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JIS

JAPANESE INDUSTRIAL STANDARD

**Chromium-Molybdenum Alloy
Steel Plates for Boilers
and Pressure Vessels**

JIS G 4109—1987

Translated and Published

by

Japanese Standards Association

**In the event of any doubt arising,
the original Standard in Japanese is to be final authority.**

JAPANESE INDUSTRIAL STANDARD

J I S

Chromium-Molybdenum Alloy Steel Plates
for Boilers and Pressure Vessels

G 4109-1987

1. Scope

This Japanese Industrial Standard specifies hot-rolled chromium-molybdenum steel plates, hereinafter referred to as the "steel plates", to be used for boilers and pressure vessels (except those to be used at low temperature.).

Remark: The units and numerical values given in { } in this standard are in accordance with the International System of Units (SI) and are appended for reference.

The conventional units and values used in this standard will be replaced by SI units and values on 1st January 1991.

2. Classes, Strength Divisions and Symbols

- (1) Symbols for Classes The steel plates shall be classified into six classes and the symbols for them shall be as given in Table 1.
- (2) Strength Divisions The steel plates of each class specified in (1) shall be further divided into two depending upon mechanical properties. Those with lower tensile strength shall be designated as Strength Division 1 and those with higher tensile strength as Strength Division 2 and the symbol for class shall be followed by "-1" and "-2" in each.

Applicable Standards: See page 15.

Table 1. Symbols for Classes and Strength Divisions

Symbol for class	Strength division	Applicable thickness mm
SCMV 1	1	6 and over, up to and including 200
	2	
SCMV 2	1	
	2	
SCMV 3	1	
	2	
SCMV 4	1	6 and over, up to and including 300
	2	
SCMV 5	1	
	2	
SCMV 6	1	
	2	

3. Chemical Composition

3.1 Cast Analysis Steel plates shall be tested in accordance with 9.1 and the cast analysis shall be as given in Table 2.

Table 2. Chemical Composition (Cast Analysis)

Symbol for class	Chemical composition %						
	C	Si	Mn	P	S	Cr	Mo
SCMV 1	0.21 max.	0.40 max.	0.55 to 0.80	0.030 max.	0.030 max.	0.50 to 0.80	0.45 to 0.60
SCMV 2	0.17 max.	0.40 max.	0.40 to 0.65	0.030 max.	0.030 max.	0.80 to 1.15	0.45 to 0.60
SCMV 3	0.17 max.	0.50 to 0.80	0.40 to 0.65	0.030 max.	0.030 max.	1.00 to 1.50	0.45 to 0.65
SCMV 4	0.17 max.	0.50 max.	0.30 to 0.60	0.030 max.	0.030 max.	2.00 to 2.50	0.90 to 1.10
SCMV 5	0.17 max.	0.50 max.	0.30 to 0.60	0.030 max.	0.030 max.	2.75 to 3.25	0.90 to 1.10
SCMV 6	0.15 max.	0.50 max.	0.30 to 0.60	0.030 max.	0.030 max.	4.00 to 6.00	0.45 to 0.65

Remark: The chemical composition of the steel plates over 150 mm in thickness may be agreed specially between the parties concerned for the purpose of attainment of the mechanical properties specified in 5.

3.2 Product Analysis Product analysis is carried out when the purchaser requests it by testing in accordance with 9.1 and the values obtained shall conform to Table 3.

