

Changes in ASME Section VIII Div. 2

2019 Edition

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12 July 2019



Part 1

GENERAL REQUIREMENTS



Part 1

1.2.1 OVERVIEW

New paragraph 1.2.1.2 added

Vessels with an internal or external design pressure not exceeding 103 kPa (15 psi) and multichambered vessels having common elements with design pressures not exceeding 103 kPa (15 psi) were not considered when the rules of this Division were developed and are not considered within the scope.

Existing 1.2.1.2 renumbered as 1.2.1.3

Classification Outside the Scope of this Division

1.2.4.2

First sentence cross reference changed to 1.2.1.3 for scope of this Division 2 vessels.

1.2.6.1 ...Subparagraph (c) revised to remove PRT Certificate of Authorization for field portion of work

Units of Measurements.

1.4 Subparagraph (a) to (c) revised to use material data published in Sec VII Div 1 or 2 and Sec II-D in design calculations.

New Table 1.2 added with *Standard Units for Use in Equations*

Annex 1-C, paragraph 1-C.1 referred to Table 1.2 for the use of Units in equations , either SI or US Customary units.

Year of Acceptable Edition of Referenced Standards

Table 1.1...*new additions*

1. *"Fired Heaters for General Refinery Service API Standard 560 Latest edition"*
2. *"Standard Practice for Quantitative Measurement and Reporting of Hypoeutectoid Carbon and Low-Alloy Steel Phase Transformations ASTM A1033 Latest edition"*
3. *Petroleum, petrochemical and natural gas industries -- Fired heaters for general refinery service ISO 13705 Latest edition"*

Annex 1-B

1-B.2 Definitions of terms

New definitions added for “Certifying Engineer” and “Designer”

1-B.2.9 Certifying Engineer – an engineer or other technically competent professional duly accredited and qualified to practice engineering as required by this Division

1-B.2.14 Designer – an individual who is qualified to design pressure vessels in accordance with the rules of this Division by demonstrated knowledge in Code requirements and proficiency in selecting correct design formulas and appropriate values to be used when preparing the design of a pressure vessel.

Part 2

RESPONSIBILITIES AND DUTIES



Responsibilities and duties

New paragraph 2.2.2 added to address “ Multiple Identical Vessels” made to single User’s Design Specification when these are installed at locations under single jurisdiction.

New paragraph added 2.3.1.3 to permit single Manufacturer’s Design Report for “ Multiple Identical Vessels”

Paragraph 2.3.3 is revised in entirety to include roles of Designer, Certifying Engineers in certifying “Manufacturer’s Design Report “ for Class 1 and Class 2 vessels.

Responsibilities and duties

User's Design Specification

2.2.3.1 sub paragraph (e) Operating conditions revised to include Dead loads, live loads, and other operating loads required to perform the load case combinations required in Part 5

Responsibilities and duties

New paragraph added 2.3.1.3 to permit single Manufacturer's Design Report for "Multiple Identical Vessels"

Paragraph 2.3.3 is revised in entirety to include roles of Designer, Certifying Engineers in certifying "Manufacturer's Design Report " for Class 1 and Class 2 vessels.

The Manufacturer's Design Report may be certified by a designer when none of following applies:

- (1) fatigue analysis*
- (2) use of Part 5 to determine thickness of pressure parts when design rules are not provided in Part 4*
- (3) use of Part 4.8 to design a quick-actuating closure*
- (4) a dynamic seismic analysis*

Design Personnel

New paragraph added 2.3.7 to describe Manufacturer's responsibility of qualifying competent design personnel.

