JIS

JAPANESE INDUSTRIAL STANDARD

Carbon Steel Pipes for High Pressure Service

JIS G 3455-1988

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

Carbon Steel Pipes for High Pressure Service   G 3455-1988
(Reaffirmed: 1994)

1. Scope

This Japanese Industrial Standard specifies the carbon steel pipes, hereinafter referred to as the "pipes", used for high pressure service at an approximate maximum temperature of 350°C.

> Remarks 1. With the previous agreement of the manufacturer, the purchaser may designate part or all of the supplementary quality requirements Z 2, Z 3, Z 4 and Z 5 specified in Appendix, in addition to the items specified in this text.
>
>   Appendix Z 2:   Elevated Temperature Yield Point or Proof Stress
>
>   Appendix Z 3:   Ultrasonic Examination
>
>   Appendix Z 4:   Eddy Current Examination
>
>   Appendix Z 5:   Charpy Impact Test
>
> 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 three 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
STS 38
STS 42
STS 49

Table 1-2. Letter Symbol of Grade

(Applicable on and after Jan. 1, 1991)

Letter symbol of grade	(Informative reference) Traditional symbol
STS 370	STS 38
STS 410	STS 42
STS 480	STS 49

3. Chemical Composition

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

Table 2-1. Chemical Composition

(Applicable to the end of 1990)

Unit: %

Letter symbol of grade	C	Si	Mn	P	S
STS 38	0.25 max.	0.10 to 0.35	0.30 to 1.10	0.035 max.	0.035 max.
STS 42	0.30 max.	0.10 to 0.35	0.30 to 1.40	0.035 max.	0.035 max.
STS 49	0.33 max.	0.10 to 0.35	0.30 to 1.50	0.035 max.	0.035 max.

Remark: When product analysis is required by the purchaser, the tolerances on the above-mentioned values shall be as given in Table 2 in JIS G 0321.

Table 2-2. Chemical Composition

(Applicable on and after Jan. 1, 1991)

Unit: %

Letter symbol of grade	C	Si	Mn	P	S
STS 370	0.25 max.	0.10 to 0.35	0.30 to 1.10	0.035 max.	0.035 max.
STS 410	0.30 max.	0.10 to 0.35	0.30 to 1.40	0.035 max.	0.035 max.
STS 480	0.33 max.	0.10 to 0.35	0.30 to 1.50	0.035 max.	0.035 max.

Remark: When product analysis is required by the purchaser, the tolerances on the above-mentioned values shall be as given in Table 2 in JIS G 0321.

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 of the pipe obtained shall comply with Table 3-1 or Table 3-2.

Table 3-1. Mechanical Properties

(Applicable to the end of 1990)

Letter symbol of grade	Tensile strength kgf/mm² {N/mm²}	Yield point or proof stress kgf/mm² {N/mm²}	Elongation %				
			No.11 and No.12 test pieces	No.5 test piece	No.4 test piece	
			Longi-tudinal	Trans-verse	Longi-tudinal	Trans-verse
STS 38	38 {373} min.	22 {216} min.	30 min.	25 min.	28 min.	23 min.
STS 42	42 {412} min.	25 {245} min.	25 min.	20 min.	24 min.	19 min.
STS 49	49 {481} min.	28 {275} min.	25 min.	20 min.	22 min.	17 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 value of elongation given in Table 3-1 shall not be applied to the pipe whose nominal outside diameter is under 40 mm. However, the value of elongation shall be recorded.

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

(Applicable to the end of 1990)

Letter symbol of grade	Shape of test piece	Elongation value relating to wall thickness %						
		Over 7 mm up 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
STS 38	No.12 test piece	30	28	27	26	24	22	21
	No.5 test piece	25	24	22	20	19	18	16
STS 42 STS 49	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 point or proof stress N/mm^2	Elongation %			
			No.11 and No.12 test piece	No.5 test piece	No.4 test piece	
			Longitudinal	Transverse	Longitudinal	Transverse
STS 370	370 min.	215 min.	30 min.	25 min.	28 min.	23 min.
STS 410	410 min.	245 min.	25 min.	20 min.	24 min.	19 min.
STS 480	480 min.	275 min.	25 min.	20 min.	22 min.	17 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 value of elongation given in Table 3-2 shall not be applied to the pipe whose nominal outside diameter is under 40 mm. However, the value of elongation shall be recorded.

