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JAPANESE INDUSTRIAL STANDARD

**Manganese-Molybdenum and
Manganese-Molybdenum-Nickel
Alloy Steel Plates for Boilers
and Other Pressure Vessels**

JIS G 3119—1987

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JIS G 3119-1987

Manganese-molybdenum alloy and
manganese-molybdenum-nickel alloy steel plates
for boilers and other pressure vessels

May, 1996

ERRATA

Page	Position	Wrong	Correct
6	Table 3-2, in column of Yield point N/mm ²	315	315 min.
		345	345 min.
		345	345 min.
		345	345 min.

Remarks: This errata is for correcting the first edition of this Standard.
Japanese Standards Association

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Manganese-Molybdenum and Manganese-Molybdenum-Nickel Alloy Steel Plates for Boilers and Other Pressure Vessels G 3119-1987

1. Scope

This Japanese Industrial Standard specifies hot rolled manganese-molybdenum and manganese-molybdenum-nickel alloy steel plates, hereinafter referred to as the "steel plate", to be used for boilers and other pressure vessels (excluding those 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.

Further, the traditional units and numerical values in this Standard shall be converted to the SI units and numerical values on and after Jan. 1, 1991.

2. Classification and Symbol

The steel plate shall be classified into four and their symbols shall be as shown in Table 1.

Table 1. Symbols for Class

Symbol	Applied thickness mm
SBV 1 A	6 and over, up to and incl. 150
SBV 1 B	6 and over, up to and incl. 150
SBV 2	6 and over, up to and incl. 150
SBV 3	6 and over, up to and incl. 150

3. Chemical Composition

3.1 Ladle Analysis Values Steel plates shall be tested in accordance with 8.1, and the ladle analysis values obtained shall conform to Table 2.

Table 2. Chemical Composition

Symbol	Chemical composition %						
	C	Si	Mn	P	S	Ni	Mo
SBV 1 A	25 mm and under in thickness	0.15 to 0.30	0.95 to 1.30	0.035 max.	0.040 max.	—	0.45 to 0.60
	Over 25 mm to 50 mm incl. in thickness						
	Over 50 mm to 150 mm incl. in thickness						
SBV 1 B	25 mm and under in thickness	0.15 to 0.30	1.15 to 1.50	0.035 max.	0.040 max.	—	0.45 to 0.60
	Over 25 mm to 50 mm incl. in thickness						
	Over 50 mm to 150 mm incl. in thickness						
SBV 2	25 mm and under in thickness	0.15 to 0.30	1.15 to 1.50	0.035 max.	0.040 max.	0.40 to 0.70	0.45 to 0.60
	Over 25 mm to 50 mm incl. in thickness						
	Over 50 mm to 150 mm incl. in thickness						
SBV 3	25 mm and under in thickness	0.15 to 0.30	1.15 to 1.50	0.035 max.	0.040 max.	0.70 to 1.00	0.45 to 0.60
	Over 25 mm to 50 mm incl. in thickness						
	Over 50 mm to 150 mm incl. in thickness						

3.2 Product Analysis When required by the purchaser, the product analysis shall be made in accordance with 8.1, and the values obtained shall conform to Table 2, except that the values of silicon, manganese, nickel, and molybdenum shall be as follows:

Si: 0.13 to 0.32 %

Mn: 0.91 to 1.35 % for SBV 1 A

1.10 to 1.55 % for SBV 1 B, SBV 2, and SBV 3

Ni: 0.37 to 0.73 % for SBV 2

0.67 to 1.03 % for SBV 3

Mo: 0.41 to 0.64 %

4. Mechanical Properties

Steel plates shall be tested in accordance with 8.2, and their yield point, tensile strength, elongation and bending shall conform to Table 3-1 or Table 3-2.

For bendability, no crack shall be produced on the outside of the bent portion.

