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JIS

JAPANESE INDUSTRIAL STANDARD

**Carbon Steel Pipes for
Pressure Service**

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JAPANESE INDUSTRIAL STANDARD
Carbon Steel Pipes for Pressure Service

J I S
G 3454-1988
(Reaffirmed: 1994)

1. Scope

This Japanese Industrial Standard specifies the carbon steel pipes, hereinafter referred to as the "pipes", used for pressure service at an approximate maximum temperature of 350°C. The pipes for high pressure service shall be in accordance with JIS G 3455.

- Remarks 1. Pertaining to the electric-resistance welded steel tubes, when previously agreed upon with the manufacturer, the purchaser may designate the supplementary quality requirements Z 3 or Z 4 specified in Appendix, in addition to the items specified in this text.

Appendix Z 3 Ultrasonic Examination

Appendix Z 4 Eddy Current Examination

2. The units and numerical values given in { } in this Standard are based on the International System of Units (SI) and are appended for informative reference.

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

2. Grade and Designation

The pipe shall be classified into two grades and their letter symbols shall be as given in Table 1-1 or Table 1-2.

Table 1-1. Letter Symbol of Grade
(Applicable till the end of 1990)

Letter symbol of grade
STPG 38
STPG 42

Table 1-2. Letter Symbol of Grade
(Applicable on and after Jan. 1, 1991)

Letter symbol of grade	(Informative reference) Traditional letter symbol of grade
STPG 370	STPG 38
STPG 410	STPG 42

3. Chemical Composition

The pipe shall be tested in accordance with 9.1 and the ladle analysis values obtained shall conform to Table 2-1 or Table 2-2.

Table 2-1. Chemical Composition
(Applicable till the end of 1990)

Letter symbol of grade	Unit: %				
	C	Si	Mn	P	S
STPG 38	0.25 max.	0.35 max.	0.30 to 0.90	0.040 max.	0.040 max.
STPG 42	0.30 max.	0.35 max.	0.30 to 1.00	0.040 max.	0.040 max.

Table 2-2. Chemical Composition
(Applicable on and after Jan. 1, 1991)

Letter symbol of grade	Unit: %				
	C	Si	Mn	P	S
STPG 370	0.25 max.	0.35 max.	0.30 to 0.90	0.040 max.	0.040 max.
STPG 410	0.30 max.	0.35 max.	0.30 to 1.00	0.040 max.	0.040 max.

4. Mechanical Properties

4.1 Tensile Strength, Yield Point or Proof Stress and Elongation The pipe shall be tested in accordance with 9.2 and the tensile strength, yield point or proof stress and elongation obtained shall comply with Table 3-1 or Table 3-2.

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

Letter symbol of grade	Tensile strength kgf/mm ² {N/mm ² }	Yield point or proof stress kgf/mm ² {N/mm ² }	Elongation %				
			No. 11 and No. 12 test pieces	No. 5 test piece		No. 4 test piece	
				Longitudinal	Transverse	Longitudinal	Transverse
STPG 38	38 {373} min.	22 {216} min.	30 min.	25 min.	28 min.	23 min.	
STPG 42	42 {412} min.	25 {245} min.	25 min.	20 min.	24 min.	19 min.	

- Remarks 1. When the tensile test is carried out for No. 12 or No. 5 test piece for the pipe under 8 mm in wall thickness, the minimum value of elongation shall be obtained by subtracting 1.5% from the values of elongation given in Table 3-1 for each 1 mm decrease in wall thickness, and rounding off to an integer in accordance with JIS Z 8401. Examples of calculation are given in Informative Reference Table 1.
2. The values of elongation given in Table 3-1 shall not be applied to the pipe whose nominal diameter is 25 A or smaller. However, the value of elongation shall be recorded.
3. In sampling the tensile test pieces from the electric resistance welded steel pipe, No. 12 or No. 5 test piece shall be taken from the portion not involving welded seams.