Table 3. Chemical Composition (Product Analysis)

Symbol for class	Chemical composition %						
	C	Si	Mn	P	S	Cr	Mo
SCMV 1	0.21 max.	0.45 max.	0.51 to 0.84	0.030 max.	0.030 max.	0.46 to 0.85	0.40 to 0.65
SCMV 2	0.17 max.	0.45 max.	0.36 to 0.69	0.030 max.	0.030 max.	0.74 to 1.21	0.40 to 0.65
SCMV 3	0.17 max.	0.44 to 0.86	0.36 to 0.69	0.030 max.	0.030 max.	0.94 to 1.56	0.40 to 0.70
SCMV 4	0.17 max.	0.50 max.	0.27 to 0.63	0.030 max.	0.030 max.	1.88 to 2.62	0.85 to 1.15
SCMV 5	0.17 max.	0.50 max.	0.27 to 0.63	0.030 max.	0.030 max.	2.63 to 3.37	0.85 to 1.15
SCMV 6	0.15 max.	0.55 max.	0.27 to 0.63	0.030 max.	0.030 max.	3.90 to 6.10	0.40 to 0.70

Remark: The chemical composition of the steel plates over 150 mm in thickness may be agreed specially between the parties concerned for the purpose of obtaining the mechanical properties specified in 5.

4. Austenite Grain Size

As a result of test carried out in accordance with 9.3 the size number of the austenite grain size of steel plates of SCMV 1 shall be 1 to 5.

5. Mechanical Properties

- (1) The purchaser shall designate either Strength Division 1 or Strength Division 2.
- (2) Steel plates designated as Strength Division 1 shall be tested in accordance with 9.2 and its mechanical properties shall be as specified in Table 4-1 or Table 4-2.

However, when bent, cracks shall not appear on the outside of bent portion.

Furthermore, the bend test may be omitted, unless designated specially by the purchaser.

- (3) Steel plates designated as Strength Division 2 shall be tested in accordance with 9.2 and its mechanical properties shall be as specified in Table 5-1 or Table 5-2.

However, when bent, cracks shall not appear on the outside of bent portion.

Furthermore, the bend test may be omitted, unless designated specially by the purchaser.

**Table 4-1. Mechanical Properties of Strength Division 1
(Apply until 31st December 1990)**

Symbol for class	Yield point or proof stress kgf/mm ² {N/mm ² }	Tensile strength kgf/mm ² {N/mm ² }	Elongation %	Reduction of area %	Test piece	Bend test	
						Bend angle	Inside radius
SCMV 1	23{226} min.	39 to 56 {382 to 549}	18 min.	-	No. 1 A	180°	Up to and including 25 mm in thickness, 0.75 × thickness
			22 min.	-	No. 10		
SCMV 2	23{226} min.	39 to 56 {382 to 549}	19 min.	-	No. 1 A		Over 25 mm, up to and including 100 mm in thickness, 1.0 × thickness
			22 min.	-	No. 10		
SCMV 3	24{235} min.	42 to 60 {412 to 588}	19 min.	-	No. 1 A		Over 100 mm in thickness 1.25 × thickness
			22 min.	-	No. 10		
SCMV 4	21{206} min.	42 to 60 {412 to 588}	18 min.	45 min.	No. 10	180°	Up to and including 25 mm in thickness, 1.0 × thickness
SCMV 5	21{206} min.	42 to 60 {412 to 588}	18 min.	45 min.	No. 10		Over 25 mm, up to and including 50 mm in thickness, 1.25 × thickness
SCMV 6	21{206} min.	42 to 60 {412 to 588}	18 min.	45 min.	No. 10	180°	Over 50 mm, up to and including 100 mm in thickness, 1.5 × thickness
							Over 100 mm in thickness 1.75 × thickness

Remarks 1. No. 1 A test pieces shall be used for the steel plates of SCMV 1, SCMV 2 and SCMV 3 of 50 mm or under in thickness, No. 10 test pieces shall be used for those over 50 mm in thickness. However, for those over 40 mm, No. 10 test pieces may be used.

2. When the steel plates of SCMV 4, SCMV 5 and SCMV 6 are too thin in thickness to take the No. 10 test pieces, the test pieces similar to No. 10 in which the gauge length is four times the diameter of parallel portion shall be used.

Further, for the steel plates 20 mm or under in thickness, No. 1 A test pieces may be used. In this case, the gauge length for the measurement of elongation shall be 50 mm, and the elongation shall be measured including ruptured part. When No. 1 A test pieces are used, the reduction of area shall be subtracted by 5 % from the value of reduction of area given in Table 4-1.