Table 3-1. Mechanical Properties
(Applicable till the end of 1990)

Symbol	Yield point	Tensile strength	Elongation %	Tensile test piece	Bend	
					Bend angle	Inside radius
SBV 1 A SBV 1 A	32 min. {314} min.	53 to 67 {520 to 657}	15 min.	No. 1 A	180°	25 mm and under in thickness 1 0 x thickness
			19 min.	No. 10	180°	Over 25 mm, up to and incl. 1.25 x thickness 50 mm in thickness 1.5 x thickness Over 50 mm, up to and incl. 1.5 x thickness 150 mm in thickness
SBV 1 B	35 min. {343} min.	56 to 70 {549 to 686}	15 min.	No. 1 A	180°	25 mm and under in thickness 1.25 x thickness
			18 min.	No. 10		Over 25 mm, up to and incl. 1.5 x thickness 50 mm in thickness 1.75 x thickness Over 50 mm, up to and incl. 1.75 x thickness 150 mm in thickness
SBV 2	35 min. {343} min.	56 to 70 {549 to 686}	17 min.	No. 1 A	180°	25 mm and under in thickness 1.25 x thickness
			20 min.	No. 10		Over 25 mm, up to and incl. 1.5 x thickness 50 mm in thickness 1.75 x thickness Over 50 mm, up to and incl. 1.75 x thickness 150 mm in thickness
SBV 3	35 min. {343} min.	56 to 70 {549 to 686}	17 min.	No. 1 A	180°	25 mm and under in thickness 1.25 x thickness
			20 min.	No. 19		Over 25 mm, up to and incl. 1.5 x thickness 50 mm in thickness 1.75 x thickness Over 50 mm, up to and incl. 1.75 x thickness 150 mm in thickness

- Remarks 1. For steel plates 50 mm and under in thickness, No. 1 A test piece shall be used. For steel plates over 50 mm in thickness, No. 10 test piece shall be used. However, for those over 40 mm in thickness, No. 10 test piece may be used.
2. The elongation of No. 1 A test piece for steel plates under 8 mm in thickness shall be deducted by 1 % from the values given in the above Table for each decrease of 1 mm or its fraction in thickness.
 3. The elongation of No. 1 A test piece for steel plates over 20 mm in thickness shall be deducted by 0.5 % from the values given in the above Table for each increase of 3 mm or its fraction in thickness. The deduction rate shall not exceed 3 %.
 4. The elongation of No. 10 test piece for steel plates over 90 mm in thickness shall be deducted by 0.5 % from the values given in the above Table for each increase of 12.5 mm or its fraction in thickness. The deduction rate shall not exceed 3 %.
 5. When the elongation of No. 1 A test piece for steel plates over 6 mm to 20 mm, excl. in thickness falls short of the values given in the above Table by within 3 %, if the value of elongation in a 50 mm gauge length including the fracture is 25 % or over, the test piece shall be considered acceptable despite the requirements in the above Table.

Table 3-2. Mechanical Properties

Symbol	Yield point N/mm ²	Tensile strength N/mm ²	Elongation %	Tensile test piece	Bendability	
					Bend angle	Inside radius
SBV 1 A	315	520 to 660	15 min.	No. 1 A	180°	25 mm and under in thickness 1.0 x thickness
			19 min.	No. 10		Over 25 mm, up to and incl. 1.25 x thickness 50 mm in thickness
SBV 1 B	345	550 to 690	15 min.	No. 1 A	180°	Over 50 mm, up to and incl. 1.5 x thickness 150 mm in thickness
			18 min.	No. 10		
SBV 2	345	550 to 690	17 min.	No. 1 A	180°	25 mm and under in thickness 1.25 x thickness
			20 min.	No. 10		Over 25 mm, up to and incl. 1.5 x thickness 50 mm in thickness
SBV 3	345	550 to 690	17 min.	No. 1 A	180°	Over 50 mm, up to and incl. 1.75 x thickness 150 mm in thickness
			20 min.	No. 10		