Informative Reference Table 1. Examples of Elongation Values Calculated for No. 12 Test Piece (Longitudinal) and No. 5 Test Piece (Transverse) Taken from Pipes under 8 mm in Wall Thickness

(Applicable till the end of 1990)

Letter symbol of grade	Shape of test piece	Elongation value relating to wall thickness %						
		Over 7 mm to and excl. 8 mm	Over 6 mm up to and incl. 7 mm	Over 5 mm up to and incl. 6 mm	Over 4 mm up to and incl. 5 mm	Over 3 mm up to and incl. 4 mm	Over 2 mm up to and incl. 3 mm	Over 1 mm up to and incl. 2 mm
STPG 38	No. 12 test piece	30	28	27	26	24	22	21
	No. 5 test piece	25	24	22	20	19	18	16
STPG 42	No. 12 test piece	25	24	22	20	19	18	16
	No. 5 test piece	20	18	17	16	14	12	11

Table 3-2. Mechanical Properties
(Applicable on and after Jan. 1, 1991)

Letter symbol of grade	Tensile strength N/mm ²	Yield points or proof stress N/mm ²	Elongation %			
			No. 11 and No. 12 test pieces	No. 5 test piece	No. 4 test piece	
					Longitudinal	Transverse
STPG 370	370 min.	215 min.	30 min.	25 min.	28 min.	23 min.
STPG 410	410 min.	245 min.	25 min.	20 min.	24 min.	19 min.

- Remarks 1. When the tensile test is carried out for No. 12 or No. 5 test piece for the pipe under 8 mm in wall thickness, the minimum value of elongation shall be obtained by subtracting 1.5 % from the values of elongation given in Table 3-2 for each 1 mm decrease in wall thickness, and rounding off to an integer in accordance with JIS Z 8401. Examples of calculation are given in Informative Reference Table 2.
2. The values of elongation given in Table 3-2 shall not be applied to the pipe whose nominal diameter is 25 A or smaller. However, the value of elongation shall be recorded.
3. In sampling the tensile test pieces from the electric resistance welded steel pipe, No. 12 or No. 5 test piece shall be taken from the portion not involving welded seams.

Informative Reference Table 2. Examples of Elongation Values Calculated for No. 12 Test Piece (Longitudinal) and No. 5 Test Piece (Transverse) Taken from Pipes under 8 mm in Wall Thickness

(Applicable on and after Jan. 1, 1991)

Letter symbol of grade	Shape of test piece	Elongation value relating to wall thickness %						
		Over 7 mm to and excl. 8 mm	Over 6 mm up to and incl. 7 mm	Over 5 mm up to and incl. 6 mm	Over 4 mm up to and incl. 5 mm	Over 3 mm up to and incl. 4 mm	Over 2 mm up to and incl. 3 mm	Over 1 mm up to and incl. 2 mm
STPG 370	No. 12 test piece	30	28	27	26	24	22	21
	No. 5 test piece	25	24	22	20	19	18	16
STPG 410	No. 12 test piece	25	24	22	20	19	18	16
	No. 5 test piece	20	18	17	16	14	12	11

4.2 Flatness When tested in accordance with 9.3, the pipe shall not generate flaws or cracks on its wall surface. In this case, the distance between the two plates shall be in accordance with the following formula:

In the case of seamless steel pipe:

$$H = \frac{(1+\epsilon) t}{\epsilon + \frac{1}{D}}$$

In the case of electric resistance welded steel pipe:

$$\text{for weld} = H = \frac{2}{3}D$$

$$\text{for the portion without weld} = H = \frac{1}{3}D$$

where (Applicable till the end of 1990)

H : distance between flattening plates (mm)

t : wall thickness of pipe (mm)

D : outside diameter of pipe (mm)

ϵ : constant individually defined for each grade of pipe,
0.08 for STPG 38,
0.07 for STPG 42

where (Applicable on and after Jan. 1, 1991)

H : distance between flattening plates (mm)

t : wall thickness of pipe (mm)

D : outside diameter of pipe (mm)

ϵ : constant individually defined for each grade of pipe,
0.08 for STPG 370,
0.07 for STPG 410

4.3 Bendability For the pipe whose nominal diameter is 40 A or smaller, the purchaser may specify the bending test instead of the flattening test. In the test of 9.4, the pipe shall be free from the occurrence of flaws or cracks on its wall surface. In this case, the pipe shall be bent through 90° around an inside radius that is 6 times its outside diameter.