3. The elongation of No. 1 A test pieces of the steel plates of SCMV 1, SCMV 2 and SCMV 3 under 8 mm in thickness shall be subtracted by 1 % from the value given in Table 4-1 for each decrease of 1 mm or its fraction in thickness.

4. When the elongation of No. 1 A test pieces of the steel plates of SCMV 1, SCMV 2 and SCMV 3 under 20 mm in thickness falls within 3 % below the values given in Table 4-1, if the value of elongation including the ruptured part in 50 mm gauge length is 25 % or over, the product shall be accepted irrespective of the specification in Table 4-1.
5. The elongation of No. 1 A test pieces of the steel plates over 20 mm in thickness shall be subtracted by 0.5 % from the value given in Table 4-1 for each increase of 3 mm or its fraction in thickness. However, the limit of subtraction shall be 3 %.
6. The elongation of No. 10 test pieces of the steel plates over 90 mm in thickness shall be subtracted by 0.5 % for each increase of 12.5 mm or its fraction from the values given in Table 4-1. However, the limit of subtraction shall be 3 %.

Table 4-2. Mechanical Properties of Strength Division 1
(Apply from 1st January 1991 on)

Symbol for class	Yield point or proof stress N/mm ²	Tensile strength N/mm ²	Elongation %	Reduction of area %	Test piece	Bend test	
						Bend angle	Inside radius
SCMV 1	225 min.	380 to 550	18 min.	-	No. 1 A	180°	Up to and including 25 mm in thickness, 0.75 × thickness Over 25 mm, up to and including 100 mm in thickness, 1.0 × thickness Over 100 mm in thickness 1.25 × thickness
			22 min.	-	No. 10		
SCMV 2	225 min.	380 to 550	19 min.	-	No. 1 A		
			22 min.	-	No. 10		
SCMV 3	235 min.	410 to 590	19 min.	-	No. 1 A		
			22 min.	-	No. 10		
SCMV 4	205 min.	410 to 590	18 min.	45 min.	No. 10	180°	Up to and including 25 mm in thickness, 1.0 × thickness Over 25 mm, up to and including 50 mm in thickness, 1.25 × thickness Over 50 mm, up to and including 100 mm in thickness, 1.5 × thickness Over 100 mm in thickness 1.75 × thickness
SCMV 5	205 min.	410 to 590	18 min.	45 min.	No. 10		
SCMV 6	205 min.	410 to 590	18 min.	45 min.	No. 10	180°	

- Remarks 1. No. 1 A test pieces shall be used for the steel plates of SCMV 1, SCMV 2 and SCMV 3 of 50 mm or under in thickness. No. 10 test pieces shall be used for those over 50 mm in thickness. However, for those over 40 mm, No. 10 test pieces may be used.
2. When the steel plates of SCMV 4, SCMV 5 and SCMV 6 are too thin in thickness to take the No. 10 test pieces, the test pieces similar to No. 10 in which the gauge length is four times the diameter of parallel portion shall be used.

Further, for the steel plates 20 mm or under in thickness, No. 1 A test pieces may be used. In this case, the gauge length for the measurement of elongation shall be 50 mm, and the elongation shall be measured including ruptured part. When No. 1 A test pieces are used, the reduction of area shall be subtracted by 5 % from the value of reduction of area given in Table 4-2.