- Remarks 1. For steel plates 50 mm and under in thickness, No. 1 A test piece shall be used. For steel plates over 50 mm in thickness, No. 10 test piece shall be used. However, for those over 40 mm in thickness, No. 10 test piece may be used.
2. The elongation of No. 1 A test piece for steel plates under 8 mm in thickness shall be deducted by 1 % from the values given in the above Table for each decrease of 1 mm or its fraction in thickness.
 3. The elongation of No. 1 A test piece for steel plates over 20 mm in thickness shall be deducted by 0.5 % from the values given in the above Table for each increase of 3 mm or its fraction in thickness. The deduction rate shall not exceed 3 %.
 4. The elongation of No. 10 test piece for steel plates over 90 mm in thickness shall be deducted by 0.5 % from the values given in the above Table for each increase of 12.5 mm or its fraction in thickness. The deduction rate shall not exceed 3 %.
 5. When the elongation of No. 1 A test piece for steel plates over 6 mm to 20 mm, excl. in thickness falls short of the values given in the above Table by within 3 %, if the value of elongation in a 50 mm gauge length including the fracture is 25 % or over, the test piece shall be considered acceptable despite the requirements in the above Table.

5. Shape, Dimension, Mass and Tolerances

The shape, dimension, mass and tolerances of steel plates shall be the same as those specified in JIS G 3193, provided that the following requirements are satisfied.

- (1) Unless otherwise specified, tolerance A applies to the length of the steel plate and the width of cut edged one. Tolerances on thickness shall be as given in Table 4.
- (2) In the calculation of the mass of the steel plate, the value obtained by adding the numerical value in Table 5 to the indicated thickness shall be used in place of the latter.

Table 4. Tolerances on 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	+ 1.95
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

Remark: Tolerances on the minus side shall be 0.25 mm.

Table 5. Values to Be Added for Weight Calculation of Steel Plate

Unit: mm

Thickness \ Width	Up to	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

6. Appearance

Appearance of steel plates shall conform to 7. of JIS G 3193. However, to conduct the repairing by welding, the approval by the purchaser shall be obtained in advance.

7. Heat Treatment

7.1 Heat Treatment of Steel Plates Heat treatment of steel plate shall be performed as follows:

- (1) The steel plates 50 mm and under in thickness shall either be delivered as rolled without undergoing heat treatment or heat-treated by normalizing, stress relieving, or normalizing and stress relieving subject to agreement between the parties concerned.
- (2) The steel plates over 50 mm in thickness shall either be normalized to obtain normal grain size, or heated uniformly at such a normalizing temperature that the same effect will be obtained in process of hot forming. The normalizing for steel plates over 100 mm in thickness shall include the accelerated cooling to improve the mechanical properties and the subsequent tempering.

In the case where these heat treatments are to be performed by the purchaser, the steel plates shall either be delivered as rolled or stress relieved subject to agreement between the parties concerned.

Remark: The steel plates specified in this Standard, as they are rolled, are liable to produce cracks in the course up to the time before the plates are ready to be worked, so that especially in the case of plates 25 mm and over in thickness, it is desirable that the steel plates should be heat-treated.

7.2 Specification for Heat Treatment of Steel Plates The purchaser shall indicate in the order as to which of the parties concerned is to perform the heat treatment specified in 7.1.

7.3 Heat Treatment of Test Pieces Heat treatment of test pieces shall be performed as follows:

- (1) If the manufacturer is to perform heat treatment of steel plates, the test pieces shall be taken from the heat-treated steel plates.
- (2) If the purchaser is to perform the normalizing of steel plates, the manufacturer shall cut out test pieces from the steel plates as-rolled, or from those stress-relieved conforming to the indication of the purchaser, and heat-treat them as indicated by the purchaser. If no indication is made by the purchaser, the manufacturer shall heat-treat the test pieces under the condition that he considers appropriate to obtain normal grain size and to satisfy the requirements of mechanical properties, and shall inform the purchaser of the procedure taken in the heat treatment of the test pieces.
- (3) If the purchaser has specified stress relieving of the test pieces, the manufacturer shall heat-treat the test pieces in accordance with the indication of the purchaser.

In this case, the purchaser shall indicate the number of times and conditions of the heat treatment to the manufacturer. If no indication is made, the test pieces shall be gradually heated to 595 to 650°C and, after being maintained at the above-stated temperature for at least 1 h per 25 mm of thickness, they shall be cooled down to 300 °C in the furnace and then cooled in the atmosphere.

- (4) The heat treatment for test pieces specified in (2) and (3) shall be performed in the state as they are in the test specimen.