However, the purchaser may specify the bend test in which the bend angle is 180° and the bending inside radius is 4 times the outside diameter.

5. Hydrostatic Test or Nondestructive Test

The pipe shall be tested in accordance with 9.5 and the resulting hydrostatic characteristic or nondestructive characteristic shall conform to either of the following two. The preference for which of them shall be left to the specification by the purchaser or to the discretion of the manufacturer.

5.1 Hydrostatic Test When a hydrostatic pressure specified in Attached Table 1-1 or 1-2 is applied, the pipe shall withstand it without leakage.

5.2 Nondestructive Test A nondestructive examination by either an ultrasonic test or an eddy current test shall be made on the pipe, and there shall be no signal greater than those produced by the artificial defects of the reference test block of division UD of the working sensitivity specified in JIS G 0582 or of division EY of the working sensitivity specified in JIS G 0583.

6. Dimensions, Mass and Dimensional Tolerances

6.1 Dimensions and Mass The outside diameter, wall thickness and mass of the pipe shall be as specified in Attached Table 2.

6.2 Dimensional Tolerances The tolerances on the outside diameter and wall thickness of the pipe shall conform to Table 4.

The length of a pipe shall be 4000 mm or over.

Table 4. Tolerances on Outside Diameter and Wall Thickness

Division	Tolerances on outside diameter	Tolerances on wall thickness
Hot-finished seamless steel pipe	40 A or under ± 0.5 mm	Under 4 mm + 0.6 mm - 0.5 mm
	50 A or over up to and incl. 125 A ± 1 %	4 mm or over + 15 % - 12.5 %
	150 A ± 1.6 mm	
	200 A or over ± 0.8 % For the pipe of nominal size 350 A or over, the tolerances on outside diameter may be determined by the measurement of the length of circumference. In this case, the tolerances shall be ± 0.5 %.	
Cold-finished seamless steel pipe and electric resistance welded steel pipe	25 A or under ± 0.3 mm	Under 3 mm ± 0.3 mm
	32 A or over ± 0.8 % For the pipe of nominal size 350 A or over, the tolerances on outside diameter may be determined by the measurement of the length of circumference. In this case, the tolerances shall be ± 0.5 %.	3 mm or over ± 10 %

Remarks 1. When the length of circumference is used in measuring the outside diameter, either the measured value of the length of circumference or the diameter derived from the measured value may be used as the criteria. In both cases, the same value (± 0.5 %) of tolerances shall be applied. The diameter (D) and the length of circumference (l) shall be calculated reversibly from the following formula.

$$l = \pi \cdot D$$

where $\pi = 3.1416$

2. In the case where the tolerances on wall thickness are confirmed to meet the specifications in the above table, the tolerances on outside diameter in the above table shall not be applied to the local part being subjected to repairing, etc.

7. Appearance

- (1) The pipe shall be practically straight, and its both ends shall be at a right angle to its axis.
- (2) The inside and outside surfaces of the pipe shall be well-finished and free from defects that are detrimental to practical use.

8. Method of Manufacture

The method of manufacture shall be as follows:

(1) The pipe shall be manufactured by either the seamless or the electric resistance welding process.

(2)-1 (Applicable till the end of 1990) The pipe shall stay as manufactured. However, the cold-finished steel pipe shall be annealed after manufacture.

The purchaser may specify heat treatment for the weld of the electric resistance welded steel pipe of grade STPG 42, as necessary.

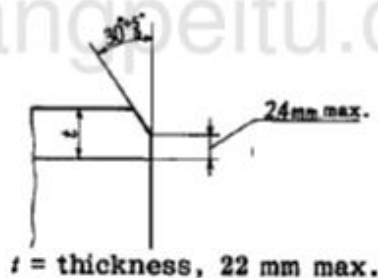
(2)-2 (Applicable on and after Jan. 1, 1991) The pipe shall stay as manufactured. However, the cold-finished steel pipe shall be annealed after manufacture.

The purchaser may specify heat treatment for the weld of the electric resistance welded steel pipe of grade STPG 410, as necessary.

(3) When required by the purchaser, the pipe may be furnished with a bevel end⁽¹⁾

Note ⁽¹⁾ Unless otherwise specified, the shape of the bevel end shall be as shown in Fig. 1.