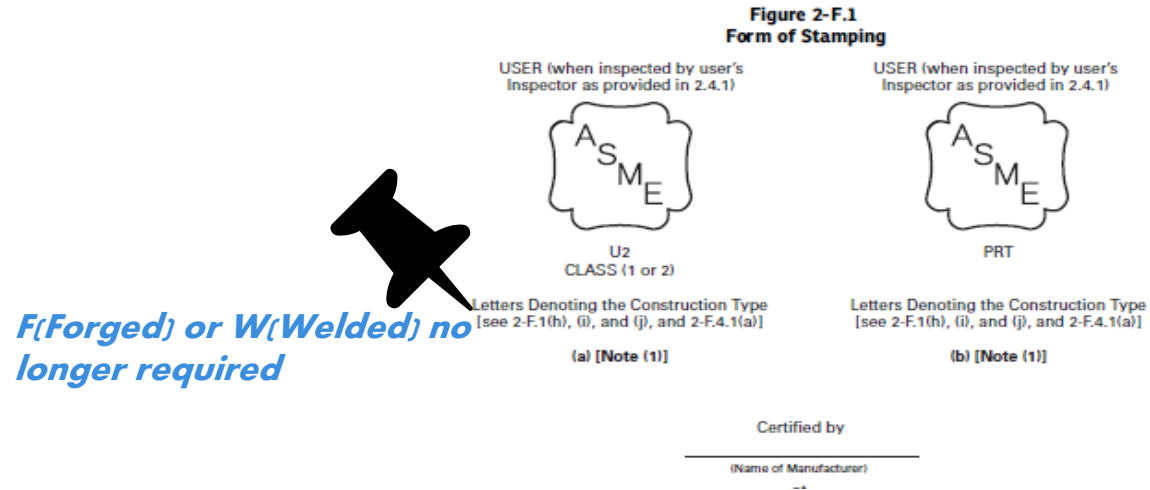
Para 2.4.1 and 2.4.2 revised completely to make reference to ASME QAI-1 for Inspector qualification and identification.

Annex 2-A and 2-B revised in respect of Certifying Engineers and Designer in line with current code provisions.

2-E.5.2 added >>>The Manufacturer's or Assembler's Quality Control System shall provide procedures that will ensure Certifying Engineers and Designers performing design activities are competent for each activity they perform (see Annex2-J).

Annex 2-F

Paragraph 2-F.1 revised . Please note WL (welded layered) is the only construction type that is required to be marked on the vessel.



F(Forged) or W(Welded) no longer required

2-F.4.2

The requirements for marking of “PART” with MAWP and MDMT do not apply for the following:

(a) parts for which the parts Manufacturer does not prepare a Manufacturer's Design Report.

Annex 2-I

2-I.2 revised more or less in line with Div 1 to clarify applicable code edition for vessels, parts sub contracted, parts built for stock and parts used from stock.

Annex 2-J

New Annex 2-J added to address QUALIFICATIONS AND REQUIREMENTS FOR CERTIFYING ENGINEERS AND DESIGNERS

Certifying Engineer : An authorized member of European Federation of National Engineering Association (FEANI) is now included as qualification criteria other than Registered PE, IPEA, APEC

Annex 2-J Certifying Engineer

(c) The Certifying Engineer shall be a chartered, registered, or licensed engineer within either the jurisdiction where the design activity takes place or the jurisdiction of the location of installation.

(d) The Certifying Engineer shall be chartered, registered, or licensed in accordance with one or more of the following:

(1) a registered Professional Engineer in at least one state of the United States or province of Canada

(2) the International Register of Professional Engineers by an authorized member of the International Professional Engineers Agreement (IPEA)

(3) an authorized member of the Asia Pacific Economic Cooperation (APEC)

(4) an authorized member of the European Federation of National Engineering Associations (FEANI)

Annex 2-J Design Engineer

(a) A Designer engaged in and/or having responsible oversight for pressure vessel design shall as a minimum hold the qualification described in (1). Optionally, the Designer may also hold any of the additional qualifications described in (2) through (4).

(1) *General Pressure Vessel Design.* The ability to demonstrate through documentation that they have a minimum of 4 yr of experience in pressure vessel design. This qualification includes all design activity required for this Division that they engage in, or as listed in the Manufacturer's Quality Control System, except as provided for in (2), (3), and (4).

(2) *Heat Exchanger Design.* The ability to demonstrate through documentation that they have a minimum of 2 yr of experience in each design Code activity for heat exchanger tubesheets (4.18), bellows expansion joints (4.19), and flexible shell element expansion joints (4.20).

(3) *Numerical Analysis.* The ability to demonstrate through documentation that they have a minimum of 2 yr of experience performing design calculations not specifically addressed in this Division, including numerical analysis. A Designer engaged in the performance of numerical analysis shall be able to demonstrate through documentation that they have received instruction in the use and understanding of any numerical analysis computer program(s). This documentation shall be provided to the Designer by one of the following:

(-a) the developer of the computer program (e.g., the software vendor)

(-b) a training course acceptable to or licensed by the developer

(-c) a Certifying Engineer with requisite knowledge of the computer program and qualifications to train others on its use

(4) *Quick-Actuating Closures.* The ability to demonstrate through documentation that they have a minimum of 2 yr of experience in design activity for quick-actuating closures (4.8).