7.4 Symbols for Heat Treatment The symbols for heat treatment to be used in the order shall be as follows:

- | | |
|--|----|
| (1) Steel plates to be normalized | N |
| (2) Steel plates to be stress-relieve heat-treated | P |
| (3) Test pieces only to be normalized | TN |
| (4) Test pieces to be stress-relieve heat-treated | SR |

Examples:

SBV 2 N Steel plates to be normalized

SBV 2 NP Steel plates to be normalized and stress-relieve heat-treated

SBV 2 NSR Steel plates to be normalized, and moreover, test pieces to be stress-relieved heat-treated

SBV 2 PTN Steel plates to be stress-relieve heat-treated, and moreover, test pieces to be normalized.

SBV 2 PTNSR Steel plates to be stress-relieve heat-treated, and moreover, test pieces to be normalized and stress-relieve heat-treated.

SBV 2 TNSR Steel plates not to be heat-treated, but test pieces only to be normalized and stress-relieve heat-treated.

8. Test

8.1 Analysis Analysis test shall be performed as follows:

- (1) The general rules for the analytical examination and the sampling of the test specimen for the ladle analysis shall be the same as those provided in 3. of JIS G 0303.
- (2) The sampling of the test specimen for the product analysis shall be the same as that specified in 3.3.1 of JIS G 0321. The tension test piece after rupture can be offered for the analytical examination.
- (3) The analysis method shall conform to one of the following Standards:

JIS G 1211	JIS G 1212	JIS G 1213	JIS G 1214
JIS G 1215	JIS G 1216	JIS G 1218	JIS G 1252
JIS G 1253	JIS G 1256	JIS G 1257	

8.2 Mechanical Test

8.2.1 The general rules for the mechanical test shall be same as those provided in 4. of JIS G 0303. However, the sampling of the test specimen shall be of Class A, and the number of test pieces and the sampling position shall be as follows:

(1) Number of Test Pieces for Tension and Bend Tests

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

(2) Sampling Position for Test Piece for Tension and Bend Tests

- (a) Tension Test Piece When the final rolling direction of the steel plate is parallel to the axial direction of the ingot, the sampling position shall be the corner of the bottom, at the time of ingot, of the steel plate. When the final rolling direction is at right angles to the axial direction of the ingot or when the correspondence is not clear, the sampling position shall be the corner of either end, and the sampling direction shall be perpendicular to the final rolling direction. When No. 10 test piece is used for the tension test, the axis of the test piece shall be situated 1/4 of thickness apart from the surface of the steel plate.
- (b) Bend Test Piece The sampling position shall be the middle part in the direction of plate width at the opposing end where the tension test piece has been sampled, and the sampling direction shall be at right angles to the final rolling direction.

8.2.2 The tension and bend test pieces shall be as follows:

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

8.2.3 The method of the tension and bend tests shall conform to one of the following Standards:

JIS Z 2241

JIS Z 2248

9. Inspection

Inspection shall be performed as follows:

- (1) The test results on chemical composition, mechanical property, shape, dimension, mass and appearance shall satisfy the requirements specified in 3., 4., 5. and 6., except that with the purchaser's designation, the test and inspection on mechanical property may be partially or wholly omitted.
- (2) In addition to the inspection specified in (1), the purchaser may designate the nondestructive inspection such as sulfur print and ultrasonic flaw detection, and impact test. In this case, the agreement shall be made in advance between the parties concerned on the sampling method, the test method, the criteria for acceptance, etc.
- (3) The steel plate which has failed in passing the tension test or the bend test or both may be retested for acceptance in accordance with the provisions of 4.4 in JIS G 0303.

10. Marking

The steel plates having passed the inspection shall be marked clearly on each plate with the following items with a suitable means:

- (1) Symbol of classification
- (2) Heat number or inspection number
- (3) Size
- (4) Manufacturer's name or its abbreviation

11. Report

The report shall comply with 8. in 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 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 1216-Methods for Determination of Nickel 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 Fluorescent X-ray 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-Tension Test Pieces for Metallic Materials
- JIS Z 2204-Bend Test Pieces for Metallic Materials
- JIS Z 2241-Method of Tension Test for Metallic Materials
- JIS Z 2248-Method of Bend Test for Metallic Materials

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