3. The elongation of No. 1 A test pieces of the steel plates of SCMV 1, SCMV 2 and SCMV 3 under 8 mm in thickness shall be subtracted by 1 % from the value given in Table 4-2 for each decrease of 1 mm or its fraction in thickness.
4. When the elongation of No. 1 A test pieces of the steel plates of SCMV 1, SCMV 2 and SCMV 3 under 20 mm in thickness falls within 3 % below the values given in Table 4-2, if the value of elongation including the ruptured part in 50 mm gauge length is 25 % or over, the product shall be accepted irrespective of the specification in Table 4-2.
5. The elongation of No. 1 A test pieces of the steel plates over 20 mm in thickness shall be subtracted by 0.5 % from the value given in Table 4-2 for each increase of 3 mm or its fraction in thickness. However, the limit of subtraction shall be 3 %.
6. The elongation of No. 10 test pieces of the steel plates over 90 mm in thickness shall be subtracted by 0.5 % for each increase of 12.5 mm or its fraction from the values given in Table 4-2. However, the limit of subtraction shall be 3 %.

Table 5-1. Mechanical Properties of Strength Division 2
(Apply until 31st December 1990)

Symbol for class	Yield point or proof stress kgf/mm ² {N/mm ² }	Tensile strength kgf/mm ² {N/mm ² }	Elongation %	Reduction of area %	Test piece	Bend test	
						Bend angle	Inside radius
SCMV 1	32{314} min.	49 to 63 {481 to 618}	18 min.	-	No. 1 A	180°	Up to and including 25 mm in thickness, 0.75 × thickness Over 25 mm, up to and including 100 mm in thickness, 1.0 × thickness Over 100 mm in thickness 1.25 × thickness
			22 min.	-	No. 10		
SCMV 2	28{275} min.	46 to 60 {451 to 588}	19 min.	-	No. 1 A		
			22 min.	-	No. 10		
SCMV 3	32{314} min.	53 to 70 {520 to 686}	18 min.	-	No. 1 A		
			22 min.	-	No. 10		
SCMV 4	32{314} min.	53 to 70 {520 to 686}	18 min.	45 min.	No. 10	180°	Up to and including 25 mm in thickness, 1.0 × thickness Over 25 mm, up to and including 50 mm in thickness, 1.25 × thickness Over 50 mm, up to and including 100 mm in thickness, 1.5 × thickness Over 100 mm in thickness, 1.75 × thickness
SCMV 5	32{314} min.	53 to 70 {520 to 686}	18 min.	45 min.	No. 10		
SCMV 6	32{314} min.	53 to 70 {520 to 686}	18 min.	45 min.	No. 10	180°	

- Remarks 1. No. 1 A test pieces shall be used for the steel plates of SCMV 1, SCMV 2 and SCMV 3 of 50 mm or under in thickness, No. 10 test pieces shall be used for the steel plates over 50 mm in thickness. However, for those over 40 mm in thickness, No. 10 test pieces may be used.
2. When the steel plates of SCMV 4, SCMV 5 and SCMV 6 are too thin in thickness to take the No. 10 test pieces, the test similar to No. 10 in which the gauge length is four times the diameter of parallel portion shall be used.

Further, for the steel plates of 20 mm or under in thickness, No. 1 A test pieces may be used. In this case, the gauge length for the measurement of elongation shall be 50 mm and elongation shall be measured including ruptured part. When No. 1 A test pieces are used, reduction of area shall be subtracted by 5 % from the value of reduction of area given in Table 5-1.

3. The elongation of No. 1 A test pieces of the steel plates of SCMV 1, SCMV 2 and SCMV 3 under 8 mm in thickness shall be subtracted by 1 % from the value given in Table 5-1 for each decrease of 1 mm or its fraction in thickness.
4. When the elongation of No. 1 A test pieces of the steel plates of SCMV 1, SCMV 2 and SCMV 3 under 20 mm in thickness falls within 3 % below the values given in Table 5-1, if the value of elongation including the ruptured part in 50 mm gauge length is 25 % or over, the product shall be accepted irrespective of the specification in Table 5-1.
5. The elongation of No. 1 A test pieces of the steel plates over 20 mm in thickness shall be subtracted by 0.5 % from the value given in Table 5-1 for each increase of 3 mm or its fraction in thickness. However, the limit of subtraction shall be 3 %.
6. The elongation of No. 10 test pieces of the steel plates over 90 mm in thickness shall be subtracted by 0.5 % for each increase of 12.5 mm or its fraction from the value given in Table 5-1. However, the limit of subtraction shall be 3 %.