Fig. 1. Shape of Bevel End



9. Test

9.1 Chemical Analysis

9.1.1 Chemical Analysis General matters common to chemical analysis and method of sampling specimens for analysis shall be in accordance with 3. in JIS G 0303.

9.1.2 Analytical Method The analytical method shall be in accordance with one of the following Standards.

JIS G 1211

JIS G 1212

JIS G 1213

JIS G 1214

JIS G 1215

JIS G 1253

JIS G 1256

JIS G 1257

9.2 Tensile Test

9.2.1 Test Piece The test piece shall be No. 11, No. 12 A, No. 12 B, No. 12 C, No. 4 or No. 5 test piece specified in JIS Z 2201 and shall be sampled from a pipe. In this case, the gauge length for No. 4 test piece shall be 50 mm.

9.2.2 Test Method The test method shall be in accordance with JIS Z 2241.

9.3 Flattening Test

9.3.1 Test Piece A test piece 50 mm or over in length shall be cut off from the end of a pipe.

9.3.2 Test Method The test piece shall be placed between two flat plates at ordinary temperature and flattened by compression until the distance between the plates comes to the specified value, and checked for the occurrence of flaws or cracks on its wall surface. For the electric resistance welded steel pipe, the weld shall be placed at right angles to the direction of compression, and either the weld in case $H = 2/3 D$ or the portion other than the weld in case $H = 1/3 D$ shall be examined as shown in Fig. 2 and Fig. 3.

Fig. 2. Flattening Test of Weld

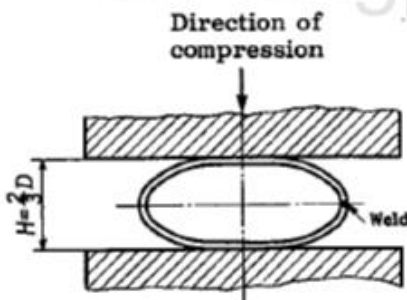
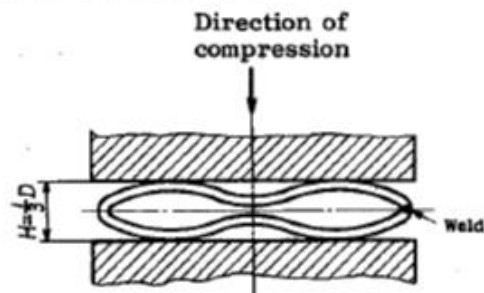


Fig. 3. Flattening Test of Portion Other Than Weld



9.4 Bending Test

9.4.1 Test Piece A test piece with an appropriate length shall be cut off from the end of a pipe.

9.4.2 Test Method The test piece shall be bent at ordinary temperature through the angle around a cylinder with the inside radius specified in 4.3, and checked for the occurrence of flaws or cracks on its wall surface. In this case, for the electric resistance welded steel pipe, the weld shall be placed in the outermost bent portion.

9.5 Hydrostatic Test or Nondestructive Examination The hydrostatic test or nondestructive examination shall be in accordance with either one of the following:

- (1) When the pipe is subjected to hydrostatic pressure and kept under the specified pressure, its strength to withstand the pressure without leakage shall be examined.

- (2) The test method of nondestructive examination shall be in accordance with either JIS G 0582 or JIS G 0583.

10. Inspection

10.1 Inspection Inspection shall be as following:

- (1) General matters common to inspection shall be in accordance with JIS G 0303.
- (2) The chemical composition, mechanical properties, hydrostatic characteristic or nondestructive characteristic, dimensions and appearance shall conform to the requirements specified in 3., 4., 5., 6., and 7. However, appropriate nondestructive examinations other than those specified in 9.5 (2) may substitute as agreed upon by the purchaser and the manufacturer.
- Further, when the supplementary quality requirements given in Appendix are specified by agreement between the purchaser and the manufacturer, the results of inspection shall conform to the requirements specified in Z 3 or Z 4.
- (3) Either the hydrostatic test or the nondestructive examination shall be performed for each pipe.
- (4) For the tensile test and flattening test or bending test, take pipes as test specimens as specified in Table 5, and take one test piece from each test specimen.

