 |
| S41026 | 364, 365 |
| S41050 | 159, 162, 445, 451 |
| S41500 | 159, 163, 364, 365, 439, 443, 521, 532 |
| S41600 | 519, 526, 615 |
| S42000 | 439, 442, 520, 527 |
| S42020 | 520, 528 |
| S42035 | 159, 163, 445, 452 |
| S42200 | 521, 532 |
| S42900 | 446, 452 |
| S43000 | 227, 230, 286, 287, 366, 446, 453, 534, 538 |
| S43020 | 534, 538, 615 |
| S43035 | 160, 163, 227, 231, 447, 455 |
| S43100 | 520, 529 |
| S43400 | 447, 454 |
| S43600 | 447, 455 |
| S43932 | 160, 163, 447, 455 |
| S43940 | 160, 163, 447, 455 |
| S44002 | 520, 531 |
| S44003 | 520, 531 |
| S44004 | 521, 531 |
| S44020 | 521, 533 |
| S44400 | 161, 164, 448, 456 |
| S44600 | 448, 456, 535, 540 |
| S44627 | 286, 287, 448, 457, 535, 540 |
| S44700 | 535, 540 |
| S44735 | 449, 457 |
| S50200 | 145 |
| S50400 | 283, 284 |
| S50460 | 140 |
| S64152 | 521, 531 |
| S66286 | 550, 590 |
| T11301 | 623 |
| T11302 | 624 |
| T11304 | 624 |
| T11307 | 624 |
| T11313 | 624 |
| T11323 | 624 |
| T11336 | 624 |
| T11342 | 625 |
| T12001 | 623 |
| T12004 | 623 |
| T12005 | 623 |
| T12015 | 623 |
| T20810 | 626 |
| T20811 | 626 |
| T20812 | 626 |
| T20813 | 626 |
| T20819 | 627 |
| T20821 | 627 |
| T30102 | 625 |
| T30106 | 626 |
| T30402 | 625 |
| T30403 | 625 |
| T31501 | 626 |
| T31502 | 626 |
| T41901 | 627 |
| T41905 | 627 |
| T41907 | 627 |
| T60602 | 627 |
| T61203 | 627 |
| T61206 | 627 |
| T72301 | 622, 625 |
| T72302 | 622 |

# *STEEL NUMBER INDEX*

| Steel Number | Page Number |
|---|---|
| 1.0031 | 198, 213 |
| 1.0033 | 198, 199, 201, 202, 213, 215, 217 |
| 1.0034 | 198, 199, 200, 201, 204, 213, 214, 215, 219 |
| 1.0035 | 51, 66 |
| 1.0038 | 54, 67, 333, 339 |
| 1.0044 | 59, 69 |
| 1.0045 | 63, 72 |
| 1.0050 | 61, 70 |
| 1.0060 | 64, 73 |
| 1.0070 | 65, 73 |
| 1.0107 | 255, 258 |
| 1.0108 | 255, 258 |
| 1.0111 | 112, 120 |
| 1.0114 | 54, 67 |
| 1.0116 | 333, 339 |
| 1.0143 | 59, 69 |
| 1.0212 | 198, 199, 202, 205, 213, 216, 219 |
| 1.0215 | 199, 214 |
| 1.0220 | 200, 214 |
| 1.0225 | 202, 203, 205, 208, 209, 216, 217, 221, 222 |
| 1.0236 | 206, 219 |
| 1.0237 | 203, 217 |
| 1.0254 | 256, 258 |
| 1.0255 | 256, 258 |
| 1.0258 | 256, 259 |
| 1.0259 | 256, 259 |
| 1.0261 | 206, 219, 220 |
| 1.0300 | 21 |
| 1.0304 | 21 |
| 1.0308 | 199, 200, 201, 202, 204, 205, 206, 207, 214, 215, 216, 218, 219, 220, 221 |
| 1.0310 | 21 |
| 1.0311 | 22 |
| 1.0313 | 21 |
| 1.0345 | 112, 120, 261, 264 |
| 1.0348 | 260, 264 |
| 1.0352 | 342, 345 |
| 1.0402 | 23, 334, 339 |
| 1.0406 | 334, 339 |
| 1.0408 | 202, 205, 208, 209, 216, 219, 221, 222 |
| 1.0413 | 22 |
| 1.0414 | 23 |
| 1.0415 | 24 |
| 1.0416 | 23 |

| Steel Number | Page Number |
|---|---|
| 1.0420 | 389, 392 |
| 1.0423 | 113, 121 |
| 1.0425 | 113, 121, 262, 265 |
| 1.0426 | 342, 345 |
| 1.0436 | 343, 346 |
| 1.0437 | 115, 124 |
| 1.0446 | 389, 393 |
| 1.0449 | 389, 392 |
| 1.0451 | 246, 249 |
| 1.0452 | 246, 249 |
| 1.0453 | 248, 250 |
| 1.0455 | 389, 393 |
| 1.0456 | 201, 203, 215, 217 |
| 1.0473 | 117, 126 |
| 1.0477 | 341, 344 |
| 1.0478 | 341, 344 |
| 1.0481 | 115, 124 |
| 1.0487 | 112, 120 |
| 1.0488 | 128, 131 |
| 1.0501 | 26, 336, 339 |
| 1.0503 | 28, 337, 339 |
| 1.0509 | 208, 209, 210, 211, 212, 221, 222, 223 |
| 1.0511 | 27, 336, 339 |
| 1.0516 | 26 |
| 1.0517 | 28 |
| 1.0518 | 30 |
| 1.0528 | 335, 339 |
| 1.0530 | 25 |
| 1.0535 | 30, 338, 340 |
| 1.0536 | 211, 223 |
| 1.0540 | 338, 340 |
| 1.0541 | 27 |
| 1.0553 | 63, 72 |
| 1.0557 | 117, 126 |
| 1.0558 | 391, 394 |
| 1.0562 | 116, 125 |
| 1.0565 | 116, 125, 343, 346 |
| 1.0566 | 129, 132 |
| 1.0571 | 342, 345 |
| 1.0575 | 207, 221 |
| 1.0580 | 206, 207, 209, 210, 211, 219, 221, 222, 223 |
| 1.0586 | 29 |
| 1.0588 | 29 |

| Steel Number | Page Number |
|---|---|
| 1.0599 | 210, 223 |
| 1.0601 | 31 |
| 1.0609 | 31 |
| 1.0610 | 31 |
| 1.0611 | 32 |
| 1.0612 | 32 |
| 1.0613 | 32 |
| 1.0614 | 33 |
| 1.0615 | 32 |
| 1.0616 | 33 |
| 1.0617 | 32 |
| 1.0618 | 34 |
| 1.0619 | 396, 397 |
| 1.0620 | 33 |
| 1.0622 | 33 |
| 1.0625 | 396, 397 |
| 1.0626 | 33 |
| 1.0628 | 33 |
| 1.0644 | 212, 224 |
| 1.0715 | 613 |
| 1.0718 | 614 |
| 1.0721 | 611 |
| 1.0722 | 614 |
| 1.0725 | 611 |
| 1.0726 | 612 |
| 1.0727 | 613 |
| 1.0736 | 614 |
| 1.0737 | 614 |
| 1.0760 | 612 |
| 1.0762 | 612 |
| 1.0764 | 612 |
| 1.1104 | 128, 131, 247, 249 |
| 1.1106 | 129, 132 |
| 1.1110 | 21 |
| 1.1111 | 21 |
| 1.1113 | 21 |
| 1.1114 | 21 |
| 1.1118 | 391, 395 |
| 1.1121 | 21 |
| 1.1124 | 22 |
| 1.1126 | 22 |
| 1.1127 | 211, 223 |
| 1.1129 | 23 |
| 1.1131 | 389, 393, 398, 399 |
| 1.1137 | 23 |
| 1.1139 | 24 |
| 1.1140 | 22 |
| 1.1141 | 22 |
| 1.1143 | 25 |
| 1.1145 | 26 |
| 1.1148 | 22 |
| 1.1149 | 23 |
| 1.1150 | 26 |
| 1.1151 | 23, 204, 208, 219, 221 |
| 1.1153 | 27 |
| 1.1154 | 27 |
| 1.1158 | 334, 339 |
| 1.1161 | 211, 212, 223, 224 |
| 1.1162 | 28 |
| 1.1164 | 28 |
| 1.1165 | 391, 395 |
| 1.1170 | 34 |
| 1.1171 | 29 |
| 1.1180 | 26 |
| 1.1181 | 26, 205, 206, 208, 209, 210, 211, 212, 219, 220, 222, 223, 224, 336, 339 |
| 1.1186 | 27 |
| 1.1189 | 27 |
| 1.1191 | 28, 208, 209, 211, 212, 221, 223, 338, 340 |
| 1.1201 | 28 |
| 1.1202 | 29 |
| 1.1203 | 30 |
| 1.1204 | 616 |
| 1.1206 | 29 |
| 1.1207 | 21 |
| 1.1208 | 22 |
| 1.1209 | 30 |
| 1.1211 | 616 |
| 1.1212 | 31 |
| 1.1217 | 618 |
| 1.1220 | 30 |
| 1.1221 | 31 |
| 1.1222 | 32 |
| 1.1223 | 31 |
| 1.1228 | 31 |
| 1.1231 | 617 |
| 1.1232 | 32 |

| Steel Number | Page Number |
|---|---|
| 1.1236 | 32 |
| 1.1241 | 29 |
| 1.1242 | 32 |
| 1.1248 | 617 |
| 1.1251 | 32 |
| 1.1252 | 33 |
| 1.1253 | 33 |
| 1.1255 | 33 |
| 1.1262 | 33 |
| 1.1265 | 33 |
| 1.1269 | 617 |
| 1.1274 | 618 |
| 1.1282 | 34 |
| 1.1283 | 34 |
| 1.4000 | 438, 441, 534, 536 |
| 1.4002 | 159, 162, 227, 228, 445, 450 |
| 1.4003 | 159, 162, 445, 451, 534, 536 |
| 1.4005 | 519, 526, 615 |
| 1.4006 | 227, 229, 364, 365, 438, 440, 519, 524, 525 |
| 1.4008 | 413, 414 |
| 1.4011 | 413, 414 |
| 1.4016 | 227, 230, 366, 446, 453, 534, 537 |
| 1.4021 | 439, 442, 520, 527 |
| 1.4028 | 439, 443, 520, 528, 621 |
| 1.4029 | 520, 529 |
| 1.4031 | 439, 444, 521, 533, 621 |
| 1.4057 | 520, 530 |
| 1.4105 | 534, 538 |
| 1.4107 | 420, 421 |
| 1.4109 | 520, 531 |
| 1.4112 | 521, 533 |
| 1.4113 | 447, 454, 535, 539 |
| 1.4125 | 521, 531 |
| 1.4301 | 165, 171, 233, 239, 288, 298, 367, 373, 460, 478, 542, 556, 557, 621 |
| 1.4303 | 462, 483, 543, 563 |
| 1.4305 | 541, 554 |
| 1.4306 | 165, 173, 232, 236, 289, 299, 367, 373, 461, 479, 542, 560 |
| 1.4307 | 165, 173, 289, 299, 367, 373, 461, 479, 542, 559, 560 |
| 1.4308 | 415, 417, 422, 424 |
| 1.4309 | 415, 417, 422, 424 |
| 1.4310 | 459, 475, 541, 552, 621 |
| 1.4311 | 166, 175, 233, 238, 289, 300, 368, 374, 462, 482, 543, 561 |

| Steel Number | Page Number |
|---|---|
| 1.4313 | 159, 163, 364, 365, 439, 443, 521, 532 |
| 1.4315 | 166, 174, 461, 481, 543, 561 |
| 1.4317 | 413, 414, 419, 421 |
| 1.4318 | 165, 171, 459, 477 |
| 1.4319 | 459, 475 |
| 1.4325 | 543, 562 |
| 1.4335 | 470, 500 |
| 1.4361 | 462, 483 |
| 1.4362 | 185, 186, 243, 244, 382, 384, 513, 516, 600, 602 |
| 1.4369 | 469, 498, 549, 585 |
| 1.4371 | 458, 474 |
| 1.4372 | 458, 473, 541, 551 |
| 1.4373 | 458, 474 |
| 1.4374 | 549, 585 |
| 1.4401 | 167, 177, 233, 238, 291, 305, 369, 375, 464, 487, 488, 545, 569, 571, 621 |
| 1.4404 | 167, 178, 233, 238, 292, 307, 369, 376, 465, 489, 546, 573, 576 |
| 1.4405 | 413, 414 |
| 1.4406 | 168, 180, 370, 376, 467, 493, 547, 580 |
| 1.4408 | 415, 417, 422, 424 |
| 1.4409 | 415, 417, 423, 425 |
| 1.4410 | 185, 187, 243, 245, 381, 383, 514, 517, 600, 604 |
| 1.4412 | 416, 418 |
| 1.4416 | 416, 418 |
| 1.4418 | 439, 444 |
| 1.4424 | 243, 244, 513, 515, 600, 602 |
| 1.4429 | 168, 180, 233, 239, 292, 307, 370, 376, 467, 493, 547, 580 |
| 1.4432 | 167, 178, 233, 238, 292, 307, 369, 376, 465, 489, 546, 574, 576 |
| 1.4434 | 169, 181, 468, 495 |
| 1.4435 | 167, 178, 233, 238, 292, 307, 369, 376, 465, 489, 546, 575, 576 |
| 1.4436 | 167, 177, 233, 238, 291, 305, 369, 375, 464, 487, 488, 545, 570, 571 |
| 1.4438 | 168, 181, 294, 309, 467, 494, 548, 581 |
| 1.4439 | 169, 182, 234, 242, 294, 310, 468, 495, 548, 581 |
| 1.4446 | 416, 418 |
| 1.4458 | 416, 418, 423, 425 |
| 1.4460 | 381, 383, 601, 605 |
| 1.4462 | 185, 186, 243, 244, 381, 383, 513, 515, 600, 603 |
| 1.4466 | 464, 486 |
| 1.4468 | 416, 418 |
| 1.4477 | 243, 245, 514, 518, 601, 605 |
| 1.4501 | 185, 187, 243, 244, 382, 384, 514, 517, 600, 604 |

| Steel Number | Page Number |
|---|---|
| 1.4507 | 185, 187, 382, 384, 513, 516, 601, 605 |
| 1.4509 | 160, 163, 447, 455 |
| 1.4510 | 160, 164, 227, 231, 446, 454 |
| 1.4511 | 160, 164, 446, 454 |
| 1.4512 | 227, 228, 445, 451 |
| 1.4513 | 469, 498 |
| 1.4516 | 159, 163, 445, 452 |
| 1.4517 | 416, 418 |
| 1.4520 | 160, 164, 446, 454 |
| 1.4521 | 161, 164, 448, 456 |
| 1.4523 | 534, 538 |
| 1.4526 | 447, 455 |
| 1.4527 | 416, 418 |
| 1.4529 | 170, 184, 297, 315, 472, 503 |
| 1.4537 | 472, 503 |
| 1.4539 | 170, 183, 297, 315, 372, 379, 472, 504, 550, 591 |
| 1.4541 | 169, 182, 234, 240, 295, 311, 371, 378, 468, 496, 548, 583, 584 |
| 1.4542 | 379, 380, 505, 508, 593, 596 |
| 1.4547 | 464, 487, 545, 566 |
| 1.4550 | 169, 183, 234, 241, 296, 313, 372, 379, 469, 498, 549, 586 |
| 1.4552 | 415, 417, 422, 424 |
| 1.4557 | 416, 418 |
| 1.4563 | 472, 504, 550, 592 |
| 1.4565 | 470, 500, 547, 579 |
| 1.4567 | 550, 588, 589 |
| 1.4568 | 505, 511, 593, 598, 621 |
| 1.4570 | 549, 587 |
| 1.4571 | 168, 179, 234, 240, 293, 308, 370, 377, 466, 491, 546, 577, 578 |
| 1.4580 | 168, 180, 466, 491, 546, 578 |
| 1.4581 | 415, 417, 422, 424 |
| 1.4588 | 416, 418 |
| 1.4589 | 159, 163, 445, 452 |
| 1.4592 | 449, 457 |
| 1.4597 | 470, 499, 550, 590 |
| 1.4652 | 470, 500, 545, 566 |
| 1.4659 | 470, 500, 545, 566 |
| 1.4710 | 407, 408 |
| 1.4729 | 426, 430 |
| 1.4740 | 426, 430 |
| 1.4745 | 426, 430 |
| 1.4749 | 535, 540 |
| 1.4776 | 426, 430 |
| 1.4777 | 426, 430 |
| 1.4805 | 428, 432 |
| 1.4806 | 428, 432 |
| 1.4807 | 428, 432 |
| 1.4818 | 234, 241 |
| 1.4823 | 426, 430 |
| 1.4825 | 426, 430 |
| 1.4826 | 426, 430 |
| 1.4832 | 426, 430 |
| 1.4833 | 463, 484 |
| 1.4837 | 427, 431 |
| 1.4841 | 463, 485, 545, 567 |
| 1.4845 | 463, 485 |
| 1.4848 | 427, 431 |
| 1.4849 | 428, 432 |
| 1.4852 | 428, 432 |
| 1.4854 | 550, 588 |
| 1.4855 | 428, 432 |
| 1.4857 | 428, 432 |
| 1.4864 | 468, 497 |
| 1.4865 | 428, 432 |
| 1.4870 | 549, 587 |
| 1.4874 | 429, 432 |
| 1.4876 | 471, 502 |
| 1.4878 | 470, 501 |
| 1.4903 | 146, 283, 285, 356 |
| 1.4910 | 470, 501 |
| 1.4912 | 296, 314, 372, 379 |
| 1.4913 | 521, 532 |
| 1.4918 | 293, 308 |
| 1.4922 | 357 |
| 1.4931 | 420, 421 |
| 1.4938 | 521, 531 |
| 1.4940 | 295, 312 |
| 1.4941 | 469, 499 |
| 1.4948 | 165, 172, 289, 301, 367, 374, 461, 480 |
| 1.4950 | 166, 176, 463, 484 |
| 1.4951 | 166, 176, 463, 486 |
| 1.4958 | 471, 502 |
| 1.4959 | 170, 184, 471, 503 |
| 1.4961 | 470, 471, 499, 501 |
| 1.4971 | 471, 502 |
| 1.4980 | 471, 502, 550, 590 |

| Steel Number | Page Number |
|---|---|
| 1.4983 | 470, 499 |
| 1.5414 | 134, 138 |
| 1.5415 | 134, 138, 267, 348 |
| 1.5417 | 224, 225 |
| 1.5419 | 406, 407 |
| 1.5422 | 409, 411 |
| 1.5450 | 268, 270 |
| 1.5502 | 44 |
| 1.5503 | 44 |
| 1.5508 | 44 |
| 1.5510 | 44 |
| 1.5511 | 44 |
| 1.5514 | 44 |
| 1.5515 | 44 |
| 1.5530 | 44 |
| 1.5636 | 409, 411 |
| 1.5637 | 151, 152, 251, 253, 357, 358 |
| 1.5638 | 409, 411 |
| 1.5662 | 153, 154, 357, 358 |
| 1.5663 | 153, 154 |
| 1.5680 | 153, 251, 253, 357, 358 |
| 1.5682 | 251, 254 |
| 1.5752 | 41 |
| 1.6212 | 147, 251, 252 |
| 1.6217 | 147, 251, 252, 359 |
| 1.6220 | 390, 393, 398, 399 |
| 1.6228 | 148, 357, 358 |
| 1.6311 | 155, 156 |
| 1.6368 | 157, 158, 273 |
| 1.6523 | 42 |
| 1.6526 | 42 |
| 1.6570 | 403, 405 |
| 1.6571 | 42 |
| 1.6657 | 43 |
| 1.6781 | 410, 412 |
| 1.6982 | 419, 421 |
| 1.7014 | 36 |
| 1.7016 | 36 |
| 1.7030 | 36 |
| 1.7033 | 37 |
| 1.7034 | 37 |
| 1.7035 | 37 |
| 1.7036 | 36 |

| Steel Number | Page Number |
|---|---|
| 1.7037 | 37 |
| 1.7038 | 37 |
| 1.7039 | 37 |
| 1.7077 | 45 |
| 1.7102 | 619 |
| 1.7176 | 618 |
| 1.7177 | 618 |
| 1.7213 | 40 |
| 1.7216 | 224, 225 |
| 1.7218 | 40, 224, 225, 347 |
| 1.7219 | 251, 254 |
| 1.7220 | 40, 224, 226, 347 |
| 1.7221 | 402, 403 |
| 1.7225 | 41, 224, 226, 347 |
| 1.7226 | 40 |
| 1.7227 | 41 |
| 1.7228 | 41, 347 |
| 1.7231 | 402, 404 |
| 1.7239 | 619 |
| 1.7240 | 619 |
| 1.7241 | 619 |
| 1.7243 | 39 |
| 1.7244 | 39 |
| 1.7319 | 39 |
| 1.7320 | 39 |
| 1.7321 | 39 |
| 1.7323 | 39 |
| 1.7333 | 39 |
| 1.7335 | 141, 274, 275, 350 |
| 1.7336 | 142 |
| 1.7338 | 276, 277 |
| 1.7357 | 406, 408 |
| 1.7362 | 145 |
| 1.7362+I | 280, 281 |
| 1.7362+NT1 | 280, 281 |
| 1.7362+NT2 | 280, 281 |
| 1.7365 | 407, 408 |
| 1.7366 | 355, 356 |
| 1.7379 | 407, 408 |
| 1.7380 | 143, 278, 279 |
| 1.7383 | 278, 279, 352, 353 |
| 1.7386+I | 283, 284 |
| 1.7386+NT | 283, 284 |

| Steel Number | Page Number |
|---|---|
| 1.7706 | 406, 408 |
| 1.7715 | 271, 272 |
| 1.7720 | 407, 408 |
| 1.8152 | 620 |
| 1.8159 | 45, 620 |
| 1.8505 | 43 |
| 1.8507 | 43 |
| 1.8509 | 43 |
| 1.8550 | 43 |
| 1.8700 | 316, 318, 321, 324 |
| 1.8707 | 316, 318, 321, 324 |
| 1.8713 | 316, 318 |
| 1.8723 | 316, 318 |
| 1.8724 | 317, 319 |
| 1.8725 | 317, 319 |
| 1.8726 | 317, 320 |
| 1.8727 | 317, 320 |
| 1.8728 | 316, 318 |
| 1.8729 | 316, 319 |
| 1.8730 | 316, 319 |
| 1.8736 | 323, 327 |
| 1.8737 | 321, 324 |
| 1.8738 | 321, 325 |
| 1.8739 | 322, 325 |
| 1.8740 | 322, 326 |
| 1.8741 | 322, 326 |
| 1.8742 | 323, 327 |
| 1.8743 | 323, 327 |
| 1.8744 | 323, 327 |
| 1.8745 | 323, 327 |
| 1.8746 | 321, 324 |
| 1.8747 | 321, 325 |
| 1.8748 | 322, 325 |
| 1.8749 | 322, 326 |
| 1.8752 | 323, 327 |
| 1.8754 | 323, 327 |
| 1.8756 | 323, 327 |
| 1.8758 | 323, 327 |
| 1.8788 | 321, 324 |
| 1.8789 | 321, 325 |
| 1.8790 | 321, 324 |
| 1.8791 | 321, 325 |
| 1.8792 | 322, 325 |
| 1.8793 | 322, 326 |
| 1.8932 | 359, 360 |
| 1.8936 | 359, 360 |
| 1.8970 | 322, 326 |
| 1.8971 | 322, 326 |
| 2.4680 | 428, 432 |
| 2.4778 | 429, 432 |
| 2.4815 | 429, 432 |
| 2.4879 | 429, 432 |

# *SPECIFICATION DESIGNATION INDEX*

| Specification | Designation | Page Number |
|---|---|---|
| AFNOR NF A 32-058:1984 | Grade Z 100 MD 6 1-M | 400, 401 |
| | Grade Z 100 MN 13 4-M | 400, 401 |
| | Grade Z 110 MD 12 1-M | 400, 401 |
| | Grade Z 120 M 12-M | 400, 401 |
| | Grade Z 120 MC 12-M | 400, 401 |
| | Grade Z 120 MC 17 2-M | 400, 401 |
| AFNOR NF A 49-220:1990 | TU 10 CD 5-05 | 276, 277 |
| | TU 10 CD 9-10 | 278, 279 |
| | TU 13 CD 4-04 | 274, 275 |
| | TU 15 CD 2-05 | 271, 272 |
| | TU 15 D 3 | 267 |
| | TU 37 C | 261, 264 |
| | TU 42 C | 261, 265 |
| | TU 48 C | 263, 266 |
| | TU 52 C | 263, 266 |
| AFNOR NF A 49-647:1979 | TS Z 2 CN 18-10 | 232, 236 |
| | TS Z 6 CN 18-09 | 232, 235 |
| | TS Z 6 CND 17-11 | 232, 237 |
| | TS Z 8 C 17 | 227, 230 |
| API 5L - 2012 | L175 or A25 | 316, 321 |
| | L175 or A25 Seamless | 318, 324 |
| | L175 or A25 Welded | 318, 324 |
| | L175P or A25P | 316, 321 |
| | L175P or A25P Seamless | 318, 324 |
| | L175P or A25P Welded | 318, 324 |
| | L210 or A | 316 |
| | L210 or A Seamless | 318 |
| | L210 or A Welded | 18 |
| | L245 or B | 316 |
| | L245 or B Seamless | 318 |
| | L245 or B Welded | 318 |
| | L245M or BM | 321, 324 |
| | L245N or BN | 321, 324 |
| | L245Q or BQ | 321, 324 |
| | L245R or BR | 321, 324 |
| | L290 or X42 | 316 |
| | L290 or X42 Seamless | 318 |
| | L290 or X42 Welded | 318 |
| | L290M or X42M | 321, 325 |
| | L290N or X42N | 321, 325 |
| | L290Q or X42Q | 321, 325 |
| | L290R or X42R | 321, 325 |
| | L320 or X46 | 316 |
| API 5L – 2012 (continued) | L320 or X46 Seamless | 319 |
| | L320 or X46 Welded | 319 |
| | L320M or X46M | 322, 325 |
| | L320N or X46N | 322, 325 |
| | L320Q or X46Q | 322, 325 |
| | L360 or X52 | 316 |
| | L360 or X52 Seamless | 319 |
| | L360 or X52 Welded | 319 |
| | L360M or X52M | 322, 326 |
| | L360N or X52N | 322, 326 |
| | L360Q or X52Q | 322, 326 |
| | L390 or X56 | 317 |
| | L390 or X56 Seamless | 319 |
| | L390 or X56 Welded | 319 |
| | L390M or X56M | 322, 326 |
| | L390N or X56N | 322, 326 |
| | L390Q or X56Q | 322, 326 |
| | L415 or X60 | 317 |
| | L415 or X60 Seamless | 319 |
| | L415 or X60 Welded | 319 |
| | L415M or X60M | 323, 327 |
| | L415N or X60N | 323, 327 |
| | L415Q or X60Q | 323, 327 |
| | L450 or X65 | 317 |
| | L450 or X65 Seamless | 320 |
| | L450 or X65 Welded | 320 |
| | L450M or X65M | 323, 327 |
| | L450Q or X65Q | 323, 327 |
| | L485 or X70 | 317 |
| | L485 or X70 Seamless | 320 |
| | L485 or X70 Welded | 320 |
| | L485M or X70M | 323, 327 |
| | L485Q or X70Q | 323, 327 |
| | L555M or X80M | 323, 327 |
| | L555Q or X80Q | 323, 327 |
| ASME SA-29/SA-29M | Grade 1005 | 21 |
| | Grade 1006 | 21 |
| | Grade 1008 | 21 |
| | Grade 1010 | 21 |
| | Grade 1012 | 22 |
| | Grade 1015 | 22 |
| | Grade 1016 | 22 |
| | Grade 1017 | 23 |

| Specification | Designation | Page Number |
|---|---|---|
| ASME SA-29/SA-29M (continued) | Grade 1018 | 23 |
| | Grade 1019 | 23 |
| | Grade 1020 | 23 |
| | Grade 1021 | 23 |
| | Grade 1022 | 23 |
| | Grade 1023 | 24 |
| | Grade 1025 | 24 |
| | Grade 1026 | 24 |
| | Grade 1029 | 25 |
| | Grade 1030 | 25 |
| | Grade 1034 | 26 |
| | Grade 1035 | 26 |
| | Grade 1037 | 26 |
| | Grade 1038 | 26 |
| | Grade 1039 | 27 |
| | Grade 1040 | 27 |
| | Grade 1042 | 27 |
| | Grade 1043 | 27 |
| | Grade 1044 | 28 |
| | Grade 1045 | 28 |
| | Grade 1046 | 28 |
| | Grade 1049 | 29 |
| | Grade 1050 | 29 |
| | Grade 1053 | 29 |
| | Grade 1055 | 30 |
| | Grade 1059 | 31 |
| | Grade 1060 | 31 |
| | Grade 1064 | 32 |
| | Grade 1065 | 32 |
| | Grade 1069 | 32 |
| | Grade 1070 | 32 |
| | Grade 1071 | 32 |
| | Grade 1074 | 33 |
| | Grade 1075 | 33 |
| | Grade 1078 | 33 |
| | Grade 1080 | 33 |
| | Grade 1084 | 33 |
| | Grade 1086 | 33 |
| | Grade 1090 | 34 |
| | Grade 1095 | 34 |
| | Grade 1109 | 611 |
| | Grade 1110 | 611 |
| | Grade 1117 | 611 |
| | Grade 1118 | 611 |
| | Grade 1132 | 611 |
| | Grade 1137 | 612 |
| | Grade 1139 | 612 |
| | Grade 1140 | 612 |
| | Grade 1141 | 612 |
| | Grade 1144 | 612 |
| | Grade 1146 | 613 |
| | Grade 1151 | 613 |
| | Grade 1212 | 613 |
| | Grade 1213 | 613 |
| | Grade 1215 | 613 |
| | Grade 12L13 | 614 |
| | Grade 12L14 | 614 |
| | Grade 12L15 | 614 |
| | Grade 1522 | 34 |
| | Grade 1536 | 34 |
| | Grade 1541 | 35 |
| | Grade 4118 | 39 |
| | Grade 4120 | 39 |
| | Grade 4121 | 39 |
| | Grade 4130 | 40 |
| | Grade 4137 | 40 |
| | Grade 4140 | 41 |
| | Grade 4145 | 41 |
| | Grade 4150 | 41 |
| | Grade 4320 | 42 |
| | Grade 4340 | 42 |
| | Grade 50B44 | 45 |
| | Grade 50B46 | 45 |
| | Grade 50B50 | 45 |
| | Grade 50B60 | 45 |
| | Grade 5120 | 36 |
| | Grade 5130 | 36 |
| | Grade 5132 | 37 |
| | Grade 5135 | 37 |
| | Grade 5140 | 37 |
| | Grade 5145 | 38 |
| | Grade 51B60 | 45 |
| | Grade 6150 | 45 |
| | Grade 8620 | 42 |
| | Grade 8640 | 43 |
| | Grade E4340 | 42 |

| Specification | Designation | Page Number |
|---|---|---|
| ASME SA-29/SA-29M (continued) | Grade E9310 | 43 |
| ASME SA-36/SA-36M | --- | 57, 68 |
| ASME SA-53/SA-53M | Grade A Type E | 255, 258 |
| | Grade A Type F | 255, 258 |
| | Grade A Type S | 255, 258 |
| | Grade B Type E | 257, 259 |
| | Grade B Type S | 257, 259 |
| ASME SA-105/SA-105M | --- | 342, 345 |
| ASME SA-106 | Grade A | 260, 264 |
| | Grade B | 262, 265 |
| | Grade C | 263, 266 |
| ASME SA-135 | Grade A | 255, 258 |
| | Grade B | 257, 259 |
| ASME SA-178/SA-178M | Grade A | 260, 264 |
| | Grade C | 262, 265 |
| | Grade D | 263, 266 |
| ASME SA-179/SA-179M | --- | 260, 264 |
| ASME SA-181/SA-181M | Class 60 | 342, 345 |
| | Class 70 | 342, 345 |
| ASME SA-182/SA-182M | Grade F 1 | 348 |
| | Grade F 11, Class 2 | 351 |
| | Grade F 11, Class 3 | 351 |
| | Grade F 12, Class 2 | 350 |
| | Grade F 2 | 349 |
| | Grade F 21 | 354 |
| | Grade F 22, Class 1 | 352, 353 |
| | Grade F 22, Class 3 | 352, 353 |
| | Grade F 22V | 352, 353 |
| | Grade F 304 | 367, 373 |
| | Grade F 304H | 367, 374 |
| | Grade F 304L | 367, 373 |
| | Grade F 304LN | 368, 374 |
| | Grade F 304N | 368, 374 |
| | Grade F 310 | 368, 375 |
| | Grade F 310H | 368, 375 |
| | Grade F 316 | 369, 375 |
| | Grade F 316H | 370, 377 |
| | Grade F 316L | 369, 376 |
| | Grade F 316LN | 370, 376 |
| | Grade F 316N | 367, 373 |
| | Grade F 317 | 370, 377 |
| | Grade F 317L | 370, 377 |
| | Grade F 321 | 371, 378 |
| ASME SA-182/SA-182M (continued) | Grade F 321H | 371, 378 |
| | Grade F 347 | 372, 379 |
| | Grade F 347H | 372, 379 |
| | Grade F 348 | 372, 379 |
| | Grade F 3V | 354, 355 |
| | Grade F 430 | 366 |
| | Grade F 5 | 355, 356 |
| | Grade F 50 | 381, 383 |
| | Grade F 51 | 381, 383 |
| | Grade F 53 | 381, 383 |
| | Grade F 55 | 382, 384 |
| | Grade F 59 | 382, 384 |
| | Grade F 5a | 355, 356 |
| | Grade F 60 | 381, 383 |
| | Grade F 6a, Class 1 | 364, 365 |
| | Grade F 6a, Class 2 | 364, 365 |
| | Grade F 6a, Class 3 | 364, 365 |
| | Grade F 6a, Class 4 | 364, 365 |
| | Grade F 6b | 364, 365 |
| | Grade F 6NM | 364, 365 |
| | Grade F 9 | 356 |
| ASME SA-192/SA-192M | --- | 260, 264 |
| ASME SA-203/SA-203M | Grade A | 149, 150 |
| | Grade B | 149, 150 |
| | Grade D | 151, 152 |
| | Grade E | 151, 152 |
| | Grade F | 151, 152 |
| ASME SA-204/SA-204M | Grade A | 134, 138 |
| | Grade B | 134, 138 |
| | Grade C | 134, 138 |
| ASME SA-209/SA-209M | Grade T1 | 268, 269 |
| | Grade T1a | 268, 269 |
| | Grade T1b | 268, 269 |
| ASME SA-210/SA-210M | Grade A-1 | 262, 265 |
| | Grade C | 263, 266 |
| ASME SA-213/SA-213M | Grade T11 | 276, 277 |
| | Grade T12 | 274, 275 |
| | Grade T2 | 271, 272 |
| | Grade T22 | 278, 279 |
| | Grade T5 | 280, 281 |
| | Grade T5b | 280, 281 |
| | Grade T9 | 283, 284 |
| | Grade T91 | 283, 285 |