Table 5-2. Mechanical Properties of Strength Division 2
(Apply from 1st January 1991 on)

Symbol for class	Yield point or proof stress N/mm ²	Tensile strength N/mm ²	Elongation %	Reduction of area %	Test piece	Bend test	
						Bend angle	Inside radius
SCMV 1	315 min.	480 to 620	18 min.	-	No. 1 A	180°	Up to and including 25 mm in thickness, 0.75 × thickness
			22 min.	-	No. 10		
SCMV 2	275 min.	450 to 590	18 min.	-	No. 1 A		Over 25 mm, up to and including 100 mm in thickness, 1.0 × thickness
			22 min.	-	No. 10		
SCMV 3	315 min.	520 to 690	18 min.	-	No. 1 A		Over 100 mm in thickness, 1.25 × thickness
			22 min.	-	No. 10		
SCMV 4	315 min.	520 to 690	18 min.	45 min.	No. 10	180°	Up to and including 25 mm in thickness, 1.0 × thickness
SCMV 5	315 min.	520 to 690	18 min.	45 min.	No. 10		Over 25 mm, up to and including 50 mm in thickness, 1.25 × thickness
SCMV 6	315 min.	520 to 690	18 min.	45 min.	No. 10	180°	Over 50 mm, up to and including 100 mm in thickness, 1.5 × thickness Over 100 mm in thickness 1.75 × thickness

Remarks 1. No. 1 A test pieces shall be used for the steel plates of SCMV 1, SCMV 2 and SCMV 3 of 50 mm or under in thickness, No. 10 test pieces shall be used for the steel plates over 50 mm in thickness. However, for those over 40 mm in thickness, No. 10 test pieces may be used.

2. When the steel plates of SCMV 4, SCMV 5 and SCMV 6 are too thin in thickness to take the No. 10 test pieces, the test similar to No. 10 in which the gauge length is four times the diameter of parallel portion shall be used.

Further, for the steel plates of 20 mm or under in thickness, No. 1 A test pieces may be used. In this case, the gauge length for the measurement of elongation shall be 50 mm and elongation shall be measured including ruptured part. When No. 1 A test pieces are used, reduction of area shall be subtracted by 5 % from the value of reduction of area given in Table 5-2.

3. The elongation of No. 1 A test pieces of the steel plates of SCMV 1, SCMV 2 and SCMV 3 under 8 mm in thickness shall be subtracted by 1 % from the value given in Table 5-2 for each decrease of 1 mm or its fraction in thickness.

4. When the elongation of No. 1 A test pieces of the steel plates of SCMV 1, SCMV 2 and SCMV 3 under 20 mm in thickness falls within 3 % below the values given in Table 5-2, if the value of elongation including the ruptured part in 50 mm gauge length is 25 % or over, the product shall be accepted irrespective of the specification in Table 5-2.
5. The elongation of No. 1 A test pieces of the steel plates over 20 mm in thickness shall be subtracted by 0.5 % from the value given in Table 5-2 for each increase of 3 mm or its fraction in thickness. However, the limit of subtraction shall be 3 %.
6. The elongation of No. 10 test pieces of the steel plates over 90 mm in thickness shall be subtracted by 0.5 % for each increase of 12.5 mm or its fraction from the value given in Table 5-2. However, the limit of subtraction shall be 3 %.

6. Shapes, Dimensions, Weights and Permissible Deviations Thereof

The shapes, dimensions, weights and permissible deviations thereof shall be in accordance with JIS G 3193. However, the following conditions shall be satisfied.