(b) The experience requirements of (2), (3), and (4) may be acquired concurrently.

(c) The Designer's qualification(s) remain valid if they can demonstrate through documentation design activity completed within a continuous period of 36 months for each of their qualification(s) in (1), (2), (3), or (4).

Annex 2-J Certifying Engineer

Additional requirements in 2-J.4.1 for CERTIFYING ENGINEERS

(a) ***The Manufacturer who employs (directly or by contract) the engineer who certifies the Manufacturer's Design Report shall prepare a statement, in conjunction with 2-J.3.2(b)(1), that the Certifying Engineer is qualified to perform the design activities used.***

(b) Engineers who certify the User's Design Specification shall indicate their qualification as shown in 2-J.3.2(b)(2).

(c) Unless otherwise modified by the Manufacturer as stated in their Quality Control Manual, certification of pressure vessel design competence qualification expires for all design activities when no single design activity has occurred within a continuous period of 36 months.

Annex 2-J Design Engineer

Additional requirements in 2-J.4.2 for DESIGNERS

(a) The Manufacturer who employs (directly or by contract) the Designer who certifies the Manufacturer's Design Report shall prepare a statement that the Designer is qualified to perform the design activities used.

(b) Unless otherwise modified by the Manufacturer as stated in their Quality Control Manual, certification of pressure vessel design competence qualification expires for all Code activities when no single design activity has occurred within a continuous period of 36 months.

Part 3

MATERIALS REQUIREMENTS



3.2.4 DISSIMILAR MATERIALS

3.2.4.2 “weld metal(s) of dissimilar metal weldments “ is substituted by *"metals of weldments between metals having different impact testing requirements and acceptance criteria“*

Product Specification

3.2.5.2

Parts machined from *Rods and Bars* for use in *Pressure vessels* has been elaborated with manufacturing restrictions, examination and testing of such parts..

3.3.7 CLAD TUBESHEETS

New paragraph added

3.3.7.4 *When the tubes are strength welded (full or partial) to integral or weld metal overlay clad tube sheets, 'St' shall be the allowable stress value of the integral cladding or the wrought material whose chemistry most closely approximates that of the weld metal overlay cladding. The thickness of the integral or weld metal clad overlay material shall be sufficient to prevent any of the strength weld from extending into the base material.*

St: Allowable stress value of the material to which tube is welded

3.10.3 EXEMPTIONS FROM REQUIREMENT OF SAMPLE TEST COUPONS

3.10.3.1 Revised to cover **non welded** standard pressure parts , as in 3.2.8.3 and 3.2.8.4 . (cast , forged ,rolled, die formed),instead of “welded pipes and tubes”

Consistent with Div 1

3.10.4.2 Forgings & 3.10.4.5 Castings

3.10.4.2(c) has been modified to indicate the location of of test coupon in relation to heat treated surfaces for clarity:

The specimens shall be removed as follows:

(1) The distance from the longitudinal axis of the specimen to the nearest heat-treated surface shall be no less than the distance from the location where the maximum tensile stress is expected to the nearest heat-treated surface. This distance shall be at least 19 mm (3/4 in.).

(2) The distance from the mid-length of the specimen to a second heat-treated surface shall be at least twice the distance in (1). This distance shall be at least 38 mm (1.5 in.).

Similar changes made to paragraph **3.10.4.5** for castings

3.11.4.1

Ferrite Number (FN) of Weld metal deposited from each heat of Type 316L filler metal shall be no greater than 10 (*earlier edition it was 5*)

IMPACT TESTING OF WELDING PROCEDURES AND TEST PLATES OF FERROUS MATERIALS

3.11.8

Additional para (g) added in **3.11.8.2 Location, Orientation, Temperature, and Values of Weld Impact Tests**

(g) When qualifying a WPS for welding base metals having different impact testing requirements and acceptance criteria, the following shall apply:

(1) The weld metal impact test specimens shall meet the acceptance criteria for either base metals.