| Specification | Designation | Page Number |
|---|---|---|
| ASME SA-213/SA-213M (continued) | Grade TP304 | 288, 298 |
| | Grade TP304H | 289, 301 |
| | Grade TP304L | 288, 299 |
| | Grade TP304LN | 289, 300 |
| | Grade TP309H | 290, 303 |
| | Grade TP309S | 290, 302 |
| | Grade TP310H | 290, 304 |
| | Grade TP310S | 290, 303 |
| | Grade TP316 | 291, 305 |
| | Grade TP316H | 293, 308 |
| | Grade TP316L | 292, 306 |
| | Grade TP316LN | 292, 307 |
| | Grade TP317 | 293, 309 |
| | Grade TP317L | 294, 309 |
| | Grade TP317LM | 234, 242, 294, 310 |
| | Grade TP321 | 233, 240, 295, 311 |
| | Grade TP321H | 295, 312 |
| | Grade TP347 | 296, 313 |
| | Grade TP347H | 296, 314 |
| | Grade TP347HFG | 296, 314 |
| ASME SA-214/SA-214M | --- | 260, 264 |
| ASME SA-216/SA-216M | Grade WCA | 396, 397 |
| | Grade WCB | 396, 397 |
| | Grade WCC | 396, 397 |
| ASME SA-217/SA-217M | Grade C12 | 407, 408 |
| | Grade C5 | 407, 408 |
| | Grade CA15 | 419, 421 |
| | Grade WC1 | 406, 407 |
| | Grade WC6 | 406, 407 |
| | Grade WC9 | 406, 408 |
| ASME SA-240/SA-240M | --- | 159, 160, 162, 163, 170, 184, 185, 187, 439, 443, 445, 447, 449, 451, 452, 455, 457, 462, 464, 470, 471, 472, 483, 487, 499, 500, 503, 513, 514, 515, 516, 517, 518 |
| | Type 201-1 | 458, 473 |
| | Type 201-2 | 458, 473 |
| | Type 201L | 458, 474 |
| | Type 201LN | 458, 474 |
| | Type 202 | 458, 474 |

| Specification | Designation | Page Number |
|---|---|---|
| ASME SA-240/SA-240M (continued) | Type 2205 | 185, 186, 513, 515 |
| | Type 2304 | 185, 186, 513, 516 |
| | Type 2507 | 185, 187, 514, 517 |
| | Type 301 | 459, 475 |
| | Type 301L | 459, 476 |
| | Type 301LN | 165, 171, 459, 477 |
| | Type 302 | 459, 477 |
| | Type 304 | 165, 171, 460, 478 |
| | Type 304H | 165, 172, 461, 480 |
| | Type 304L | 165, 173, 461, 479 |
| | Type 304LN | 166, 175, 462, 482 |
| | Type 304N | 166, 174, 461, 481 |
| | Type 305 | 462, 483 |
| | Type 309H | 166, 176, 463, 484 |
| | Type 309S | 463, 484 |
| | Type 310 MoLN | 464, 486 |
| | Type 310H | 166, 176, 463, 486 |
| | Type 310S | 463, 485 |
| | Type 316 | 167, 177, 464, 487 |
| | Type 316Cb | 168, 180, 466, 491 |
| | Type 316L | 167, 178, 465, 489 |
| | Type 316LN | 467, 493 |
| | Type 316N | 466, 492 |
| | Type 316Ti | 168, 179, 466, 491 |
| | Type 317 | 467, 494 |
| | Type 317L | 168, 181, 467, 494 |
| | Type 317LMN | 169, 182, 468, 495 |
| | Type 317LN | 169, 181, 468, 495 |
| | Type 321 | 169, 182, 468, 496 |
| | Type 321H | 468, 497 |
| | Type 329 | 514, 518 |
| | Type 347 | 169, 183, 469, 498 |
| | Type 347H | 470, 501 |
| | Type 405 | 159, 162, 445, 450 |
| | Type 410 | 519, 523 |
| | Type 410S | 438, 441 |
| | Type 429 | 446, 452 |

| Specification | Designation | Page Number |
|---|---|---|
| ASME SA-240/SA-240M (continued) | Type 430 | 446, 453 |
| | Type 434 | 447, 454 |
| | Type 436 | 447, 455 |
| | Type 439 | 160, 163, 447, 455 |
| | Type 444 | 161, 164, 448, 456 |
| | Type 800 | 471, 502 |
| | Type 800H | 170, 184, 471, 503 |
| | Type 904L | 170, 183, 472, 504 |
| | Type XM-27 | 448, 457 |
| ASME SA-249/SA-249M | --- | 234, 241, 294, 297, 310, 315 |
| | Grade TP304 | 232, 235, 288, 298 |
| | Grade TP304H | 289, 301 |
| | Grade TP304L | 288, 299 |
| | Grade TP304LN | 289, 300 |
| | Grade TP304N | 288, 299 |
| | Grade TP309H | 290, 303 |
| | Grade TP309S | 290, 302 |
| | Grade TP310S | 290, 303 |
| | Grade TP316 | 291, 305 |
| | Grade TP316H | 293, 308 |
| | Grade TP316L | 292, 306 |
| | Grade TP316LN | 292, 307 |
| | Grade TP317 | 293, 309 |
| | Grade TP317L | 294, 309 |
| | Grade TP321 | 233, 240, 295, 311 |
| | Grade TP321H | 295, 312 |
| | Grade TP347 | 296, 313 |
| | Grade TP347H | 296, 314 |
| ASME SA-250/SA-250M | Grade T1 | 268, 269 |
| | Grade T11 | 276, 277 |
| | Grade T12 | 274, 275 |
| | Grade T1a | 268, 269 |
| | Grade T1b | 268, 269 |
| | Grade T2 | 271, 272 |
| | Grade T22 | 278, 279 |
| ASME SA-266/SA-266M | Grade 1 | 342, 345 |
| | Grade 2 | 342, 345 |
| | Grade 4 | 342, 345 |
| ASME SA-268/SA-268M | Grade TP405 | 227, 228 |
| | Grade TP409 | 227, 228, 286, 287 |
| | Grade TP410 | 227, 229, 286, 287 |
| ASME SA-268/SA-268M (continued) | Grade TP430 | 227, 230, 286, 287 |
| | Grade TP439 | 227, 231 |
| ASME SA-276 | --- | 521, 532, 535, 545, 549, 566, 586, 600, 602, 604 |
| | Type 201 | 541, 551 |
| | Type 202 | 541, 551 |
| | Type 302 | 541, 553 |
| | Type 304 | 542, 555 |
| | Type 304L | 542, 558 |
| | Type 304LN | 543, 561 |
| | Type 304N | 543, 560 |
| | Type 305 | 543, 562 |
| | Type 309 | 544, 564 |
| | Type 309S | 544, 564 |
| | Type 310 | 544, 564 |
| | Type 310S | 544, 565 |
| | Type 314 | 545, 567 |
| | Type 316 | 545, 568 |
| | Type 316Cb | 546, 578 |
| | Type 316L | 546, 572 |
| | Type 316LN | 547, 580 |
| | Type 316N | 547, 579 |
| | Type 316Ti | 546, 576 |
| | Type 317 | 548, 581 |
| | Type 321 | 548, 582 |
| | Type 347 | 549, 586 |
| | Type 348 | 549, 586 |
| | Type 403 | 519, 522 |
| | Type 405 | 534, 536 |
| | Type 410 | 519, 523 |
| | Type 420 | 520, 527 |
| | Type 430 | 534, 538 |
| | Type 431 | 520, 529 |
| | Type 440A | 520, 531 |
| | Type 440B | 520, 531 |
| | Type 440C | 521, 531 |
| | Type 446 | 535, 540 |
| | Type 447 | 540 |
| | Type XM-21 | 543, 562 |
| | Type XM-27 | 535, 540 |
| ASME SA-283/SA-283M | Grade A | 51, 66 |
| | Grade B | 53, 66 |
| | Grade C | 55, 67 |

| Specification | Designation | Page Number |
|---|---|---|
| ASME SA-283/SA-283M (continued) | Grade D | 59, 69 |
| ASME SA-302/SA-302M | Grade A | 136, 139 |
| | Grade B | 137, 139 |
| | Grade C | 155, 156 |
| | Grade D | 157, 158 |
| ASME SA-312/SA-312M | --- | 234, 241, 294, 297, 310, 315 |
| | Grade TP304 | 288, 298 |
| | Grade TP304H | 289, 301 |
| | Grade TP304L | 288, 299 |
| | Grade TP309S | 290, 302 |
| | Grade TP310S | 290, 303 |
| | Grade TP316 | 291, 305 |
| | Grade TP316H | 293, 308 |
| | Grade TP316L | 292, 306 |
| | Grade TP317 | 293, 309 |
| | Grade TP317L | 294, 309 |
| | Grade TP321 | 295, 311 |
| | Grade TP321H | 295, 312 |
| | Grade TP347 | 296, 313 |
| | Grade TP347H | 296, 314 |
| ASME SA-333/SA-333M | Grade 1 | 246, 249 |
| | Grade 3 | 248, 250 |
| | Grade 6 | 248, 250 |
| | Grade 8 | 248, 250 |
| ASME SA-334/SA-334M | Grade 1 | 246, 249 |
| | Grade 3 | 251, 253 |
| | Grade 6 | 248, 250 |
| | Grade 8 | 251, 254 |
| ASME SA-335/SA-335M | Grade P1 | 268, 269 |
| | Grade P11 | 276, 277 |
| | Grade P12 | 274, 275 |
| | Grade P2 | 271, 272 |
| | Grade P22 | 278, 279 |
| | Grade P5 | 280, 281 |
| | Grade P9 | 283, 284 |
| | Grade P91 | 283, 285 |
| | Grade P911 | 273 |
| | Grade P92 | 283, 285 |
| ASME SA-336/SA-336M | Grade F1 | 348 |
| | Grade F11, Class 2 | 351 |
| | Grade F11, Class 3 | 351 |
| | Grade F12 | 350 |
| | Grade F21, Class 1 | 354 |
| | Grade F21, Class 3 | 354 |
| | Grade F22, Class 1 | 352, 353 |
| | Grade F22, Class 3 | 352, 353 |
| | Grade F22V | 352, 353 |
| | Grade F3V | 354, 355 |
| | Grade F5 | 355, 356 |
| | Grade F5A | 355, 356 |
| | Grade F9 | 356 |
| ASME SA-350/SA-350M | Grade LF1, Class 1 | 342, 345 |
| | Grade LF2, Class 1 | 342, 345 |
| | Grade LF2, Class 2 | 342, 345 |
| | Grade LF3, Class 1 | 357, 358 |
| | Grade LF3, Class 2 | 357, 358 |
| ASME SA-351/SA-351M | Grade CF10M | 423, 425 |
| | Grade CF3 | 422, 424 |
| | Grade CF3A | 422, 424 |
| | Grade CF3M | 423, 425 |
| | Grade CF3MA | 423, 425 |
| | Grade CF8 | 422, 424 |
| | Grade CF8A | 422, 424 |
| | Grade CF8C | 422, 424 |
| | Grade CF8M | 422, 424 |
| | Grade CN7M | 423, 425 |
| | Grade HK30 | 427, 431 |
| | Grade HK40 | 427, 431 |
| | Grade HT30 | 428, 432 |
| ASME SA-352/SA-352M | Grade CA6NM | 419, 421 |
| | Grade LC1 | 409, 411 |
| | Grade LC2 | 409, 411 |
| | Grade LC2-1 | 410, 412 |
| | Grade LC3 | 409, 411 |
| | Grade LCA | 398, 399 |
| | Grade LCB | 398, 399 |
| | Grade LCC | 398, 399 |
| ASME SA-353/SA-353M | --- | 153, 154 |
| ASME SA-358/SA-358M | --- | 234, 241, 294, 297, 310, 315 |
| | Grade 304 | 288, 298 |
| | Grade 304H | 289, 301 |
| | Grade 304L | 288, 299 |
| | Grade 309S | 290, 302 |
| | Grade 310S | 290, 303 |
| | Grade 316 | 291, 305 |
| | Grade 316H | 293, 308 |

| Specification | Designation | Page Number |
|---|---|---|
| ASME SA-358/SA-358M (continued) | Grade 316L | 292, 306 |
| | Grade 321 | 295, 311 |
| | Grade 347 | 296, 313 |
| ASME SA-376/SA-376M | --- | 294, 310 |
| | Grade TP304 | 288, 298 |
| | Grade TP304H | 289, 301 |
| | Grade TP304LN | 289, 300 |
| | Grade TP316 | 291, 305 |
| | Grade TP316H | 293, 308 |
| | Grade TP316LN | 292, 307 |
| | Grade TP321 | 295, 311 |
| | Grade TP321H | 295, 312 |
| | Grade TP347 | 296, 313 |
| | Grade TP347H | 296, 314 |
| ASME SA-387/SA-387M | Grade 11, Class 1 | 142 |
| | Grade 11, Class 2 | 142 |
| | Grade 12, Class 1 | 141 |
| | Grade 12, Class 2 | 141 |
| | Grade 2, Class 1 | 140 |
| | Grade 2, Class 2 | 140 |
| | Grade 21, Class 1 | 144 |
| | Grade 21, Class 2 | 144 |
| | Grade 21L, Class 1 | 144 |
| | Grade 22, Class 1 | 143 |
| | Grade 22, Class 2 | 143 |
| | Grade 22L, Class 1 | 143 |
| | Grade 5, Class 1 | 145 |
| | Grade 5, Class 2 | 145 |
| | Grade 91, Class 2 | 146 |
| ASME SA-403/SA-403M | Grade CR 304 | 367, 373 |
| | Grade CR 304 LN | 368 |
| | Grade CR 304L | 367, 373 |
| | Grade CR 310S | 368, 375 |
| | Grade CR 316 | 369, 375 |
| | Grade CR 316L | 369, 376 |
| | Grade CR 317 | 370, 377 |
| | Grade CR 317L | 370, 377 |
| | Grade CR 321 | 371, 378 |
| | Grade CR 347 | 372, 379 |
| | Grade WP 304 | 367, 373 |
| | Grade WP 304L | 367, 373 |
| | Grade WP 304LN | 368 |
| | Grade WP 310S | 368, 375 |

| Specification | Designation | Page Number |
|---|---|---|
| ASME SA-403/SA-403M (continued) | Grade WP 316 | 369, 375 |
| | Grade WP 316L | 369, 376 |
| | Grade WP 317 | 370, 377 |
| | Grade WP 317L | 370, 377 |
| | Grade WP 321 | 371, 378 |
| | Grade WP 347 | 372, 379 |
| ASME SA-409/SA-409M | --- | 294, 310 |
| | Grade TP304 | 232, 235, 288, 298 |
| | Grade TP304L | 288, 299 |
| | Grade TP316 | 291, 305 |
| | Grade TP316L | 292, 306 |
| | Grade TP317 | 293, 309 |
| | Grade TP321 | 295, 311 |
| | Grade TP347 | 296, 313 |
| ASME SA-414/SA-414M | Grade C | 112, 120 |
| | Grade D | 114, 122 |
| | Grade E | 114, 123 |
| | Grade F | 115, 125 |
| | Grade G | 117, 126 |
| ASME SA-453/SA-453M | Grade 660, Class A | 550, 590 |
| ASME SA-479/SA-479M | --- | 521, 532, 535, 540, 545, 547, 549, 550, 566, 579, 586, 588, 590, 600, 601, 602, 603, 604, 605 |
| | Type 302 | 541, 553 |
| | Type 304 | 542, 555 |
| | Type 304H | 543, 562 |
| | Type 304L | 542, 558 |
| | Type 304LN | 543, 561 |
| | Type 304N | 543, 560 |
| | Type 309S | 544, 564 |
| | Type 310S | 544, 565 |
| | Type 316 | 545, 568 |
| | Type 316Cb | 546, 578 |
| | Type 316L | 546, 572 |
| | Type 316LN | 168, 180, 547, 580 |
| | Type 316N | 547, 579 |
| | Type 316Ti | 546, 576 |
| | Type 317 | 548, 581 |
| | Type 321 | 548, 582 |
| | Type 321H | 548, 582 |
| | Type 347 | 549, 586 |

| Specification | Designation | Page Number |
|---|---|---|
| ASME SA-479/SA-479M (continued) | Type 347H | 549, 586 |
| | Type 403 | 519, 522 |
| | Type 405 | 534, 536 |
| | Type 410 | 519, 523 |
| | Type 430 | 534, 538 |
| | Type 431 | 520, 529 |
| | Type XM-27 | 535, 540 |
| ASME SA-487/SA-487M | Grade 8, Class A | 406, 408 |
| | Grade 8, Class B | 406, 408 |
| | Grade 8, Class C | 406, 408 |
| | Grade CA15, Class A | 419, 421 |
| | Grade CA15, Class B | 419, 421 |
| | Grade CA15, Class C | 419, 421 |
| | Grade CA15, Class D | 419, 421 |
| | Grade CA6NM, Class A | 419, 421 |
| | Grade CA6NM, Class B | 419, 421 |
| ASME SA-508/SA-508M | Grade 1 | 342, 345 |
| | Grade 1A | 342, 345 |
| | Grade 2, Class 1 | 361 |
| | Grade 2, Class 2 | 361 |
| | Grade 22, Class 3 | 352, 353 |
| | Grade 3, Class 1 | 362 |
| | Grade 3, Class 2 | 362 |
| | Grade 3V | 354, 355 |
| | Grade 4N, Class 3 | 363 |
| ASME SA-513 | Grade 1008 | 198, 199, 200, 202, 204, 213, 214, 215, 217 |
| | Grade 1010 | 198, 199, 200, 202, 204, 213, 214, 215, 217 |
| | Grade 1015 | 199, 200, 202, 204, 205, 214, 215, 217 |
| | Grade 1020 | 200, 201, 204, 205, 207, 214, 215, 217, 220 |
| | Grade 1021 | 200, 201, 204, 206, 207, 214, 215, 219, 220, 221 |
| | Grade 1025 | 202, 205, 207, 208, 215, 219, 220, 221 |
| | Grade 1026 | 204, 207, 208, 209, 217, 220, 221, 222 |
| | Grade 1030 | 204, 207, 209, 210, 217, 220, 222, 223 |
| | Grade 1035 | 205, 206, 209, 210, 211, 219, 220, 222, 223 |
| ASME SA-513 (continued) | Grade 1040 | 205, 206, 210, 211, 219, 220, 223 |
| | Grade 1524 | 206, 210, 211, 220, 223 |
| | Grade 4130 | 224, 225 |
| | Grade 4140 | 224, 226 |
| ASME SA-515/SA-515M | Grade 60 [415] | 114, 121 |
| | Grade 65 [450] | 114, 122 |
| | Grade 70 [485] | 115, 124 |
| ASME SA-516/SA-516M | Grade 60 [415] | 114, 122 |
| | Grade 65 [450] | 114, 123 |
| | Grade 70 [485] | 115, 124 |
| ASME SA-533/SA-533M | Type A, Class 1 | 137, 139 |
| | Type A, Class 2 | 137, 139 |
| | Type A, Class 3 | 137, 139 |
| | Type B, Class 1 | 155, 156 |
| | Type B, Class 2 | 155, 156 |
| | Type B, Class 3 | 155, 156 |
| | Type C, Class 1 | 157, 158 |
| | Type C, Class 2 | 157, 158 |
| | Type C, Class 3 | 157, 158 |
| ASME SA-537/SA-537M | Class 1 | 115, 124 |
| | Class 2 | 118, 127 |
| | Class 3 | 118, 127 |
| ASME SA-541/SA-541M | Grade 1 | 342, 345 |
| | Grade 1A | 342, 345 |
| | Grade 2, Class 1 | 361 |
| | Grade 2, Class 2 | 361 |
| | Grade 22, Class 3 | 352, 353 |
| | Grade 22V | 352, 353 |
| | Grade 3, Class 1 | 362 |
| | Grade 3, Class 2 | 362 |
| | Grade 3V | 354, 355 |
| | Grade 4N, Class 3 | 363 |
| ASME SA-553/SA-553M | Type I | 153, 154 |
| | Type II | 153, 154 |
| ASME SA-556/SA-556M | Grade A2 | 260, 264 |
| | Grade B2 | 261, 265 |
| | Grade C2 | 263, 266 |
| ASME SA-564/SA-564M | Type 630 | 593, 594 |
| | Type 631 | 593, 597 |
| | Type 632 | 593, 599 |
| ASME SA-572/SA-572M | Grade 42 [290], Type 1 | 74, 80 |
| | Grade 42 [290], Type 2 | 74, 80 |

| Specification | Designation | Page Number |
|---|---|---|
| ASME SA-572/SA-572M (continued) | Grade 42 [290], Type 3 | 74, 80 |
| | Grade 42 [290], Type 5 | 74, 80 |
| | Grade 50 [345], Type 1 | 75, 81 |
| | Grade 50 [345], Type 2 | 75, 81 |
| | Grade 50 [345], Type 3 | 75, 81 |
| | Grade 50 [345], Type 5 | 75, 81 |
| | Grade 55 [380], Type 1 | 77, 82 |
| | Grade 55 [380], Type 2 | 77, 82 |
| | Grade 55 [380], Type 3 | 77, 82 |
| | Grade 55 [380], Type 5 | 77, 82 |
| | Grade 60 [415], Type 1 | 78, 83 |
| | Grade 60 [415], Type 2 | 78, 83 |
| | Grade 60 [415], Type 3 | 78, 83 |
| | Grade 60 [415], Type 5 | 78, 83 |
| | Grade 65 [450], Type 1 | 79, 84 |
| | Grade 65 [450], Type 2 | 79, 84 |
| | Grade 65 [450], Type 3 | 79, 84 |
| | Grade 65 [450], Type 5 | 79, 84 |
| ASME SA-612/SA-612M | --- | 119, 127 |
| ASME SA-662/SA-662M | Grade A | 128, 131 |
| | Grade B | 129, 132 |
| | Grade C | 129, 132 |
| ASME SA-666 | Type 201-1 | 458, 473 |
| | Type 201-2 | 458, 473 |
| | Type 201L | 458, 474 |
| | Type 201LN | 458, 474 |
| | Type 202 | 458, 474 |
| | Type 301 | 459, 475 |
| | Type 301L | 459, 476 |
| | Type 301LN | 165, 171, 459, 477 |
| | Type 302 | 459, 477 |
| | Type 304 | 165, 171, 460, 478, 542, 555 |
| | Type 304L | 165, 173, 461, 479, 542, 558 |
| | Type 304LN | 166, 175, 462, 482, 543, 561 |
| | Type 304N | 166, 174, 461, 481, 543, 560 |
| | Type 316 | 167, 177, 464, 487, 545, 568 |
| | Type 316L | 167, 178, 465, 489, 546, 572 |
| | Type 316N | 466, 492, 547, 579 |
| ASME SA-688/SA-688M | --- | 297, 315 |
| | Grade TP 304 | 232, 235, 288, 298 |
| | Grade TP 304L | 288, 299 |
| ASME SA-688/SA-688M (continued) | Grade TP 304LN | 289, 300 |
| | Grade TP 316 | 291, 305 |
| | Grade TP 316L | 292, 306 |
| | Grade TP 316LN | 292, 307 |
| ASME SA-693 | Type 630 | 505, 506 |
| | Type 631 | 505, 510 |
| ASME SA-705/SA-705M | Type 630 | 379, 380 |
| ASME SA-737/SA-737M | Grade B | 115, 124 |
| | Grade C | 119, 127 |
| ASME SA-738/SA-738M | Grade A | 118, 126 |
| | Grade B | 119, 127 |
| | Grade C | 119, 127 |
| ASME SA-789/SA-789M | --- | 243, 244, 245 |
| ASME SA-803/SA-803M | Grade TP XM-27 | 286, 287 |
| | Grade TP409 | 286, 287 |
| ASME SA-815/SA-815M | Grade CRS31803 | 381, 383 |
| | Grade CRS32205 | 381, 383 |
| | Grade CRS32750 | 381, 383 |
| | Grade CRS32760 | 382, 384 |
| | Grade WPS31803 | 381, 383 |
| | Grade WPS32205 | 381, 383 |
| | Grade WPS32750 | 381, 383 |
| | Grade WPS32760 | 382, 384 |
| ASME SA-841/SA-841M | Grade A, Class 1 | 129, 132 |
| | Grade A, Class 2 | 130, 133 |
| | Grade B, Class 1 | 129, 132 |
| | Grade B, Class 2 | 130, 133 |
| | Grade C, Class 1 | 129, 132 |
| | Grade C, Class 2 | 130, 133 |
| ASME SA-1011/SA-1011M | Grade 30 [205], SS | 52, 66 |
| | Grade 33 [230], SS | 54, 67 |
| | Grade 36 [250], Type 1, SS | 54, 67 |
| | Grade 36 [250], Type 2, SS | 57, 68 |
| | Grade 40 [275], SS | 55, 67 |
| | Grade 45 [310], Class 1, HSLAS | 74, 80 |
| | Grade 45 [310], SS | 59, 69 |
| | Grade 50 [340], Class 1, HSLAS | 75, 80 |
| | Grade 50 [340], Class 2, HSLAS | 74, 80 |
| | Grade 50 [340], SS | 60, 70 |
| | Grade 55 [380], Class 1, HSLAS | 76, 82 |
| | Grade 55 [380], Class 2, HSLAS | 75, 81 |

| Specification | Designation | Page Number |
|---|---|---|
| ASME SA-1011/SA-1011M (continued) | Grade 55 [380], SS | 60, 70 |
| | Grade 60 [410], Class 1, HSLAS | 78, 83 |
| | Grade 60 [410], Class 2, HSLAS | 76, 82 |
| | Grade 65 [450], Class 1, HSLAS | 79, 84 |
| | Grade 65 [450], Class 2, HSLAS | 78, 83 |
| | Grade 70 [480], Class 1, HSLAS | 79, 84 |
| ASTM A27/A27M-13 | Grade 60-30 [415-205] | 389, 393 |
| | Grade 65-35 [450-240] | 389, 393 |
| | Grade 70-36 [485-250] | 390, 393 |
| | Grade 70-40 [485-275] | 390, 393 |
| | Grade U-60-30 [415-205] | 389, 393 |
| ASTM A29/A29M-12e1 | Grade 1005 | 21 |
| | Grade 1006 | 21 |
| | Grade 1008 | 21 |
| | Grade 1010 | 21 |
| | Grade 1012 | 22 |
| | Grade 1015 | 22 |
| | Grade 1016 | 22 |
| | Grade 1017 | 23 |
| | Grade 1018 | 23 |
| | Grade 1019 | 23 |
| | Grade 1020 | 23 |
| | Grade 1021 | 23 |
| | Grade 1022 | 23 |
| | Grade 1023 | 24 |
| | Grade 1025 | 24 |
| | Grade 1026 | 24 |
| | Grade 1029 | 25 |
| | Grade 1030 | 25 |
| | Grade 1034 | 26 |
| | Grade 1035 | 26 |
| | Grade 1037 | 26 |
| | Grade 1038 | 26 |
| | Grade 1039 | 27 |
| | Grade 1040 | 27 |
| | Grade 1042 | 27 |
| | Grade 1043 | 27 |
| | Grade 1044 | 28 |
| | Grade 1045 | 28 |
| | Grade 1046 | 28 |
| | Grade 1049 | 29 |
| | Grade 1050 | 29 |
| ASTM A29/A29M-12e1 (continued) | Grade 1053 | 29 |
| | Grade 1055 | 30 |
| | Grade 1059 | 31 |
| | Grade 1060 | 31 |
| | Grade 1064 | 32 |
| | Grade 1065 | 32 |
| | Grade 1069 | 32 |
| | Grade 1070 | 32 |
| | Grade 1071 | 32 |
| | Grade 1074 | 33 |
| | Grade 1075 | 33 |
| | Grade 1078 | 33 |
| | Grade 1080 | 33 |
| | Grade 1084 | 33 |
| | Grade 1086 | 33 |
| | Grade 1090 | 34 |
| | Grade 1095 | 34 |
| | Grade 10B18 | 44 |
| | Grade 10B23 | 44 |
| | Grade 10B29 | 44 |
| | Grade 10B30 | 44 |
| | Grade 10B38 | 44 |
| | Grade 10B40 | 44 |
| | Grade 10B45 | 44 |
| | Grade 10B50 | 44 |
| | Grade 1109 | 611 |
| | Grade 1110 | 611 |
| | Grade 1117 | 611 |
| | Grade 1118 | 611 |
| | Grade 1132 | 611 |
| | Grade 1137 | 612 |
| | Grade 1139 | 612 |
| | Grade 1140 | 612 |
| | Grade 1141 | 612 |
| | Grade 1144 | 612 |
| | Grade 1146 | 613 |
| | Grade 1151 | 613 |
| | Grade 1212 | 613 |
| | Grade 1213 | 613 |
| | Grade 1215 | 613 |
| | Grade 12L13 | 614 |
| | Grade 12L14 | 614 |
| | Grade 12L15 | 614 |

| Specification | Designation | Page Number |
|---|---|---|
| ASTM A29/A29M-12e1 (continued) | Grade 1522 | 34 |
| | Grade 1524 | 34 |
| | Grade 1536 | 34 |
| | Grade 1541 | 35 |
| | Grade 1547 | 35 |
| | Grade 1552 | 35 |
| | Grade 15B22 | 44 |
| | Grade 4118 | 39 |
| | Grade 4120 | 39 |
| | Grade 4121 | 39 |
| | Grade 4130 | 40 |
| | Grade 4137 | 40 |
| | Grade 4140 | 41 |
| | Grade 4145 | 41 |
| | Grade 4150 | 41 |
| | Grade 4320 | 42 |
| | Grade 4340 | 42 |
| | Grade 50B44 | 45 |
| | Grade 50B46 | 45 |
| | Grade 50B50 | 45 |
| | Grade 50B60 | 45 |
| | Grade 5120 | 36 |
| | Grade 5130 | 36 |
| | Grade 5132 | 37 |
| | Grade 5135 | 37 |
| | Grade 5140 | 37 |
| | Grade 5145 | 38 |
| | Grade 5150 | 38 |
| | Grade 51B35 | 45 |
| | Grade 51B60 | 45 |
| | Grade 6150 | 45 |
| | Grade 8620 | 42 |
| | Grade 8640 | 43 |
| | Grade E4340 | 42 |
| | Grade E9310 | 43 |
| ASTM A36/A36M-14 | --- | 57, 68 |
| ASTM A53/A53M-12 | Type E Grade A | 255, 258 |
| | Type E Grade B | 257, 259 |
| | Type F Grade A | 255, 258 |
| | Type S Grade A | 255, 258 |
| | Type S Grade B | 257, 259 |
| ASTM A105/A105M-14 | --- | 342, 346 |
| ASTM A106/A106M-14 | Grade A | 260, 264 |
| ASTM A106/A106M-14 (continued) | Grade B | 262, 265 |
| | Grade C | 263, 266 |
| ASTM A128/A128M-93 (2012) | Grade A | 400, 401 |
| | Grade B-1 | 400, 401 |
| | Grade B-2 | 400, 401 |
| | Grade B-3 | 400, 401 |
| | Grade B-4 | 400, 401 |
| | Grade C | 400, 401 |
| | Grade D | 400, 401 |
| | Grade E-1 | 400, 401 |
| | Grade E-2 | 400, 401 |
| | Grade F | 400, 401 |
| ASTM A135/A135M-09 (2014) | Grade A | 255, 258 |
| | Grade B | 257, 259 |
| ASTM A139/A139M-04 (2010) | Grade A | 255, 258 |
| | Grade B | 257, 259 |
| | Grade C | 257, 259 |
| | Grade D | 257, 259 |
| | Grade E | 257, 259 |
| ASTM A148/A148 M-14 | Grade 105-85 [725-585] | 392, 395 |
| | Grade 115-95 [795-655] | 392, 395 |
| | Grade 130-115 [895-795] | 392, 395 |
| | Grade 150-135 [1035-930] | 392, 395 |
| | Grade 80-40 [550-275] | 390, 394 |
| | Grade 80-50 [550-345] | 390, 394 |
| | Grade 90-60 [620-415] | 391, 394 |
| ASTM A178/A178M-02 (2012) | Grade A | 260, 264 |
| | Grade C | 262, 265 |
| | Grade D | 263, 266 |
| ASTM A179/A179M-90a (2012) | --- | 260, 264 |
| ASTM A181/A181M-14 | Class 60 | 342, 345 |
| | Class 70 | 342, 346 |
| ASTM A182/A182M-15 | Grade F 1 | 348 |
| | Grade F 11, Class 2 | 351 |
| | Grade F 11, Class 3 | 351 |
| | Grade F 12, Class 2 | 350 |
| | Grade F 2 | 349 |
| | Grade F 21 | 354 |
| | Grade F 22, Class 1 | 352, 353 |
| | Grade F 22, Class 3 | 352, 353 |
| | Grade F 22V | 352, 353 |

| Specification | Designation | Page Number |
|---|---|---|
| ASTM A182/A182M-15 (continued) | Grade F 304 | 367, 373 |
| | Grade F 304H | 367, 374 |
| | Grade F 304L | 367, 373 |
| | Grade F 304LN | 368, 374 |
| | Grade F 304N | 368, 374 |
| | Grade F 310 | 368, 375 |
| | Grade F 310H | 368, 375 |
| | Grade F 316 | 369, 375 |
| | Grade F 316H | 370, 377 |
| | Grade F 316L | 369, 376 |
| | Grade F 316LN | 370, 376 |
| | Grade F 316N | 367, 373 |
| | Grade F 317 | 370, 377 |
| | Grade F 317L | 370, 377 |
| | Grade F 321 | 371, 378 |
| | Grade F 321H | 371, 378 |
| | Grade F 347 | 372, 379 |
| | Grade F 347H | 372, 379 |
| | Grade F 348 | 372, 379 |
| | Grade F 3V | 354, 355 |
| | Grade F 430 | 366 |
| | Grade F 5 | 355, 356 |
| | Grade F 50 | 381, 383 |
| | Grade F 51 | 381, 383 |
| | Grade F 53 | 381, 383 |
| | Grade F 55 | 382, 384 |
| | Grade F 59 | 382, 384 |
| | Grade F 5a | 355, 356 |
| | Grade F 60 | 381, 383 |
| | Grade F 6a, Class 1 | 364, 365 |
| | Grade F 6a, Class 2 | 364, 365 |
| | Grade F 6a, Class 3 | 364, 365 |
| | Grade F 6a, Class 4 | 364, 365 |
| | Grade F 6b | 364, 365 |
| | Grade F 6NM | 364, 365 |
| | Grade F 9 | 356 |
| ASTM A192/A192M-02 (2012) | --- | 260, 264 |
| ASTM A203/A203M-12 | Grade A | 149, 150 |
| | Grade B | 149, 150 |
| | Grade D | 151, 152 |
| | Grade E | 151, 152 |
| | Grade F | 151, 152 |
| ASTM A204/A204M-12 | Grade A | 134, 138 |
| ASTM A204/A204M-12 (continued) | Grade B | 135, 138 |
| | Grade C | 135, 138 |
| ASTM A209/A209M-03 (2012) | Grade T1 | 268, 269 |
| | Grade T1a | 268, 269 |
| | Grade T1b | 268, 269 |
| ASTM A210/A210M-02 (2012) | Grade A-1 | 262, 265 |
| | Grade C | 263, 266 |
| ASTM A213/A213M-15a | Grade T11 | 276, 277 |
| | Grade T12 | 274, 275 |
| | Grade T2 | 271, 272 |
| | Grade T22 | 278, 279 |
| | Grade T36 Class 1 | 273 |
| | Grade T36 Class 2 | 273 |
| | Grade T5 | 280, 281 |
| | Grade T5b | 280, 281 |
| | Grade T9 | 283, 284 |
| | Grade T91 | 283, 285 |
| | Grade TP304 | 288, 298 |
| | Grade TP304H | 289, 301 |
| | Grade TP304L | 288, 299 |
| | Grade TP304LN | 289, 300 |
| | Grade TP309H | 290, 303 |
| | Grade TP309S | 290, 302 |
| | Grade TP310H | 290, 304 |
| | Grade TP310S | 290, 303 |
| | Grade TP316 | 291, 305 |
| | Grade TP316H | 293, 308 |
| | Grade TP316L | 292, 306 |
| | Grade TP316LN | 292, 307 |
| | Grade TP317 | 293, 309 |
| | Grade TP317L | 294, 309 |
| | Grade TP317LM | 234, 242, 294, 310 |
| | Grade TP321 | 295, 311 |
| | Grade TP321H | 295, 312 |
| | Grade TP347 | 296, 313 |
| | Grade TP347H | 296, 314 |
| | Grade TP347HFG | 296, 314 |
| ASTM A214/A214M-96 (2012) | --- | 260, 264 |
| ASTM A216/A216M-14e1 | Grade WCA | 396, 397 |
| | Grade WCB | 396, 397 |
| | Grade WCC | 396, 397 |
| ASTM A217/A217M-14 | Grade C12 | 407, 408 |