Table 5. Method of Sampling Specimen

Division	Method of sampling specimen and number of test pieces
Nominal diameter, 50 A or under	One shall be taken from each 1000 pipes or its fraction of the same dimensions ⁽²⁾
Nominal diameter, 65 A or over up to and incl. 125 A	One shall be taken from each 500 pipes or its fraction of the same dimensions
Nominal diameter, 150 A or over up to and incl. 300 A	One shall be taken from each 250 pipes or its fraction of the same dimensions
Nominal diameter, 350 A or over	One shall be taken from each 150 pipes or its fraction of the same dimensions

Note (2) The expression "same dimensions" means the same outside diameter as well as the same wall thickness.

10.2 Reinspection The pipe may be determined for final acceptance by a retest specified in 4.4 in JIS G 0303.

11. Marking

Each pipe having passed the inspection shall be marked with the following items. However, the smaller pipes or other pipes specified by the purchaser may be bundled together and marked for each bundle by a suitable means. In both cases, the order of arranging the marked items is not specified.

When approved by the purchaser, a part of the items may be omitted.

- (1) Letter symbol of grade
- (2) Letter symbol indicating the manufacturing processes⁽³⁾
- (3) Dimensions⁽⁴⁾
- (4) Manufacturer's name or its identifying brand
- (5) Letter symbol denoting the supplementary quality requirement, Z

Notes ⁽³⁾ The letter symbol indicating the manufacturing processes⁽³⁾ shall be as follows, provided that the dash may be omitted leaving a blank.

Hot-finished seamless steel pipe-S-H

Cold-finished seamless steel pipe-S-C

Electric resistance welded steel pipe other than hot-finished and cold-finished ones-E-G

Hot-finished electric resistance welded steel pipe-E-H

Cold-finished electric resistance welded steel pipe-E-C

⁽⁴⁾ The dimensions shall be expressed as follows.

Nominal diameter x nominal wall thickness

Example: 50 A x Sch 40, or 2 B x Sch 40

12. Report

The manufacturer shall submit the test report when previously required by the purchaser.

Attached Table 1-1. Hydrostatic Test Pressure
(Applicable till the end of 1990)

Unit: kgf/cm²{bar}

Schedule number Sch	10	20	30	40	60	80
Hydrostatic test pressure	20 {20}	35 {34}	50 {49}	60 {59}	90 {88}	120 {118}

Remark: 1 bar = 10⁵ Pa

Attached Table 1-2. Hydrostatic Test Pressure
(Applicable on and after Jan. 1, 1991)

Unit: MPa

Schedule number Sch	10	20	30	40	60	80
Hydrostatic test pressure	2.0	3.5	5.0	6.0	9.0	12