(2) When HAZ tests are required, separate test specimens shall be removed from the HAZ of each base metal that requires impact testing, and those specimens shall meet the acceptance criteria for the base metal from which they were removed.

Impact Test Exemption Curves

Figure 3.7 (3.7 M not subjected to PWHT) & 3.8(3.8M Subjected to PWHT)

Following material assigned under Curve A

"(c) A/SA-105 forged fittings and flanges supplied in the as-forged condition"

The word “forgings” in note (k) under Curve B has been substituted by

"forgings, A/SA-105 forged fittings and flanges if normalized after forging,”

High Alloy Steel

Table 3.1 *nominal composition* 3Cr–1Mo–1/4V–Cb–Ca added

Table 3-A.3

SA/EN10028-7 is added after SA 965 in the table with 9 grades.

Table 3.18

Removal of HAZ impact specimens now rationalized to two thickness range, $t \leq 19\text{mm}$ and $t > 19\text{mm}$

Part 4

DESIGN BY RULE REQUIREMENTS



Scope

4.1.1.5.2

Additional sentence added for Class 2

Components of the same pressure vessel may be designed (thickness and configuration) using a combination of Part 4 design-by-rules or any of the three methods of Part 5 design-by-analysis in 5.2.1.1. Each component shall be evaluated for all of the applicable failure modes in 5.1.1.2 using the methodology of Part 4 or Part 5. If the failure mode is not addressed in Part 4 (e.g., ratcheting), then the analysis shall be in accordance with Part 5. Structural interactions between components shall be considered

Design Allowable stresses

4.1.6

Shear Stress(4.1.6.4) and Bearing Stress(4.1.6.5) added in “Design Allowable Stress “ considerations in addition to existing (1) design condition, (2) test condition and (3) primary plus secondary stress

4.2.5.6 In formula for distance between toe of weld and gross structural discontinuity , t_s has been replaced by t_{sh} to indicate nominal thickness of shell or head

4.2.6 Nomenclature >>>> t_{sh} defined

Design Load Combinations

Table 4.1.2 revised in entirety to introduce **load factor Ω_p** in combination of loads and also to include any other load combinations specified in UDS

The term $0.9 \times P$ has been replaced by $\Omega_p \times P$ where load factor Ω_p is to be specified by User . If not specified $\Omega_p = 1.0$

4.3.11 , 4.3.12

Step 1 and 2 revised in 4.3.11.5. 4.3.12.2 & 4.3.12.3 to clarify the cylinder and cone thickness (t_s , t_c) as *nominal thickness*.

Table 4.3.7 and 4.3.8 , acceptance criteria modified for stress calculations .

DESIGN OF SHELLS UNDER EXTERNAL PRESSURE AND ALLOWABLE COMPRESSIVE STRESSES

Paragraph 4.4.3 has been revised completely with a new procedure to calculate Inelastic buckling stress F_{ic} for any materials in Part 3.

(earlier the method covered equations based on carbon and low alloy steel only)

4.4.2 and other related paragraphs revised based on above.

Table 4.4.2 added

Workmanship tolerances etc.....

Shell tolerances

Equations in para 4.4.4.1 for out of roundness in cylindrical and conical shells are revised/corrected

Layered vessels

Paragraph 4.13.12.1 , 4.13.12.3 were revised including equations for height and length of gaps between layers.

Saddle support for horizontal vessel

Paragraph 4.15.3.1 , equation 4.15.1 corrected

Paragraph 4.15.3.4 , sub paragraph (e)(1) , (e)(2) revised for acceptance criteria

Flanges

4.16.4.3 revised to clarify the process for Flanges with hubs that are machined from plate, bar stock, or billet

4.16.6.1 equation 4.16.8 revised for non –self-energized gaskets.

4.16.12 a new paragraph added “ Evaluation of external forces and moments for flanged joints with standard flanges”

Table 4.16.12 added with Moment Factors F_m

Heat Exchangers

Sub paragraph (h) added to 4.18.3 to address location of nozzles on cylindrical shell/channel in respect of integral tube sheet.