| Specification | Designation | Page Number |
|---|---|---|
| ASTM A217/A217M-14 (continued) | Grade C5 | 407, 408 |
| | Grade CA15 | 419, 421 |
| | Grade WC1 | 406, 407 |
| | Grade WC6 | 406, 407 |
| | Grade WC9 | 406, 408 |
| ASTM A240/A240M-15a | --- | 159, 160, 162, 163, 170, 184, 185, 186, 187, 439, 443, 445, 447, 449, 451, 452, 455, 457, 462, 464, 470, 471, 472, 483, 487, 499, 500, 503, 513, 514, 515, 516, 517, 518 |
| | Type 201-1 | 458, 473 |
| | Type 201-2 | 458, 473 |
| | Type 201L | 458, 474 |
| | Type 201LN | 458, 474 |
| | Type 202 | 458, 474 |
| | Type 2205 | 185, 186, 513, 515 |
| | Type 2304 | 185, 186, 513, 516 |
| | Type 2507 | 185, 187, 514, 517 |
| | Type 301 | 459, 475 |
| | Type 301L | 459, 476 |
| | Type 301LN | 165, 171, 459, 477 |
| | Type 302 | 459, 477 |
| | Type 304 | 165, 171, 460, 478 |
| | Type 304H | 165, 172, 461, 480 |
| | Type 304L | 165, 173, 461, 479 |
| | Type 304LN | 166, 175, 462, 482 |
| | Type 304N | 166, 174, 461, 481 |
| | Type 305 | 462, 483 |
| | Type 309H | 166, 176, 463, 484 |
| | Type 309S | 463, 484 |
| | Type 310 MoLN | 464, 486 |
| | Type 310H | 166, 176, 463, 486 |
| | Type 310S | 463, 485 |
| | Type 316 | 167, 177, 464, 487 |
| | Type 316Cb | 168, 180, 466, 491 |
| | Type 316L | 167, 178, 465, 489 |
| ASTM A240/A240M-15a (continued) | Type 316LN | 467, 493 |
| | Type 316N | 466, 492 |
| | Type 316Ti | 168, 179, 466, 491 |
| | Type 317 | 467, 494 |
| | Type 317L | 168, 181, 467, 494 |
| | Type 317LMN | 169, 182, 468, 495 |
| | Type 317LN | 169, 181, 468, 495 |
| | Type 321 | 169, 182, 468, 496 |
| | Type 321H | 468, 497 |
| | Type 329 | 514, 518 |
| | Type 347 | 169, 183, 469, 498 |
| | Type 347H | 470, 501 |
| | Type 403 | 438, 440 |
| | Type 405 | 159, 162, 445, 450 |
| | Type 410 | 519, 523 |
| | Type 410S | 438, 441 |
| | Type 420 | 439, 442 |
| | Type 429 | 446, 452 |
| | Type 430 | 446, 453 |
| | Type 434 | 447, 454 |
| | Type 436 | 447, 455 |
| | Type 439 | 160, 163, 447, 455 |
| | Type 444 | 161, 164, 448, 456 |
| | Type 446 | 448, 456 |
| | Type 800 | 297, 314, 471, 502 |
| | Type 800H | 170, 184, 297, 314, 471, 503 |
| | Type 904L | 170, 183, 472, 504 |
| | Type XM-27 | 448, 457 |
| ASTM A242/A242M-13 | Type 1 | 76, 81 |
| ASTM A249/A249M-14 | Grade TP304L | 288 |
| | Grade TP304N | 288 |
| ASTM A249/A249M-14a | --- | 234, 241, 294, 297, 310, 315 |
| | Grade TP304 | 288, 298 |
| | Grade TP304H | 289, 301 |
| | Grade TP304L | 299 |
| | Grade TP304LN | 289, 300 |
| | Grade TP304N | 299 |
| | Grade TP309H | 290, 303 |
| | Grade TP309S | 290, 302 |

| Specification | Designation | Page Number |
|---|---|---|
| ASTM A249/A249M-14a (continued) | Grade TP310S | 290, 303 |
| | Grade TP316 | 291, 305 |
| | Grade TP316H | 293, 308 |
| | Grade TP316L | 292, 306 |
| | Grade TP316LN | 292, 307 |
| | Grade TP317 | 293, 309 |
| | Grade TP317L | 294, 309 |
| | Grade TP321 | 234, 240, 295, 311 |
| | Grade TP321H | 295, 312 |
| | Grade TP347 | 296, 313 |
| | Grade TP347H | 296, 314 |
| ASTM A250/A250M-05 (2014) | Grade T1 | 268, 269 |
| | Grade T11 | 276, 277 |
| | Grade T12 | 274, 275 |
| | Grade T1a | 268, 269 |
| | Grade T1b | 268, 269 |
| | Grade T2 | 271, 272 |
| | Grade T22 | 278, 279 |
| ASTM A266/A266M-13 | Grade 1 | 342, 345 |
| | Grade 2 | 342, 346 |
| | Grade 4 | 342, 346 |
| ASTM A268/A268M-10 | Grade TP405 | 227, 228 |
| | Grade TP409 | 227, 228, 286, 287 |
| | Grade TP410 | 227, 229, 286, 287 |
| | Grade TP430 | 227, 230, 286, 287 |
| | Grade TP439 | 227, 231 |
| ASTM A269/A269M-14e1 | --- | 234, 242, 297, 315 |
| | Grade TP 304LN | 233, 238 |
| | Grade TP304 | 232, 235 |
| | Grade TP304L | 232, 236 |
| | Grade TP316 | 232, 237 |
| | Grade TP316L | 232, 238 |
| | Grade TP316LN | 233, 239 |
| | Grade TP321 | 234, 240 |
| | Grade TP347 | 234, 241 |
| ASTM A270/A270M-15 | --- | 243, 244 |
| | Grade 2205 | 243, 244 |
| | Grade 2507 | 243, 245 |
| | Grade TP 304 | 288, 298 |
| ASTM A276/A276M-15 | --- | 521, 532, 535, 545, 547, 549, 566, 579, 586, 600, 601, 602, 603, 604, 605 |
| ASTM A276/A276M-15 (continued) | Type 201 | 541, 551 |
| | Type 202 | 541, 551 |
| | Type 302 | 541, 553 |
| | Type 304 | 542, 555 |
| | Type 304L | 542, 558 |
| | Type 304LN | 543, 561 |
| | Type 304N | 543, 561 |
| | Type 305 | 543, 562 |
| | Type 309 | 544, 564 |
| | Type 309S | 544, 564 |
| | Type 310 | 544, 564 |
| | Type 310S | 544, 565 |
| | Type 314 | 545, 567 |
| | Type 316 | 545, 568 |
| | Type 316Cb | 546, 578 |
| | Type 316L | 546, 572 |
| | Type 316LN | 547, 580 |
| | Type 316N | 547, 579 |
| | Type 316Ti | 546, 576 |
| | Type 317 | 548, 581 |
| | Type 321 | 548, 582 |
| | Type 347 | 549, 586 |
| | Type 348 | 549, 586 |
| | Type 403 | 519, 522 |
| | Type 405 | 534, 536 |
| | Type 410 | 519, 523 |
| | Type 420 | 520, 527 |
| | Type 430 | 534, 538 |
| | Type 431 | 520, 529 |
| | Type 440A | 520, 531 |
| | Type 440B | 520, 531 |
| | Type 440C | 521, 531 |
| | Type 446 | 535, 540 |
| | Type 447 | 540 |
| | Type XM-21 | 543, 562 |
| | Type XM-27 | 535, 540 |
| ASTM A283/A283M-13 | Grade C | 55, 67 |
| | Grade D | 59, 69 |
| ASTM A295/A295M-14 | Grade 52100 | 628 |
| ASTM A297/A297M-14 | Grade HC | 426, 430 |
| | Grade HD | 426, 430 |
| | Grade HE | 426, 430 |
| | Grade HF | 426, 430 |

| Specification | Designation | Page Number |
|---|---|---|
| ASTM A297/A297M-14 (continued) | Grade HH | 427, 431 |
| | Grade HI | 427, 431 |
| | Grade HK | 427, 431 |
| | Grade HL | 427, 431 |
| | Grade HN | 428, 432 |
| | Grade HP | 428, 432 |
| | Grade HT | 428, 432 |
| | Grade HU | 428, 432 |
| | Grade HW | 429, 432 |
| | Grade HX | 429, 432 |
| ASTM A302/A302M-12 | Grade A | 136, 139 |
| | Grade B | 137, 139 |
| | Grade C | 155, 156 |
| | Grade D | 157, 158 |
| ASTM A312/A312M-14 | --- | 310 |
| ASTM A312/A312M-15 | --- | 234, 241, 294, 297, 315 |
| | Grade TP304 | 288, 298 |
| | Grade TP304H | 289, 301 |
| | Grade TP304L | 288, 299 |
| | Grade TP309S | 290, 302 |
| | Grade TP310S | 290, 303 |
| | Grade TP316 | 291, 305 |
| | Grade TP316H | 293, 308 |
| | Grade TP316L | 292, 306 |
| | Grade TP317 | 293, 309 |
| | Grade TP317L | 294, 309 |
| | Grade TP321 | 295, 311 |
| | Grade TP321H | 295, 312 |
| | Grade TP347 | 296, 313 |
| | Grade TP347H | 296, 314 |
| ASTM A313/A313M-13 | Type 302, Class 1 | 621 |
| | Type 302, Class 2 | 621 |
| | Type 304 | 621 |
| | Type 316 | 621 |
| | Type 631 | 621 |
| ASTM A314-13a | Type 304 | 542 |
| | Type 304L | 542 |
| | Type 316Ti | 546 |
| ASTM A322-13 | Grade 4118 | 39 |
| | Grade 4120 | 39 |
| | Grade 4121 | 39 |
| | Grade 4130 | 40 |
| | Grade 4137 | 40 |
| ASTM A322-13 (continued) | Grade 4140 | 41 |
| | Grade 4145 | 41 |
| | Grade 4150 | 41 |
| | Grade 4320 | 42 |
| | Grade 4340 | 42 |
| | Grade 50B44 | 45 |
| | Grade 50B46 | 45 |
| | Grade 50B50 | 45 |
| | Grade 50B60 | 45 |
| | Grade 5120 | 36 |
| | Grade 5130 | 36 |
| | Grade 5132 | 37 |
| | Grade 5135 | 37 |
| | Grade 5140 | 37 |
| | Grade 5150 | 38 |
| | Grade 51B60 | 45 |
| | Grade 6150 | 45 |
| | Grade 8620 | 42 |
| | Grade 8640 | 43 |
| | Grade E4340 | 42 |
| ASTM A333/A333M-13 | Grade 1 | 246, 249 |
| | Grade 3 | 248, 250, 251, 253 |
| | Grade 6 | 248, 250 |
| | Grade 8 | 248, 250, 251, 254 |
| ASTM A334/A334M-04a (2010) | Grade 1 | 246, 249 |
| | Grade 3 | 251, 253 |
| | Grade 6 | 248, 250 |
| | Grade 8 | 251, 254 |
| ASTM A335/A335M-15 | Grade P1 | 268, 269 |
| | Grade P11 | 276, 277 |
| | Grade P12 | 274, 275 |
| | Grade P2 | 271, 272 |
| | Grade P22 | 278, 279 |
| | Grade P5 | 280, 281 |
| | Grade P9 | 283, 284 |
| | Grade P91 | 283, 285 |
| | Grade P911 | 273 |
| | Grade P92 | 283, 285 |
| ASTM A336/A336M-10a | Grade F1 | 348 |
| | Grade F11, Class 2 | 351 |
| | Grade F11, Class 3 | 351 |
| | Grade F12 | 350 |
| | Grade F21, Class 1 | 354 |

| Specification | Designation | Page Number |
|---|---|---|
| ASTM A336/A336M-10a (continued) | Grade F21, Class 3 | 354 |
| | Grade F22, Class 1 | 352, 353 |
| | Grade F22, Class 3 | 352, 353 |
| | Grade F22V | 352, 353 |
| | Grade F3V | 354, 355 |
| | Grade F5 | 355, 356 |
| | Grade F5A | 355, 356 |
| | Grade F9 | 356 |
| ASTM A350/A350M-15 | Grade LF1, Class 1 | 342, 345 |
| | Grade LF2, Class 1 | 343, 346 |
| | Grade LF2, Class 2 | 343, 346 |
| | Grade LF3, Class 1 | 357, 358 |
| | Grade LF3, Class 2 | 357, 358 |
| ASTM A351/A351M-14 | Grade CF10M | 423, 425 |
| | Grade CF3 | 422, 424 |
| | Grade CF3A | 422, 424 |
| | Grade CF3M | 423, 425 |
| | Grade CF3MA | 423, 425 |
| | Grade CF8 | 422, 424 |
| | Grade CF8A | 422, 424 |
| | Grade CF8C | 422, 424 |
| | Grade CF8M | 422, 424 |
| | Grade CN7M | 423, 425 |
| | Grade HK30 | 427, 431 |
| | Grade HK40 | 427, 431 |
| | Grade HT30 | 428, 432 |
| ASTM A352/A352M-06 (2012) | Grade CA6NM | 419, 421 |
| | Grade LC1 | 409, 411 |
| | Grade LC2 | 409, 411 |
| | Grade LC2-1 | 410, 412 |
| | Grade LC3 | 409, 411 |
| | Grade LCA | 398, 399 |
| | Grade LCB | 398, 399 |
| | Grade LCC | 398, 399 |
| ASTM A353/A353M-09 (2014) | --- | 153, 154 |
| ASTM A355-89 (2012) | Class A | 43 |
| ASTM A358/A358M-14a | --- | 234, 241, 294, 297, 310, 315 |
| | Grade 304 | 288, 298 |
| | Grade 304H | 289, 301 |
| | Grade 304L | 289, 299 |
| | Grade 309S | 290, 302 |
| | Grade 310S | 290, 303 |

| Specification | Designation | Page Number |
|---|---|---|
| ASTM A358/A358M-14a (continued) | Grade 316 | 291, 305 |
| | Grade 316H | 293, 308 |
| | Grade 316L | 292, 306 |
| | Grade 321 | 295, 311 |
| | Grade 347 | 296, 313 |
| ASTM A376/A376M-14 | --- | 294, 310 |
| | Grade TP304 | 288, 298 |
| | Grade TP304H | 289, 301 |
| | Grade TP304LN | 289, 300 |
| | Grade TP316 | 291, 305 |
| | Grade TP316H | 293, 308 |
| | Grade TP316LN | 292, 307 |
| | Grade TP321 | 295, 311 |
| | Grade TP321H | 295, 312 |
| | Grade TP347 | 296, 313 |
| | Grade TP347H | 296, 314 |
| ASTM A387/A387M-11 | Grade 11, Class 1 | 142 |
| | Grade 11, Class 2 | 142 |
| | Grade 12, Class 1 | 141 |
| | Grade 12, Class 2 | 141 |
| | Grade 2, Class 1 | 140 |
| | Grade 2, Class 2 | 140 |
| | Grade 21, Class 1 | 144 |
| | Grade 21, Class 2 | 144 |
| | Grade 21L, Class 1 | 144 |
| | Grade 22, Class 1 | 143 |
| | Grade 22, Class 2 | 143 |
| | Grade 22L, Class 1 | 143 |
| | Grade 5, Class 1 | 145 |
| | Grade 5, Class 2 | 145 |
| | Grade 91, Class 2 | 146 |
| ASTM A389/A389M-13 | Grade C24 | 406, 408 |
| ASTM A403/A403M-15 | Grade CR304 | 367, 373 |
| | Grade CR304L | 373 |
| | Grade CR304LN | 368 |
| | Grade CR310S | 368, 375 |
| | Grade CR316 | 369, 375 |
| | Grade CR316L | 369, 376 |
| | Grade CR317 | 370, 377 |
| | Grade CR317L | 370, 377 |
| | Grade CR321 | 371, 378 |
| | Grade CR347 | 372, 379 |
| | Grade CR403L | 367 |

| Specification | Designation | Page Number |
|---|---|---|
| ASTM A403/A403M-15 (continued) | Grade WP304 | 367, 373 |
| | Grade WP304L | 373 |
| | Grade WP304LN | 368 |
| | Grade WP310S | 368, 375 |
| | Grade WP316 | 369, 375 |
| | Grade WP316L | 369, 376 |
| | Grade WP317 | 370, 377 |
| | Grade WP317L | 370, 377 |
| | Grade WP321 | 371, 378 |
| | Grade WP347 | 372, 379 |
| | Grade WP403L | 367 |
| ASTM A409/A409M-15 | --- | 294, 310 |
| | Grade TP304 | 288, 298 |
| | Grade TP304L | 289, 299 |
| | Grade TP316 | 291, 305 |
| | Grade TP316L | 292, 306 |
| | Grade TP317 | 293, 309 |
| | Grade TP321 | 295, 311 |
| | Grade TP347 | 296, 313 |
| ASTM A414/A414M-14 | Grade C | 112, 120 |
| | Grade D | 114, 122 |
| | Grade E | 114, 123 |
| | Grade F | 115, 125 |
| | Grade G | 118, 126 |
| ASTM A447/A447M-11 | Type I | 427, 431 |
| | Type II | 427, 431 |
| ASTM A453/A453M-12 | Grade 660, Class A | 550, 590 |
| ASTM A473-15 | --- | 364, 365, 382, 384 |
| | Type 304 | 367, 373 |
| | Type 304L | 367, 373 |
| | Type 310 | 368, 375 |
| | Type 316 | 369, 375 |
| | Type 316L | 369, 376 |
| | Type 317 | 370, 377 |
| | Type 321 | 371, 378 |
| | Type 347 | 372, 379 |
| | Type 410 | 364, 365 |
| | Type 430 | 366 |
| ASTM A479/A479M-14 | --- | 521, 532, 535, 540, 545, 547, 549, 550, 566, 579, 586, 588, 590, 600, 601, 602, 603, 604, 605 |

| Specification | Designation | Page Number |
|---|---|---|
| ASTM A479/A479M-14 (continued) | Type 302 | 541, 553 |
| | Type 304 | 542, 555 |
| | Type 304H | 543, 562 |
| | Type 304L | 542, 558 |
| | Type 304LN | 543, 561 |
| | Type 304N | 543, 561 |
| | Type 309S | 544, 564 |
| | Type 310S | 544, 565 |
| | Type 316 | 545, 568 |
| | Type 316Cb | 546, 578 |
| | Type 316L | 546, 572 |
| | Type 316LN | 168, 180, 547, 580 |
| | Type 316N | 547, 579 |
| | Type 316Ti | 546, 576 |
| | Type 317 | 548, 581 |
| | Type 321 | 548, 582 |
| | Type 321H | 548, 582 |
| | Type 347 | 549, 586 |
| | Type 347H | 549, 586 |
| | Type 403 | 519, 522 |
| | Type 405 | 534, 536 |
| | Type 410 | 519, 523 |
| | Type 430 | 534, 538 |
| | Type 431 | 520, 529 |
| | Type XM-27 | 535, 540 |
| ASTM A485-14 | Grade 1 | 628 |
| | Grade B2, 100CrMnSi4-4 | 628 |
| | Grade B3, 100CrMnSi6-4 | 628 |
| | Grade B4, 100CrMnSi6-6 | 628 |
| | Grade B5, 100CrMo7 | 628 |
| | Grade B6, 100CrMo7-3 | 628 |
| | Grade B7, 100CrMo7-4 | 628 |
| | Grade B8, 100CrMnMoSi8-4-6 | 628 |
| ASTM A487/A487M-14 | Grade 8, Class A | 406, 408 |
| | Grade 8, Class B | 406, 408 |
| | Grade 8, Class C | 406, 408 |
| | Grade CA15, Class A | 419, 421 |
| | Grade CA15, Class B | 419, 421 |
| | Grade CA15, Class C | 419, 421 |
| | Grade CA15, Class D | 419, 421 |
| | Grade CA6NM, Class A | 419, 421 |
| | Grade CA6NM, Class B | 419, 421 |

| Specification | Designation | Page Number |
|---|---|---|
| ASTM A500-13 | Grade A | 199, 214 |
| | Grade B | 203, 217 |
| | Grade C | 204, 219 |
| | Grade D | 203, 217 |
| ASTM A501-14 | Grade A | 203, 217 |
| ASTM A508/A508M-14 | Grade 1 | 343, 346 |
| | Grade 1A | 343, 346 |
| | Grade 2, Class 1 | 361 |
| | Grade 2, Class 2 | 361 |
| | Grade 22, Class 3 | 352, 353 |
| | Grade 3, Class 1 | 362 |
| | Grade 3, Class 2 | 362 |
| | Grade 3V | 354, 355 |
| | Grade 4N, Class 3 | 363 |
| ASTM A511/A511M-14e1 | Grade MT 317 | 239 |
| ASTM A511/A511M-15a | Grade MT 302 | 233, 239 |
| | Grade MT 304 | 232, 235 |
| | Grade MT 304L | 232, 236 |
| | Grade MT 316 | 232, 237 |
| | Grade MT 316L | 232, 238 |
| | Grade MT 317 | 233 |
| | Grade MT 321 | 234, 240 |
| | Grade MT 347 | 234, 241 |
| | Grade MT 405 | 227, 228 |
| | Grade MT 410 | 227, 229 |
| | Grade MT 430 | 227, 230 |
| ASTM A512-06 (2012) | Grade 1011 | 205, 219 |
| | Grade 1016 | 206, 220 |
| | Grade 1018 | 206, 220 |
| | Grade 1025 | 207, 221 |
| | Grade 1030 | 209, 222 |
| | Grade 1110 | 205, 219 |
| | Grade MT 1010 | 198, 205, 213, 219 |
| | Grade MT 1015 | 199, 206, 213, 220 |
| | Grade MT 1017 | 206, 220 |
| | Grade MT 1020 | 200, 207, 214, 221 |
| | Grade MT 1025 | 201, 215 |
| | Grade MT 1030 | 205, 219 |
| ASTM A513-15 | Grade 1008 | 198, 199, 200, 202, 204, 213, 214, 215, 218 |
| | Grade 1010 | 198, 199, 200, 202, 204, 213, 214, 215, 218 |
| ASTM A513-15 (continued) | Grade 1015 | 199, 200, 202, 204, 205, 214, 215, 218 |
| | Grade 1020 | 200, 201, 204, 205, 207, 214, 215, 218, 220 |
| | Grade 1021 | 200, 201, 204, 206, 207, 214, 215, 219, 220, 221 |
| | Grade 1025 | 202, 205, 207, 208, 215, 219, 220, 221 |
| | Grade 1026 | 204, 207, 208, 209, 218, 220, 221, 222 |
| | Grade 1030 | 204, 207, 209, 210, 218, 220, 222 |
| | Grade 1035 | 205, 206, 209, 210, 219, 220, 222, 223 |
| | Grade 1040 | 205, 206, 210, 219, 220, 222, 223 |
| | Grade 1524 | 206, 210, 220, 222, 223 |
| | Grade 4130 | 224, 225 |
| | Grade 4140 | 224, 226 |
| ASTM A514/A514M-14 | Grade A | 90, 95 |
| | Grade B | 90, 95 |
| | Grade E | 90, 95 |
| | Grade F | 90, 95 |
| | Grade H | 90, 95 |
| | Grade P | 90, 95 |
| | Grade Q | 90, 95 |
| | Grade S | 90, 95 |
| ASTM A515/A515M-10 | Grade 60 [415] | 114, 122 |
| | Grade 65 [450] | 114, 123 |
| | Grade 70 [485] | 115, 125 |
| ASTM A516/A516M-10 | Grade 60 [415] | 114, 122 |
| | Grade 65 [450] | 114, 123 |
| | Grade 70 [485] | 115, 125 |
| ASTM A519-06 (2012) | Grade 1020 | 200, 201, 205, 207, 214, 215, 219, 220 |
| | Grade 1025 | 201, 207, 208, 215, 220, 221 |
| | Grade 1035 | 204, 205, 208, 210, 217, 219, 221, 223 |
| | Grade 1045 | 205, 208, 209, 210, 219, 221, 222, 223 |
| | Grade 1050 | 206, 208, 209, 220, 222 |
| | Grade 4028 | 224, 225 |
| | Grade 4130 | 224, 225 |

| Specification | Designation | Page Number |
|---|---|---|
| ASTM A519-06 (2012) (continued) | Grade 4135 | 224, 226 |
| | Grade 4137 | 224, 226 |
| | Grade 4140 | 224, 226 |
| | Grade 4142 | 224, 226 |
| ASTM A529/A529M-14 | Grade 50 [345] | 60, 70 |
| | Grade 55 [380] | 60, 70 |
| ASTM A533/A533M- 09 (2014) | Type B, Class 1 | 155 |
| | Type B, Class 2 | 155 |
| | Type B, Class 3 | 155 |
| ASTM A533/A533M-09 (2014) | Type A, Class 1 | 137, 139 |
| | Type A, Class 2 | 137, 139 |
| | Type A, Class 3 | 137, 139 |
| | Type B, Class 1 | 156 |
| | Type B, Class 2 | 156 |
| | Type B, Class 3 | 156 |
| | Type C, Class 1 | 157, 158 |
| | Type C, Class 2 | 157, 158 |
| | Type C, Class 3 | 157, 158 |
| ASTM A537/A537M-13 | Class 1 | 115, 125 |
| | Class 2 | 118, 127 |
| | Class 3 | 118, 127 |
| ASTM A541/A541M-05 (2015) | Grade 1 | 342, 345 |
| | Grade 1A | 342, 345 |
| | Grade 2, Class 1 | 361 |
| | Grade 2, Class 2 | 361 |
| | Grade 22, Class 3 | 352, 353 |
| | Grade 22V | 352, 353 |
| | Grade 3, Class 1 | 362 |
| | Grade 3, Class 2 | 362 |
| | Grade 3V | 354, 355 |
| | Grade 4N, Class 3 | 363 |
| ASTM A553/A553M-14 | Type I | 153, 154 |
| | Type II | 153, 154 |
| ASTM A554-15 | Grade MT 430 | 230 |
| | Grade MT-302 | 233, 239 |
| | Grade MT-304 | 232, 235 |
| | Grade MT-304L | 232, 236 |
| | Grade MT-316 | 232, 237 |
| | Grade MT-316L | 232, 238 |
| | Grade MT-317 | 233, 239 |
| | Grade MT-321 | 234, 240 |
| | Grade MT-347 | 234, 241 |
| ASTM A554-15 (continued) | Grade MT-430 | 227 |
| ASTM A556/A556M-96 (2012) | Grade A2 | 260, 264 |
| | Grade B2 | 261, 265 |
| | Grade C2 | 263, 266 |
| ASTM A564/A564M-13 | Type 630 | 593, 595 |
| | Type 631 | 593, 597 |
| | Type 632 | 593, 599 |
| ASTM A565/A565M-10 | Grade 616 | 521, 532 |
| | Grade XM-32 | 521, 531 |
| ASTM A572/A572M-15 | Grade 42 [290], Type 1 | 74, 80 |
| | Grade 42 [290], Type 2 | 74, 80 |
| | Grade 42 [290], Type 3 | 74, 80 |
| | Grade 42 [290], Type 5 | 74, 80 |
| | Grade 50 [345], Type 1 | 75, 81 |
| | Grade 50 [345], Type 2 | 75, 81 |
| | Grade 50 [345], Type 3 | 75, 81 |
| | Grade 50 [345], Type 5 | 75, 81 |
| | Grade 55 [380], Type 1 | 77, 82 |
| | Grade 55 [380], Type 2 | 77, 82 |
| | Grade 55 [380], Type 3 | 77, 82 |
| | Grade 55 [380], Type 5 | 77, 82 |
| | Grade 60 [415], Type 1 | 78, 83 |
| | Grade 60 [415], Type 2 | 78, 83 |
| | Grade 60 [415], Type 3 | 78, 83 |
| | Grade 60 [415], Type 5 | 78, 83 |
| | Grade 65 [450], Type 1 | 79, 84 |
| | Grade 65 [450], Type 2 | 79, 84 |
| | Grade 65 [450], Type 3 | 79, 84 |
| | Grade 65 [450], Type 5 | 79, 84 |
| ASTM A573/A573M-13 | Grade 58 [400] | 56, 67 |
| | Grade 65 [450] | 60, 70 |
| | Grade 70 [485] | 60, 70 |
| ASTM A576-90b (2012) | Grade 1008 | 21 |
| | Grade 1010 | 21 |
| | Grade 1012 | 22 |
| | Grade 1015 | 22 |
| | Grade 1016 | 22 |
| | Grade 1017 | 23 |
| | Grade 1018 | 23 |
| | Grade 1019 | 23 |
| | Grade 1020 | 23 |
| | Grade 1021 | 23 |
| | Grade 1022 | 23 |

| Specification | Designation | Page Number |
|---|---|---|
| ASTM A576-90b (2012) (continued) | Grade 1023 | 24 |
| | Grade 1025 | 24 |
| | Grade 1026 | 24 |
| | Grade 1029 | 25 |
| | Grade 1030 | 25 |
| | Grade 1035 | 26 |
| | Grade 1037 | 26 |
| | Grade 1038 | 26 |
| | Grade 1039 | 27 |
| | Grade 1040 | 27 |
| | Grade 1042 | 27 |
| | Grade 1043 | 27 |
| | Grade 1044 | 28 |
| | Grade 1045 | 28 |
| | Grade 1046 | 28 |
| | Grade 1049 | 29 |
| | Grade 1050 | 29 |
| | Grade 1053 | 29 |
| | Grade 1055 | 30 |
| | Grade 1060 | 31 |
| | Grade 1070 | 32 |
| | Grade 1078 | 33 |
| | Grade 1080 | 33 |
| | Grade 1084 | 33 |
| | Grade 1090 | 34 |
| | Grade 1095 | 34 |
| | Grade 1109 | 611 |
| | Grade 1110 | 611 |
| | Grade 1117 | 611 |
| | Grade 1118 | 611 |
| | Grade 1132 | 611 |
| | Grade 1137 | 612 |
| | Grade 1139 | 612 |
| | Grade 1140 | 612 |
| | Grade 1141 | 612 |
| | Grade 1144 | 612 |
| | Grade 1146 | 613 |
| | Grade 1151 | 613 |
| | Grade 1212 | 613 |
| | Grade 1213 | 613 |
| | Grade 1215 | 613 |
| | Grade 12L14 | 614 |
| | Grade 1522 | 34 |
| ASTM A576-90b (2012) (continued) | Grade 1524 | 34 |
| | Grade 1536 | 34 |
| | Grade 1541 | 35 |
| | Grade 1547 | 35 |
| | Grade 1552 | 35 |
| ASTM A581/A581M-95b (2014) | Type 303 | 615 |
| | Type 303Se | 615 |
| | Type 416 | 615 |
| | Type 430 F | 615 |
| ASTM A582/A582M-12e1 | --- | 534, 538 |
| | Type 303 | 541, 554, 615 |
| | Type 303Se | 541, 554 |
| | Type 416 | 519, 526 |
| | Type 420F | 520, 528 |
| | Type 430F | 534, 538 |
| | Type 440F | 521, 533 |
| ASTM A588/A588M-15 | Grade A | 77, 82 |
| | Grade B | 77, 82 |
| | Grade K | 77, 82 |
| ASTM A595/A595M-14 | Grade A | 206, 220 |
| | Grade B | 206, 220 |
| ASTM A600-92a (2010) | Type M1 | 623 |
| | Type M2 (high C) | 624 |
| | Type M2 (regular C) | 624 |
| | Type M3, Class 1 | 624 |
| | Type M3, Class 2 | 624 |
| | Type M36 | 624 |
| | Type M4 | 624 |
| | Type M42 | 625 |
| | Type M7 | 624 |
| | Type T1 | 623 |
| | Type T15 | 623 |
| | Type T4 | 623 |
| | Type T5 | 623 |
| ASTM A606/A606M-09a | Type 2 | 99, 104 |
| | Type 4 | 99, 104 |
| ASTM A608/A608M-14 | Grade HC30 | 426, 430 |
| | Grade HD50 | 426, 430 |
| | Grade HE35 | 426 |
| | Grade HF30 | 426, 430 |
| | Grade HH30 | 427, 431 |
| | Grade HH33 | 427, 431 |
| | Grade HI35 | 427, 431 |

| Specification | Designation | Page Number |
|---|---|---|
| ASTM A608/A608M-14 (continued) | Grade HK30 | 427, 431 |
| | Grade HK40 | 427, 431 |
| | Grade HL30 | 427 |
| | Grade HL40 | 427 |
| | Grade HN40 | 428 |
| | Grade HT50 | 428 |
| | Grade HU50 | 428 |
| | Grade HW50 | 429 |
| | Grade HX50 | 429 |
| ASTM A612/A612M-12 | --- | 119, 127 |
| ASTM A632-04 (2014) | Grade TP 304 | 232, 235 |
| | Grade TP 304L | 232, 236 |
| | Grade TP 316 | 232, 237 |
| | Grade TP 316L | 232, 238 |
| | Grade TP 317 | 233, 239 |
| | Grade TP 321 | 234, 240 |
| | Grade TP 347 | 234, 241 |
| ASTM A633/A633M-13 | Grade A | 74, 80 |
| | Grade C | 77, 82 |
| | Grade D | 77, 82 |
| | Grade E | 79, 84 |
| ASTM A656/A656M-13 | Grade 50 [345], Type 3 | 74, 80 |
| | Grade 50 [345], Type 7 | 74, 80 |
| | Grade 50 [345], Type 8 | 74, 80 |
| | Grade 60 [415], Type 3 | 77, 82 |
| | Grade 60 [415], Type 7 | 77, 82 |
| | Grade 60 [415], Type 8 | 77, 82 |
| | Grade 70 [485], Type 3 | 79, 84 |
| | Grade 70 [485], Type 7 | 79, 84 |
| | Grade 70 [485], Type 8 | 79, 84 |
| ASTM A662/A662M-12 | Grade A | 128, 131 |
| | Grade B | 129, 132 |
| | Grade C | 129, 132 |
| ASTM A666-15 | Type 201-1 | 458, 473 |
| | Type 201-2 | 458, 473 |
| | Type 201L | 458, 474 |
| | Type 201LN | 458, 474 |
| | Type 202 | 458, 474 |
| | Type 301 | 459, 475 |
| | Type 301L | 459, 476 |
| | Type 301LN | 165, 171, 459, 477 |
| | Type 302 | 459, 477 |
| | Type 304 | 165, 171, 460, 478, 542, 555 |
| ASTM A666-15 (continued) | Type 304L | 165, 173, 461, 479, 542, 558 |
| | Type 304LN | 166, 175, 462, 482, 543, 561 |
| | Type 304N | 166, 174, 461, 481, 543, 561 |
| | Type 316 | 167, 177, 464, 487, 545, 568 |
| | Type 316L | 167, 178, 465, 489, 546, 572 |
| | Type 316N | 466, 492, 547, 579 |
| ASTM A668/A668M-15 | Class A (AH) | 333, 339 |
| | Class B (BH) | 334, 339 |
| | Class C (CH) | 335, 339 |
| | Class D (DH) | 335, 339 |
| | Class E (EH) | 337, 339 |
| | Class F (FH) | 338, 340 |
| ASTM A681-08 | Type A2 | 625 |
| | Type A6 | 626 |
| | Type D2 | 625 |
| | Type D3 | 625 |
| | Type F2 | 627 |
| | Type H10 | 626 |
| | Type H11 | 626 |
| | Type H12 | 626 |
| | Type H13 | 626 |
| | Type H19 | 627 |
| | Type H21 | 627 |
| | Type L3 | 627 |
| | Type L6 | 627 |
| | Type O1 | 626 |
| | Type O2 | 626 |
| | Type S1 | 627 |
| | Type S5 | 627 |
| | Type S7 | 627 |
| ASTM A684/A684M-14 | Grade 1040, Type 1, Limit H | 616 |
| | Grade 1040, Type 1, Limit L | 616 |
| | Grade 1040, Type 2, Limit H | 616 |
| | Grade 1040, Type 2, Limit L | 616 |
| | Grade 1050, Type 1, Limit H | 616 |
| | Grade 1050, Type 1, Limit L | 616 |
| | Grade 1050, Type 2, Limit H | 616 |
| | Grade 1050, Type 2, Limit L | 616 |
| | Grade 1055, Type 1, Limit H | 616 |