Attached Table 2. Dimensions and Mass of Carbon Steel Pipes for Pressure Service

Nominal diameter		Outside dia. mm	Nominal wall thickness											
			Schedule 10		Schedule 20		Schedule 30		Schedule 40		Schedule 60		Schedule 80	
			Wall thick. mm	Unit mass kg/m	Wall thick. mm	Unit mass kg/m	Wall thick. mm	Unit mass kg/m	Wall thick. mm	Unit mass kg/m	Wall thick. mm	Unit mass kg/m	Wall thick. mm	Unit mass kg/m
A	B													
6	1/8	10.5	—	—	—	—	—	—	1.7	0.369	2.2	0.450	2.4	0.479
8	1/4	13.8	—	—	—	—	—	—	2.2	0.629	2.4	0.675	3.0	0.799
10	3/8	17.3	—	—	—	—	—	—	2.3	0.851	2.8	1.00	3.2	1.11
15	1/2	21.7	—	—	—	—	—	—	2.8	1.31	3.2	1.46	3.7	1.64
20	3/4	27.2	—	—	—	—	—	—	2.9	1.74	3.4	2.00	3.9	2.24
25	1	34.0	—	—	—	—	—	—	3.4	2.57	3.9	2.89	4.5	3.27
32	1 1/4	42.7	—	—	—	—	—	—	3.6	3.47	4.5	4.24	4.9	4.57
40	1 1/2	48.6	—	—	—	—	—	—	3.7	4.10	4.5	4.89	5.1	5.47
50	2	60.5	—	—	3.2	4.52	—	—	3.9	5.44	4.9	6.72	5.5	7.46
65	2 1/2	76.3	—	—	4.5	7.97	—	—	5.2	9.12	6.0	10.4	7.0	12.0
80	3	89.1	—	—	4.5	9.39	—	—	5.5	11.3	6.6	13.4	7.6	15.3
90	3 1/2	101.6	—	—	4.5	10.8	—	—	5.7	13.5	7.0	16.3	8.1	18.7
100	4	114.3	—	—	4.9	13.2	—	—	6.0	16.0	7.1	18.8	8.6	22.4
125	5	139.8	—	—	5.1	16.9	—	—	6.6	21.7	8.1	26.3	9.5	30.5
150	6	165.2	—	—	5.5	21.7	—	—	7.1	27.7	9.3	35.8	11.0	41.8
200	8	216.3	—	—	6.4	33.1	7.0	36.1	8.2	42.1	10.3	52.3	12.7	63.8
250	10	267.4	—	—	6.4	41.2	7.8	49.9	9.3	59.2	12.7	79.8	15.1	93.9
300	12	318.5	—	—	6.4	49.3	8.4	64.2	10.3	78.3	14.3	107	17.4	129
350	14	355.6	6.4	55.1	7.9	67.7	9.5	81.1	11.1	94.3	15.1	127	19.0	158
400	16	406.4	6.4	63.1	7.9	77.6	9.5	93.0	12.7	123	16.7	160	21.4	203
450	18	457.2	6.4	71.1	7.9	87.5	11.1	122	14.3	156	19.0	205	23.8	254
500	20	508.0	6.4	79.2	9.5	117	12.7	155	15.1	184	20.6	248	26.2	311
550	22	558.8	6.4	87.2	9.5	129	12.7	171	15.9	213	—	—	—	—
600	24	609.6	6.4	95.2	9.5	141	14.3	210	—	—	—	—	—	—
650	26	660.4	7.9	127	12.7	203	—	—	—	—	—	—	—	—

- Remarks 1. The designation of the pipes shall be based on the nominal diameter and nominal wall thickness (schedule number: Sch). However, for the nominal diameter, either A or B shall be used, with the letter symbol A or B suffixed to the figures of nominal diameter for identification.
2. The mass value shall be calculated from the following formula assuming 1 cm³ of steel to be 7.85 g and rounded off to 3 significant figures in accordance with JIS Z 8401.
- $$W = 0.02466 t (D - t)$$
- where W : unit mass of pipe (kg/m)
 t : wall thickness of pipe (mm)
 D : outside diameter of pipe (mm)
3. The dimensions enclosed by the bold-faced lines indicate the pipes most frequently used.

Appendix. Supplementary Quality Requirements

The supplementary quality requirements shall be applied when requested by the purchaser, and the designated items among them shall be carried out by the manufacturer.

Z 3 Ultrasonic Examination

- (1) The criterion of the working sensitivity for the ultrasonic examination shall comply with the division UC specified in JIS G 0582, and there shall be no signal greater than those produced by the artificial defects of the reference test block.
- (2) The test method of the ultrasonic examination shall be in accordance with JIS G 0582.
- (3) The ultrasonic examination shall be performed for each pipe and the results shall conform to the requirements specified in (1).

Z 4 Eddy Current Examination

- (1) The criterion of the working sensitivity for the eddy current examination shall comply with the division EW specified in JIS G 0583, and there shall be no signal greater than those produced by the artificial defects of the reference test block.
- (2) The test method of the eddy current examination shall be in accordance with JIS G 0583.
- (3) The eddy current examination shall be performed for each pipe and the results shall conform to the requirements specified in (1).

Applicable Standards:

- JIS G 0303-General Rules for Inspection of Steel
- JIS G 0582-Ultrasonic Examination of Steel Pipes and Tubes
- JIS G 0583-Eddy Current Examination of Steel Pipes and Tubes
- 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 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 3455-Carbon Steel Pipes for High Pressure Service
- JIS Z 2201-Test Pieces for Tensile Test for Metallic Materials
- JIS Z 2241-Method of Tensile Test for Metallic Materials
- JIS Z 8401-Rules for Rounding Off of Numerical Values