Figure 4.18.19
Nozzles Adjacent to Tubesheets

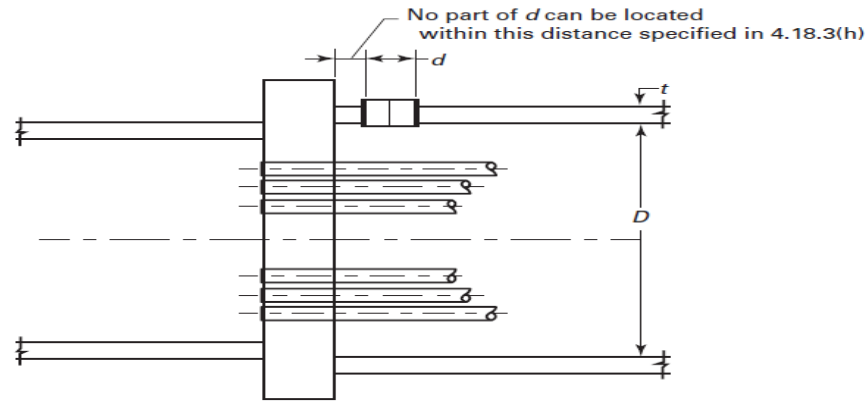


Figure 4.18.19 added

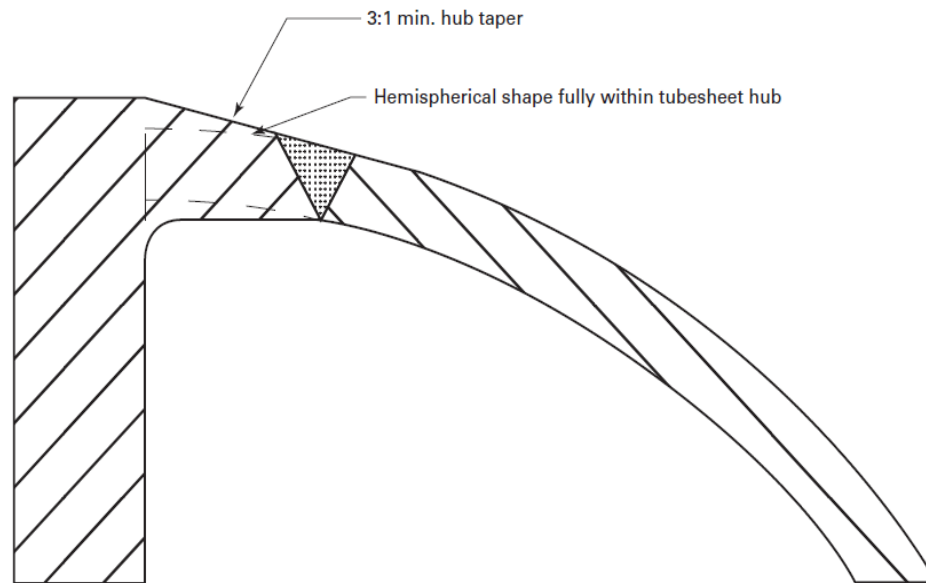
4.18.4 sub paragraph (d) and (f) revised for general conditions of applicability for tube sheets.

4.18.7.4, 4.18.8.4, 4.18.9.4 steps for calculations revised.

Table 4.18.15

Integral channels

Sketch 'c' added to show joint between hemispherical channel with tube sheet hub thicker than channel.



(c) Hemispherical Channel With Tubesheet Hub Thicker Than Channel

VPD C.

Design Rules for Bellow Expansion joints

Paragraph 4.19.2, 4.19.3.2 , 4.19.5.7 revised to address fatigue correlation testing , fatigue curves for materials other than those in 4.19

Added difference between “extension” and “compression” in 4.19.8.5 and added alternative formula for the calculation of total equivalent axial displacement range in 4.19.8.6.

Part 5

DESIGN BY ANALYSIS REQUIREMENTS



Part 5 Design by Analysis requirement

Paragraphs 5.2.2.5, 5.2.3.3, 5.2.3.4, 5.2.4.2, 5.2.4.3, 5.4.1.2, 5.5.5.2, 5.5.6.1, 5.13, Table 5.2, Table 5.3, Table 5.5, Table 5.7, Figure 5.1 were revised for texts, formulas, definitions consistent with limit load, plastic collapse loads, , operating pressure load factor, new load combinations as addressed in the new edition.

Part 6

FABRICATION REQUIREMENTS



Part 6, Fabrication requirements

Paragraph 6.1.2.3 revised to include provisions for relaxing post forming heat treatment for thin walled (up to 19mm) tubing and piping cold bent in P number 1

Paragraph 6.1.2.4 and 6.1.2.5 revised to eliminate minimum time requirements of 10 minutes for solution annealing of SS. The time shall be determined @ 20min/mm of thickness.