| Specification | Designation | Page Number |
|---|---|---|
| ASTM A684/A684M-14 (continued) | Grade 1055, Type 1, Limit L | 616 |
| | Grade 1055, Type 2, Limit H | 616 |
| | Grade 1055, Type 2, Limit L | 616 |
| | Grade 1060, Type 1, Limit H | 616 |
| | Grade 1060, Type 1, Limit L | 616 |
| | Grade 1060, Type 2, Limit H | 616 |
| | Grade 1060, Type 2, Limit L | 616 |
| | Grade 1064, Type 1, Limit H | 617 |
| | Grade 1064, Type 1, Limit L | 617 |
| | Grade 1064, Type 2, Limit H | 617 |
| | Grade 1064, Type 2, Limit L | 617 |
| | Grade 1065, Type 1, Limit H | 617 |
| | Grade 1065, Type 1, Limit L | 617 |
| | Grade 1065, Type 2, Limit H | 617 |
| | Grade 1065, Type 2, Limit L | 617 |
| | Grade 1070, Type 1, Limit H | 617 |
| | Grade 1070, Type 1, Limit L | 617 |
| | Grade 1070, Type 2, Limit H | 617 |
| | Grade 1070, Type 2, Limit L | 617 |
| | Grade 1074, Type 1, Limit H | 617 |
| | Grade 1074, Type 1, Limit L | 617 |
| | Grade 1074, Type 2, Limit H | 617 |
| | Grade 1074, Type 2, Limit L | 617 |
| | Grade 1080, Type 1, Limit H | 617 |
| | Grade 1080, Type 1, Limit L | 617 |
| | Grade 1080, Type 2, Limit H | 617 |
| | Grade 1080, Type 2, Limit L | 617 |
| | Grade 1085, Type 1, Limit H | 617 |
| | Grade 1085, Type 1, Limit L | 617 |
| | Grade 1085, Type 2, Limit H | 617 |
| | Grade 1085, Type 2, Limit L | 617 |
| | Grade 1086, Type 1, Limit H | 618 |
| | Grade 1086, Type 1, Limit L | 618 |
| | Grade 1086, Type 2, Limit H | 618 |
| | Grade 1086, Type 2, Limit L | 618 |
| | Grade 1095, Type 1, Limit H | 618 |
| | Grade 1095, Type 1, Limit L | 618 |
| | Grade 1095, Type 2, Limit H | 618 |
| | Grade 1095, Type 2, Limit L | 618 |
| ASTM A686-92 (2010) | Type W1, Grade A-10 | 622 |
| | Type W1, Grade A-10.5 | 625 |
| | Type W1, Grade A-11.5 | 622 |
| | Type W1, Grade A-8 | 622 |
| | Type W1, Grade A-8.5 | 622 |
| | Type W1, Grade A-9 | 622 |
| | Type W2, Grade A-8.5 | 622 |
| | Type W2, Grade A-9.5 | 622 |
| ASTM A688/A688M-15 | --- | 297, 315 |
| | Grade TP 304L | 299 |
| | Grade TP304 | 288, 298 |
| | Grade TP304L | 289 |
| | Grade TP304LN | 289, 300 |
| | Grade TP316 | 291, 305 |
| | Grade TP316L | 292, 306 |
| | Grade TP316LN | 292, 307 |
| ASTM A693-13 | Type 630 | 505, 507 |
| | Type 631 | 505, 511 |
| ASTM A705/A705M-13 | Type 630 | 379, 380 |
| ASTM A709/A709M-13a | Grade 36 [250] | 57, 68 |
| | Grade 50 [345], Type 1 | 75, 81 |
| | Grade 50 [345], Type 2 | 75, 81 |
| | Grade 50 [345], Type 3 | 75, 81 |
| | Grade 50 [345], Type 5 | 75, 81 |
| | Grade 50W [345W], Type A | 85, 92 |
| | Grade 50W [345W], Type B | 85, 92 |
| | Grade HPS 100W [HPS 690W] | 91, 95 |
| | Grade HPS 70W [HPS 485W] | 88 |
| | Grade HPS 70W [HPS 485W] | 93 |
| ASTM A710/A710M-02 (2013) | Grade A, Class 1 | 89, 94 |
| | Grade A, Class 2 | 86, 92 |
| | Grade A, Class 3 | 88, 94 |
| ASTM A713-04 (2010) | Grade 1064 | 615 |
| | Grade 1065 | 615 |
| | Grade 1070 | 615 |

| Specification | Designation | Page Number |
|---|---|---|
| ASTM A713-04 (2010) (continued) | Grade 1084 | 616 |
| | Grade 1086 | 616 |
| ASTM A737/A737M-09 (2013) | Grade B | 115, 125 |
| | Grade C | 119, 127 |
| ASTM A738/A738M-12a | Grade A | 118, 126 |
| | Grade B | 119, 127 |
| | Grade C | 119, 127 |
| ASTM A743/A743M-13ae1 | Grade CA15 | 413, 414 |
| | Grade CA15M | 413, 414 |
| | Grade CA40 | 413, 414 |
| | Grade CA6NM | 413, 414 |
| | Grade CF20 | 415, 417 |
| | Grade CF3 | 415, 417 |
| | Grade CF3M | 415, 417 |
| | Grade CF3MN | 416, 418 |
| | Grade CF8 | 415, 417 |
| | Grade CF8C | 415, 417 |
| | Grade CF8M | 415, 417 |
| | Grade CG3M | 416, 418 |
| | Grade CG8M | 416, 418 |
| | Grade CH20 | 416, 418 |
| | Grade CK3MCuN | 416, 418 |
| | Grade CN3M | 416, 418 |
| | Grade CN3MN | 416, 418 |
| | Grade CN7M | 416, 418 |
| ASTM A744/A744M-13 | Grade CF3 | 415, 417 |
| | Grade CF3M | 415, 417 |
| | Grade CF8 | 415, 417 |
| | Grade CF8C | 415, 417 |
| | Grade CF8M | 415, 417 |
| | Grade CG3M | 416, 418 |
| | Grade CG8M | 416, 418 |
| | Grade CK3MCuN | 416, 418 |
| | Grade CN3MN | 416, 418 |
| | Grade CN7M | 416, 418 |
| ASTM A757/A757M-15 | Grade A1Q | 398, 399 |
| | Grade A2Q | 398, 399 |
| | Grade B2N | 409, 411 |
| | Grade B2Q | 409, 411 |
| | Grade B3N | 409, 411 |
| | Grade B3Q | 409, 411 |
| | Grade C1Q | 410, 412 |
| | Grade D1N1 | 410, 412 |
| ASTM A757/A757M-15 (continued) | Grade D1N2 | 410, 412 |
| | Grade D1N3 | 410, 412 |
| | Grade D1Q1 | 410, 412 |
| | Grade D1Q2 | 410, 412 |
| | Grade D1Q3 | 410, 412 |
| | Grade E1Q | 410, 412 |
| | Grade E2N1 | 410, 412 |
| | Grade E2N2 | 410, 412 |
| | Grade E2N3 | 410, 412 |
| | Grade E2Q1 | 410, 412 |
| | Grade E2Q2 | 410, 412 |
| | Grade E2Q3 | 410, 412 |
| | Grade E3N | 419, 421 |
| ASTM A774/A774M-14 | Grade TP 317L | 370, 377 |
| | Grade TP 321 | 371, 378 |
| ASTM A778-01 (2009)e1 | Grade TP 304L | 232, 236 |
| | Grade TP 316L | 232, 238 |
| | Grade TP 321 | 234, 240 |
| | Grade TP 347 | 234, 241 |
| ASTM A789/A789M-14 | --- | 243, 244, 245 |
| ASTM A803/A803M-12 | Grade TP XM-27 | 286, 287 |
| | Grade TP409 | 286, 287 |
| ASTM A815/A815M-14 | Grade CRS31803 | 381, 383 |
| | Grade CRS32205 | 381, 383 |
| | Grade CRS32750 | 381, 383 |
| | Grade CRS32760 | 382, 384 |
| | Grade WPS31803 | 381, 383 |
| | Grade WPS32205 | 381, 383 |
| | Grade WPS32750 | 381, 383 |
| | Grade WPS32760 | 382, 384 |
| ASTM A841/A841M-13 | Grade A, Class 1 | 129, 132 |
| | Grade A, Class 2 | 130, 133 |
| | Grade B, Class 1 | 129, 132 |
| | Grade B, Class 2 | 130, 133 |
| | Grade C, Class 1 | 129, 132 |
| | Grade C, Class 2 | 130, 133 |
| ASTM A844/A844M-09 | --- | 153, 154 |
| ASTM A871/A871M-14 | Grade 60, Type I | 101, 105 |
| | Grade 60, Type II | 101, 105 |
| | Grade 60, Type IV | 101, 105 |
| | Grade 65, Type I | 102, 106 |
| | Grade 65, Type II | 102, 106 |
| | Grade 65, Type IV | 102, 106 |

| Specification | Designation | Page Number |
|---|---|---|
| ASTM A895-89 (2009) | Type 303 | 615 |
| ASTM A908-03 (2013) | Type 304 | 232, 235, 288, 298 |
| ASTM A955/A955M-15 | Grade 60 [420] | 600, 602 |
| | Grade 60 [420], Type 304 | 542, 556 |
| | Grade 60 [420], Type 316L | 546, 572 |
| | Grade 75 [520] | 600, 602 |
| | Grade 75 [520], Type 304 | 542, 556 |
| | Grade 75 [520], Type 316L | 546, 572 |
| ASTM A958/A958M-14 | Grade SC 1020, Class 65/35 | 389, 393 |
| | Grade SC 1020, Class 70/36 | 390, 393 |
| | Grade SC 1025, Class 65/35 | 389, 393 |
| | Grade SC 1025, Class 70/36 | 390, 393 |
| | Grade SC 1030, Class 65/35 | 389, 393 |
| | Grade SC 1030, Class 70/36 | 390, 393 |
| | Grade SC 1030, Class 80/40 | 390, 394 |
| | Grade SC 1030, Class 80/50 | 390, 394 |
| | Grade SC 1040, Class 70/36 | 390, 393 |
| | Grade SC 1040, Class 80/40 | 390, 394 |
| | Grade SC 1040, Class 80/50 | 390, 394 |
| | Grade SC 1040, Class 90/60 | 391, 394 |
| | Grade SC 1045, Class 105/85 | 392, 395 |
| | Grade SC 1045, Class 80/40 | 390, 394 |
| | Grade SC 1045, Class 80/50 | 390, 394 |
| | Grade SC 1045, Class 90/60 | 391, 394 |
| | Grade SC 4130, Class 105/85 | 402, 404 |
| | Grade SC 4130, Class 115/95 | 402, 404 |
| | Grade SC 4130, Class 130/115 | 402, 404 |
| | Grade SC 4130, Class 135/125 | 402, 404 |
| | Grade SC 4130, Class 150/135 | 402, 404 |
| | Grade SC 4130, Class 65/35 | 402, 404 |
| | Grade SC 4130, Class 70/36 | 402, 404 |
| | Grade SC 4130, Class 80/40 | 402, 404 |
| | Grade SC 4130, Class 80/50 | 402, 404 |
| | Grade SC 4130, Class 90/60 | 402, 404 |
| ASTM A958/A958M-14 (continued) | Grade SC 4140, Class 105/85 | 402, 404 |
| | Grade SC 4140, Class 115/95 | 402, 404 |
| | Grade SC 4140, Class 130/115 | 402, 404 |
| | Grade SC 4140, Class 135/125 | 402, 404 |
| | Grade SC 4140, Class 150/135 | 402, 404 |
| | Grade SC 4140, Class 160/145 | 402, 404 |
| | Grade SC 4140, Class 165/150 | 402, 404 |
| | Grade SC 4140, Class 65/35 | 402, 404 |
| | Grade SC 4140, Class 70/36 | 402, 404 |
| | Grade SC 4140, Class 80/40 | 402, 404 |
| | Grade SC 4140, Class 80/50 | 402, 404 |
| | Grade SC 4140, Class 90/60 | 402, 404 |
| | Grade SC 4330, Class 105/85 | 403, 405 |
| | Grade SC 4330, Class 115/95 | 403, 405 |
| | Grade SC 4330, Class 130/115 | 403, 405 |
| | Grade SC 4330, Class 135/125 | 403, 405 |
| | Grade SC 4330, Class 150/135 | 403, 405 |
| | Grade SC 4330, Class 160/145 | 403, 405 |
| | Grade SC 4330, Class 165/150 | 403, 405 |
| | Grade SC 4330, Class 210/180 | 403, 405 |
| | Grade SC 4330, Class 65/35 | 403, 405 |
| | Grade SC 4330, Class 70/36 | 403, 405 |
| | Grade SC 4330, Class 80/40 | 403, 405 |
| | Grade SC 4330, Class 80/50 | 403, 405 |
| | Grade SC 4330, Class 90/60 | 403, 405 |
| ASTM A965/A965M-14 | Grade F 348 | 372 |
| | Grade F304 | 367, 373 |
| | Grade F304H | 367, 374 |
| | Grade F304L | 367, 373 |
| | Grade F304LN | 368, 374 |
| | Grade F304N | 368, 374 |
| | Grade F310 | 368, 375 |
| | Grade F310H | 368, 375 |
| | Grade F316 | 369, 375 |
| | Grade F316H | 370, 377 |
| | Grade F316L | 369, 376 |

| Specification | Designation | Page Number |
|---|---|---|
| ASTM A965/A965M-14 (continued) | Grade F316LN | 370, 376 |
| | Grade F316N | 367, 373 |
| | Grade F321 | 371, 378 |
| | Grade F321H | 371, 378 |
| | Grade F347 | 372, 379 |
| | Grade F348 | 379 |
| ASTM A1000/A1000M-11 | Grade A | 619 |
| | Grade C | 620 |
| | Grade D | 619 |
| ASTM A1011/A1011M-14 | Grade 30 [205], SS | 52, 66 |
| | Grade 33 [230], SS | 54, 67 |
| | Grade 36 [250], Type 1, SS | 54, 67 |
| | Grade 36 [250], Type 2, SS | 57, 68 |
| | Grade 40 [275], SS | 55, 67 |
| | Grade 45 [310], Class 1, HSLAS | 74, 80 |
| | Grade 45 [310], Type 1, SS | 59, 69 |
| | Grade 45 [310], Type 2, SS | 59, 69 |
| | Grade 50 [340], Class 1, HSLAS | 75, 80 |
| | Grade 50 [340], Class 2, HSLAS | 74, 80 |
| | Grade 50 [340], SS | 60, 70 |
| | Grade 55 [380], Class 1 | 77 |
| | Grade 55 [380], Class 1, HSLAS | 82 |
| | Grade 55 [380], Class 2, HSLAS | 75, 81 |
| | Grade 55 [380], SS | 60, 70 |
| | Grade 60 [410], Class 1, HSLAS | 78, 83 |
| | Grade 60 [410], Class 2 | 77 |
| | Grade 60 [410], Class 2, HSLAS | 82 |
| | Grade 65 [450], Class 1, HSLAS | 79, 84 |
| | Grade 65 [450], Class 2, HSLAS | 78, 83 |
| | Grade 70 [480], Class 1, HSLAS | 79, 84 |
| | HSLAS | 77 |
| ASTM A1021-05 (2015) | Grade A, Class 1 | 364, 365 |
| | Grade A, Class 2 | 364, 365 |
| | Grade B, Class 1 | 364, 365 |
| ASTM A1028-03 (2015) | Grade F, Class 1 | 593, 595 |
| ASTM B688-96 (2014) | --- | 472, 503 |
| ASTM B691-02 (2013) | --- | 550, 590 |
| BS 3604-2:1991 | 620 | 274, 275 |
| | 621 | 276, 277 |
| BS 3604-2:1991 (continued) | 622 | 278, 279 |
| CSA G40.21-13 | Grade 260W (38W) | 74, 80 |
| | Grade 260WT (38WT) | 74, 80 |
| | Grade 300W (44W) | 75, 80 |
| | Grade 300WT (44WT) | 75, 80 |
| | Grade 350A (50A) | 99, 104 |
| | Grade 350AT (50AT) | 99, 104 |
| | Grade 350R (50R) | 99, 104 |
| | Grade 350W (50W) | 75, 81 |
| | Grade 350WT (50WT) | 76, 82 |
| | Grade 380W (55W) | 76, 82 |
| | Grade 400A (60A) | 101, 105 |
| | Grade 400AT (60AT) | 101, 105 |
| | Grade 400W (60W) | 78, 83 |
| | Grade 400WT (60WT) | 78, 83 |
| | Grade 480A (70A) | 102, 106 |
| | Grade 480AT (70AT) | 102, 106 |
| | Grade 480WT (70WT) | 88, 94 |
| | Grade 550A (80A) | 102, 106 |
| | Grade 550AT (80AT) | 102, 106 |
| | Grade 550WT (80WT) | 89, 94 |
| | Grade 700Q (100Q) | 91, 96 |
| | Grade 700QT (100QT) | 91, 96 |
| CSA Z245.1-14 | 241 - Category 1 | 316, 318 |
| | 290 - Category 1 | 316, 318 |
| | 359 - Category 1 | 316, 319 |
| | 386 - Category 1 | 317, 319 |
| | 414 - Category 1 | 317, 319 |
| | 448 - Category 1 | 317, 320 |
| | 483 - Category 1 | 317, 320 |
| | Grade 241 - Category 2 | 321, 324 |
| | Grade 241 - Category 3 | 321, 324 |
| | Grade 290 - Category 2 | 321, 325 |
| | Grade 290 - Category 3 | 321, 325 |
| | Grade 359 - Category 2 | 322, 326 |
| | Grade 359 - Category 3 | 322, 326 |
| | Grade 386 - Category 2 | 322, 326 |
| | Grade 386 - Category 3 | 322, 326 |
| | Grade 414 - Category 2 | 323, 327 |
| | Grade 414 - Category 3 | 323, 327 |
| | Grade 448 - Category 2 | 323, 327 |
| | Grade 448 - Category 3 | 323, 327 |
| | Grade 483 - Category 2 | 323, 327 |

| Specification | Designation | Page Number |
|---|---|---|
| CSA Z245.1-14 (continued) | Grade 483 - Category 3 | 323, 327 |
| | Grade 550 - Category 2 | 323, 327 |
| | Grade 550 - Category 3 | 323, 327 |
| DIN 5512-3:2004 | X5CrNiMoTi15-2 | 445, 452 |
| EN 10025-2:2004 | E295 | 61, 70 |
| | E335 | 64, 73 |
| | E360 | 65, 73 |
| | S185 | 51, 66 |
| | S235J0 | 54, 67 |
| | S235JR | 54, 67 |
| | S275J0 | 59, 69 |
| | S275JR | 59, 69 |
| | S355J0 | 63, 72 |
| | S355JR | 63, 72 |
| EN 10028-2:2009 | 10CrMo9-10 | 143 |
| | 13 CrMo 4-5 | 141 |
| | 13CrMoSi5-5 | 142 |
| | 15NiCuMoNb5-6-4 | 157, 158 |
| | 16Mo3 | 134, 138 |
| | 18MnMo4-5 | 134, 138 |
| | 20MnMoNi4-5 | 155, 156 |
| | P235GH | 112, 120 |
| | P265GH | 113, 121 |
| | P295GH | 115, 124 |
| | P355GH | 117, 126 |
| | X10CrMoVNb9-1 | 146 |
| | X12CrMo5 | 145 |
| EN 10028-3:2009 | P275NH | 112, 120 |
| | P275NL1 | 128, 131 |
| | P275NL2 | 128, 131 |
| | P355N | 116, 125 |
| | P355NH | 116, 125 |
| | P355NL1 | 129, 132 |
| | P355NL2 | 129, 132 |
| EN 10028-4:2009 | 11MnNi5-3 | 147 |
| | 12Ni14 | 151, 152 |
| | 13MnNi6-3 | 147 |
| | 15NiMn6 | 148 |
| | X12Ni5 | 153 |
| | X7Ni9 | 153, 154 |
| | X8Ni9 | 153, 154 |
| EN 10028-7:2007 | X1CrNi25-21 | 470, 500 |
| | X1CrNiMoCuN20-18-7 | 464, 487 |
| EN 10028-7:2007 (continued) | X1CrNiMoCuN25-25-5 | 472, 503 |
| | X1CrNiMoN25-22-2 | 464, 486 |
| | X1NiCrMoCu25-20-5 | 170, 183, 472, 504 |
| | X1NiCrMoCu31-27-4 | 472, 504 |
| | X1NiCrMoCuN25-20-7 | 170, 184, 472, 503 |
| | X2CrMoTi18-2 | 161, 164, 448, 456 |
| | X2CrNi12 | 159, 162, 445, 451 |
| | X2CrNi18-9 | 165, 173, 461, 479 |
| | X2CrNi19-11 | 165, 173, 461, 479 |
| | X2CrNiMo17-12-2 | 167, 178, 465, 489 |
| | X2CrNiMo17-12-3 | 167, 178, 465, 489 |
| | X2CrNiMo18-14-3 | 167, 178, 465, 489 |
| | X2CrNiMo18-15-4 | 168, 181, 467, 494 |
| | X2CrNiMoCuN25-6-3 | 185, 187, 513, 516 |
| | X2CrNiMoCuWN25-7-4 | 185, 187, 514, 517 |
| | X2CrNiMoN17-11-2 | 168, 180, 467, 493 |
| | X2CrNiMoN17-13-3 | 168, 180, 467, 493 |
| | X2CrNiMoN17-13-5 | 169, 182, 468, 495 |
| | X2CrNiMoN18-12-4 | 169, 181, 468, 495 |
| | X2CrNiMoN22-5-3 | 185, 186, 513, 515 |
| | X2CrNiMoN25-7-4 | 185, 187, 514, 517 |
| | X2CrNiN18-10 | 166, 175, 462, 482 |
| | X2CrNiN18-7 | 165, 171, 459, 477 |
| | X2CrNiN23-4 | 185, 186, 513, 516 |
| | X2CrTi17 | 160, 164, 446, 454 |
| | X2CrTiNb18 | 160, 163, 447, 455 |
| | X3CrNiMo13-4 | 159, 163, 439, 443 |
| | X3CrNiMo17-13-3 | 167, 177, 464, 487 |
| | X3CrNiMoBN17-13-3 | 470, 501 |
| | X3CrTi17 | 160, 164, 446, 454 |
| | X4CrNiMo16-5-1 | 439, 444 |
| | X5CrNi18-10 | 165, 171, 460, 478 |
| | X5CrNiMo17-12-2 | 167, 177, 464, 487 |
| | X5CrNiN19-9 | 166, 174, 461, 481 |
| | X5NiCrAlTi31-20 | 471, 502 |

| Specification | Designation | Page Number |
|---|---|---|
| EN 10028-7:2007 (continued) | X6CrNi18-10 | 165, 172, 461, 480 |
| | X6CrNi23-13 | 166, 176, 463, 484 |
| | X6CrNi25-20 | 166, 176, 463, 486 |
| | X6CrNiMoNb17-12-2 | 168, 180, 466, 491 |
| | X6CrNiMoTi17-12-2 | 168, 179, 466, 491 |
| | X6CrNiNb18-10 | 169, 183, 469, 498 |
| | X6CrNiTi12 | 159, 163, 445, 452 |
| | X6CrNiTi18-10 | 169, 182, 468, 496 |
| | X6CrNiTiB18-10 | 469, 499 |
| | X8CrNiNb16-13 | 471, 501 |
| | X8NiCrAlTi32-21 | 170, 184, 471, 503 |
| EN 10083-2:2006 | 28Mn6 | 34 |
| | C22E | 23 |
| | C22R | 23 |
| | C35 | 26 |
| | C35E | 26 |
| | C35R | 26 |
| | C40 | 27 |
| | C40E | 27 |
| | C40R | 27 |
| | C45 | 28 |
| | C45E | 28 |
| | C45R | 28 |
| | C50E | 29 |
| | C50R | 29 |
| | C55 | 30 |
| | C55E | 30 |
| | C55R | 30 |
| | C60 | 31 |
| | C60E | 31 |
| | C60R | 31 |
| EN 10083-3:2006 C1:2008 | 25CrMo4 | 40 |
| | 25CrMoS4 | 40 |
| | 34Cr4 | 37 |
| | 34CrMo4 | 40 |
| | 34CrMoS4 | 40 |
| | 34CrS4 | 37 |
| | 37Cr4 | 37 |
| | 37CrS4 | 37 |
| | 41Cr4 | 37 |
| | 41CrS4 | 37 |
| EN 10083-3:2006 C1:2008 (continued) | 42CrMo4 | 41 |
| | 42CrMoS4 | 41 |
| | 50CrMo4 | 41 |
| | 51CrV4 | 45 |
| | Grade 20MnB5 | 44 |
| EN 10084:2008 | 14NiCrMo13-4 | 43 |
| | 15NiCr13 | 41 |
| | 17Cr3 | 36 |
| | 17CrS3 | 36 |
| | 18CrMo4 | 39 |
| | 18CrMoS4 | 39 |
| | 20MoCr3 | 39 |
| | 20MoCr4 | 39 |
| | 20MoCrS3 | 39 |
| | 20MoCrS4 | 39 |
| | 20NiCrMo2-2 | 42 |
| | 20NiCrMoS2-2 | 42 |
| | 20NiCrMoS6-4 | 42 |
| | 22CrMoS3-5 | 39 |
| | 28Cr4 | 36 |
| | 28CrS4 | 36 |
| | C10E | 21 |
| | C10R | 21 |
| | C15E | 22 |
| | C15R | 22 |
| | C16E | 22 |
| | C16R | 22 |
| EN 10085:2001 | 32CrAlMo7-10 | 43 |
| | 34CrAlMo5-10 | 43 |
| | 34CrAlNi7-10 | 43 |
| | 41CrAlMo7-10 | 43 |
| EN 10087:1998 C2:2006 | 10S20 | 611 |
| | 10SPb20 | 614 |
| | 11SMn30 | 613 |
| | 11SMn37 | 614 |
| | 11SMnPb30 | 614 |
| | 11SMnPb37 | 614 |
| | 15SMn13 | 611 |
| | 35S20 | 612 |
| | 36SMn14 | 612 |
| | 38SMn28 | 612 |
| | 44SMn28 | 612 |
| | 46S20 | 613 |

| Specification | Designation | Page Number |
|---|---|---|
| EN 10088-2:2014 | X10CrNi18-8 | 459, 475 |
| | X11CrNiMnN19-8-6 | 469, 498 |
| | X12Cr13 | 438, 440 |
| | X12CrMnNiN17-7-5 | 458, 473 |
| | X12CrMnNiN18-9-5 | 458, 474 |
| | X1CrNi25-21 | 470, 500 |
| | X1CrNiMoCuN20-18-7 | 464, 487 |
| | X1CrNiMoCuN24-22-8 | 470, 500 |
| | X1CrNiMoCuN25-25-5 | 472, 503 |
| | X1CrNiMoCuNW24-22-6 | 470, 500 |
| | X1CrNiMoN25-22-2 | 464, 486 |
| | X1CrNiSi18-15-4 | 462, 483 |
| | X1NiCrMoCu25-20-5 | 170, 183, 472, 504 |
| | X1NiCrMoCu31-27-4 | 472, 504 |
| | X1NiCrMoCuN25-20-7 | 170, 184, 472, 503 |
| | X20Cr13 | 439, 442 |
| | X2CrMnNiN17-7-5 | 458, 474 |
| | X2CrMoTi17-1 | 469, 498 |
| | X2CrMoTi18-2 | 161, 164, 448, 456 |
| | X2CrMoTi29-4 | 449, 457 |
| | X2CrNi12 | 159, 162, 445, 451 |
| | X2CrNi18-9 | 165, 173, 461, 479 |
| | X2CrNi19-11 | 165, 173, 461, 479 |
| | X2CrNiMnMoN25-18-6-5 | 470, 500 |
| | X2CrNiMo17-12-2 | 167, 178, 465, 489 |
| | X2CrNiMo17-12-3 | 167, 178, 465, 489 |
| | X2CrNiMo18-14-3 | 167, 178, 465, 489 |
| | X2CrNiMo18-15-4 | 168, 181, 467, 494 |
| | X2CrNiMoCuN25-6-3 | 185, 187, 513, 516 |
| | X2CrNiMoCuWN25-7-4 | 185, 187, 514, 517 |
| | X2CrNiMoN17-11-2 | 467, 493 |
| | X2CrNiMoN17-13-3 | 467, 493 |
| | X2CrNiMoN17-13-5 | 169, 182, 468, 495 |
| | X2CrNiMoN18-12-4 | 169, 181, 468, 495 |
| | X2CrNiMoN22-5-3 | 185, 186, 513, 515 |
| | X2CrNiMoN25-7-4 | 185, 187, 514, 517 |
| | X2CrNiMoN29-7-2 | 514, 518 |
| | X2CrNiMoSi18-5-3 | 513, 515 |
| | X2CrNiN18-10 | 166, 175, 462, 482 |
| EN 10088-2:2014 (continued) | X2CrNiN18-7 | 165, 171, 459, 477 |
| | X2CrNiN23-4 | 185, 186, 513, 516 |
| | X2CrTi12 | 445, 451 |
| | X2CrTi17 | 160, 164, 446, 454 |
| | X2CrTiNb18 | 160, 163, 447, 455 |
| | X30Cr13 | 439, 443 |
| | X39Cr13 | 439, 444 |
| | X3CrNb17 | 160, 164, 446, 454 |
| | X3CrNiMo17-13-3 | 167, 177, 464, 488 |
| | X3CrTi17 | 160, 164, 446, 454 |
| | X4CrNi18-12 | 462, 483 |
| | X4CrNiMo16-5-1 | 439, 444 |
| | X5CrNi17-7 | 459, 475 |
| | X5CrNi18-10 | 165, 171, 460, 478 |
| | X5CrNiCuNb16-4 | 505, 508 |
| | X5CrNiMo17-12-2 | 167, 177, 464, 488 |
| | X5CrNiMoTi15-2 | 159, 163, 445, 452 |
| | X5CrNiN19-9 | 166, 174, 461, 481 |
| | X6Cr13 | 438, 441 |
| | X6Cr17 | 446, 453 |
| | X6CrAl13 | 159, 162, 445, 450 |
| | X6CrMo17-1 | 447, 454 |
| | X6CrMoNb17-1 | 447, 455 |
| | X6CrNiMoNb17-12-2 | 168, 180, 466, 491 |
| | X6CrNiMoTi17-12-2 | 168, 179, 466, 491 |
| | X6CrNiNb18-10 | 169, 183, 469, 498 |
| | X6CrNiTi12 | 159, 163, 445, 452 |
| | X6CrNiTi18-10 | 169, 182, 468, 496 |
| | X7CrNiAl17-7 | 505, 511 |
| | X8CrMnCuN17-8-3 | 470 |
| | X8CrMnCuNB17-8-3 | 499 |
| EN 10088-3:2014 | X105CrMo17 | 521, 531 |
| | X10CrNi18-8 | 541, 552 |
| | X11CrNiMnN19-8-6 | 549, 585 |
| | X12Cr13 | 519, 524 |
| | X12CrMnNiN17-7-5 | 541, 551 |
| | X12CrS13 | 519, 526, 615 |
| | X17CrNi16-2 | 520, 530 |
| | X1CrNiMoCuN20-18-7 | 545, 566 |

| Specification | Designation | Page Number |
|---|---|---|
| EN 10088-3:2014 (continued) | X1CrNiMoCuN24-22-8 | 545, 566 |
| | X1CrNiMoCuNW24-22-6 | 545, 566 |
| | X1NiCrMoCu25-20-5 | 550, 591 |
| | X1NiCrMoCu31-27-4 | 550, 592 |
| | X20Cr13 | 520, 527 |
| | X29CrS13 | 520, 529 |
| | X2CrMoTiS18-2 | 534, 538 |
| | X2CrNi12 | 534, 536 |
| | X2CrNi18-9 | 542, 559 |
| | X2CrNiMnMoN25-18-6-5 | 547, 579 |
| | X2CrNiMo17-12-2 | 546, 573 |
| | X2CrNiMo17-12-3 | 546, 574 |
| | X2CrNiMo18-14-3 | 546, 575 |
| | X2CrNiMo18-15-4 | 548, 581 |
| | X2CrNiMo25-7-4 | 604 |
| | X2CrNiMoCuN25-6-3 | 601, 605 |
| | X2CrNiMoCuWN25-7-4 | 600, 604 |
| | X2CrNiMoN17-11-2 | 168, 180, 547, 580 |
| | X2CrNiMoN17-13-3 | 168, 547, 580 |
| | X2CrNiMoN17-13-5 | 548, 581 |
| | X2CrNiMoN22-5-3 | 600, 603 |
| | X2CrNiMoN25-7-4 | 600 |
| | X2CrNiMoN29-7-2 | 601, 605 |
| | X2CrNiMoSi18-5-3 | 600, 602 |
| | X2CrNiN18-10 | 543, 561 |
| | X2CrNiN23-4 | 600, 602 |
| | X30Cr13 | 520, 528 |
| | X39Cr13 | 521, 533 |
| | X3CrNiCu18-9-4 | 550, 588 |
| | X3CrNiMo13-4 | 521, 532 |
| | X3CrNiMo17-13-3 | 545 |
| | X3NiCrMo17-13-3 | 570 |
| | X4CrNi18-12 | 543, 563 |
| | X5CrNi18-10 | 542, 556 |
| | X5CrNiCuNb16-4 | 593, 596 |
| | X5CrNiMo17-12-2 | 545, 569 |
| | X5CrNiN19-9 | 543, 561 |
| | X6Cr13 | 534, 536 |
| | X6Cr17 | 534, 537 |
| | X6CrMo17-1 | 535, 539 |
| | X6CrMoS17 | 534, 538 |
| | X6CrNiCuS18-9-2 | 549, 587 |
| | X6CrNiMoNb17-12-2 | 546, 578 |
| | X6CrNiMoTi17-12-2 | 546, 577 |
| | X6CrNiNb18-10 | 549, 586 |
| | X6CrNiTi18-10 | 548, 583 |
| | X70CrMo15 | 520, 531 |
| | X7CrNiAl17-7 | 593, 598 |
| | X8CrMnCuN17-8-3 | 550 |
| | X8CrMnCuNB17-8-3 | 590 |
| | X8CrMnNiN18-9-5 | 549, 585 |
| | X8CrNiS18-9 | 541, 554 |
| | X90CrMoV18 | 521, 533 |
| | X9CrNi18-9 | 543, 562 |
| EN 10089:2002 | 51CrV4 | 620 |
| | 54SiCr6 | 619 |
| | 54SiCrV6 | 620 |
| | 55Cr3 | 618 |
| | 60Cr3 | 618 |
| | 60CrMo3-1 | 619 |
| | 60CrMo3-2 | 619 |
| | 60CrMo3-3 | 619 |
| EN 10090:1998 | X53CrMnNiNbN21-9 | 549, 587 |
| EN 10095:1999 | X10NiCrAlTi32-21 | 471, 502 |
| | X12CrNi23-13 | 463, 484 |
| | X12NiCrSi35-16 | 468, 497 |
| | X15CrNiSi25-21 | 463, 485, 545, 567 |
| | X18CrN28 | 535, 540 |
| | X6NiCrSiNCe35-25 | 550, 588 |
| | X8CrNi25-21 | 463, 485 |
| | X8CrNiTi18-10 | 470, 501 |
| EN 10120:2008 | P245NB | 112, 120 |
| | P265NB | 113, 121 |
| | P310NB | 115, 124 |
| | P355NB | 117, 126 |
| EN 10132-4:2000 | 51CrV4 | 620 |
| | C100S | 618 |
| | C55S | 616 |
| | C60S | 616 |
| | C67S | 617 |
| | C75S | 617 |
| | C85S | 617 |
| | C90S | 618 |
| EN 10151:2002 | X10CrNi18-8 | 621 |
| | X11CrNiMnN19-8-6 | 469, 498 |