- (1) For the permissible deviations of width and length of steel plates gained by cut edge, unless specially designated, the permissible deviations A given in Table 5 and Table 6 of JIS G 3193 shall apply.
- (2) The permissible deviations of thickness shall be as given in Table 6.
- (3) For the calculation of mass of the steel plate, the indicated thickness added by the numerical value given in Table 7 shall be used.

Table 6. Permissible Deviations of Thickness

Unit: mm

Thickness \ Width	Up to 1600	1600 and over, up to 2000	2000 and over, up to 2500	2500 and over, up to 3150	3150 and over, up to 4000	4000 and over, up to 5000
6.00 and over, up to 10.0	+0.95	+1.05	+1.25	+1.45	+1.65	+1.85
10.0 and over, up to 16.0	+0.95	+1.15	+1.35	+1.55	+1.75	+1.95
16.0 and over, up to 25.0	+1.15	+1.35	+1.55	+1.75	+2.15	+2.35
25.0 and over, up to 40.0	+1.35	+1.55	+1.75	+1.95	+2.35	+2.55
40.0 and over, up to 63.0	+1.55	+1.75	+2.15	+2.35	+2.55	+2.75
63.0 and over, up to 100	+1.95	+2.15	+2.55	+2.75	+2.95	+3.15
100 and over, up to 160	+2.35	+2.55	+2.95	+3.15	+3.35	+3.55
160 and over, up to 200	+2.95	+3.15	+3.55	+3.75	+3.95	+4.15

- Remarks 1. The permissible deviations in minus side shall be 0.25 mm.
2. The permissible deviations of the steel plates 200 mm or over in thickness or 5000 mm or over in width shall be as agreed between the parties concerned.

**Table 7. Additional Value Used for Calculation of
Mass of Steel Plate**

Unit: mm

Thickness \ Width	Up to 1600	1600 and over, up to 2000	2000 and over, up to 2500	2500 and over, up to 3150	3150 and over, up to 4000	4000 and over, up to 5000
6.00 and over, up to 10.0	0.35	0.40	0.50	0.60	0.70	0.80
10.0 and over, up to 16.0	0.35	0.45	0.55	0.65	0.75	0.85
16.0 and over, up to 25.0	0.45	0.55	0.65	0.75	0.95	1.05
25.0 and over, up to 40.0	0.55	0.65	0.75	0.85	1.05	1.15
40.0 and over, up to 63.0	0.65	0.75	0.95	1.05	1.15	1.25
63.0 and over, up to 100	0.85	0.95	1.15	1.25	1.35	1.45
100 and over, up to 160	1.05	1.15	1.35	1.45	1.55	1.65
160 and over, up to 200	1.35	1.45	1.65	1.75	1.85	1.95

Remark: Additional values of the steel plates 200 mm or over in thickness or 5000 mm or over in width shall be as agreed between the parties concerned.

7. Appearance

Appearance of steel plates shall comply with the specification of Clause 7. in JIS G 3193. In the case of welding repair, it shall be based on the agreement between the parties concerned.

8. Methods of Manufacture and Heat Treatment

8.1 Method of Manufacture The steel plates shall be manufactured from the killed steel by hot rolling.

8.2 Designation of Heat Treatment The purchaser shall indicate clearly in the order sheet the condition of heat treatment of steel plates to be performed by the manufacturer and the condition of heat treatment of test pieces.

8.3 Heat Treatment of Steel Plates

- (1) All the steel plates shall be heat treated by either annealing or normalizing and successive tempering so that the normal grain size can be obtained.
- (2) The steel plates of Strength Division 1 shall be annealed or normalized and successively tempered.

The steel plates of Strength Division 2 shall be normalized and successively tempered.

- (3) In normalizing, the accelerated cooling to obtain the specified mechanical properties may be performed by liquid cooling, air blast or other adequate methods.

Normalizing and successive tempering may be replaced by uniform heating and cooling and successive tempering in the hot-forming process capable to obtain equivalent effect.