Paragraph 6.2.5.8 has been revised to add nickel based alloys (Table 3-A.6) to the list of base materials on which filler metals NiCrMo-3 and NiCrMo-12 can be used.

Part 6, Fabrication requirements

Paragraph 6.4.2.2 has been revised to **make reference to ASME Sec IX as governing document to determine P and Group numbers.**

Paragraph 6.4.2.6 has been revised to **address requirements of PWHT of weld between different P Number groups differently** (*not just based on material requiring higher PWHT temperature but based on engineering judgement required*)

Paragraph 6.4.6.2 revised to **remove PWHT requirements of castings of SB-148, Alloy CDA 954 when welded.**

Part 6, Fabrication requirements

Table 6.2.A , Note 2 revised for **post forming temperature of P- No. 15 E materials.** (*instead of 730-775deg C it is now 730-780deg C*)

Table 6.3 included **additional Nickel alloys from Table UNF 23.3 of Section VIII Div.1 , Table 3.7, 3-A.6, 3-A.10**

Table 6.11.A revised to **address Mn+Ni limits for weld consumables and delete maximum holding temperature for P- number 15E Group 1 materials.**

Table 6.13 , Section for P-No. 8 revised with additional cautionary notes in case PWHT done on such materials..

Similar notes added for P-No 45 in Table 6.15

Table 6.17 and 6.18, SA 553 Type III added.

Part 7

INSPECTION AND EXAMINATION REQUIREMENTS



Part 7, INSPECTION AND EXAMINATION REQUIREMENTS

Major change in NDT personnel certification



Paragraph 7.3 has been revised as below:

"Personnel performing nondestructive examinations in accordance with 7.5.3, 7.5.4, 7.5.5, 7.5.6, 7.5.7, or 7.5.8 shall be qualified and certified in accordance with the requirements of Section V, **Article 1, T-120(e)**, T-120(f), T-120(g), T-120(i), T-120(j), or T-120(k), as applicable."

Article 1, T-120(e) stipulated >>>>

"(1) SNT-TC-1A (2016 Edition), 3 Personnel Qualification and Certification in Nondestructive Testing, as amended by Mandatory Appendix III;"

Appendix III, Article 1

Specific examination for NDE Level III with ASNT Certificate isn't waived

Practical examination passing grade 80% for L I and II

Recertification by examination

Recertification after 3 yers.

Eye sight Jager 1

Part 7, INSPECTION AND EXAMINATION REQUIREMENTS

Paragraph 7.3 revised to **delete** reference to Sec V, Article 1 , T-120(h) and instead **added reference to Sec V, Article 1 , T-120(j) and T-120(k)**



Performance based alternate qualification like ANDE is now withdrawn...T-120(h)

Manufacturer is responsible to qualify and certify NDT personnel. Certification to earlier edition of SNT TC 1A would continue till expiry.

Part 7, INSPECTION AND EXAMINATION REQUIREMENTS

Paragraph 7.3 revised to **delete** reference to Sec V, Article 1 , T-120(h) and **add reference to Sec V, Article 1 , T-120(j) and T-120(k)**

New paragraph added to define “t” as below for thickness to be considered for extent of examination by NDE and as covered by Note 4 & 5 in Table 7.2 :

7.4.3.6 Thickness. When cited in the acceptance criteria of the various examination methods in 7.5 and Table 7.2, the thickness t is defined as the thickness of the weld, excluding any allowable reinforcement [see 6.2.4.1(d)]. For a butt weld joining two members having different thicknesses at the weld, t is the thinner of these two thicknesses. If a full penetration weld includes a fillet weld, the thickness of the throat of the fillet shall be included in “ t “.

(4) 10% if $t > 35$ mm ($1\frac{3}{8}$ in.), 0% if $t \leq 35$ mm ($1\frac{3}{8}$ in.), with t as defined in 7.4.3.6.

(5) 2% if $t \leq 35$ mm ($1\frac{3}{8}$ in.) and same weld procedure specification as longitudinal, for steel of material groups 1.1, 8.1, and 11.1, with t as defined in 7.4.3.6.