| Specification | Designation | Page Number |
|---|---|---|
| EN 10151:2002 (continued) | X30Cr13 | 621 |
| | X39Cr13 | 621 |
| | X5CrNi18-10 | 621 |
| | X5CrNiMo17-12-2 | 621 |
| | X7CrNiAl17-7 | 621 |
| EN 10213:2007 C1:2008 | G12MoCrV5-2 | 407, 408 |
| | G17CrMo5-5 | 406, 408 |
| | G17CrMo9-10 | 407, 408 |
| | G17CrMoV5-10 | 406, 408 |
| | G17Mn5 | 398, 399 |
| | G17NiCrMo13-6 | 410, 412 |
| | G18Mo5 | 409, 411 |
| | G20Mn5 | 398, 399 |
| | G20Mo5 | 406, 407 |
| | G9Ni10 | 409, 411 |
| | G9Ni14 | 409, 411 |
| | GP240GH | 396, 397 |
| | GP280GH | 396, 397 |
| | GX15CrMo5 | 407, 408 |
| | GX23CrMoV12-1 | 420, 421 |
| | GX2CrNi19-11 | 422, 424 |
| | GX2CrNiMo19-11-2 | 423, 425 |
| | GX2NiCrMo28-20-2 | 423, 425 |
| | GX3CrNi13-4 | 419, 421 |
| | GX4CrNi13-4 | 419, 421 |
| | GX5CrNi19-10 | 422, 424 |
| | GX5CrNiMo19-11-2 | 422, 424 |
| | GX5CrNiMoNb19-11-2 | 422, 424 |
| | GX5CrNiNb19-11 | 422, 424 |
| | GX8CrNi12 | 420, 421 |
| EN 10216-1:2013 | P195TR1 | 255, 258 |
| | P195TR2 | 255, 258 |
| | P235TR1 | 256, 258 |
| | P235TR2 | 256, 258 |
| | P265TR1 | 256, 259 |
| | P265TR2 | 256, 259 |
| EN 10216-2:2013 | 10CrMo5-5 | 276, 277 |
| | 10CrMo9-10 | 278, 279 |
| | 11CrMo9-10 | 278, 279 |
| | 13CrMo4-5 | 274, 275 |
| | 14MoV6-3 | 271, 272 |
| | 15NiCuMoNb5-6-4 | 273 |
| | 16Mo3 | 267 |
| | 8MoB5-4 | 268, 270 |
| | P195GH | 260, 264 |
| | P235GH | 261, 264 |
| | P265GH | 262, 265 |
| | X10CrMoVNb9-1 | 283, 285 |
| | X11CrMo5+I | 280, 281 |
| | X11CrMo5+NT1 | 280, 281 |
| | X11CrMo5+NT2 | 280, 281 |
| | X11CrMo9-1+I | 283, 284 |
| | X11CrMo9-1+NT | 283, 284 |
| EN 10216-3:2013 | P275NL2 | 247, 249 |
| EN 10216-4:2013 | 11MnNi5-3 | 251, 252 |
| | 12Ni14 | 251, 253 |
| | 13MnNi6-3 | 251, 252 |
| | 26CrMo4-2 | 251, 254 |
| | P215NL | 246, 249 |
| | P255QL | 246, 249 |
| | P265NL | 248, 250 |
| | X10Ni9 | 251, 254 |
| | X12Ni5 | 251, 253 |
| EN 10216-5:2013 | X1NiCrMoCu25-20-5 | 297, 315 |
| | X1NiCrMoCuN25-20-7 | 297, 315 |
| | X2CrNi18-9 | 289, 299 |
| | X2CrNi19-11 | 289, 299 |
| | X2CrNiMo17-12-2 | 292, 307 |
| | X2CrNiMo18-14-3 | 292, 307 |
| | X2CrNiMoN17-13-3 | 292, 307 |
| | X2CrNiMoN17-13-5 | 294, 310 |
| | X2CrNiN18-10 | 289, 300 |
| | X3CrNiMo17-13-3 | 291, 305 |
| | X5CrNi18-10 | 288, 298 |
| | X5CrNiMo17-12-2 | 291, 305 |
| | X6CrNi18-10 | 289, 301 |
| | X6CrNiMo17-13-2 | 293, 308 |
| | X6CrNiMoTi17-12-2 | 293, 308 |
| | X6CrNiNb18-10 | 296, 313 |
| | X6CrNiTi18-10 | 295, 311 |
| | X7CrNiNb18-10 | 296, 314 |
| | X7CrNiTi18-10 | 295, 312 |
| EN 10217-1:2002 A1:2005 | P195TR1 | 255, 258 |
| | P195TR2 | 255, 258 |
| | P235TR1 | 256, 258 |
| | P235TR2 | 256, 258 |

| Specification | Designation | Page Number |
|---|---|---|
| EN 10217-1:2002 A1:2005 (continued) | P265TR1 | 256, 259 |
| | P265TR2 | 256, 259 |
| EN 10217-2:2002 A1:2005 | 16Mo3 | 267 |
| | P195GH | 260, 264 |
| | P235GH | 261, 264 |
| | P265GH | 262, 265 |
| EN 10217-4:2002 A1:2005 | P215NL | 246, 249 |
| | P265NL | 248, 250 |
| EN 10217-5:2002 A1:2005 | 16Mo3 | 267 |
| | P235GH | 261, 264 |
| | P265GH | 262, 265 |
| EN 10217-6:2002 A1:2005 | P215NL | 246, 249 |
| | P265NL | 248, 250 |
| EN 10217-7:2014 | X1NiCrMoCu25-20-5 | 297, 315 |
| | X1NiCrMoCuN25-20-7 | 297, 315 |
| | X2CrNi18-9 | 289, 299 |
| | X2CrNi19-11 | 289, 299 |
| | X2CrNiMo17-12-2 | 292, 307 |
| | X2CrNiMo17-12-3 | 292, 307 |
| | X2CrNiMo18-14-3 | 292, 307 |
| | X2CrNiMo18-15-4 | 294, 309 |
| | X2CrNiMoN17-13-3 | 292, 307 |
| | X2CrNiMoN17-13-5 | 294, 310 |
| | X2CrNiN18-10 | 289, 300 |
| | X3CrNiMo17-13-3 | 291, 305 |
| | X5CrNi18-10 | 288, 298 |
| | X5CrNiMo17-12-2 | 291, 305 |
| | X6CrNiMoTi17-12-2 | 293, 308 |
| | X6CrNiNb18-10 | 296, 313 |
| | X6CrNiTi18-10 | 295, 311 |
| EN 10222-2:1999 | 11CrMo9-10 | 352, 353 |
| | 13CrMo4-5 | 350 |
| | 16Mo3 | 348 |
| | P245GH | 342, 345 |
| | P280GH | 342, 345 |
| | P305GH | 343, 346 |
| | X10CrMoVNb9-1 | 356 |
| | X16CrMo5-1 | 355, 356 |
| | X20CrMoV11-1 | 357 |
| EN 10222-3:1998 | 12Ni14 | 357, 358 |
| | 13MnNi6-3 | 359 |
| | 15NiMn6 | 357, 358 |
| | X12Ni5 | 357, 358 |
| EN 10222-3:1998 (continued) | X8Ni9 | 357, 358 |
| EN 10222-4:1998 A1:2001 | P285NH | 341, 344 |
| | P285QH | 341, 344 |
| | P355NH | 343, 346 |
| | P355QH | 342, 345 |
| | P420NH | 359, 360 |
| | P420QH | 359, 360 |
| EN 10222-5:1999 | X2 CrNi 18-9 | 367, 373 |
| | X2 CrNiMo 17-12-2 | 369, 376 |
| | X2 CrNiMo 17-12-3 | 369, 376 |
| | X2 CrNiMo 18-14-3 | 369, 376 |
| | X2 CrNiMoN 17-11-2 | 370, 376 |
| | X2 CrNiMoN 17-13-3 | 370, 376 |
| | X2 CrNiMoN 22-5-3 | 381, 383 |
| | X2 CrNiMoN 25-7-4 | 381, 383 |
| | X2CrNiN 18-10 | 368, 374 |
| | X3 CrNiMo 13-4 | 364 |
| | X3 CrNiMo 17-13-3 | 369, 375 |
| | X3 CrNiMo13-4 | 365 |
| | X5 CrNi 18-10 | 367, 373 |
| | X5 CrNiMo 17-12-2 | 369, 375 |
| | X6 CrNi 18-10 | 367, 374 |
| | X6 CrNiNb 18-10 | 372, 379 |
| | X6 CrNiTi 18-10 | 371, 378 |
| | X7 CrNiNb 18-10 | 372, 379 |
| EN 10250-2:1999 C1:2000 | C22 | 23, 334, 339 |
| | C25 | 334, 339 |
| | C25E | 334, 339 |
| | C30 | 335, 339 |
| | C35 | 336, 339 |
| | C35E | 336, 339 |
| | C40 | 336, 339 |
| | C45 | 337, 339 |
| | C45E | 338, 340 |
| | C50 | 338, 340 |
| | C55 | 338, 340 |
| | S235J2G3 | 333, 339 |
| | S235JRG2 | 333, 339 |
| EN 10250-3:1999 | 25CrMo4 | 347 |
| | 34CrMo4 | 347 |
| | 42CrMo4 | 347 |
| | 50CrMo4 | 347 |

| Specification | Designation | Page Number |
|---|---|---|
| EN 10250-4:1999 | X12Cr13 | 364, 365 |
| | X1NiCrMoCu25-20-5 | 372, 379 |
| | X2CrNi18-9 | 367, 373 |
| | X2CrNi19-11 | 367, 373 |
| | X2CrNiMo17-12-2 | 369, 376 |
| | X2CrNiMo18-14-3 | 369, 376 |
| | X2CrNiMoCuN25-6-3 | 382, 384 |
| | X2CrNiMoCuWN25-7-4 | 382, 384 |
| | X2CrNiMoN17-11-2 | 370, 376 |
| | X2CrNiMoN17-13-3 | 370, 376 |
| | X2CrNiMoN22-5-3 | 381, 383 |
| | X2CrNiMoN25-7-4 | 381, 383 |
| | X2CrNiN18-10 | 368, 374 |
| | X2CrNiN23-4 | 382, 384 |
| | X3CrNiMo13-4 | 364, 365 |
| | X3CrNiMo17-13-3 | 369, 375 |
| | X3CrNiMoN27-5-2 | 381, 383 |
| | X5CrNi18-10 | 367, 373 |
| | X5CrNiCuNb16-4 | 379, 380 |
| | X5CrNiMo17-12-2 | 369, 375 |
| | X6Cr17 | 366 |
| | X6CrNiMoTi17-12-2 | 370, 377 |
| | X6CrNiTi18-10 | 371, 378 |
| EN 10263-3:2001 C1:2001 | Grade 18B2 | 44 |
| EN 10263-4:2001 C2:2003 | Grade 17B2 | 44 |
| | Grade 23B2 | 44 |
| | Grade 28B2 | 44 |
| | Grade 33B2 | 44 |
| | Grade 36CrB4 | 45 |
| | Grade 38B2 | 44 |
| EN 10263-5:2001 | X10CrNi18-8 | 541, 552 |
| | X12Cr13 | 519, 525 |
| | X2CrNi18-9 | 542, 560 |
| | X2CrNiMo17-12-2 | 546, 576 |
| | X2CrNiMo17-12-3 | 546, 576 |
| | X2CrNiMoN17-13-3 | 547, 580 |
| | X2CrNiMoN22-5-3 | 600, 603 |
| | X3CrNiCu18-9-4 | 550, 589 |
| | X3CrNiMo17-13-3 | 545, 571 |
| | X4CrNi18-12 | 543, 563 |
| | X5CrNi18-10 | 542, 557 |
| | X5CrNiMo17-12-2 | 545, 571 |
| | X6Cr17 | 534, 537 |

| Specification | Designation | Page Number |
|---|---|---|
| EN 10263-5:2001 (continued) | X6CrMo17-1 | 535, 539 |
| | X6CrNiMoTi17-12-2 | 546, 578 |
| | X6CrNiTi18-10 | 548, 584 |
| EN 10269:2013 | Grade 35B2 | 44 |
| | X12CrNiMoV12-3 | 521, 531 |
| | X19CrMoNbVN11-1 | 521, 532 |
| | X3CrNiCu18-9-4 | 550, 589 |
| | X4CrNi18-12 | 543, 563 |
| EN 10270-2:2011 | Grade FDC | 615 |
| | Grade FDCrV | 620 |
| | Grade FDSiCr | 619 |
| | Grade TDC | 615 |
| | Grade TDCrV | 620 |
| | Grade TDSiCr | 619 |
| | Grade VDC | 615 |
| | Grade VDCrV | 620 |
| | Grade VDSiCr | 619 |
| EN 10270-3:2011 | X10CrNi18-8 | 621 |
| | X5CrNiMo17-12-2 | 621 |
| | X7CrNiAl17-7 | 621 |
| EN 10272:2007 | X1NiCrMoCu31-27-4 | 550, 592 |
| EN 10277-3:2008 | 10S20 | 611 |
| | 10SPb20 | 614 |
| | 11SMn30 | 613 |
| | 11SMn37 | 614 |
| | 11SMnPb30 | 614 |
| | 11SMnPb37 | 614 |
| | 15SMn13 | 611 |
| | 35S20 | 612 |
| | 36SMn14 | 612 |
| | 38SMn28 | 612 |
| | 44SMn28 | 612 |
| | 46S20 | 613 |
| EN 10283:2010 | GX12Cr12 | 413, 414 |
| | GX2CrNi19-11 | 415, 417 |
| | GX2CrNiMo19-11-2 | 415, 417 |
| | GX2CrNiMoCuN20-18-6 | 416, 418 |
| | GX2CrNiMoCuN25-6-3-3 | 416, 418 |
| | GX2CrNiMoN17-13-4 | 416, 418 |
| | GX2CrNiMoN25-6-3 | 416, 418 |
| | GX2NiCrMo28-20-2 | 416, 418 |
| | GX2NiCrMoCuN25-20-6 | 416, 418 |
| | GX2NiCrMoN25-20-5 | 416, 418 |

| Specification | Designation | Page Number |
|---|---|---|
| EN 10283:2010 (continued) | GX4CrNi13-4 | 413, 414 |
| | GX4CrNiMo16-5-1 | 413, 414 |
| | GX4NiCrCuMo30-20-4 | 416, 418 |
| | GX5CrNi19-10 | 415, 417 |
| | GX5CrNiMo19-11-2 | 415, 417 |
| | GX5CrNiMo19-11-3 | 416, 418 |
| | GX5CrNiMoNb19-11-2 | 415, 417 |
| | GX5CrNiNb19-11 | 415, 417 |
| | GX7CrNiMo12-1 | 413, 414 |
| EN 10293:2015 | G17Mn5 | 389, 393 |
| | G20Mn5 | 390, 393 |
| | G24Mn6 | 391, 395 |
| | G26CrMo4 | 402, 403 |
| | G28Mn6 | 391, 395 |
| | G32NiCrMo8-5-4 | 403, 405 |
| | G42CrMo4 | 402, 404 |
| | GE200 | 389, 392 |
| | GE240 | 389, 393 |
| | GE300 | 391, 394 |
| | GS200 | 389, 392 |
| | GS240 | 389, 393 |
| EN 10294-2:2012 | X2CrNi18-9 | 542, 560 |
| | X2CrNi19-11 | 542, 560 |
| | X2CrNiMo17-12-2 | 546, 576 |
| | X2CrNiMo18-14-3 | 546, 576 |
| | X2CrNiMoN22-5-3 | 600, 603 |
| | X3CrNiMoN27-5-2 | 601, 605 |
| | X5CrNi18-10 | 542, 557 |
| | X5CrNiMo17-12-2 | 545, 571 |
| | X6CrNiMoTi17-12-2 | 546, 578 |
| | X8CrNiS18-9 | 541, 554 |
| EN 10295:2002 | G-CoCr28 | 429, 432 |
| | G-NiCr15 | 429, 432 |
| | G-NiCr28W | 429, 432 |
| | G-NiCr50Nb | 428, 432 |
| | GX130CrSi29 | 426, 430 |
| | GX25CrNiSi18-9 | 426, 430 |
| | GX25CrNiSi20-14 | 426, 430 |
| | GX30CrSi7 | 407, 408 |
| | GX35NiCrSi25-21 | 428, 432 |
| | GX40CrNiSi22-10 | 426, 430 |
| | GX40CrNiSi25-12 | 427, 431 |
| | GX40CrNiSi25-20 | 427, 431 |

| Specification | Designation | Page Number |
|---|---|---|
| EN 10295:2002 (continued) | GX40CrNiSi27-4 | 426, 430 |
| | GX40CrNiSiNb24-24 | 428, 432 |
| | GX40CrSi13 | 426, 430 |
| | GX40CrSi17 | 426, 430 |
| | GX40CrSi24 | 426, 430 |
| | GX40CrSi28 | 426, 430 |
| | GX40NiCrSi35-17 | 428, 432 |
| | GX40NiCrSi35-26 | 428, 432 |
| | GX40NiCrSi38-19 | 428, 432 |
| | GX40NiCrSiNb35-18 | 428, 432 |
| | GX40NiCrSiNb35-26 | 428, 432 |
| | GX40NiCrSiNb38-19 | 428, 432 |
| | GX50NiCrCo20-20-20 | 429, 432 |
| EN 10296-1:2003 | E155 | 198, 199, 213 |
| | E190 | 198, 213 |
| | E195 | 199, 200 |
| | E220 | 199, 214 |
| | E235 | 199, 200, 202, 214, 216 |
| | E260 | 200, 214 |
| | E275 | 202, 203, 205, 216, 217 |
| | E275K2 | 201, 215 |
| | E320 | 203, 217 |
| | E355 | 207, 209, 221, 222 |
| | E370 | 206, 220 |
| EN 10296-2:2005 C2:2007 | Grade X2CrNi19-11 | 232, 236 |
| | Grade X2CrNiMo17-12-2 | 233, 238 |
| | Grade X2CrNiMo17-12-3 | 233, 238 |
| | Grade X2CrNiMo18-14-3 | 233, 238 |
| | Grade X2CrNiMoN17-13-3 | 233, 239 |
| | Grade X2CrNiMoN17-13-5 | 234, 242 |
| | Grade X2CrNiMoN22-5-3 | 243, 244 |
| | Grade X2CrNiMoN25-7-4 | 243, 245 |
| | Grade X2CrNiN18-10 | 233, 238 |
| | Grade X2CrNiN23-4 | 243, 244 |
| | Grade X2CrTi12 | 227, 228 |
| | Grade X3CrNiMo17-13-3 | 233, 238 |
| | Grade X3CrTi17 | 227, 231 |
| | Grade X5CrNi18-10 | 233, 239 |
| | Grade X5CrNiMo17-12-2 | 233, 238 |
| | Grade X6Cr17 | 227, 230 |
| | Grade X6CrNiMoTi17-12-2 | 234, 240 |

| Specification | Designation | Page Number |
|---|---|---|
| EN 10296-2:2005 C2:2007 (continued) | Grade X6CrNi Nb18-10 | 234, 241 |
| | Grade X6CrNiSiNCe19-10 | 234, 241 |
| | Grade X6CrNiTi18-10 | 234, 240 |
| EN 10297-1:2003 | 25CrMo4 | 224, 225 |
| | 30CrMo4 | 224, 225 |
| | 34CrMo4 | 224, 226 |
| | 38Mn6 | 211, 223 |
| | 42CrMo4 | 224, 226 |
| | C22E | 204, 208, 219, 221 |
| | C35E | 209, 211, 222, 223 |
| | C45E | 210, 212, 223, 224 |
| | E235 | 201, 215 |
| | E275 | 203, 217 |
| | E275K2 | 203, 217 |
| | E315 | 206, 219 |
| | E355 | 207, 221 |
| | E420J2 | 210, 223 |
| | E470 | 211, 223 |
| | E590K2 | 212, 224 |
| EN 10297-2:2005 C1:2007 | Grade X12Cr13 | 227, 229 |
| | Grade X2CrNi19-11 | 232, 236 |
| | Grade X2CrNiMo17-12-2 | 233, 238 |
| | Grade X2CrNiMo18-14-3 | 233, 238 |
| | Grade X2CrNiMoCuWN25-7-4 | 243, 244 |
| | Grade X2CrNiMoN17-13-3 | 233, 239 |
| | Grade X2CrNiMoN17-13-5 | 234, 242 |
| | Grade X2CrNiMoN22-5-3 | 243, 244 |
| | Grade X2CrNiMoN25-7-4 | 243, 245 |
| | Grade X2CrNiMoN29-7-2 | 243, 245 |
| | Grade X2CrNiMoSi18-5-3 | 243, 244 |
| | Grade X2CrNiN18-10 | 233, 238 |
| | Grade X2CrNiN23-4 | 243, 244 |
| | Grade X2CrTi12 | 227, 228 |
| | Grade X3CrNiMo17-13-3 | 233, 238 |
| | Grade X3CrTi17 | 227, 231 |
| | Grade X5CrNi18-10 | 233, 239 |
| | Grade X5CrNiMo17-12-2 | 233, 238 |
| | Grade X6Cr17 | 227, 230 |
| | Grade X6CrAl13 | 227, 228 |
| | Grade X6CrNiMoTi17-12-2 | 234, 240 |
| | Grade X6CrNiNb18-10 | 234, 241 |
| EN 10297-2:2005 C1:2007 (continued) | Grade X6CrNiTi18-10 | 234, 240 |
| EN 10302:2008 | X12CrCoNi21-20 | 471, 502 |
| | X12CrNiMoV12-3 | 521, 531 |
| | X3CrNiMoBN17-13-3 | 470, 501 |
| | X5NiCrAlTi31-20 | 471, 502 |
| | X6CrNiMoTiB17-13 | 470, 499 |
| | X6CrNiTiB18-10 | 469, 499 |
| | X6NiCrTiMoVB25-15-2 | 471, 502, 550, 590 |
| | X8CrNiNb16-13 | 470, 499 |
| EN 10305-1:2010 | 25CrMo4 | 224, 225 |
| | 26Mn5 | 211, 212, 223, 224 |
| | 26Mo2 | 224, 225 |
| | 42CrMo4 | 224, 226 |
| | C35E | 205, 206, 208, 210, 219, 220, 222, 223 |
| | C45E | 208, 209, 211, 212, 221, 223 |
| | E215 | 198, 199, 202, 205, 213, 216, 219 |
| | E235 | 199, 200, 204, 206, 214, 218, 220 |
| | E255 | 202, 205, 208, 209, 216, 219, 221, 222 |
| | E355 | 206, 207, 209, 211, 219, 222, 223 |
| | E410 | 208, 209, 210, 211, 212, 221, 222, 223 |
| EN 10305-2:2010 | E155 | 198, 201, 202, 213, 215, 217 |
| | E195 | 198, 199, 201, 204, 213, 215, 219 |
| | E235 | 199, 200, 205, 207, 214, 219, 221 |
| | E275 | 202, 203, 208, 209, 216, 217, 221, 222 |
| | E355 | 206, 207, 210, 211, 219, 223 |
| EN 10305-3:2010 | E155 | 198, 213 |
| | E190 | 198, 213 |
| | E195 | 198, 199, 200, 213, 214 |
| | E220 | 199, 214 |
| | E235 | 199, 200, 202, 214, 216 |
| | E260 | 200, 214 |
| | E275 | 202, 203, 205, 216, 217 |
| | E320 | 203, 217 |

| Specification | Designation | Page Number |
|---|---|---|
| EN 10305-3:2010 (continued) | E355 | 206, 207, 209, 219, 222 |
| | E370 | 206, 219 |
| | E420 | 207, 221 |
| EN ISO 16120-2:2011 | C10D | 21 |
| | C12D | 22 |
| | C15D | 22 |
| | C18D | 23 |
| | C20D | 23 |
| | C26D | 24 |
| | C32D | 25 |
| | C38D | 26 |
| | C42D | 27 |
| | C48D | 28 |
| | C4D | 21 |
| | C50D | 29 |
| | C52D | 29 |
| | C56D | 30 |
| | C58D | 31 |
| | C60D | 31 |
| | C62D | 32 |
| | C66D | 32 |
| | C68D | 32 |
| | C70D | 32 |
| | C72D | 32 |
| | C76D | 33 |
| | C78D | 33 |
| | C7D | 21 |
| | C80D | 33 |
| | C82D | 33 |
| | C86D | 33 |
| | C88D | 33 |
| | C92D | 34 |
| | C9D | 21 |
| EN ISO 16120-4:2011 | C10D2 | 21 |
| | C12D2 | 22 |
| | C15D2 | 22 |
| | C18D2 | 23 |
| | C20D2 | 23 |
| | C26D2 | 24 |
| | C32D2 | 25 |
| | C36D2 | 26 |
| | C38D2 | 26 |
| | C3D2 | 21 |
| EN ISO 16120-4:2011 (continued) | C40D2 | 27 |
| | C42D2 | 27 |
| | C46D2 | 28 |
| | C48D2 | 28 |
| | C50D2 | 29 |
| | C52D2 | 29 |
| | C56D2 | 30 |
| | C58D2 | 31 |
| | C5D2 | 21 |
| | C60D2 | 31 |
| | C62D2 | 32 |
| | C66D2 | 32 |
| | C68D2 | 32 |
| | C70D2 | 32 |
| | C72D2 | 32 |
| | C76D2 | 33 |
| | C78D2 | 33 |
| | C80D2 | 33 |
| | C82D2 | 33 |
| | C86D2 | 33 |
| | C88D2 | 33 |
| | C8D2 | 21 |
| | C92D2 | 34 |
| | C98D2 | 34 |
| EN ISO 3183:2012 | L175 or A25 | 316, 321 |
| | L175 or A25 Seamless | 318, 324 |
| | L175 or A25 Welded | 318, 324 |
| | L175P or A25P | 316, 321 |
| | L175P or A25P Seamless | 318, 324 |
| | L175P or A25P Welded | 318, 324 |
| | L210 or A | 316 |
| | L210 or A Seamless | 318 |
| | L210 or A Welded | 318 |
| | L245 or B | 316 |
| | L245 or B Seamless | 318 |
| | L245 or B Welded | 318 |
| | L245M or BM | 321, 324 |
| | L245N or BN | 321, 324 |
| | L245Q or BQ | 321, 324 |
| | L245R or BR | 321, 324 |
| | L290 or X42 | 316 |
| | L290 or X42 Seamless | 318 |
| | L290 or X42 Welded | 318 |

| Specification | Designation | Page Number |
|---|---|---|
| EN ISO 3183:2012 (continued) | L290M or X42M | 321, 325 |
| | L290N or X42N | 321, 325 |
| | L290Q or X42Q | 321, 325 |
| | L290R or X42R | 321, 325 |
| | L320 or X46 | 316 |
| | L320 or X46 Seamless | 319 |
| | L320 or X46 Welded | 319 |
| | L320M or X46M | 322, 325 |
| | L320N or X46N | 322, 325 |
| | L320Q or X46Q | 322, 325 |
| | L360 or X52 | 316 |
| | L360 or X52 Seamless | 319 |
| | L360 or X52 Welded | 319 |
| | L360M or X52M | 322, 326 |
| | L360N or X52N | 322, 326 |
| | L360Q or X52Q | 322, 326 |
| | L390 or X56 | 317 |
| | L390 or X56 Seamless | 319 |
| | L390 or X56 Welded | 319 |
| | L390M or X56M | 322, 326 |
| | L390N or X56N | 322, 326 |
| | L390Q or X56Q | 322, 326 |
| | L415 or X60 | 317 |
| | L415 or X60 Seamless | 319 |
| | L415 or X60 Welded | 319 |
| | L415M or X60M | 323, 327 |
| | L415N or X60N | 323, 327 |
| | L415Q or X60Q | 323, 327 |
| | L450 or X65 | 317 |
| | L450 or X65 Seamless | 320 |
| | L450 or X65 Welded | 320 |
| | L450M or X65M | 323, 327 |
| | L450Q or X65Q | 323, 327 |
| | L485 or X70 | 317 |
| | L485 or X70 Seamless | 320 |
| | L485 or X70 Welded | 320 |
| | L485M or X70M | 323, 327 |
| | L485Q or X70Q | 323, 327 |
| | L555M or X80M | 323, 327 |
| | L555Q or X80Q | 323, 327 |
| GB 11251-89 | Grade 15 Cr | 85, 92 |
| | Grade 20 Cr | 85, 92 |
| | Grade 20CrMnSiA | 85, 92 |

| Specification | Designation | Page Number |
|---|---|---|
| GB 11251-89 (continued) | Grade 25CrMnSiA | 86, 92 |
| | Grade 27SiMn | 87, 93 |
| | Grade 30 Cr | 86, 92 |
| | Grade 30CrMnSiA | 87, 93 |
| | Grade 35 Cr | 87, 93 |
| | Grade 35CrMnSiA | 88, 94 |
| | Grade 40 B | 62, 71 |
| | Grade 40 Cr | 87, 93 |
| | Grade 45 B | 64, 72 |
| | Grade 45Mn2 | 64, 72 |
| | Grade 50 B | 64, 72 |
| GB 11352-89 | Grade ZG 200-400 | 389, 392 |
| | Grade ZG 230-450 | 389, 393 |
| | Grade ZG 270-500 | 390, 394 |
| | Grade ZG 310-570 | 391, 394 |
| | Grade ZG 340-640 | 391, 394 |
| GB 1220-92 | Grade 00Cr12 | 534, 536 |
| | Grade 00Cr17Ni13Mo2N | 547, 580 |
| | Grade 00Cr17Ni14Mo2 | 547, 578 |
| | Grade 00Cr18Ni10N | 543, 561 |
| | Grade 00Cr18Ni14Mo2Cu2 | 547, 579 |
| | Grade 00Cr18Ni5Mo3Si2 | 600, 602 |
| | Grade 00Cr19Ni10 | 542, 560 |
| | Grade 00Cr19Ni13Mo3 | 548, 581 |
| | Grade 00Cr27Mo | 535, 540 |
| | Grade 00Cr30Mo2 | 535, 540 |
| | Grade 0Cr13Al | 534, 536 |
| | Grade 0Cr15Ni7Mo2Al | 593, 599 |
| | Grade 0Cr17Ni12Mo2 | 545, 571 |
| | Grade 0Cr17Ni12Mo2N | 547, 579 |
| | Grade 0Cr17Ni4Cu4Nb | 593, 596 |
| | Grade 0Cr17Ni7Al | 593, 598 |
| | Grade 0Cr18Ni10Ti | 548, 584 |
| | Grade 0Cr18Ni11Nb | 549, 586 |
| | Grade 0Cr18Ni12Mo2Cu2 | 546, 578 |
| | Grade 0Cr18Ni13Si4 | 550, 589 |
| | Grade 0Cr18Ni16Mo5 | 548, 581 |
| | Grade 0Cr18Ni9 | 542, 557 |
| | Grade 0Cr18Ni9Cu3 | 550, 589 |
| | Grade 0Cr19Ni10NbN | 543, 562 |
| | Grade 0Cr19Ni13Mo3 | 548, 581 |
| | Grade 0Cr19Ni9N | 543, 561 |
| | Grade 0Cr23Ni13 | 544, 564 |

| Specification | Designation | Page Number |
|---|---|---|
| GB 1220-92 (continued) | Grade 0Cr25Ni20 | 544, 565 |
| | Grade 0Cr26Ni5Mo2 | 601, 605 |
| | Grade 11Cr17 | 521, 531 |
| | Grade 1Cr12 | 519, 522 |
| | Grade 1Cr13 | 519, 525 |
| | Grade 1Cr13Mo | 519, 525 |
| | Grade 1Cr17 | 534, 538 |
| | Grade 1Cr17Mn6Ni5N | 541, 551 |
| | Grade 1Cr17Mo | 535, 539 |
| | Grade 1Cr17Ni7 | 541, 552 |
| | Grade 1Cr18Mn8Ni5N | 541, 551 |
| | Grade 1Cr18Ni12 | 543, 562 |
| | Grade 1Cr18Ni9 | 548, 584 |
| | Grade 2Cr13 | 520, 527 |
| | Grade 3Cr13 | 520, 528 |
| | Grade 4Cr13 | 521, 533 |
| | Grade 7Cr17 | 520, 531 |
| | Grade 8Cr17 | 520, 531 |
| | Grade 9Cr18MoV | 521, 533 |
| | Grade Y11Cr17 | 521, 533 |
| | Grade Y1Cr13 | 519, 526 |
| | Grade Y1Cr17 | 534, 538 |
| | Grade Y1Cr18Ni9 | 541, 554 |
| | Grade Y1Cr18Ni9Se | 541, 554 |
| | Grade Y3Cr13 | 520, 529 |
| GB 1221-92 | Grade 00Cr12 | 534, 536 |
| | Grade 0Cr13Al | 534, 536 |
| | Grade 0Cr15Ni25Ti2MoAlVB | 550, 590 |
| | Grade 0Cr17Ni12Mo2 | 545, 571 |
| | Grade 0Cr17Ni4Cu4Nb | 593, 596 |
| | Grade 0Cr17Ni7Al | 593, 598 |
| | Grade 0Cr18Ni10Ti | 548, 584 |
| | Grade 0Cr18Ni13Si4 | 550, 589 |
| | Grade 0Cr18Ni9 | 542, 557 |
| | Grade 0Cr19Ni13Mo3 | 548, 581 |
| | Grade 0Cr23Ni13 | 544, 564 |
| | Grade 0Cr25Ni20 | 544, 565 |
| | Grade 1Cr13 | 519, 525 |
| | Grade 1Cr13Mo | 519, 525 |
| | Grade 1Cr17 | 534, 538 |
| | Grade 1Cr25Ni20Si2 | 545, 567 |
| | Grade 2Cr12MoVNbN | 521, 532 |
| | Grade 2Cr12NiMoWV | 521, 532 |

| Specification | Designation | Page Number |
|---|---|---|
| GB 1221-92 (continued) | Grade 2Cr13 | 520, 527 |
| | Grade 2Cr21Ni12N | 550, 589 |
| | Grade 2Cr23Ni13 | 544, 564 |
| | Grade 2Cr25N | 535, 540 |
| | Grade 2Cr25Ni20 | 544, 564 |
| | Grade 5Cr21Mn9Ni4N | 549, 587 |
| | Grade 8Cr20Si2Ni | 521, 533 |
| GB 1298-86 | Grade T10 | 622 |
| | Grade T11 | 625 |
| | Grade T12 | 622 |
| | Grade T7 | 622 |
| | Grade T8 | 622 |
| | Grade T8Mn | 622 |
| | Grade T9 | 622 |
| GB 13791-92 | Grade 10 | 21 |
| | Grade 15 | 22 |
| | Grade 20 | 23 |
| | Grade 20Cr | 36 |
| | Grade 20CrMo(A) | 39 |
| | Grade 25 | 24 |
| | Grade 30 | 25 |
| | Grade 35 | 26 |
| | Grade 35CrMo(A) | 40 |
| | Grade 40 | 27 |
| | Grade 40Cr | 37 |
| | Grade 45 | 28 |
| | Grade 50 | 29 |
| | Grade 50B | 44 |
| | Grade 50Mn | 29 |
| | Grade 60 | 31 |
| GB 18248-2000 | Grade 37Mn | 212, 224 |
| GB 3087-1999 | Grade 10 | 260, 264 |
| | Grade 20 | 261, 265 |
| GB 3280-92 | Grade 00Cr12 | 438, 441 |
| | Grade 00Cr17 | 160, 164, 446, 454 |
| | Grade 00Cr17Mo | 469, 498 |
| | Grade 00Cr17Ni13Mo2N | 168, 180, 467, 493 |
| | Grade 00Cr17Ni14Mo2 | 167, 178, 465, 489 |
| | Grade 00Cr18Mo2 | 161, 164, 448, 456 |
| | Grade 00Cr18Ni10N | 166, 175, 462, 482 |
| | Grade 00Cr18Ni5Mo3Si2 | 513, 515 |