- (4) Temperature of annealing and normalizing shall be 875 to 1000°C. However, as for the steel plates of SCM V 6 whose carbon content has been made 0.10 % or less according to the designation, the temperature of annealing and normalizing may be 875°C or lower, the temperature of tempering shall be 620°C or over for the steel plates of SCM V 1, SCM V 2 and SCM V 3, 650°C or over for those of SCM V 4 and SCM V 5, 700°C or over for those of SCM V 6.
- (5) When the purchaser performs the heat treatment specified in (1) and (2), the steel plates supplied by the manufacturer shall be as rolled unless designated as for SCM V 1, SCM V 2 and SCM V 3 and shall be stress relieved as for SCM V 4, SCM V 5 and SCM V 6.
- (6) When the purchaser performs the heat treatment of steel plates in hot-forming process in accordance with (3), the temperature shall be in accordance with (4) and when (4) cannot be complied with, the products shall be cooled sufficiently below the transformation point and anew be heat treated according to (4).

8.4 Heat Treatment of Test Pieces

- (1) When the manufacturer performs heat treatment of steel plates, the test pieces shall be taken from the heat treated steel plates.
- (2) When the purchaser performs the heat treatment of steel plates, the manufacturer shall sample specimens from the steel plates manufactured according to 8.3 (5) and after having heat treated the specimens according to the condition of heat treatment designated by the purchaser, shall cut out test pieces.
- (3) When the purchaser designates the heat treatment corresponding to the heat treatment of test pieces after welding, the manufacturer shall perform the heat treatment of specimens according to the designation of the purchaser. In this case, the purchaser shall designate the number of times and conditions of the heat treatment to the manufacturer.

8.5 Symbols for Heat Treatment The symbols for heat treatment of steel plates and test pieces to be described in the order sheet shall be as follows:

- | | |
|---|-----|
| (1) When the steel plates shall be annealed | A |
| (2) When the steel plates shall be normalized and successively tempered | NT |
| (3) When the steel plates shall be stress relieved | P |
| (4) When only the test pieces shall be annealed | TA |
| (5) When only the test pieces shall be normalized and successively tempered | TNT |

- (6) When the test pieces shall be performed with the heat treatment corresponding to that after welding SR

Example: SCMV1-1 A

When the steel plates designated as Strength Division 1 shall be annealed

SCMV1-1 NTSR

When the steel plates designated as Strength Division 1 shall be normalized and successively tempered and moreover the test pieces shall be performed with heat treatment corresponding to that after welding

SCMV4-2 PTNT2SR

When the steel plates designated as Strength Division 2 shall be stress relieved and furthermore, the test pieces shall be normalized and successively tempered and thereafter shall be performed two times with the heat treatment corresponding to that after welding

9. Tests

9.1 Chemical Analysis

- (1) Sampling for cast analysis shall be in accordance with specifications in 3.2 of JIS G 0303.
- (2) Sampling for the product analysis shall be in accordance with specifications in 3.3.1 of JIS G 0321. However, as the specimen, the tensile test piece after rupture may be used.
- (3) Method of analysis shall be in accordance with one or more of the following standards:

JIS G 1211, JIS G 1212, JIS G 1213, JIS G 1214, JIS G 1215,
JIS G 1217, JIS G 1218, JIS G 1252, JIS G 1253, JIS G 1256,
JIS G 1257

9.2 Mechanical Tests

9.2.1 Tests in General General matters in mechanical tests shall comply with the Clause 4. in JIS G 0303 and the specimen for the mechanical test shall be sampled according to Class A. In this case, the number of test pieces and the sampling position shall be as follows:

(1) Number of Tensile Test Pieces and Bend Test Pieces

- (a) Tensile Test Piece One piece from each set of steel plates as rolled from the same slab or directly from the same ingot.
- (b) Bend Test Piece One piece from each set of steel plates as rolled from the same slab or directly from the same ingot.
- (c) The number of test pieces of the heat treated steel plates shall be in accordance with (a) and (b) for each same condition of heat treatment.