Table 7.2

Table 7.2 Nondestructive Examination										
Examination Group					1a	1b	2a	2b	3a	3b
Permitted Materials					All Materials in Annex 3-A	Groups 1.1, 1.2, 8.1, 11.1	Groups 8.2, 9.1, 9.2, 9.3, 10	Groups 1.1, 1.2, 8.1, 11.1	Groups 8.2, 9.1, 9.2, 10	Groups 1.1, 1.2, 8.1, 11.1
Weld Joint Efficiency					1.0	1.0	1.0	1.0	0.85	0.85
Joint Category	Type of Weld (see Table 4.2.2)			Type of NDE [Note (1)]	Extent of NDE [Note (2)] [Note (3)]					
A	Full penetration butt weld (see Table 4.2.4 and Table 4.2.5)	1	Longitudinal joints	RT or UT	100%	100%	100%	100%	25%	10%
				MT or PT	10%	10% [Note (4)]	10%	0	0	0
B		1	Circumferential joints on a shell, including circumferential joints between a shell and a non-hemispherical head	RT or UT	25%	10%	25%	10%	10%	5% [Note (5)]
				MT or PT	10%	10% [Note (4)]	10%	0	0	0
B		2, 3	Circumferential joints on a shell, including circumferential joints between a shell and a non-hemispherical head, with backing strip (as limited by	RT	NP	100%	NP	25%	NP	25%
				MT or PT	NP	10%	NP	10%	NP	10%

Note 4 & 5 of this table guides the examination percentage based on t

Part 7, INSPECTION AND EXAMINATION REQUIREMENTS...

Paragraph 7.4.11.3 and 7.4.11.4 are revised to provide alternative PT for non ferromagnetic materials in “layered vessels”.

Paragraph 7.5.3.2 and 7.5.4.2 revised to make reference to 7.4.3.6 for “t” to be considered in acceptance criteria.

Part 7, Paragraph 7.5.5.1

(c) Personnel performing and evaluating UT examinations shall be qualified and certified in accordance with 7.3. Only UT Level II or or Level III personnel shall analyze the data or interpret the results. In addition, UT personnel shall meet the requirements of Section V, Article 4, Mandatory Appendix VIII, VIII-423 prior to performing production scans.

(d) Contractor qualification records of certified personnel shall be approved by the Certificate Holder and maintained by their employer.

(e) Qualification of the procedure shall be performed per Section V, Article 1, T-150(d), and Section V, Article 4, Mandatory Appendix VIII, VIII-421.2.



The requirement was that personnel who acquire and analyze UT data shall participate in the qualification of the procedure per Section V, Article 4 Mandatory Appendix IX. But the term "participation" wasn't clear. Now it is clarified by reference to VIII-423 of Article 4 in Sec V

Part 7, INSPECTION AND EXAMINATION REQUIREMENTS...

Added ISO Materials Group 11.1 to Examination Groups 1b, 2b and 3b in Tables 7.1 and Table 7.2

Part 8

PRESSURE TESTING REQUIREMENTS



PART 8 PRESSURE TESTING REQUIREMENTS

Paragraph 8.1.3.1 revised.. *1.43 is replaced by $\gamma_{St/S}$*

Paragraph 8.2 revised in entirety to cover all type of pressure test including pneumatic test.

Minimum test pressure calculated by $P_T = \gamma_{St/S} \cdot \text{MAWP} \left(\frac{S_t}{S} \right)$

Table 4.1.3 Load Factor, β , and Pressure Test Factors, β_T , γ_{min} , and $\gamma_{St/S}$, for Class 1 and Class 2 Construction and Hydrostatic or Pneumatic Testing							
Class	β	β_T		γ_{min}		$\gamma_{St/S}$	
		Hydrostatic	Pneumatic	Hydrostatic	Pneumatic	Hydrostatic	Pneumatic
1	3.0	0.95	0.8	$1.5\beta_T$	$1.5\beta_T$	1.25	1.15
2	2.4	0.95	0.8	$1.5\beta_T$	$1.5\beta_T$	1.25	1.15

PART 8 PRESSURE TESTING REQUIREMENTS

Further the formula $P_T = \gamma_{\min} \cdot \text{MAWP}$ deleted and the definition 'γmin' withdrawn.

Paragraph 8.3 Pneumatic Testing deleted

Thank you

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