| Specification | Designation | Page Number |
|---|---|---|
| GB 3280-92 (continued) | Grade 00Cr19Ni10 | 165, 173, 461, 479 |
| | Grade 00Cr19Ni13Mo3 | 165, 173, 461, 479 |
| | Grade 00Cr27Mo | 448, 457 |
| | Grade 00Cr30Mo2 | 449, 457 |
| | Grade 0Cr13 | 438, 441 |
| | Grade 0Cr13Al | 159, 162, 445, 450 |
| | Grade 0Cr17Ni12Mo2 | 167, 177, 464, 488 |
| | Grade 0Cr17Ni12Mo2N | 466, 492 |
| | Grade 0Cr18Ni10Ti | 169, 182, 468, 496 |
| | Grade 0Cr18Ni11Nb | 169, 183, 469, 498 |
| | Grade 0Cr18Ni12Mo2Cu2 | 465, 490 |
| | Grade 0Cr18Ni12Mo2Ti | 168, 179, 466, 491 |
| | Grade 0Cr18Ni13Si4 | 469, 499 |
| | Grade 0Cr18Ni16Mo5 | 467, 494 |
| | Grade 0Cr18Ni9 | 165, 171, 460, 478 |
| | Grade 0Cr19Ni10NbN | 462, 481 |
| | Grade 0Cr19Ni13Mo3 | 467, 494 |
| | Grade 0Cr19Ni9N | 166, 174, 461, 481 |
| | Grade 0Cr23Ni13 | 463, 484 |
| | Grade 0Cr25Ni20 | 463, 485 |
| | Grade 0Cr26Ni5Mo2 | 514, 518 |
| | Grade 1Cr12 | 438, 440 |
| | Grade 1Cr13 | 438, 440 |
| | Grade 1Cr15 | 446, 452 |
| | Grade 1Cr17 | 446, 453 |
| | Grade 1Cr17Mn6Ni5N | 458, 473 |
| | Grade 1Cr17Mo | 447, 454 |
| | Grade 1Cr17Ni7 | 459, 475 |
| | Grade 1Cr17Ni8 | 459, 475 |
| | Grade 1Cr18Mn8Ni5N | 458, 474 |
| | Grade 1Cr18Ni12 | 462, 483 |
| | Grade 1Cr18Ni9 | 468, 497 |
| | Grade 1Cr18Ni9Si3 | 460, 478 |
| | Grade 1Cr18Ni9Ti | 470, 501 |
| | Grade 2Cr13 | 439, 442 |
| | Grade 3Cr13 | 439, 443 |
| | Grade 4Cr13 | 439, 444 |
| | Grade 7Cr17 | 439, 444 |
| GB 3522-83 | Grade 40 | 616 |
| | Grade 50 | 616 |
| | Grade 55 | 616 |
| GB 3522-83 (continued) | Grade 60 | 616 |
| | Grade 65 | 617 |
| | Grade 70 | 617 |
| GB 3531-1996 | Grade 15MnNiDR | 147 |
| | Grade 16MnDR | 116, 125 |
| GB 4226-84 | Grade 00Cr17Ni14Mo2 | 547 |
| | Grade 00Cr19Ni11 | 542 |
| | Grade 0Cr17Ni12Mo2 | 545 |
| | Grade 0Cr18Ni11Nb | 549 |
| | Grade 0Cr18Ni11Ti | 548 |
| | Grade 0Cr18Ni12 | 543 |
| | Grade 0Cr19Ni9 | 542 |
| | Grade 0Cr23Ni13 | 544 |
| | Grade 0Cr25Ni20 | 544 |
| | Grade 0Cr26Ni5Mo2 | 601 |
| | Grade 11Cr17 | 521 |
| | Grade 1Cr12 | 519 |
| | Grade 1Cr13 | 519 |
| | Grade 1Cr17 | 534 |
| | Grade 1Cr18Ni12 | 543 |
| | Grade 1Cr18Ni9 | 548 |
| | Grade 2Cr13 | 520 |
| | Grade 3Cr13 | 520 |
| | Grade Y1Cr13 | 519 |
| | Grade Y1Cr17 | 534 |
| | Grade Y1Cr18Ni9 | 541 |
| | Grade Y1Cr18Ni9Se | 541 |
| | Grade Y3Cr13 | 520 |
| GB 4237-92 | Grade 00Cr12 | 438, 441 |
| | Grade 00Cr17Mo | 469, 498 |
| | Grade 00Cr17Ni13Mo2N | 168, 180, 467, 493 |
| | Grade 00Cr17Ni14Mo2 | 167, 178, 465, 489 |
| | Grade 00Cr18Mo2 | 161, 164, 448, 456 |
| | Grade 00Cr18Ni10N | 166, 175, 462, 482 |
| | Grade 00Cr18Ni12Mo2Cu2 | 465, 490 |
| | Grade 00Cr18Ni5Mo3Si2 | 513, 515 |
| | Grade 00Cr19Ni10 | 165, 173, 461, 480 |
| | Grade 00Cr19Ni13Mo3 | 168, 181, 467, 494 |
| | Grade 00Cr27Mo | 448, 457 |
| | Grade 00Cr30Mo2 | 449, 457 |
| | Grade 0Cr13 | 438, 441 |

| Specification | Designation | Page Number |
|---|---|---|
| GB 4237-92 (continued) | Grade 0Cr13Al | 159, 162, 445, 450 |
| | Grade 0Cr17Ni12Mo2 | 167, 177, 464, 488 |
| | Grade 0Cr17Ni12Mo2N | 466, 492 |
| | Grade 0Cr17Ni7Al | 505, 512 |
| | Grade 0Cr18Ni10Ti | 169, 182, 468, 496 |
| | Grade 0Cr18Ni11Nb | 169, 183, 469, 498 |
| | Grade 0Cr18Ni12Mo2Cu2 | 465, 490 |
| | Grade 0Cr18Ni12Mo2Ti | 168, 179, 466, 491 |
| | Grade 0Cr18Ni13Si4 | 469, 499 |
| | Grade 0Cr18Ni16Mo5 | 467, 494 |
| | Grade 0Cr18Ni9 | 165, 171, 460, 478 |
| | Grade 0Cr19Ni10NbN | 462, 481 |
| | Grade 0Cr19Ni13Mo3 | 467, 494 |
| | Grade 0Cr19Ni9N | 166, 174, 461, 481 |
| | Grade 0Cr23Ni13 | 463, 484 |
| | Grade 0Cr25Ni20 | 463, 485 |
| | Grade 0Cr26Ni5Mo2 | 514, 518 |
| | Grade 1Cr12 | 438, 440 |
| | Grade 1Cr13 | 438, 440 |
| | Grade 1Cr15 | 446, 452 |
| | Grade 1Cr17 | 446, 453 |
| | Grade 1Cr17Mn6Ni5N | 458, 473 |
| | Grade 1Cr17Mo | 447, 454 |
| | Grade 1Cr18Mn8Ni5N | 458, 474 |
| | Grade 1Cr18Ni12 | 462, 483 |
| | Grade 1Cr18Ni9 | 468, 497 |
| | Grade 1Cr18Ni9Si3 | 460, 478 |
| | Grade 1Cr18Ni9Ti | 470, 501 |
| | Grade 2Cr13 | 439, 442 |
| | Grade 3Cr13 | 439, 443 |
| | Grade 4Cr13 | 439, 444 |
| | Grade 7Cr17 | 439, 444 |
| GB 4238-92 | Grade 00Cr12 | 438, 441 |
| | Grade 0Cr13Al | 159, 162, 445, 450 |
| | Grade 0Cr15Ni25Ti2MoAlVB | 471, 502 |
| | Grade 0Cr17Ni12Mo2 | 167, 177, 464, 488 |
| | Grade 0Cr17Ni7Al | 505, 512 |
| | Grade 0Cr18Ni10Ti | 169, 182, 468, 496 |
| | Grade 0Cr18Ni11Nb | 169, 183, 469, 498 |
| | Grade 0Cr18Ni13Si4 | 469, 499 |

| Specification | Designation | Page Number |
|---|---|---|
| GB 4238-92 (continued) | Grade 0Cr18Ni9 | 165, 172, 460, 478 |
| | Grade 0Cr19Ni13Mo3 | 467, 494 |
| | Grade 0Cr23Ni13 | 463, 484 |
| | Grade 0Cr25Ni20 | 463, 485 |
| | Grade 1Cr12 | 438, 440 |
| | Grade 1Cr13 | 438, 440 |
| | Grade 1Cr16Ni35 | 468, 497 |
| | Grade 1Cr17 | 446, 453 |
| | Grade 1Cr18Ni9Si3 | 460, 478 |
| | Grade 1Cr18Ni9Ti | 470, 501 |
| | Grade 1Cr19Al3 | 448, 456 |
| | Grade 1Cr25Ni20Si2 | 463, 485 |
| | Grade 2Cr23Ni13 | 462, 483 |
| | Grade 2Cr25N | 448, 456 |
| | Grade 2Cr25Ni20 | 463, 485 |
| GB 4239-91 | Grade 00Cr12 | 438, 441 |
| | Grade 00Cr17 | 446, 454 |
| | Grade 00Cr17Mo | 469, 498 |
| | Grade 00Cr17Ni13Mo2N | 467, 493 |
| | Grade 00Cr17Ni14Mo2 | 465, 489 |
| | Grade 00Cr18Mo2 | 448, 456 |
| | Grade 00Cr18Ni10N | 462, 482 |
| | Grade 00Cr18Ni14Mo2Cu2 | 465, 490 |
| | Grade 00Cr19Ni10 | 461, 480 |
| | Grade 00Cr19Ni13Mo3 | 467, 494 |
| | Grade 00Cr24Ni6Mo3N | 513, 517 |
| | Grade 00Cr27Mo | 448, 457 |
| | Grade 00Cr30Mo2 | 449, 457 |
| | Grade 0Cr13 | 438, 441 |
| | Grade 0Cr13Al | 445, 450 |
| | Grade 0Cr17Ni12Mo2 | 464, 488 |
| | Grade 0Cr17Ni12Mo2N | 466, 492 |
| | Grade 0Cr17Ni7Al | 505, 512 |
| | Grade 0Cr18Ni10Ti | 468, 496 |
| | Grade 0Cr18Ni11Nb | 469, 498 |
| | Grade 0Cr18Ni12Mo2Cu2 | 465, 490 |
| | Grade 0Cr18Ni13Si4 | 469, 499 |
| | Grade 0Cr18Ni16Mo5 | 467, 494 |
| | Grade 0Cr18Ni9 | 460, 478 |
| | Grade 0Cr19Ni10NbN | 462, 481 |
| | Grade 0Cr19Ni13Mo3 | 467, 494 |
| | Grade 0Cr19Ni9N | 461, 481 |
| | Grade 0Cr23Ni13 | 463, 484 |

| Specification | Designation | Page Number |
|---|---|---|
| GB 4239-91 (continued) | Grade 0Cr25Ni20 | 463, 485 |
| | Grade 0Cr26Ni5Mo2 | 514, 518 |
| | Grade 1Cr12 | 438, 440 |
| | Grade 1Cr13 | 438, 440 |
| | Grade 1Cr15 | 446, 452 |
| | Grade 1Cr17 | 446, 453 |
| | Grade 1Cr17Mn6Ni5N | 458, 473 |
| | Grade 1Cr17Mo | 447, 454 |
| | Grade 1Cr17Ni7 | 459, 475 |
| | Grade 1Cr17Ni8 | 459, 475 |
| | Grade 1Cr18Mn8Ni5N | 458, 474 |
| | Grade 1Cr18Ni12 | 462, 483 |
| | Grade 1Cr18Ni9 | 468, 497 |
| | Grade 1Cr18Ni9Si3 | 460, 478 |
| | Grade 1Cr18Ni9Ti | 470, 501 |
| | Grade 2Cr13 | 439, 442 |
| | Grade 3Cr13 | 439, 443 |
| | Grade 7Cr17 | 439, 444 |
| GB 5216-85 | Grade 20CrH | 36 |
| | Grade 20CrMnMoH | 39 |
| | Grade 20CrNiMoH | 42 |
| | Grade 40CrH | 37 |
| | Grade 45CrH | 38 |
| GB 5310-1995 | Grade 10Cr9Mo1VNb | 283, 285 |
| | Grade 12Cr2MoG | 278, 279 |
| | Grade 12CrMoG | 271, 272 |
| | Grade 15CrMog | 274, 275 |
| | Grade 15MoG | 267 |
| | Grade 1Cr18Ni9 | 289, 301 |
| | Grade 1Cr19Ni11Nb | 296, 314 |
| | Grade 20g | 261, 265 |
| | Grade 20MnG | 261, 265 |
| | Grade 20MoG | 268, 270 |
| | Grade 25MnG | 263, 266 |
| GB 6479-2000 | Grade 10 | 255, 258 |
| | Grade 12Cr2Mo | 278, 279 |
| | Grade 12CrMo | 271, 272 |
| | Grade 15CrMo | 274, 275 |
| | Grade 1Cr5Mo | 280, 282 |
| | Grade 20 | 256, 259 |
| GB 6653-94 | Grade HP245 | 112, 120 |
| | Grade HP265 | 113, 121 |
| | Grade HP295 | 114, 122 |
| GB 6653-94 (continued) | Grade HP325 | 116, 125 |
| | Grade HP345 | 117, 126 |
| | Grade HP365 | 118, 126 |
| GB 6654-1996 | Grade 13MnNiMoNbR | 157, 158 |
| | Grade 15CrMoR | 141 |
| | Grade 15MnVR | 118, 126 |
| | Grade 16MnR | 117, 126 |
| | Grade 18MnMoNbR | 137, 139 |
| | Grade 20R | 113, 120 |
| GB 700-88 | Grade Q195 | 51, 66 |
| | Grade Q215A | 52, 66 |
| | Grade Q215B | 52, 66 |
| | Grade Q235A | 55, 67 |
| | Grade Q235B | 55, 67 |
| | Grade Q235C | 55, 67 |
| | Grade Q235D | 55, 67 |
| | Grade Q255A | 58, 69 |
| | Grade Q255B | 58, 69 |
| | Grade Q275 | 60, 70 |
| GB 711-88 | Grade 08 | 51, 66 |
| | Grade 08F | 51, 66 |
| | Grade 10 | 51, 66 |
| | Grade 10F | 51, 66 |
| | Grade 15 | 54, 67 |
| | Grade 15F | 54, 67 |
| | Grade 20 | 58, 69 |
| | Grade 20F | 55, 67 |
| | Grade 20Mn | 60, 70 |
| | Grade 25 | 60, 70 |
| | Grade 25Mn | 60, 70 |
| | Grade 30 | 60, 70 |
| | Grade 30Mn | 64, 72 |
| | Grade 35 | 64, 72 |
| | Grade 40 | 64, 73 |
| | Grade 40Mn | 64, 73 |
| | Grade 45 | 64, 73 |
| | Grade 50 | 65, 73 |
| | Grade 50Mn | 65, 73 |
| | Grade 55 | 65, 73 |
| | Grade 60 | 65, 73 |
| | Grade 60Mn | 65, 73 |
| | Grade 65 | 65, 73 |

| Specification | Designation | Page Number |
|---|---|---|
| GB 712-2000 | Grade A | 56, 67 |
| | Grade A32 | 60, 69 |
| | Grade A36 | 62, 71 |
| | Grade A40 | 63, 72 |
| | Grade B | 56, 67 |
| | Grade D | 56, 67 |
| | Grade D32 | 60, 69 |
| | Grade D36 | 62, 71 |
| | Grade D40 | 63, 72 |
| | Grade E | 56, 67 |
| | Grade E32 | 60, 69 |
| | Grade E36 | 62, 71 |
| | Grade E40 | 63, 72 |
| | Grade F32 | 60, 69 |
| | Grade F36 | 62, 71 |
| | Grade F40 | 63, 72 |
| GB 713-1997 | Grade 13MnNiMoNbg | 134, 138 |
| | Grade 15CrMog | 141 |
| | Grade 16Mng | 117, 126 |
| | Grade 19Mng | 117, 126 |
| | Grade 20g | 113, 120 |
| | Grade 22Mng | 117, 126 |
| GB 715-89 | Grade BL2 | 22 |
| | Grade BL3 | 23 |
| GB 7659-87 | Grade ZG200-400H | 389, 392 |
| | Grade ZG230-450H | 389, 393 |
| | Grade ZG275-485H | 390, 393 |
| GB 8731-88 | Grade Y12 | 611 |
| | Grade Y12Pb | 614 |
| | Grade Y15 | 613 |
| | Grade Y15Pb | 614 |
| | Grade Y20 | 611 |
| | Grade Y30 | 611 |
| | Grade Y35 | 612 |
| | Grade Y40Mn | 612 |
| | Grade Y45Ca | 613 |
| GB/T 1222-84 | Grade 60CrMnBA | 621 |
| GB/T 12770-2002 | Grade 00Cr12Ti | 227, 228 |
| | Grade 00Cr17Ni14Mo2 | 233, 238 |
| | Grade 00Cr19Ni10 | 232, 236 |
| | Grade 0Cr13 | 227, 229 |
| | Grade 0Cr17Ni12Mo2 | 233, 238 |
| | Grade 0Cr18Ni10Ti | 234, 240 |
| GB/T 12770-2002 (continued) | Grade 0Cr18Ni11Nb | 234, 241 |
| | Grade 0Cr18Ni9 | 233, 239 |
| | Grade 1Cr13 | 227, 229 |
| | Grade 1Cr17 | 227, 230 |
| | Grade 1Cr18Ni9 | 233, 239 |
| GB/T 1299-2000 | Grade 5Cr3Mn1SiMo1V | 627 |
| | Grade 5CrW2Si | 627 |
| | Grade 6CrMnSi2Mo1 | 627 |
| | Grade 9CrWMn | 626 |
| | Grade Cr12 | 625 |
| | Grade Cr12Mo1V1 | 625 |
| | Grade Cr2 | 627 |
| | Grade Cr5Mo1V | 625 |
| | Grade CrWMn | 626 |
| GB/T 14164-2005 | Grade S175 I - PSL1 | 321, 324 |
| | Grade S175 II - PSL1 | 321, 324 |
| | Grade S210 - PSL1 | 316, 318 |
| | Grade S245 - PSL1 | 316, 318 |
| | Grade S245 - PSL2 | 321, 324 |
| | Grade S290 - PSL1 | 316, 318 |
| | Grade S290 - PSL2 | 321, 325 |
| | Grade S320 - PSL1 | 316, 319 |
| | Grade S320 - PSL2 | 322, 325 |
| | Grade S360 - PSL1 | 316, 319 |
| | Grade S360 - PSL2 | 322, 326 |
| | Grade S390 - PSL1 | 317, 319 |
| | Grade S390 - PSL2 | 322, 326 |
| | Grade S415 - PSL1 | 317, 319 |
| | Grade S415 - PSL2 | 323, 327 |
| | Grade S450 - PSL1 | 317, 320 |
| | Grade S450 - PSL2 | 323, 327 |
| | Grade S485 - PSL1 | 317, 320 |
| | Grade S485 - PSL2 | 323, 327 |
| | Grade S555 - PSL2 | 323, 327 |
| GB/T 14408-93 | Grade ZGD270-480 | 390, 393 |
| | Grade ZGD290-510 | 390, 394 |
| | Grade ZGD345-570 | 390, 394 |
| | Grade ZGD410-620 | 391, 394 |
| | Grade ZGD535-720 | 392, 395 |
| | Grade ZGD650-830 | 392, 395 |
| | Grade ZGD730-910 | 392, 395 |
| | Grade ZGD840-1030 | 392, 395 |

| Specification | Designation | Page Number |
|---|---|---|
| GB/T 14975-2002 | Grade 00Cr17Ni13Mo2N | 233, 239 |
| | Grade 00Cr17Ni14Mo2 | 233, 238 |
| | Grade 00Cr18Ni10N | 233, 238 |
| | Grade 00Cr18Ni5Mo3Si2 | 243, 244 |
| | Grade 00Cr19Ni10 | 232, 236 |
| | Grade 0Cr13 | 227, 229 |
| | Grade 0Cr17Ni12Mo2 | 233, 238 |
| | Grade 0Cr18Ni10Ti | 234, 240 |
| | Grade 0Cr18Ni11Nb | 234, 241 |
| | Grade 0Cr18Ni12Mo2Ti | 234, 240 |
| | Grade 0Cr18Ni9 | 233, 239 |
| | Grade 0Cr19Ni13Mo3 | 233, 239 |
| | Grade 0Cr19Ni9N | 234, 241 |
| | Grade 1Cr13 | 227, 229 |
| | Grade 1Cr17 | 227, 230 |
| | Grade 1Cr18Ni9 | 233, 239 |
| | Grade 2Cr13 | 227, 230 |
| GB/T 15712-1995 | Grade YF35V | 337, 339 |
| | Grade YF40V | 338, 340 |
| GB/T 1591-94 | Grade Q295A | 74, 80 |
| | Grade Q295B | 74, 80 |
| | Grade Q345A | 76, 81 |
| | Grade Q345B | 76, 81 |
| | Grade Q345C | 76, 81 |
| | Grade Q345D | 76, 81 |
| | Grade Q345E | 76, 81 |
| | Grade Q390A | 86, 92 |
| | Grade Q390B | 86, 92 |
| | Grade Q390C | 86, 92 |
| | Grade Q390D | 86, 92 |
| | Grade Q390E | 86, 92 |
| | Grade Q420A | 78, 83 |
| | Grade Q420B | 78, 83 |
| | Grade Q420C | 78, 83 |
| | Grade Q420D | 79, 83 |
| | Grade Q420E | 79, 83 |
| | Grade Q460C | 87, 93 |
| | Grade Q460D | 87, 93 |
| | Grade Q460E | 87, 93 |
| GB/T 16253-1996 | Grade ZG03Cr18Ni10 | 422, 424 |
| | Grade ZG03Cr19Ni11Mo2 | 423, 425 |
| | Grade ZG03Cr19Ni11Mo3 | 423, 425 |
| | Grade ZG07Cr18Ni10D | 423, 425 |
| GB/T 16253-1996 (continued) | Grade ZG07Cr19Ni11Mo2 | 422, 424 |
| | Grade ZG07Cr19Ni11Mo2G | 423, 425 |
| | Grade ZG07Cr19Ni11Mo3 | 422, 424 |
| | Grade ZG07Cr20Ni10 | 422, 424 |
| | Grade ZG07Cr20Ni10G | 423, 425 |
| | Grade ZG08Cr12Ni1MoG | 420, 421 |
| | Grade ZG08Cr12Ni4Mo1D | 419, 421 |
| | Grade ZG08Cr12Ni4Mo1G | 419, 421 |
| | Grade ZG08Cr19Ni11Mo2Nb | 422, 424 |
| | Grade ZG08Cr20Ni10Nb | 422, 424 |
| | Grade ZG12Cr2Mo1G | 407, 408 |
| | Grade ZG14Cr12Ni1MoG | 419, 421 |
| | Grade ZG14Cr9Mo1G | 407, 408 |
| | Grade ZG14MoVG | 407, 408 |
| | Grade ZG14Ni4D | 409, 411 |
| | Grade ZG15Cr1MoG | 406, 408 |
| | Grade ZG16Cr2Mo1G | 407, 408 |
| | Grade ZG16Cr5MoG | 407, 408 |
| | Grade ZG17Cr1Mo1VG | 406, 408 |
| | Grade ZG19MoG | 406, 407 |
| | Grade ZG20Cr2Mo1D | 410, 412 |
| | Grade ZG22Ni3Cr2MoAD | 410, 412 |
| | Grade ZG22Ni3Cr2MoBD | 410, 412 |
| | Grade ZG23Cr12Mo1NiVG | 420, 421 |
| | Grade ZG240-450A | 396, 397 |
| | Grade ZG240-450AG | 396, 397 |
| | Grade ZG240-450B | 396, 397 |
| | Grade ZG240-450BD | 398, 399 |
| | Grade ZG240-450BG | 396, 397 |
| | Grade ZG24Ni2MoD | 410, 412 |
| | Grade ZG280-520 | 396, 397 |
| | Grade ZG280-520D | 398, 399 |
| | Grade ZG280-520G | 396, 397 |
| | Grade ZG29Cr1MoD | 410, 412 |
| GB/T 16270-1996 | Grade Q420C | 79, 83 |
| | Grade Q420D | 79, 83 |
| | Grade Q420E | 79, 83 |
| | Grade Q460C | 87, 93 |
| | Grade Q460D | 87, 93 |
| | Grade Q460E | 87, 93 |

| Specification | Designation | Page Number |
|---|---|---|
| GB/T 16270-1996 (continued) | Grade Q500D | 89, 94 |
| | Grade Q500E | 89, 94 |
| | Grade Q550D | 90, 95 |
| | Grade Q550E | 90, 95 |
| | Grade Q620D | 90, 95 |
| | Grade Q620E | 90, 95 |
| | Grade Q690D | 91, 96 |
| | Grade Q690E | 91, 96 |
| GB/T 17107-1997 | Grade 15 | 333, 339 |
| | Grade 20 | 333, 339 |
| | Grade 25 | 334, 339 |
| | Grade 30 | 335, 339 |
| | Grade 35 | 335, 339 |
| | Grade 40 | 336, 339 |
| | Grade 45 | 337, 339 |
| | Grade 50 | 338, 340 |
| | Grade 55 | 338, 340 |
| | Grade Q235 | 333, 339 |
| GB/T 17396-1998 | Grade 20 | 203, 217 |
| | Grade 35 | 208, 221 |
| | Grade 45 | 210, 223 |
| GB/T 18254-2002 | Grade GCr15 | 628 |
| | Grade GCr15SiMn | 628 |
| | Grade GCr18Mo | 628 |
| GB/T 18982-2003 | Grade Q245NHYJ | 98, 103 |
| | Grade Q295GNHJ | 97, 103 |
| | Grade Q310GNHJ | 98, 103 |
| | Grade Q310GNHLJ | 98, 103 |
| | Grade Q325NHYJ | 99, 104 |
| | Grade Q345GNHJ | 99, 104 |
| | Grade Q345GNHLJ | 99, 104 |
| GB/T 18983-2003 | Grade FDC | 615 |
| | Grade FDCrSi | 619 |
| | Grade FDCrV-A | 620 |
| | Grade FDCrV-B | 620 |
| | Grade FDSiMn | 618 |
| | Grade TDC | 615 |
| | Grade TDCrSi | 619 |
| | Grade TDCrV-A | 620 |
| | Grade TDCrV-B | 620 |
| | Grade TDSiMn | 618 |
| | Grade VDC | 615 |
| | Grade VDCrSi | 619 |
| GB/T 18983-2003 (continued) | Grade VDCrV-A | 620 |
| | Grade VDCrV-B | 620 |
| GB/T 18984-2003 | Grade 06Ni3MoDG | 251, 253 |
| | Grade 09DG | 247, 249 |
| | Grade 10MnDG | 248, 250 |
| | Grade 16MnDG | 248, 250 |
| GB/T 2100-2002 | Grade ZG03Cr26Ni5Cu3Mo3N | 416, 418 |
| | Grade ZG03Cr26Ni5Mo3N | 416, 418 |
| GB/T 3077-1999 | Grade 12CrNi3 | 41 |
| | Grade 15Cr | 36 |
| | Grade 15CrA | 36 |
| | Grade 20Cr | 36 |
| | Grade 20CrMnMo | 39 |
| | Grade 20CrMo | 39 |
| | Grade 20CrNiMo | 42 |
| | Grade 20Mn2 | 34 |
| | Grade 30Cr | 36 |
| | Grade 30CrMo | 40 |
| | Grade 30CrMoA | 40 |
| | Grade 30CrNi3 | 41 |
| | Grade 30Mn2 | 34 |
| | Grade 35Cr | 37 |
| | Grade 35CrMo | 40 |
| | Grade 35Mn2 | 34 |
| | Grade 38CrMoAl | 43 |
| | Grade 40B | 44 |
| | Grade 40Cr | 37 |
| | Grade 40CrNiMoA | 42 |
| | Grade 40Mn2 | 35 |
| | Grade 42CrMo | 41 |
| | Grade 45B | 44 |
| | Grade 45Cr | 38 |
| | Grade 45Mn2 | 35 |
| | Grade 50B | 44 |
| | Grade 50Cr | 38 |
| | Grade 50CrVA | 45 |
| | Grade 50Mn2 | 35 |
| GB/T 3078-94 | Grade 10 | 21 |
| | Grade 10F | 21 |
| | Grade 15 | 22 |
| | Grade 15CrA | 36 |
| | Grade 15F | 22 |
| | Grade 15Mn | 22 |

| Specification | Designation | Page Number |
|---|---|---|
| GB/T 3078-94 (continued) | Grade 20 | 23 |
| | Grade 20Cr | 36 |
| | Grade 20CrMnMo | 39 |
| | Grade 20CrMo | 39 |
| | Grade 20F | 23 |
| | Grade 20Mn | 23 |
| | Grade 20Mn2 | 34 |
| | Grade 25 | 24 |
| | Grade 25Mn | 24 |
| | Grade 30 | 25 |
| | Grade 30Cr | 36 |
| | Grade 30CrMo | 40 |
| | Grade 30Mn | 25 |
| | Grade 35 | 26 |
| | Grade 35Cr | 37 |
| | Grade 35CrMo | 40 |
| | Grade 35Mn | 26 |
| | Grade 35Mn2 | 34 |
| | Grade 38CrMoAlA | 43 |
| | Grade 40 | 27 |
| | Grade 40B | 44 |
| | Grade 40Cr | 37 |
| | Grade 40CrNiMoA | 42 |
| | Grade 40Mn | 27 |
| | Grade 40Mn2 | 35 |
| | Grade 42CrMo | 41 |
| | Grade 45 | 28 |
| | Grade 45B | 44 |
| | Grade 45Cr | 38 |
| | Grade 45Mn | 28 |
| | Grade 45Mn2 | 35 |
| | Grade 50 | 29 |
| | Grade 50B | 44 |
| | Grade 50Mn | 29 |
| | Grade 50Mn2 | 35 |
| | Grade 55 | 30 |
| | Grade 60 | 31 |
| | Grade 60Mn | 31 |
| | Grade 65 | 32 |
| | Grade 65Mn | 32 |
| GB/T 3080-2001 | Grade W18Cr4V | 623 |
| | Grade W6Mo5Cr4V2 | 623 |
| GB/T 3524-92 | Grade Q195 | 51, 66 |
| | Grade Q215A | 52, 66 |
| | Grade Q215B | 52, 66 |
| | Grade Q235A | 55, 67 |
| | Grade Q235B | 55, 67 |
| | Grade Q255A | 58, 69 |
| | Grade Q255B | 58, 69 |
| | Grade Q275 | 60, 70 |
| GB/T 4231-93 | Grade 0Cr17Ni7Al | 621 |
| | Grade 0Cr19Ni9 | 621 |
| | Grade 1Cr17Ni7 | 621 |
| | Grade 3Cr13 | 621 |
| GB/T 4358-1995 | Grade 65Mn | 615 |
| | Grade 70 | 615 |
| | Grade T8MnA | 616 |
| | Grade T9A | 616 |
| GB/T 5680-1998 | Grade ZGMn13-1 | 400, 401 |
| | Grade ZGMn13-2 | 400, 401 |
| | Grade ZGMn13-3 | 400, 401 |
| | Grade ZGMn13-4 | 400, 401 |
| | Grade ZGMn13-5 | 400 |
| GB/T 699-1999 | Grade 08 | 21 |
| | Grade 08F | 21 |
| | Grade 10 | 21 |
| | Grade 10F | 21 |
| | Grade 15 | 22 |
| | Grade 15F | 22 |
| | Grade 15Mn | 22 |
| | Grade 20 | 23 |
| | Grade 20Mn | 23 |
| | Grade 25 | 24 |
| | Grade 25Mn | 24 |
| | Grade 30 | 25 |
| | Grade 30Mn | 25 |
| | Grade 35 | 26 |
| | Grade 35Mn | 26 |
| | Grade 40 | 27 |
| | Grade 40Mn | 27 |
| | Grade 45 | 28 |
| | Grade 45Mn | 28 |
| | Grade 50 | 29 |
| | Grade 50Mn | 29 |
| | Grade 55 | 30 |

| Specification | Designation | Page Number |
|---|---|---|
| GB/T 699-1999 (continued) | Grade 60 | 31 |
| | Grade 60Mn | 31 |
| | Grade 65 | 32 |
| | Grade 65Mn | 32 |
| | Grade 70 | 32 |
| | Grade 70Mn | 32 |
| | Grade 75 | 33 |
| | Grade 80 | 33 |
| | Grade 85 | 33 |
| ISO 11972:1998 | Grade GX 12 Cr 12 | 413, 414 |
| | Grade GX 2 CrNi 18 10 | 415, 417 |
| | Grade GX 2 CrNiCuMoN 26 5 3 3 | 416, 418 |
| | Grade GX 2 CrNiMo 19 11 2 | 415, 417 |
| | Grade GX 2 CrNiMo 19 11 3 | 416, 418 |
| | Grade GX 2 CrNiMoN 19 11 2 | 416, 418 |
| | Grade GX 2 CrNiMoN 19 11 3 | 416, 418 |
| | Grade GX 2 CrNiMoN 26 5 3 | 416, 418 |
| | Grade GX 4 CrNi 12 4 (QT1) | 413, 414 |
| | Grade GX 4 CrNi 12 4 (QT2) | 413, 414 |
| | Grade GX 4 CrNiMo 16 5 1 | 413, 414 |
| | Grade GX 5 CrNi 19 9 | 415, 417 |
| | Grade GX 5 CrNiMo 19 11 2 | 415, 417 |
| | Grade GX 5 CrNiMo 19 11 3 | 415, 417 |
| | Grade GX 6 CrNiMoNb 19 11 2 | 415, 417 |
| | Grade GX 6 CrNiNb 19 10 | 413, 414 |
| | Grade GX 8 CrNiMo 12 1 | 413, 414 |
| ISO 11973:1999 | Grade GX10NiCrNb50-50 | 428, 432 |
| | Grade GX130CrSi29 | 426, 430 |
| | Grade GX25 CrNiSi 20-14 | 426, 430 |
| | Grade GX25CrNiSi18-9 | 426, 430 |
| | Grade GX30CoCr50-28 | 429, 432 |
| | Grade GX30CrSi7 | 407, 408 |
| | Grade GX40CrNiSi22-10 | 426, 430 |
| | Grade GX40CrNiSi25-12 | 427, 431 |
| | Grade GX40CrNiSi25-20 | 427, 431 |
| | Grade GX40CrNiSi27-4 | 426, 430 |
| | Grade GX40CrNiSiNb24-24 | 428, 432 |
| | Grade GX40CrSi13 | 426, 430 |
| | Grade GX40CrSi17 | 426, 430 |