(2) Sampling Position of Tensile Test Piece and Bend Test Piece

- (a) Tensile Test Piece It shall be taken at any one of the corners of the steel plate and the direction of taking test piece shall be at right angles with the final rolling direction. When No. 10 test piece is used as tensile test piece, the axis of test piece shall be positioned at 1/4 of thickness from the surface of steel plate.
- (b) Bend Test Piece It shall be taken from the central part in width direction of either end of the steel plate and the direction of taking test piece shall be at right angles with the final rolling direction.

9.2.2 Test Pieces The tensile test piece and bend test piece shall be in accordance with the following specifications:

- (1) No. 1 A or No. 10 test piece specified in JIS Z 2201.
- (2) No. 1 test piece specified in JIS Z 2204.

9.2.3 Test Methods Method of tensile test and bend test shall be in accordance with the following standards:

- (1) JIS Z 2241
- (2) JIS Z 2248

9.3 Austenite Grain Size Test

- (1) The test piece shall be one for each heat and shall be taken from the position adjacent to the tensile test piece.
- (2) The test method shall be in accordance with JIS G 0551.

10. Inspection

- (1) Chemical composition, austenite grain size, mechanical properties, shape, dimensions, mass and appearance shall comply with the specifications in 3., 4., 5., 6. and 7.
- (2) In addition to the inspections specified in (1), the purchaser may designate nondestructive examinations specified in JIS G 0560, JIS G 0801, etc. In this case, the purchaser shall preliminarily agree with the manufacturer on the sampling of specimens, the method of test and the criteria of acceptance, etc.
- (3) The steel plates having not passed the tensile test and the bend test may be retested according to the specifications of 4.4 of JIS G 0303 to determine the acceptance or rejection.

11. Marking

The steel plate having passed the inspection shall be marked for each plate with the following items. However, a part of the items may be omitted according to the agreement between the parties concerned.

- (1) Symbol for class and strength division (symbol for heat treatment specified in 8.5 is included.)
- (2) Heat number or other inspection number
- (3) Dimensions
- (4) Manufacturer's name or its abbreviation

12. Report

The report shall be in accordance with the specifications in 8. of JIS G 0303.

Applicable Standards:

- JIS G 0303-General Rules for Inspection of Steel
- JIS G 0321-Product Analysis and its Tolerance for Wrought Steel
- JIS G 0551-Methods of Austenite Grain Size Test for Steel
- JIS G 0560-Method of Sulphur Print Test for Steel
- JIS G 0801-Ultrasonic Examination of Steel Plates for Pressure Vessels
- JIS G 1211-Methods for Determination of Carbon in Iron and Steel
- JIS G 1212-Methods for Determination of Silicon in Iron and Steel
- JIS G 1213-Methods for Determination of Manganese in Iron and Steel
- JIS G 1214-Methods for Determination of Phosphorus in Iron and Steel
- JIS G 1215-Methods for Determination of Sulfur in Iron and Steel
- JIS G 1217-Methods for Determination of Chromium in Iron and Steel
- JIS G 1218-Methods for Determination of Molybdenum in Iron and Steel
- JIS G 1252-Emission-Spectroscopic Analysis for Carbon Steel and Low Alloy Steel
- JIS G 1253-Method for Photoelectric Emission Spectrochemical Analysis of Iron and Steel
- JIS G 1256-Method for X-Ray Fluorescence Spectrometric Analysis of Iron and Steel
- JIS G 1257-Atomic Absorption Spectrochemical Analysis of Iron and Steel
- JIS G 3193-Dimensions, Weight and Permissible Variations of Hot Rolled Steel Plates, Sheets and Strip
- JIS Z 2201-Test Pieces for Tensile Test for Metallic Materials
- JIS Z 2204-Bend Test Pieces for Metallic Materials
- JIS Z 2241-Method of Tensile Test for Metallic Materials
- JIS Z 2248-Method of Bend Test for Metallic Materials

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