| Specification | Designation | Page Number |
|---|---|---|
| ISO 11973:1999 (continued) | Grade GX40CrSi24 | 426, 430 |
| | Grade GX40CrSi28 | 426, 430 |
| | Grade GX40NiCrCo20-20-20 | 429, 432 |
| | Grade GX40NiCrSi35-17 | 428, 432 |
| | Grade GX40NiCrSi35-26 | 428, 432 |
| | Grade GX40NiCrSi38-19 | 428, 432 |
| | Grade GX40NiCrSiNb35-26 | 428, 432 |
| | Grade GX40NiCrSiNb38-19 | 428, 432 |
| | Grade GX45NiCrWSi48-28-5 | 429, 432 |
| | Grade GX50NiCr65-15 | 429, 432 |
| ISO 13521:1999 | Grade GX100Mn13 | 400, 401 |
| | Grade GX110MnMo13-1 | 400, 401 |
| | Grade GX120Mn13 | 400, 401 |
| | Grade GX120MnCr13-2 | 400, 401 |
| | Grade GX120MnCr17-2 | 400, 401 |
| | Grade GX120MnMo7-1 | 400, 401 |
| | Grade GX120MnNi13-3 | 400, 401 |
| | Grade GX90MnMo14 | 400, 401 |
| ISO 14737:2003 | Grade G25CrMo4 | 402, 403 |
| | Grade G32CrMo4 | 402, 404 |
| | Grade G32NiCrMo8-5-4 | 403, 405 |
| | Grade G42CrMo4 | 402, 404 |
| ISO 16143-1:2004 | X10CrNi18-8 | 459, 476 |
| | X11CrNiMnN19-8-6 | 469, 498 |
| | X12Cr13 | 438, 440 |
| | X12CrMnNiN17-7-5 | 458, 473 |
| | X1CrNi25-21 | 470, 500 |
| | X1CrNiMoCuN24-22-8 | 470, 500 |
| | X1CrNiMoN25-22-2 | 464, 486 |
| | X1NiCrMoCu25-20-5 | 472, 504 |
| | X1NiCrMoCu31-27-4 | 472, 504 |
| | X20Cr13 | 439, 442 |
| | X2CrNi12 | 445, 451 |
| | X2CrNi18-9 | 461, 480 |
| | X2CrNi19-11 | 461, 480 |
| | X2CrNiMnMoN25-18-6-5 | 470, 500 |
| | X2CrNiMo17-12-2 | 465, 490 |
| | X2CrNiMo17-12-3 | 465, 490 |
| | X2CrNiMo18-14-3 | 465, 490 |
| | X2CrNiMoCuN25-6-3 | 513, 516 |
| | X2CrNiMoCuWN25-7-4 | 514, 517 |
| | X2CrNiMoN17-12-3 | 467, 493 |

| Specification | Designation | Page Number |
|---|---|---|
| ISO 16143-1:2004 (continued) | X2CrNiMoN22-5-3 | 513, 515 |
| | X2CrNiMoN25-7-4 | 514, 517 |
| | X2CrNiN18-9 | 462, 482 |
| | X2CrNiN23-4 | 513, 516 |
| | X2CrTi12 | 445, 451 |
| | X30Cr13 | 439, 443 |
| | X39Cr13 | 439, 444 |
| | X3CrNb17 | 446, 454 |
| | X3CrNiMo17-12-3 | 464, 488 |
| | X3CrTi17 | 446, 454 |
| | X5CrNi18-9 | 460, 478 |
| | X5CrNiMo17-12-2 | 464, 488 |
| | X6Cr17 | 446, 453 |
| | X6CrNiCu17-8-2 | 460, 479 |
| | X6CrNiMoTi17-12-2 | 466, 491 |
| | X6CrNiNb18-10 | 469, 498 |
| | X6CrNiTi18-10 | 468, 496 |
| | X7CrNiAl17-7 | 505, 512 |
| | X8CrMnCuN17-8-3 | 470, 499 |
| ISO 16143-2:2004 | X11CrNiMnN19-8-6 | 549, 585 |
| | X1CrNiMoCuN24-22-8 | 545, 566 |
| | X1CrNiMoCuNW24-22-6 | 545, 566 |
| | X1NiCrMoCu31-27-4 | 550, 592 |
| | X2CrNiMnMoN25-18-6-5 | 547, 579 |
| | X2CrNiMoCuN25-6-3 | 601, 605 |
| | X2CrNiMoCuWN25-7-4 | 600, 604 |
| | X2CrNiMoN25-7-4 | 600, 604 |
| | X2CrNiN23-4 | 600, 602 |
| | X3CrNiCu18-9-4 | 550, 589 |
| | X3CrNiMo13-4 | 521, 532 |
| | X6CrNiCuS18-9-2 | 549, 587 |
| | X6CrNiMoTi17-12-2 | 546 |
| | X7CrS17 | 534, 538 |
| | X8CrMnCuN17-8-3 | 550, 590 |
| | X8CrMnNiN18-9-5 | 549, 585 |
| ISO 2937:1974 | C 35 | 209, 222 |
| | TS 1 | 199, 214 |
| | TS 18 | 207, 221 |
| | TS 4 | 201, 215 |
| | TS 9 | 204, 217 |
| | R28 | 198, 201, 202, 213, 215, 217 |
| | R33 | 199, 201, 204, 214, 215, 218 |
| ISO 3304:1985 (continued) | R37 | 200, 201, 202, 205, 214, 215, 217, 219 |
| | R44 | 202, 204, 205, 208, 217, 219, 221 |
| | R50 | 206, 207, 209, 210, 220, 222, 223 |
| ISO 3305:1985 | R28 | 198, 201, 202, 213, 215, 217 |
| | R33 | 199, 201, 204, 214, 215, 218 |
| | R37 | 200, 201, 202, 205, 214, 215, 217, 219 |
| | R44 | 202, 204, 205, 208, 217, 219, 221 |
| | R50 | 206, 207, 209, 210, 220, 222, 223 |
| ISO 3306:1985 | R28 | 198, 199, 213, 214 |
| | R33 | 199, 200, 214 |
| | R37 | 200, 201, 202, 214, 215, 217 |
| | R44 | 202, 204, 205, 217 |
| | R50 | 206, 207, 208, 220, 222 |
| ISO 3755:1991 | Grade 200-400 | 389, 392 |
| | Grade 200-400W | 389, 392 |
| | Grade 230-450 | 389, 393 |
| | Grade 230-450W | 389, 393 |
| | Grade 270-480 | 390, 393 |
| | Grade 270-480W | 390, 393 |
| | Grade 340-550 | 390, 394 |
| | Grade 340-550W | 390, 394 |
| ISO 4706:1989 | alloy steel | 116, 125 |
| | carbon steel | 116, 125 |
| ISO 4950-2:1995 A1:2003 | Grade E 355, Quality DD | 85, 92 |
| | Grade E 355, Quality E | 85, 92 |
| ISO 4950-3:1995 A1:2003 | Grade E 460, Quality DD | 88, 93 |
| | Grade E 460, Quality E | 88, 93 |
| ISO 4952:2006 | Grade S235W, Quality B | 97, 103 |
| | Grade S235W, Quality C | 97, 103 |
| | Grade S235W, Quality D | 97, 103 |
| | Grade S355W, Quality B | 104 |
| | Grade S355W, Quality C | 104 |
| | Grade S355W, Quality D | 104 |
| | Grade S355W, Quality B | 99 |
| | Grade S355W, Quality C | 99 |
| | Grade S355W, Quality D | 99 |

| Specification | Designation | Page Number |
|---|---|---|
| ISO 4952:2006 (continued) | Grade S355WP, Quality A | 104 |
| | Grade S355WP, Quality D | 104 |
| | Grade S355WP, Quality A | 99 |
| | Grade S355WP, Quality D | 99 |
| ISO 4954:1993 | Type X 10 CrNi 18 9 E | 541, 553 |
| | Type X 12 Cr 13 E | 519, 525 |
| | Type X 19 CrNi 16 2 E | 520, 530 |
| | Type X 2 CrNi 18 10 E | 542, 560 |
| | Type X 2 CrNiMo 17 13 3 E | 546, 576 |
| | Type X 2 CrNiMoN 17 13 3 E | 547, 580 |
| | Type X 3 CrNiCu 18 9 3 E | 550, 589 |
| | Type X 5 CrNi 18 12 E | 543, 563 |
| | Type X 5 CrNi 18 9 E | 542, 557 |
| | Type X 5 CrNiMo 17 12 2 E | 545, 571 |
| | Type X 6 Cr 17 E | 534, 537 |
| | Type X 6 CrMo 17 1 E | 535, 539 |
| | Type X 6 CrNiMoTi 17 12 2 E | 546, 578 |
| | Type X 6 CrNiTi 18 10 E | 548, 584 |
| ISO 4955:2005 | X12CrNi23-13 | 463, 484 |
| | X15CrN26 | 448, 456 |
| | X2CrTi12 | 445, 451 |
| | X2CrTiNb18 | 447, 455 |
| | X3CrTi17 | 446, 454 |
| | X6Cr13 | 438, 441, 534, 536 |
| | X6Cr17 | 534, 537 |
| | X6NiCrSiNCe35-25 | 550, 588 |
| | X7CrNi18-9 | 461, 480, 543, 562 |
| | X7CrNiNb18-10 | 470, 501 |
| | X7CrNiSiNCe21-11 | 549, 586 |
| | X7CrNiTi18-10 | 468, 497 |
| | X8CrNi25-21 | 463, 485 |
| | X8NiCrAlTi32-21 | 471, 503 |
| ISO 4957:1999 | 102Cr6 | 627 |
| | 105V | 622 |
| | 32CrMoV12-28 | 626 |
| | 38CrCoWV18-17-17 | 627 |
| | 50CrMoV13-15 | 627 |
| | 55NiCrMoV7 | 627 |
| | 70MnMoCr8 | 626 |
| | 95MnWCr5 | 626 |

| Specification | Designation | Page Number |
|---|---|---|
| ISO 4957:1999 (continued) | C105U | 622 |
| | C120U | 622 |
| | C70U | 622 |
| | C80U | 622 |
| | C90U | 622 |
| | HS10-4-3-10 | 625 |
| | HS18-0-1 | 623 |
| | HS1-8-1 | 623 |
| | HS2-9-1-8 | 625 |
| | HS2-9-2 | 624 |
| | HS6-5-2 | 624 |
| | HS6-5-2-5 | 625 |
| | HS6-5-3 | 624 |
| | HS6-5-4 | 624 |
| | HS6-6-2 | 624 |
| | X100CrMoV5 | 625 |
| | X210Cr12 | 625 |
| | X30WCrV9-3 | 627 |
| | X35CrWMoV5 | 626 |
| | X37CrMoV5-1 | 626 |
| | X40CrMoV5-1 | 626 |
| ISO 4978:1983 | Grade 2 | 112, 120 |
| | Grade 3 | 113, 121 |
| | Grade 4 | 116, 125 |
| ISO 4991:1994 | Type C23-45A | 396, 397 |
| | Type C23-45AH | 396, 397 |
| | Type C23-45B | 396, 397 |
| | Type C23-45BH | 396, 397 |
| | Type C23-45BL | 398, 399 |
| | Type C26-52 | 396, 397 |
| | Type C26-52H | 396, 397 |
| | Type C26-52L | 398, 399 |
| | Type C28H | 406, 407 |
| | Type C31L | 410, 412 |
| | Type C32H | 406, 408 |
| | Type C33H | 407, 408 |
| | Type C34AH | 407, 408 |
| | Type C34BH | 407, 408 |
| | Type C34BL | 410, 412 |
| | Type C35BH | 406, 408 |
| | Type C37H | 407, 408 |
| | Type C38H | 407, 408 |
| | Type C39CH | 419, 421 |

| Specification | Designation | Page Number |
|---|---|---|
| ISO 4991:1994 (continued) | Type C39CNiH | 420, 421 |
| | Type C39NiH | 419, 421 |
| | Type C39NiL | 419, 421 |
| | Type C40H | 420, 421 |
| | Type C43C1L | 410, 412 |
| | Type C43E2aL | 410, 412 |
| | Type C43E2bL | 410, 412 |
| | Type C43L | 409, 411 |
| | Type C46 | 422, 424 |
| | Type C47 | 422, 424 |
| | Type C47H | 423, 425 |
| | Type C47L | 423, 425 |
| | Type C50 | 422, 424 |
| | Type C57 | 423, 425 |
| | Type C60 | 422, 424 |
| | Type C60H | 423, 425 |
| | Type C60Nb | 422, 424 |
| | Type C61 | 422, 424 |
| | Type C61LC | 423, 425 |
| ISO 5952:2005 | Grade HSA 235W, Class B | 97, 103 |
| | Grade HSA 235W, Class D | 97, 103 |
| | Grade HSA 245W, Class B | 98, 103 |
| | Grade HSA 245W, Class D | 98, 103 |
| | Grade HSA 355W1, Class A | 101, 105 |
| | Grade HSA 355W1, Class D | 101, 105 |
| | Grade HSA 355W2, Class C | 101, 105 |
| | Grade HSA 355W2, Class D | 101, 105 |
| | Grade HSA 365W, Class B | 104 |
| | Grade HSA 365W, Class D | 104 |
| | Grade HSA 365W, Class B | 99 |
| | Grade HSA 365W, Class D | 99 |
| ISO 630:1995 A1:2003 | Grade E 185 (Fe 310), Quality 0 | 51, 66 |
| | Grade E 235 (Fe 360), Quality A | 52, 66 |
| | Grade E 235 (Fe 360), Quality B | 52, 66 |
| | Grade E 235 (Fe 360), Quality B NF | 52, 66 |
| | Grade E 235 (Fe 360), Quality C | 53, 66 |
| | Grade E 235 (Fe 360), Quality D | 53, 66 |
| | Grade E 275 (Fe 430), Quality A | 58, 69 |
| | Grade E 275 (Fe 430), Quality B | 58, 69 |
| | Grade E 275 (Fe 430), Quality C | 58, 69 |
| | Grade E 275 (Fe 430), Quality D | 59, 69 |
| | Grade E 355 (Fe 510), Quality C | 62, 71 |
| | Grade E 355 (Fe 510), Quality D | 62, 71 |
| ISO 683-1:1987 | Grade 22 Mn 6 | 34 |
| | Grade 25 CrMo 4 | 40 |
| | Grade 25 CrMoS 4 | 40 |
| | Grade 28 Mn 6 | 34 |
| | Grade 34 Cr 4 | 37 |
| | Grade 34 CrMo 4 | 40 |
| | Grade 34 CrMoS 4 | 40 |
| | Grade 34 CrS 4 | 37 |
| | Grade 36 Mn 6 | 35 |
| | Grade 37 Cr 4 | 37 |
| | Grade 37 CrS 4 | 37 |
| | Grade 41 Cr 4 | 37 |
| | Grade 41 CrNiMo 2 | 43 |
| | Grade 41 CrNiMoS 2 | 43 |
| | Grade 41 CrS 4 | 37 |
| | Grade 42 CrMo 4 | 41 |
| | Grade 42 CrMoS 4 | 41 |
| | Grade 42 Mn 6 | 35 |
| | Grade 50 CrMo 4 | 41 |
| | Grade 51 CrV 4 | 45 |
| | Grade C 25 | 24 |
| | Grade C 25 E4 | 24 |
| | Grade C 25 M2 | 24 |
| | Grade C 30 | 25 |
| | Grade C 30 E4 | 25 |
| | Grade C 30 M2 | 25 |
| | Grade C 35 | 26 |
| | Grade C 35 E4 | 26 |
| | Grade C 35 M2 | 26 |
| | Grade C 40 | 27 |
| | Grade C 40 E4 | 27 |
| | Grade C 40 M2 | 27 |
| | Grade C 45 | 28 |
| | Grade C 45 E4 | 28 |
| | Grade C 45 M2 | 28 |
| | Grade C 50 | 29 |
| | Grade C 50 E4 | 29 |

| Specification | Designation | Page Number |
|---|---|---|
| ISO 683-1:1987 (continued) | Grade C 50 M2 | 29 |
| | Grade C 55 | 30 |
| | Grade C 55 E4 | 30 |
| | Grade C 55 M2 | 30 |
| | Grade C 60 | 31 |
| | Grade C 60 E4 | 31 |
| | Grade C 60 M2 | 31 |
| ISO 683-10:1987 | Type 41 CrAlMo 74 | 43 |
| ISO 683-11:1987 | Type 15 NiCr 13 | 41 |
| | Type 17 NiCrMo 6 | 42 |
| | Type 18 CrMo 4 | 39 |
| | Type 18 CrMoS 4 | 39 |
| | Type 20 Cr 4 | 36 |
| | Type 20 CrS 4 | 36 |
| | Type 20 NiCrMo 2 | 42 |
| | Type 20 NiCrMoS 2 | 42 |
| | Type C 10 | 21 |
| | Type C 15 E4 | 22 |
| | Type C 15 M2 | 22 |
| | Type C 16 E4 | 22 |
| | Type C 16 M2 | 22 |
| ISO 683-14:2004 | Type 51CrV4 | 620 |
| | Type 55Cr3 | 618 |
| | Type 55SiCr6-3 | 619 |
| | Type 60CrMo3-3 | 619 |
| ISO 683-15:1992 | Grade X 53CrMnNiNbN 21 9 | 587 |
| | Grade X 3CrMnNiNbN21 9 | 549 |
| ISO 683-17:1999 | 100Cr6 | 628 |
| | 100CrMnMoSi8-4-6 | 628 |
| | 100CrMnSi4-4 | 628 |
| | 100CrMnSi6-4 | 628 |
| | 100CrMnSi6-6 | 628 |
| | 100CrMo7 | 628 |
| | 100CrMo7-3 | 628 |
| | 100CrMo7-4 | 628 |
| ISO 683-9:1988 | Type 10 S 20 | 611 |
| | Type 10 SPb 20 | 614 |
| | Type 11 SMn 28 | 613 |
| | Type 11 SMnPb 28 | 614 |
| | Type 12 SMn 35 | 614 |
| | Type 12 SMnPb 35 | 614 |
| | Type 17 SMn 20 | 611 |
| ISO 683-9:1988 (continued) | Type 35 S 20 | 612 |
| | Type 35 SMn 20 | 612 |
| | Type 44 SMn 28 | 612 |
| | Type 46 S 20 | 613 |
| | Type 9 S 20 | 613 |
| ISO 8458-3:2002 | Grade FDC | 615 |
| | Grade FDCrV-A | 620 |
| | Grade FDCrV-B | 620 |
| | Grade FDSiCr | 619 |
| | Grade TDC | 615 |
| | Grade TDCrV-A | 620 |
| | Grade TDCrV-B | 620 |
| | Grade TDSiCr | 619 |
| | Grade VDC | 615 |
| | Grade VDCrV-A | 620 |
| | Grade VDCrV-B | 620 |
| | Grade VDSiCr | 619 |
| ISO 9327-2:1999 | Type 13CrMo9-10 | 352, 353 |
| | Type 14CrMo4-5 | 350 |
| | Type 16Mo3 | 348 |
| | Type PH 26 | 334, 339 |
| | Type PH 29 | 335, 339 |
| | Type PH 31 | 335, 339 |
| | Type X12CrMo5-1 | 355, 356 |
| | Type X20CrMoV12-1 | 357 |
| ISO 9327-3:1999 | Type 11MnNi5-3 | 359 |
| | Type 12Ni14G1 | 357, 358 |
| | Type 12Ni14G2 | 357, 358 |
| | Type 12Ni19 | 357, 358 |
| | Type 13MnNi6-3 | 359 |
| | Type 15NiMn6 | 357, 358 |
| | Type X8Ni9 | 357, 358 |
| ISO 9327-4:1999 | Type P 28 | 341, 344 |
| | Type P 35 | 343, 346 |
| | Type P 42 | 359, 360 |
| | Type PH 28 | 341, 344 |
| | Type PH 35 | 343, 346 |
| | Type PH 42 | 359, 360 |
| | Type PL 28 | 341, 344 |
| | Type PL 35 | 343, 346 |
| | Type PL 42 | 359, 360 |
| | Type PLH 35 | 344, 346 |
| | Type PLH 42 | 359, 360 |

| Specification | Designation | Page Number |
|---|---|---|
| ISO 9327-5:1999 | Type X2CrNi18-10 | 367, 373 |
| | Type X2CrNiMo17-12 | 369, 376 |
| | Type X2CrNiMo17-13 | 369, 376 |
| | Type X2CrNiMoN17-12 | 370, 376 |
| | Type X2CrNiMoN17-13 | 370, 376 |
| | Type X2CrNiMoN22-5-3 | 381, 383 |
| | Type X2CrNiN18-10 | 368, 374 |
| | Type X2CrNiN23-4 | 382, 384 |
| | Type X2NiCrMoCu25-20-5 | 372, 379 |
| | Type X5CrNi18-9 | 367, 373 |
| | Type X5CrNiMo17-12 | 369, 375 |
| | Type X5CrNiMo17-13 | 369, 375 |
| | Type X6CrNi25-21 | 368, 375 |
| | Type X6CrNiMoTi17-12 | 370, 377 |
| | Type X6CrNiNb18-10 | 372, 379 |
| | Type X6CrNiTi18-10 | 371, 378 |
| | Type X7CrNi18-9 | 367, 374 |
| | Type X7CrNiMo17-12 | 370, 377 |
| | Type X7CrNiNb18-10 | 372, 379 |
| | Type X7CrNiTi18-10 | 371, 378 |
| ISO 9328-2:2004 | Grade 16Mo3 | 134, 138 |
| | Grade P235GH | 112, 120 |
| | Grade P265GH | 113, 121 |
| ISO 9328-4:2004 | Grade 11MnNi5-3 | 147 |
| | Grade 13MnNi6-3 | 147 |
| | Grade 15NiMn6 | 148 |
| ISO 9328-7:2004 | Grade X1CrNi25-21 | 470, 500 |
| | Grade X1CrNiMoCuN20-18-7 | 464, 487 |
| | Grade X1CrNiMoCuN25-25-5 | 472, 503 |
| | Grade X1CrNiMoN25-22-2 | 464, 486 |
| | Grade X1NiCrMoCu25-20-5 | 170, 183, 472, 504 |
| | Grade X1NiCrMoCu31-27-4 | 472, 504 |
| | Grade X1NiCrMoCuN25-20-7 | 170, 184, 472, 503 |
| | Grade X2CrMoTi18-2 | 161, 164, 448, 456 |
| | Grade X2CrNi12 | 159, 162, 445, 451 |
| | Grade X2CrNi18-9 | 165, 173, 461, 480 |
| | Grade X2CrNi19-11 | 165, 173, 461, 480 |
| | Grade X2CrNiMo17-12-2 | 167, 179, 465, 490 |
| | Grade X2CrNiMo17-12-3 | 167, 179, 465, 490 |
| ISO 9328-7:2004 (continued) | Grade X2CrNiMo18-14-3 | 167, 179, 465, 490 |
| | Grade X2CrNiMo18-15-4 | 168, 181, 467, 495 |
| | Grade X2CrNiMoCuN25-6-3 | 185, 187, 513, 516 |
| | Grade X2CrNiMoCuWN25-7-4 | 185, 187, 514, 517 |
| | Grade X2CrNiMoN17-11-2 | 168, 180, 467, 493 |
| | Grade X2CrNiMoN17-13-3 | 168, 180, 467, 493 |
| | Grade X2CrNiMoN17-13-5 | 169, 182, 468, 495 |
| | Grade X2CrNiMoN18-12-4 | 169, 181, 468, 495 |
| | Grade X2CrNiMoN22-5-3 | 185, 186, 513, 515 |
| | Grade X2CrNiMoN25-7-4 | 185, 187, 514, 517 |
| | Grade X2CrNiN18-10 | 166, 175, 462, 482 |
| | Grade X2CrNiN18-7 | 165, 171, 459, 477 |
| | Grade X2CrNiN23-4 | 185, 186, 513, 516 |
| | Grade X2CrTi17 | 160, 164, 446, 454 |
| | Grade X2CrTiNb18 | 160, 163, 447, 455 |
| | Grade X3CrNiMo13-4 | 159, 163, 439, 443 |
| | Grade X3CrNiMo17-12-3 | 167, 177, 464, 488 |
| | Grade X3CrNiMoBN17-13-3 | 470, 501 |
| | Grade X3CrTi17 | 160, 164, 446, 454 |
| | Grade X4CrNiMo16-5-1 | 439, 444 |
| | Grade X5CrNi18-9 | 165, 172, 460, 478 |
| | Grade X5CrNiMo17-12-2 | 167, 177, 464, 488 |
| | Grade X5CrNiN18-8 | 166, 174, 461, 481 |
| | Grade X5NiCrAlTi31-20 | 471, 502 |
| | Grade X6CrNi18-10 | 165, 172, 461, 480 |
| | Grade X6CrNi23-13 | 166, 176, 463, 484 |
| | Grade X6CrNi25-20 | 166, 176, 463, 486 |
| | Grade X6CrNiMoNb17-12-2 | 168, 180, 466, 491 |
| | Grade X6CrNiMoTi17-12-2 | 168, 179, 466, 491 |
| | Grade X6CrNiNb18-10 | 169, 183, 469, 498 |
| | Grade X6CrNiTi12 | 159, 163, 445, 452 |
| | Grade X6CrNiTi18-10 | 169, 182, 468, 496 |
| | Grade X6CrNiTiB18-10 | 469, 499 |
| | Grade X8CrNiNb16-13 | 471, 501 |
| | Grade X8NiCrAlTi32-21 | 170, 184, 471, 503 |

| Specification | Designation | Page Number |
|---|---|---|
| ISO 9328-7:2004 (continued) | X2CrNiMoCuW N25-7-4 | 185 |
| ISO 9329-2:1997 | Grade 11 CrMo 9-10 TA | 278, 279 |
| | Grade 11 CrMo 9-10 TN+TT | 278, 279 |
| | Grade 12 MoCrV 6-2 | 271, 272 |
| | Grade 13 CrMo 4-5 | 274, 275 |
| | Grade 16 Mo 3 | 267 |
| | Grade 8 CrMo 4-5 | 274, 275 |
| | Grade 8 CrMo 5-5 | 276, 277 |
| | Grade 9 NiMnMoNb 5-4-4 | 273 |
| | Grade X10 CrMoVNb 9-1 | 283, 285 |
| | Grade X11 CrMo 5 TA | 280, 282 |
| | Grade X11 CrMo 5 TN+TT | 280, 282 |
| | Grade X11 CrMo 9-1 TA | 283, 284 |
| | Grade X11 CrMo 9-1 TN+TT | 283, 284 |
| ISO 9329-3:1997 | 11 MnNi 5-3 | 251, 252 |
| | 12 Ni 14 | 251, 253 |
| | 13 MnNi 6-3 | 251, 252 |
| | 26 CrMo 4 | 251, 254 |
| | PL 21 | 246, 249 |
| | PL 23 | 248, 250 |
| | PL 25 | 246, 249 |
| | X 10 Ni 9 | 251, 254 |
| | X 12 Ni 5 | 251, 253 |
| ISO 9330-3:1997 | 11 MnNi 5-3 | 251, 252 |
| | 12 Ni 14 | 251, 253 |
| | 13 MnNi 6-3 | 251, 252 |
| | PL 21 | 246, 249 |
| | PL 23 | 248, 250 |
| | PL 25 | 246, 249 |
| | X 12 Ni 5 | 251, 253 |
| ISO 9330-5:2000 | 11 MnNi 5-3 | 251, 252 |
| | 12 Ni 14 | 251, 253 |
| | 13 MnNi 6-3 | 251, 252 |
| | PL 21 | 246, 249 |
| | PL 23 | 248, 250 |
| | PL 25 | 246, 249 |
| | X 10 Ni 9 | 251, 254 |
| | X 12 Ni 5 | 251, 253 |
| ISO 9477:1992 | Grade 410-620 | 391, 394 |
| | Grade 540-720 | 392, 395 |
| | Grade 620-820 | 392, 395 |
| | Grade 840-1030 | 392, 395 |

| Specification | Designation | Page Number |
|---|---|---|
| JIS G 3101:2010 | Symbol SS330 | 51, 66 |
| | Symbol SS400 | 56, 68 |
| | Symbol SS490 | 61, 70 |
| | Symbol SS540 | 64, 72 |
| JIS G 3103:2012 | Symbol SB410 | 113, 121 |
| | Symbol SB450 | 114, 123 |
| | Symbol SB450M | 135, 138 |
| | Symbol SB480 | 115, 124 |
| | Symbol SB480M | 135, 138 |
| JIS G 3106:2008 | Grade SM400A | 56, 68 |
| | Grade SM400B | 56, 68 |
| | Grade SM400C | 56, 68 |
| | Grade SM490A | 61, 70 |
| | Grade SM490B | 61, 70 |
| | Grade SM490C | 61, 70 |
| | Grade SM490YA | 62, 71 |
| | Grade SM490YB | 62, 71 |
| | Grade SM520B | 63, 72 |
| | Grade SM520C | 63, 72 |
| | Grade SM570 | 64, 73 |
| JIS G 3114:2008 | Symbol SMA400AP | 98, 103 |
| | Symbol SMA400AW | 98, 103 |
| | Symbol SMA400BP | 98, 103 |
| | Symbol SMA400BW | 98, 103 |
| | Symbol SMA400CP | 98, 103 |
| | Symbol SMA400CW | 98, 103 |
| | Symbol SMA490AP | 100, 105 |
| | Symbol SMA490AW | 100, 105 |
| | Symbol SMA490BP | 100, 105 |
| | Symbol SMA490BW | 100, 105 |
| | Symbol SMA490CP | 100, 105 |
| | Symbol SMA490CW | 100, 105 |
| | Symbol SMA570P | 102, 106 |
| | Symbol SMA570W | 102, 106 |
| JIS G 3115:2010 | Symbol SPV235 | 113, 120 |
| | Symbol SPV315 | 116, 125 |
| | Symbol SPV355 | 118, 126 |
| | Symbol SPV410 | 119, 127 |
| | Symbol SPV450 | 119, 127 |
| JIS G 3116:2013 | Symbol SG255 | 112, 120 |
| | Symbol SG295 | 114, 122 |
| | Symbol SG325 | 116, 125 |
| | Symbol SG365 | 118, 126 |

| Specification | Designation | Page Number |
|---|---|---|
| JIS G 3118:2010 | Symbol SGV410 | 114, 121 |
| | Symbol SGV450 | 114, 123 |
| | Symbol SGV480 | 115, 124 |
| JIS G 3119:2013 | Symbol SBV1A | 136, 139 |
| | Symbol SBV1B | 137, 139 |
| | Symbol SBV2 | 155, 156 |
| | Symbol SBV3 | 157, 158 |
| JIS G 3120:2014 | Symbol SQV1A | 137, 139 |
| | Symbol SQV1B | 137, 139 |
| | Symbol SQV2A | 155, 156 |
| | Symbol SQV2B | 155, 156 |
| | Symbol SQV3A | 157, 158 |
| | Symbol SQV3B | 157, 158 |
| JIS G 3124:2009 | Symbol SEV 245 | 117 |
| | Symbol SEV245 | 126 |
| | Symbol SEV295 | 136, 139 |
| | Symbol SEV345 | 137, 139 |
| JIS G 3125:2010 | Symbol SPA-C | 99, 104 |
| | Symbol SPA-H | 100, 105 |
| JIS G 3126:2009 | Symbol SLA235A | 128, 131 |
| | Symbol SLA235B | 128, 131 |
| | Symbol SLA325A | 128, 131 |
| | Symbol SLA325B | 128, 131 |
| | Symbol SLA365 | 129, 132 |
| | Symbol SLA410 | 130, 133 |
| JIS G 3127:2013 | Symbol SL2N255 | 149, 150 |
| | Symbol SL3N255 | 151, 152 |
| | Symbol SL3N275 | 151, 152 |
| | Symbol SL3N440 | 151, 152 |
| | Symbol SL5N590 | 153 |
| | Symbol SL9N520 | 153, 154 |
| | Symbol SL9N590 | 153, 154 |
| JIS G 3128:2009 | Grade SHY685 | 91, 96 |
| | Grade SHY685N | 91, 96 |
| | Grade SHY685NS | 91, 96 |
| JIS G 3136:2012 | Grade SN400A | 56, 68 |
| | Grade SN400B | 56, 68 |
| | Grade SN400C | 56, 68 |
| | Grade SN490B | 61, 70 |
| | Grade SN490C | 60, 70 |
| JIS G 3201:1988 A1:2008 | Symbol SF 340 A | 333, 339 |
| | Symbol SF 390 A | 333, 339 |
| | Symbol SF 440 A | 334, 339 |
| JIS G 3201:1988 A1:2008 (continued) | Symbol SF 490 A | 335, 339 |
| | Symbol SF 540 A | 336, 339 |
| | Symbol SF 540 B | 336, 339 |
| | Symbol SF 590 A | 337, 339 |
| | Symbol SF 590 B | 337, 339 |
| | Symbol SF 640 B | 338, 340 |
| JIS G 3202:1988 A1:2008 | Symbol SFVC 1 | 342, 345 |
| | Symbol SFVC 2 A | 343, 346 |
| | Symbol SFVC 2 B | 343, 346 |
| JIS G 3203:1988 A1:2008 | Grade SFVA F 1 | 348 |
| | Grade SFVA F 11 A | 351 |
| | Grade SFVA F 11 B | 351 |
| | Grade SFVA F 12 | 350 |
| | Grade SFVA F 2 | 349 |
| | Grade SFVA F 21 A | 354 |
| | Grade SFVA F 21 B | 354 |
| | Grade SFVA F 22 A | 352, 353 |
| | Grade SFVA F 22 B | 352, 353 |
| | Grade SFVA F 5 A | 355, 356 |
| | Grade SFVA F 5 B | 355, 356 |
| | Grade SFVA F 5 C | 355, 356 |
| | Grade SFVA F 5 D | 355, 356 |
| | Grade SFVA F 9 | 356 |
| JIS G 3204:1988 A1:2008 | Grade SFVQ 1 A | 362 |
| | Grade SFVQ 1 B | 362 |
| | Grade SFVQ 2 A | 361 |
| | Grade SFVQ 2 B | 361 |
| | Grade SFVQ 3 | 363 |
| JIS G 3205:1988 A1:2008 | Symbol SFL 1 | 342, 345 |
| | Symbol SFL 2 | 343, 346 |
| | Symbol SFL 3 | 357, 358 |
| JIS G 3206:1993 A1:2008 | Symbol SFVCM F22B | 352, 353 |
| | Symbol SFVCM F22V | 352, 353 |
| | Symbol SFVCM F3V | 354, 355 |
| JIS G 3214:1991 A1:2009 | Symbol SUS F 304 | 367, 373 |
| | Symbol SUS F 304H | 367, 374 |
| | Symbol SUS F 304L | 367, 373 |
| | Symbol SUS F 304LN | 368, 374 |
| | Symbol SUS F 304N | 368, 374 |
| | Symbol SUS F 310 | 368, 375 |
| | Symbol SUS F 316 | 369, 375 |
| | Symbol SUS F 316H | 370, 377 |
| | Symbol SUS F 316L | 369, 376 |

| Specification | Designation | Page Number |
|---|---|---|
| JIS G 3214:1991 A1:2009 (continued) | Symbol SUS F 316LN | 370, 376 |
| | Symbol SUS F 316N | 367, 373 |
| | Symbol SUS F 317 | 370, 377 |
| | Symbol SUS F 317L | 370, 377 |
| | Symbol SUS F 321 | 371, 378 |
| | Symbol SUS F 321H | 371, 378 |
| | Symbol SUS F 347 | 372, 379 |
| | Symbol SUS F 347H | 372, 379 |
| | Symbol SUS F 410-A | 364, 365 |
| | Symbol SUS F 410-B | 364, 365 |
| | Symbol SUS F 410-C | 364, 365 |
| | Symbol SUS F 410-D | 364, 365 |
| | Symbol SUS F 630 | 379, 380 |
| | Symbol SUS F 6B | 364, 365 |
| | Symbol SUS F 6NM | 364, 365 |
| JIS G 3221:1988 A1:2008 | Symbol SFCM 690 S | 347 |
| | Symbol SFCM 740 S | 347 |
| | Symbol SFCM 780 S | 347 |
| JIS G 3441:2012 | Symbol SCM418TK | 224, 225 |
| | Symbol SCM420TK | 224, 225 |
| | Symbol SCM430TK | 224, 225 |
| | Symbol SCM435TK | 224, 226 |
| | Symbol SCM440TK | 224, 226 |
| JIS G 3444:2010 | Symbol STK290 | 198, 213 |
| | Symbol STK400 | 202, 217 |
| | Symbol STK490 | 207, 221 |
| | Symbol STK500 | 208, 221 |
| | Symbol STK540 | 209, 222 |
| | Symbol STKM11A | 198, 213 |
| | Symbol STKM12A | 200, 214 |
| | Symbol STKM12B | 202, 216 |
| | Symbol STKM12C | 206, 220 |
| | Symbol STKM13A | 201, 215 |
| | Symbol STKM13B | 205, 219 |
| | Symbol STKM13C | 208, 221 |
| | Symbol STKM14A | 204, 217 |
| | Symbol STKM14B | 208, 221 |
| | Symbol STKM14C | 209, 222 |
| | Symbol STKM15A | 206, 220 |
| | Symbol STKM15C | 209, 222 |
| | Symbol STKM16A | 208, 221 |
| | Symbol STKM16C | 210, 223 |
| | Symbol STKM17A | 209, 222 |
| JIS G 3445:2010 (continued) | Symbol STKM17C | 211, 223 |
| | Symbol STKM18A | 205, 219 |
| | Symbol STKM18B | 207, 221 |
| | Symbol STKM18C | 208, 221 |
| | Symbol STKM19A | 207, 221 |
| | Symbol STKM19C | 209, 222 |
| | Symbol STKM20A | 209, 222 |
| JIS G 3446:2012 | Symbol SUS304TKA | 232, 235 |
| | Symbol SUS304TKC | 232, 235 |
| | Symbol SUS316TKA | 232, 237 |
| | Symbol SUS316TKC | 232, 237 |
| | Symbol SUS321TKA | 234, 240 |
| | Symbol SUS347TKA | 234, 241 |
| | Symbol SUS410TKA | 227, 229 |
| | Symbol SUS410TKC | 227, 229 |
| | Symbol SUS420J1TKA | 227, 230 |
| | Symbol SUS430TKA | 227, 231 |
| | Symbol SUS430TKC | 227, 231 |
| JIS G 3452:2014 | Symbol SGP | 198, 213 |
| JIS G 3454:2012 | Symbol STPG370 | 256, 258 |
| | Symbol STPG410 | 257, 259 |
| JIS G 3455:2012 | Symbol STS370 | 261, 264 |
| | Symbol STS410 | 261, 265 |
| | Symbol STS480 | 263, 266 |
| JIS G 3456:2014 | Symbol STPT370 | 261, 264 |
| | Symbol STPT410 | 261, 265 |
| | Symbol STPT480 | 263, 266 |
| JIS G 3457:2012 | Symbol STPY400 | 256, 259 |
| JIS G 3458:2013 | Symbol STPA12 | 268, 270 |
| | Symbol STPA20 | 271, 272 |
| | Symbol STPA22 | 274, 275 |
| | Symbol STPA23 | 276, 277 |
| | Symbol STPA24 | 278, 279 |
| | Symbol STPA25 | 280, 282 |
| | Symbol STPA26 | 283, 284 |
| JIS G 3459:2012 | Symbol SUS304HTP | 289, 301 |
| | Symbol SUS304LTP | 289, 299 |
| | Symbol SUS304TP | 288, 298 |
| | Symbol SUS309STP | 290, 302 |
| | Symbol SUS309TP | 290, 303 |
| | Symbol SUS310STP | 290, 303 |
| | Symbol SUS316HTP | 293, 308 |
| | Symbol SUS316LTP | 292, 307 |

| Specification | Designation | Page Number |
|---|---|---|
| JIS G 3459:2012 (continued) | Symbol SUS316TiTP | 293, 308 |
| | Symbol SUS316TP | 291, 305 |
| | Symbol SUS317LTP | 294, 309 |
| | Symbol SUS317TP | 293, 309 |
| | Symbol SUS321HTP | 295, 312 |
| | Symbol SUS321TP | 295, 311 |
| | Symbol SUS347HTP | 296, 314 |
| | Symbol SUS347TP | 296, 313 |
| | Symbol SUS890LTP | 297, 315 |
| JIS G 3460:2013 | Symbol STPL380 | 246, 249 |
| | Symbol STPL450 | 248, 250, 251, 253 |
| | Symbol STPL690 | 248, 250, 251, 254 |
| JIS G 3461:2012 | Symbol STB340 | 260, 264 |
| | Symbol STB410 | 261, 265 |
| | Symbol STB510 | 263, 266 |
| JIS G 3462:2014 | Symbol STBA12 | 268, 270 |
| | Symbol STBA13 | 268, 270 |
| | Symbol STBA20 | 271, 272 |
| | Symbol STBA22 | 274, 275 |
| | Symbol STBA23 | 276, 277 |
| | Symbol STBA24 | 278, 279 |
| | Symbol STBA25 | 280, 282 |
| | Symbol STBA26 | 283, 284 |
| JIS G 3463:2012 | Symbol SUS304HTB | 289, 301 |
| | Symbol SUS304LTB | 289, 299 |
| | Symbol SUS304TB | 288, 298 |
| | Symbol SUS309STB | 290, 302 |
| | Symbol SUS309TB | 290, 303 |
| | Symbol SUS310STB | 290, 303 |
| | Symbol SUS310TB | 290, 304 |
| | Symbol SUS316HTB | 293, 308 |
| | Symbol SUS316LTB | 292, 307 |
| | Symbol SUS316TB | 291, 305 |
| | Symbol SUS316TiTB | 293, 308 |
| | Symbol SUS317LTB | 294, 309 |
| | Symbol SUS317TB | 293, 309 |
| | Symbol SUS321HTB | 295, 312 |
| | Symbol SUS321TB | 295, 311 |
| | Symbol SUS347HTB | 296, 314 |
| | Symbol SUS347TB | 296, 313 |
| | Symbol SUS409TB | 286, 287 |
| | Symbol SUS410TB | 286, 287 |
| | Symbol SUS430LXTB | 286, 287 |
| JIS G 3463:2012 (continued) | Symbol SUS430TB | 286, 287 |
| | Symbol SUS836LTB | 297, 315 |
| | Symbol SUS890LTB | 297, 315 |
| | Symbol SUSXM27TB | 286, 287 |
| JIS G 3464:2013 | Symbol STBL 690 | 254 |
| | Symbol STBL380 | 247, 249 |
| | Symbol STBL450 | 251, 253 |
| | Symbol STBL690 | 251 |
| JIS G 3467:2013 | Symbol NCF800HTF | 297, 314 |
| | Symbol NCF800TF | 297, 314 |
| | Symbol STF410 | 261, 265 |
| | Symbol STFA12 | 268, 270 |
| | Symbol STFA22 | 274, 275 |
| | Symbol STFA23 | 276, 277 |
| | Symbol STFA24 | 278, 279 |
| | Symbol STFA25 | 280, 282 |
| | Symbol STFA26 | 283, 284 |
| | Symbol SUS304HTF | 289, 301 |
| | Symbol SUS304TF | 288, 298 |
| | Symbol SUS310TF | 290, 304 |
| | Symbol SUS316HTF | 293, 308 |
| | Symbol SUS316TF | 291, 305 |
| | Symbol SUS321HTF | 295, 312 |
| | Symbol SUS321TF | 295, 311 |
| | Symbol SUS347HTF | 296, 314 |
| | Symbol SUS347TF | 296, 313 |
| JIS G 3468:2011 | Symbol SUS304LTPY | 289, 299 |
| | Symbol SUS304TPY | 288, 298 |
| | Symbol SUS309STPY | 290, 302 |
| | Symbol SUS310STPY | 290, 303 |
| | Symbol SUS316LTPY | 292, 307 |
| | Symbol SUS316TPY | 291, 305 |
| | Symbol SUS317LTPY | 294, 309 |
| | Symbol SUS317TPY | 293, 309 |
| | Symbol SUS321TPY | 295, 311 |
| | Symbol SUS347TPY | 296, 313 |
| JIS G 3472:2013 | Symbol STAM290GA | 199, 213 |
| | Symbol STAM290GB | 199, 213 |
| | Symbol STAM340G | 200, 214 |
| | Symbol STAM390G | 202, 216 |
| | Symbol STAM440G | 205, 219 |
| | Symbol STAM440H | 205, 219 |
| | Symbol STAM470G | 206, 220 |

| Specification | Designation | Page Number |
|---|---|---|
| JIS G 3472:2013 (continued) | Symbol STAM470H | 206, 220 |
| | Symbol STAM500G | 208, 221 |
| | Symbol STAM500H | 208, 221 |
| | Symbol STAM540H | 209, 222 |
| JIS G 3473:2013 | Symbol STC370 | 201, 215 |
| | Symbol STC440 | 205, 219 |
| | Symbol STC510A | 208, 221 |
| | Symbol STC510B | 208, 221 |
| | Symbol STC540 | 209, 222 |
| | Symbol STC590A | 210, 223 |
| | Symbol STC590B | 210, 223 |
| JIS G 3474:2014 | Symbol STKT590 | 210, 223 |
| JIS G 4051:2009 | Symbol S09CK | 21 |
| | Symbol S10C | 21 |
| | Symbol S12C | 22 |
| | Symbol S15C | 22 |
| | Symbol S15CK | 22 |
| | Symbol S17C | 23 |
| | Symbol S20C | 24 |
| | Symbol S20CK | 24 |
| | Symbol S22C | 24 |
| | Symbol S25C | 24 |
| | Symbol S28C | 25 |
| | Symbol S30C | 25 |
| | Symbol S33C | 25 |
| | Symbol S35C | 26 |
| | Symbol S38C | 26 |
| | Symbol S40C | 27 |
| | Symbol S43C | 27 |
| | Symbol S45C | 28 |
| | Symbol S48C | 28 |
| | Symbol S50C | 29 |
| | Symbol S53C | 29 |
| | Symbol S55C | 30 |
| | Symbol S58C | 31 |
| JIS G 4053:2008 | Symbol SACM645 | 43 |
| | Symbol SCM418 | 39 |
| | Symbol SCM420 | 39 |
| | Symbol SCM421 | 39 |
| | Symbol SCM425 | 40 |
| | Symbol SCM430 | 40 |
| | Symbol SCM432 | 40 |
| | Symbol SCM435 | 40 |
| JIS G 4053:2008 (continued) | Symbol SCM440 | 41 |
| | Symbol SCM445 | 41 |
| | Symbol SCM822 | 39 |
| | Symbol SCr415 | 36 |
| | Symbol SCr420 | 36 |
| | Symbol SCr430 | 36 |
| | Symbol SCr435 | 37 |
| | Symbol SCr440 | 37 |
| | Symbol SCr445 | 38 |
| | Symbol SMn420 | 34 |
| | Symbol SMn433 | 34 |
| | Symbol SMn438 | 35 |
| | Symbol SMn443 | 35 |
| | Symbol SMnC420 | 34 |
| | Symbol SNC631 | 41 |
| | Symbol SNC815 | 41 |
| | Symbol SNCM220 | 42 |
| | Symbol SNCM240 | 43 |
| | Symbol SNCM415 | 42 |
| | Symbol SNCM420 | 42 |
| | Symbol SNCM439 | 42 |
| JIS G 4109:2013 | Symbol SCMV1-1 | 140 |
| | Symbol SCMV1-2 | 140 |
| | Symbol SCMV2-1 | 141 |
| | Symbol SCMV2-2 | 141 |
| | Symbol SCMV3-1 | 142 |
| | Symbol SCMV3-2 | 142 |
| | Symbol SCMV4-1 | 143 |
| | Symbol SCMV4-2 | 143 |
| | Symbol SCMV5-1 | 144 |
| | Symbol SCMV5-2 | 144 |
| | Symbol SCMV6-1 | 145 |
| | Symbol SCMV6-2 | 145 |
| JIS G 4110:2008 | Symbol SCMQ4E | 143 |
| JIS G 4303:2012 | Symbol SUS201 | 541, 551 |
| | Symbol SUS202 | 541, 551 |
| | Symbol SUS301 | 541, 552 |
| | Symbol SUS302 | 541, 553 |
| | Symbol SUS303 | 541, 554 |
| | Symbol SUS303Se | 541, 554 |
| | Symbol SUS304 | 542, 557 |
| | Symbol SUS304L | 542, 560 |
| | Symbol SUS304LN | 543, 562 |

| Specification | Designation | Page Number |
|---|---|---|
| JIS G 4303:2012 (continued) | Symbol SUS304N1 | 543, 561 |
| | Symbol SUS304N2 | 543, 562 |
| | Symbol SUS305 | 543, 562 |
| | Symbol SUS309S | 544, 564 |
| | Symbol SUS310S | 544, 565 |
| | Symbol SUS312L | 545, 566 |
| | Symbol SUS316 | 545, 571 |
| | Symbol SUS316J1 | 546, 578 |
| | Symbol SUS316J1L | 547, 579 |
| | Symbol SUS316L | 547, 578 |
| | Symbol SUS316LN | 547, 580 |
| | Symbol SUS316N | 547, 580 |
| | Symbol SUS316Ti | 546, 578 |
| | Symbol SUS317 | 548, 581 |
| | Symbol SUS317J1 | 548, 581 |
| | Symbol SUS317L | 548, 581 |
| | Symbol SUS321 | 548, 584 |
| | Symbol SUS329J1 | 601, 605 |
| | Symbol SUS329J3L | 600, 603 |
| | Symbol SUS329J4L | 600, 603 |
| | Symbol SUS347 | 549, 586 |
| | Symbol SUS403 | 519, 522 |
| | Symbol SUS405 | 534, 536 |
| | Symbol SUS410 | 519, 525 |
| | Symbol SUS410J1 | 519, 525 |
| | Symbol SUS410L | 534, 536 |
| | Symbol SUS416 | 519, 526 |
| | Symbol SUS420F | 520, 529 |
| | Symbol SUS420J1 | 520, 528 |
| | Symbol SUS420J2 | 520, 529 |
| | Symbol SUS430 | 534, 538 |
| | Symbol SUS430F | 534, 538 |
| | Symbol SUS431 | 520, 530 |
| | Symbol SUS434 | 535, 539 |
| | Symbol SUS440A | 520, 531 |
| | Symbol SUS440B | 520, 531 |
| | Symbol SUS440C | 521, 531 |
| | Symbol SUS440F | 521, 533 |
| | Symbol SUS447J1 | 535, 540 |
| | Symbol SUS630 | 593, 597 |
| | Symbol SUS631 | 593, 598 |
| | Symbol SUS836L | 550, 590 |
| | Symbol SUS890L | 550, 591 |
| JIS G 4303:2012 (continued) | Symbol SUSXM15J1 | 550, 589 |
| | Symbol SUSXM27 | 535, 540 |
| | Symbol SUSXM7 | 550, 589 |
| JIS G 4304:2012 | Symbol SUS301 | 459, 476 |
| | Symbol SUS301J1 | 459, 476 |
| | Symbol SUS301L | 459, 476 |
| | Symbol SUS302B | 460, 478 |
| | Symbol SUS303 | 459, 477 |
| | Symbol SUS304 | 165, 172, 460, 479 |
| | Symbol SUS304J1 | 460, 479 |
| | Symbol SUS304L | 165, 173, 461, 480 |
| | Symbol SUS304LN | 166, 175, 462, 482 |
| | Symbol SUS304N1 | 166, 174, 461, 481 |
| | Symbol SUS304N2 | 462, 481 |
| | Symbol SUS304N2-X | 462, 481 |
| | Symbol SUS305 | 462, 483 |
| | Symbol SUS309S | 463, 484 |
| | Symbol SUS310S | 463, 485 |
| | Symbol SUS312L | 464, 487 |
| | Symbol SUS316 | 167, 177, 464, 488 |
| | Symbol SUS316J1 | 465, 491 |
| | Symbol SUS316J1L | 465, 490 |
| | Symbol SUS316L | 167, 179, 465, 490 |
| | Symbol SUS316LN | 168, 180, 467, 493 |
| | Symbol SUS316N | 466, 492 |
| | Symbol SUS316Ti | 168, 179, 466, 491 |
| | Symbol SUS317 | 467, 494 |
| | Symbol SUS317J1 | 467, 494 |
| | Symbol SUS317L | 168, 181, 467, 495 |
| | Symbol SUS317LN | 169, 181, 468, 496 |
| | Symbol SUS321 | 169, 182, 468, 496 |
| | Symbol SUS329J1 | 514, 518 |
| | Symbol SUS329J3L | 185, 186, 513, 515 |
| | Symbol SUS329J4L | 513, 517 |
| | Symbol SUS347 | 169, 183, 469, 498 |
| | Symbol SUS403 | 438, 440 |
| | Symbol SUS405 | 159, 162, 445, 450 |
| | Symbol SUS410 | 438, 440 |
| | Symbol SUS410L | 438, 441 |

| Specification | Designation | Page Number |
|---|---|---|
| JIS G 4304:2012 (continued) | Symbol SUS410S | 438, 441 |
| | Symbol SUS420J1 | 439, 442 |
| | Symbol SUS420J2 | 439, 443 |
| | Symbol SUS429 | 446, 452 |
| | Symbol SUS430 | 446, 453 |
| | Symbol SUS430LX | 160, 164, 446, 454 |
| | Symbol SUS434 | 447, 454 |
| | Symbol SUS436L | 469, 498 |
| | Symbol SUS440A | 439, 444 |
| | Symbol SUS444 | 161, 164, 448, 456 |
| | Symbol SUS447J1 | 449, 457 |
| | Symbol SUS630 | 505, 508 |
| | Symbol SUS631 | 505, 512 |
| | Symbol SUS836L | 170, 184, 472, 504 |
| | Symbol SUS890L | 170, 183, 472, 504 |
| | Symbol SUSXM15J1 | 469, 499 |
| | Symbol SUSXM27 | 448, 457 |
| JIS G 4305:2012 | Symbol SUS301 | 459, 476 |
| | Symbol SUS301J1 | 459, 476 |
| | Symbol SUS301L | 459, 477 |
| | Symbol SUS302B | 460, 478 |
| | Symbol SUS304 | 165, 172, 460, 479 |
| | Symbol SUS304J1 | 460, 479 |
| | Symbol SUS304L | 165, 173, 461, 480 |
| | Symbol SUS304LN | 166, 175, 462, 482 |
| | Symbol SUS304N1 | 166, 174, 461, 481 |
| | Symbol SUS304N2 | 462, 481 |
| | Symbol SUS305 | 462, 483 |
| | Symbol SUS309S | 463, 484 |
| | Symbol SUS310S | 463, 485 |
| | Symbol SUS312L | 464, 487 |
| | Symbol SUS316 | 167, 177, 464, 488 |
| | Symbol SUS316J1 | 465, 491 |
| | Symbol SUS316J1L | 465, 490 |
| | Symbol SUS316L | 167, 179, 465, 490 |
| | Symbol SUS316LN | 168, 180, 467, 493 |
| | Symbol SUS316N | 466, 492 |
| | Symbol SUS316Ti | 168, 179, 466, 491 |
| | Symbol SUS317 | 467, 494 |
| | Symbol SUS317J1 | 467, 494 |

| Specification | Designation | Page Number |
|---|---|---|
| JIS G 4305:2012 (continued) | Symbol SUS317L | 168, 181, 467, 495 |
| | Symbol SUS317LN | 169, 181, 468, 496 |
| | Symbol SUS321 | 169, 182, 468, 496 |
| | Symbol SUS329J1 | 514, 518 |
| | Symbol SUS329J3L | 185, 186, 513, 515 |
| | Symbol SUS329J4L | 513, 517 |
| | Symbol SUS347 | 169, 183, 469, 498 |
| | Symbol SUS403 | 438, 440 |
| | Symbol SUS405 | 159, 162, 445, 450 |
| | Symbol SUS410 | 438, 440 |
| | Symbol SUS410L | 438, 441 |
| | Symbol SUS410S | 438, 441 |
| | Symbol SUS420J1 | 439, 442 |
| | Symbol SUS420J2 | 439, 443 |
| | Symbol SUS429 | 446, 452 |
| | Symbol SUS430 | 446, 453 |
| | Symbol SUS430LX | 160, 164, 446, 454 |
| | Symbol SUS434 | 447, 454 |
| | Symbol SUS436L | 469, 498 |
| | Symbol SUS440A | 439, 444 |
| | Symbol SUS444 | 161, 164, 448, 456 |
| | Symbol SUS447J1 | 449, 457 |
| | Symbol SUS630 | 505, 509 |
| | Symbol SUS631 | 505, 512 |
| | Symbol SUS836L | 170, 184, 472, 504 |
| | Symbol SUS890L | 170, 183, 472, 504 |
| | Symbol SUSXM15J1 | 469, 499 |
| | Symbol SUSXM27 | 448, 457 |
| JIS G 4308:2013 | Symbol SUS303 | 615 |
| | Symbol SUS303Se | 615 |
| | Symbol SUS416 | 615 |
| | Symbol SUS430F | 615 |
| JIS G 4311:2011 | Symbol SUH309 | 544, 564 |
| | Symbol SUH310 | 544, 564 |
| | Symbol SUH35 | 549, 587 |
| | Symbol SUH37 | 550, 589 |
| | Symbol SUH4 | 521, 533 |
| | Symbol SUH446 | 535, 540 |
| | Symbol SUH600 | 521, 532 |
| | Symbol SUH616 | 521, 532 |
| | Symbol SUH660 | 550, 590 |

| Specification | Designation | Page Number |
|---|---|---|
| JIS G 4312:2011 | Symbol SUH21 | 448, 456 |
| | Symbol SUH309 | 462, 483 |
| | Symbol SUH310 | 463, 485 |
| | Symbol SUH330 | 468, 497 |
| | Symbol SUH409 | 445, 452 |
| | Symbol SUH409L | 159, 162, 445, 451 |
| | Symbol SUH446 | 448, 456 |
| | Symbol SUH660 | 471, 502 |
| | Symbol SUH661 | 471, 502 |
| JIS G 4313:2011 | Symbol SUS 301-CSP | 621 |
| | Symbol SUS 304-CSP | 621 |
| | Symbol SUS 420J2-CSP | 621 |
| | Symbol SUS 631-CSP | 621 |
| JIS G 4318:1998 A1:2007 | Symbol SUS302 | 541 |
| | Symbol SUS303 | 541 |
| | Symbol SUS303Se | 541 |
| | Symbol SUS304 | 542 |
| | Symbol SUS304L | 542 |
| | Symbol SUS305 | 543 |
| | Symbol SUS305J1 | 543 |
| | Symbol SUS309S | 544 |
| | Symbol SUS310S | 544 |
| | Symbol SUS316 | 545 |
| | Symbol SUS316L | 547 |
| | Symbol SUS321 | 548 |
| | Symbol SUS329J1 | 601 |
| | Symbol SUS347 | 549 |
| | Symbol SUS403 | 519 |
| | Symbol SUS410 | 519 |
| | Symbol SUS416 | 519 |
| | Symbol SUS420F | 520 |
| | Symbol SUS420J1 | 520 |
| | Symbol SUS420J2 | 520 |
| | Symbol SUS430 | 534 |
| | Symbol SUS430F | 534 |
| | Symbol SUS440C | 521 |
| JIS G 4401:2009 | Grade SK105 | 622 |
| | Grade SK120 | 622 |
| | Grade SK65 | 622 |
| | Grade SK75 | 622 |
| | Grade SK85 | 622 |
| | Grade SK95 | 622 |
| JIS G 4403:2006 | Grade SKH10 | 623 |
| | Grade SKH2 | 623 |
| | Grade SKH3 | 623 |
| | Grade SKH4 | 623 |
| | Grade SKH50 | 623 |
| | Grade SKH51 | 624 |
| | Grade SKH52 | 624 |
| | Grade SKH53 | 624 |
| | Grade SKH54 | 624 |
| | Grade SKH55 | 625 |
| | Grade SKH56 | 624 |
| | Grade SKH57 | 625 |
| | Grade SKH58 | 624 |
| | Grade SKH59 | 625 |
| JIS G 4404:2006 | Grade SKD 1 | 625 |
| | Grade SKD 11 | 625 |
| | Grade SKD 12 | 625 |
| | Grade SKD 5 | 627 |
| | Grade SKD 6 | 626 |
| | Grade SKD 61 | 626 |
| | Grade SKD 62 | 626 |
| | Grade SKD 7 | 626 |
| | Grade SKD 8 | 627 |
| | Grade SKS 11 | 627 |
| | Grade SKS 3 | 626 |
| | Grade SKS 31 | 626 |
| | Grade SKS 43 | 622 |
| | Grade SKS 44 | 622 |
| | Grade SKS 51 | 627 |
| | Grade SKT 4 | 627 |
| JIS G 4801:2011 | Grade SUP10 | 620 |
| | Grade SUP11A | 621 |
| | Grade SUP12 | 619 |
| | Grade SUP13 | 619 |
| | Grade SUP6 | 618 |
| | Grade SUP9 | 618 |
| | Grade SUP9A | 618 |
| JIS G 4802:2011 | Grade S50C-CSP | 616 |
| | Grade S55C-CSP | 616 |
| | Grade S60C-CSP | 616 |
| | Grade S65C-CSP | 617 |
| | Grade S70C-CSP | 617 |
| | Grade SK85-CSP | 617 |

| Specification | Designation | Page Number |
|---|---|---|
| JIS G 4802:2011 (continued) | Grade SK95-CSP | 618 |
| | Grade SUP10-CSP | 620 |
| JIS G 4804:2008 | Grade SUM 21 | 613 |
| | Grade SUM 22 | 613 |
| | Grade SUM 22 L | 614 |
| | Grade SUM 23 | 613 |
| | Grade SUM 23 L | 614 |
| | Grade SUM 24 L | 614 |
| | Grade SUM 25 | 614 |
| | Grade SUM 31 | 611 |
| | Grade SUM 32 | 611 |
| | Grade SUM 41 | 612 |
| | Grade SUM 42 | 612 |
| | Grade SUM 43 | 612 |
| JIS G 4805:2008 | Grade SUJ2 | 628 |
| | Grade SUJ3 | 628 |
| JIS G 5101:1991 | Class SC 360 | 389, 392 |
| | Class SC 410 | 389, 393 |
| | Class SC 450 | 389, 393 |
| | Class SC 480 | 390, 393 |
| JIS G 5102:1991 | Class SCW 410 | 389, 393 |
| | Class SCW 450 | 389, 393 |
| | Class SCW 480 | 390, 393 |
| | Class SCW 550 | 390, 394 |
| | Class SCW 620 | 391, 394 |
| JIS G 5111:1991 | Class SCC 3A | 390, 394 |
| | Class SCC 3B | 391, 394 |
| | Class SCC 5A | 391, 394 |
| | Class SCC 5B | 391, 395 |
| | Class SCCrM 1A | 402, 403 |
| | Class SCCrM 3A | 402, 404 |
| | Class SCMn 1A | 390, 394 |
| | Class SCMn 1B | 391, 394 |
| | Class SCMn 2A | 391, 394 |
| | Class SCMn 2B | 391, 394 |
| | Class SCMn 3A | 391, 394 |
| | Class SCMn 3B | 391, 395 |
| | Class SCMn 5A | 391, 395 |
| | Class SCMn 5B | 392, 395 |
| | Class SCNCrM 2A | 403, 405 |
| | Class SCSiMn 2A | 391, 394 |
| | Class SCSiMn 2B | 391, 394 |

| Specification | Designation | Page Number |
|---|---|---|
| JIS G 5121:2003 | Class SCS 1 | 413, 414 |
| | Class SCS 10 | 416, 418 |
| | Class SCS 12 | 415, 417 |
| | Class SCS 13 | 415, 417 |
| | Class SCS 13A | 415, 417 |
| | Class SCS 14 | 415, 417 |
| | Class SCS 14A | 415, 417 |
| | Class SCS 16A | 415, 417 |
| | Class SCS 17 | 416, 418 |
| | Class SCS 19 | 415, 417 |
| | Class SCS 19A | 415, 417 |
| | Class SCS 2 | 413, 414 |
| | Class SCS 21 | 415, 417 |
| | Class SCS 22 | 415, 417 |
| | Class SCS 23 | 416, 418 |
| | Class SCS 2A | 413, 414 |
| | Class SCS 3 | 413, 414 |
| | Class SCS 32 | 416, 418 |
| | Class SCS 33 | 416, 418 |
| | Class SCS 5 | 413, 414 |
| | Class SCS 6 | 413, 414 |
| JIS G 5122:2003 | Class SCH 1 | 426, 430 |
| | Class SCH 11 | 426, 430 |
| | Class SCH 12 | 426, 430 |
| | Class SCH 13 | 427, 431 |
| | Class SCH 13A | 427, 431 |
| | Class SCH 15 | 428, 432 |
| | Class SCH 16 | 428, 432 |
| | Class SCH 17 | 426, 430 |
| | Class SCH 18 | 427, 431 |
| | Class SCH 19 | 428, 432 |
| | Class SCH 2 | 426, 430 |
| | Class SCH 20 | 428, 432 |
| | Class SCH 21 | 427, 431 |
| | Class SCH 22 | 427, 431 |
| | Class SCH 23 | 427, 431 |
| | Class SCH 24 | 428, 432 |
| | Class SCH 3 | 426, 430 |
| JIS G 5131:2008 | Class SCMnH 1 | 400, 401 |
| | Class SCMnH 11 | 400, 401 |
| | Class SCMnH 2 | 400, 401 |
| | Class SCMnH 3 | 400, 401 |

| Specification | Designation | Page Number |
|---|---|---|
| JIS G 5151:1991 | Class SCPH 1 | 396, 397 |
| | Class SCPH 11 | 406, 407 |
| | Class SCPH 2 | 396, 397 |
| | Class SCPH 21 | 406, 408 |
| | Class SCPH 23 | 406, 408 |
| | Class SCPH 32 | 407, 408 |
| | Class SCPH 61 | 407, 408 |
| JIS G 5152:1991 | Class SCPL 1 | 398, 399 |
| | Class SCPL 11 | 409, 411 |
| | Class SCPL 21 | 409, 411 |
| | Class SCPL 31 | 409, 411 |
| JIS G 7105:2000 | Type 50CrMo4 | 41 |
| SAE J403 JUN14 | Grade 1005 | 21 |
| | Grade 1006 | 21 |
| | Grade 1008 | 21 |
| | Grade 1010 | 21 |
| | Grade 1012 | 22 |
| | Grade 1015 | 22 |
| | Grade 1016 | 22 |
| | Grade 1017 | 23 |
| | Grade 1018 | 23 |
| | Grade 1020 | 24 |
| | Grade 1021 | 24 |
| | Grade 1022 | 24 |
| | Grade 1023 | 24 |
| | Grade 1025 | 24 |
| | Grade 1026 | 24 |
| | Grade 1029 | 25 |
| | Grade 1030 | 25 |
| | Grade 1035 | 26 |
| | Grade 1038 | 26 |
| | Grade 1039 | 27 |
| | Grade 1040 | 27 |
| | Grade 1042 | 27 |
| | Grade 1043 | 27 |
| | Grade 1044 | 28 |
| | Grade 1045 | 28 |
| | Grade 1046 | 28 |
| | Grade 1049 | 29 |
| | Grade 1050 | 29 |
| | Grade 1053 | 29 |
| | Grade 1055 | 30 |
| | Grade 1060 | 31 |
| SAE J403 JUN14 (continued) | Grade 1065 | 32 |
| | Grade 1070 | 32 |
| | Grade 1074 | 33 |
| | Grade 1075 | 33 |
| | Grade 1078 | 33 |
| | Grade 1080 | 33 |
| | Grade 1084 | 33 |
| | Grade 1086 | 33 |
| | Grade 1090 | 34 |
| | Grade 1095 | 34 |
| | Grade 10B18 | 44 |
| | Grade 10B23 | 44 |
| | Grade 10B29 | 44 |
| | Grade 10B30 | 44 |
| | Grade 10B38 | 44 |
| | Grade 10B40 | 44 |
| | Grade 10B45 | 44 |
| | Grade 10B50 | 44 |
| | Grade 1117 | 611 |
| | Grade 1118 | 611 |
| | Grade 1132 | 611 |
| | Grade 1137 | 612 |
| | Grade 1138 | 612 |
| | Grade 1140 | 612 |
| | Grade 1141 | 612 |
| | Grade 1144 | 612 |
| | Grade 1146 | 613 |
| | Grade 1151 | 613 |
| | Grade 1212 | 613 |
| | Grade 1213 | 613 |
| | Grade 1215 | 613 |
| | Grade 12L14 | 614 |
| | Grade 1522 | 34 |
| | Grade 1524 | 34 |
| | Grade 1536 | 34 |
| | Grade 1541 | 35 |
| | Grade 1547 | 35 |
| | Grade 1552 | 35 |
| | Grade 15B22 | 44 |
| SAE J404 JAN09 | Grade 4118 | 39 |
| | Grade 4120 | 39 |
| | Grade 4130 | 40 |
| | Grade 4137 | 40 |

| Specification | Designation | Page Number |
|---|---|---|
| SAE J404 JAN09 (continued) | Grade 4140 | 41 |
| | Grade 4145 | 41 |
| | Grade 4150 | 41 |
| | Grade 4320 | 42 |
| | Grade 4340 | 42 |
| | Grade 5120 | 36 |
| | Grade 5130 | 36 |
| | Grade 5132 | 37 |
| | Grade 5140 | 37 |
| | Grade 5150 | 38 |
| | Grade 51B60 | 45 |
| | Grade 6150 | 45 |
| | Grade 8620 | 42 |
| | Grade 8640 | 43 |
| | Grade E4340 | 42 |
| SAE J405 JUN98 | --- | 439, 445, 447, 449, 458, 462, 464, 468, 470, 471, 472, 513, 514 |
| | Type 201 | 458 |
| | Type 202 | 458 |
| | Type 301 | 459 |
| | Type 302 | 459 |
| | Type 304 | 460 |
| | Type 304H | 461 |
| | Type 304L | 461 |
| | Type 304LN | 462 |
| | Type 304N | 461 |
| | Type 305 | 462 |
| | Type 309H | 463 |
| | Type 309S | 463 |
| | Type 310 MoLN | 464 |
| | Type 310H | 463 |
| | Type 310S | 463 |
| | Type 316 | 464 |
| | Type 316Cb | 466 |
| | Type 316L | 465 |
| | Type 316LN | 467 |
| | Type 316N | 466 |
| | Type 316Ti | 466 |
| | Type 317 | 467 |
| | Type 317L | 467 |
| | Type 317LN | 468 |
| | Type 321 | 468 |
| SAE J405 JUN98 (continued) | Type 321H | 468 |
| | Type 329 | 514 |
| | Type 347 | 469 |
| | Type 347H | 470 |
| | Type 405 | 445 |
| | Type 410 | 438 |
| | Type 410S | 438 |
| | Type 429 | 446 |
| | Type 430 | 446 |
| | Type 444 | 448 |
| | Type 904L | 472 |
| | Type SM-27 | 448 |
| SAE J438b MAY70 | Grade A2 | 625 |
| | Grade D2 | 625 |
| | Grade D3 | 625 |
| | Grade H11 | 626 |
| | Grade H12 | 626 |
| | Grade H13 | 626 |
| | Grade H21 | 627 |
| | Grade L6 | 627 |
| | Grade L7 | 627 |
| | Grade M2 | 624 |
| | Grade M3 | 624 |
| | Grade M4 | 624 |
| | Grade O2 | 626 |
| | Grade S5 | 627 |
| | Grade T1 | 623 |
| | Grade T4 | 623 |
| | Grade T5 | 623 |
| | Grade W108 | 622 |
| | Grade W109 | 622 |
| | Grade W110 | 622 |
| | Grade W112 | 622 |
| SAE J526 NOV10 | --- | 199, 213 |



The book editor, John E. Bringas, P.Eng., is president and founder of Codes and Standards Training Institute (CASTI), headquartered in Edmonton, Alberta, Canada. A metallurgical and materials engineer, he is an engineering codes and standards information specialist with over 40 years of experience. He understands the needs of the users of this handbook because he is one himself. Mr. Bringas also authored the *ASTM Handbook of Steel Data: American and European* and is the principle developer of the *ASTM Passport to Steel Online Database.* Mr. Bringas has been teaching codes and standards related courses worldwide through CASTI (www.casti.ca) since 1989. Mr. Bringas has been a codes and standards committee member since 1982 and currently serves on:

- ASTM Steels (Chair of Steel Terminology), Coated Steels, Nonferrous Alloys (Chair of Nonferrous Terminology), Metallography, Mechanical Testing;
- ISO TC17/SC4 Steels, Canadian delegate; and
- NACE Oil and Gas Corrosion and Metallurgy, Petroleum Refining and Gas Processing, Pipelines, Tanks, and Well Casings, and Process Industries—Materials.

Mr. Bringas is also a long-time member of the American Welding Society (AWS), ASME International, and ASM International.

www.astm.org

ISBN 978-0-8031-7077-3

ASTM Stock #: DS67D