Informative Reference Table 2.   Examples of Elongation Values Calculated for No. 12 Test Piece (Longitudinal) and No. 5 Test Piece (Transverse) for 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 up 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
STS 370	No.12 test piece	30	28	27	26	24	22	21
	No.5 test piece	25	24	22	20	19	18	16
STS 410 STS 480	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:

$$H = \frac{(1+e)\,t}{e + \dfrac{t}{D}}$$

where   (Applicable to the end of 1990)

H :   distance between flattening plates (mm)

t :   wall thickness of pipe (mm)

D :   outside diameter of pipe (mm)

e :   constant individually defined for each grade of pipe, 0.08 for STS 38, 0.07 for STS 42 and STS 49

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)

e :   constant individually defined for each grade of pipe,
0.08 for STS 370,
0.07 for STS 410 and STS 480

4.3 Bending   For the pipe whose outside diameter is 50 mm 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.

5. Hydrostatic Characteristic or Nondestructive Characteristic

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 specification by the purchaser or to the discretion of the manufacturer.

5.1-1 Hydrostatic Characteristic (Applicable to the end of 1990)   When a hydrostatic pressure that is specified by the purchaser, or in the absence of that specification, the values given in Attached Table 1-1 is applied, the pipe shall withstand it without leakage. In this case, the purchaser may specify a value of pressure lower or higher than those given in Attached Table 1-1.

In a hydrostatic pressure test designated by the purchaser, a test pressure exceeding either the value of P calculated from the following formula or 200 kgf/cm² {196 bar} shall be agreed upon by the purchaser and the manufacturer. In this case, the hydrostatic test pressure shall be expressed in each 5 kgf/cm² {4.9 bar} and its multiples, and in calculation, the value P in the following formula shall be obtained to the number of units and rounded off to the nearest 5 kgf/cm² {4.9 bar}.

$$P = \frac{200\,st}{D}$$

where P :   test pressure [kgf/cm² {10^{-1} bar}([1])]

t :   wall thickness of pipe (mm)

D :   outside diameter of pipe (mm)

s :   60 % of the minimum value of yield point or proof stress specified in Table 3-1 [kgf/mm²{N/mm²}]

Note ([1])   1 bar = 10^5Pa

5.1-2 Hydrostatic Characteristic   (Applicable on and after Jan. 1, 1991) When a hydrostatic pressure that is specified by the purchaser, or in the absence of that specification, the values given in Attached Table 1-2 is applied, the pipe shall withstand it without leakage. In this case, the purchaser may specify a value of pressure lower or higher than those given in Attached Table 1-2.

In a hydrostatic pressure test designated by the purchaser, a test pressure exceeding either the value of P calculated from the following formula or 20 MPa shall be agreed upon by the purchaser and the manufacturer. In this case, the hydrostatic test pressure shall be graduated in 0.5 MPa for under 10 MPa and in 1 MPa for 10 MPa or over, and in calculation, the value P shall be calculated from the following formula and rounded off to the nearest 0.5 MPa or 1 MPa.

$$P = \frac{2st}{D}$$

where P : test pressure (MPa)

           t : wall thickness of pipe (mm)

           D : outside diameter of pipe (mm)

           s : 60 % of the minimum value of yield point or proof stress specified in Table 3-2 (N/mm²)

5.2 Nondestructive Examination Characteristic 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, Weight and Dimensional Tolerances

6.1 Dimensions and Weight 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, wall thickness and wall thickness deviation of the pipe shall conform to Table 4.

In the case where the pipe length is designated, the value shall be the minimum length.

Table 4. Tolerances on Outside Diameter, Wall Thickness and
Wall Thickness Deviation

Division	Tolerances on outside diameter	Tolerances on wall thickness	Tolerances on wall thickness deviation
Hot-finished seamless steel pipe	Under 50 mm: ± 0.5 mm	Under 4 mm: ± 0.5 mm 4 mm or over: ± 12.5 %	Within 20 % of wall thickness
	50 mm or over to and excl. 160 mm: ± 1 %		
	160 mm or over to and excl. 200 mm: ± 1.6 mm		
	200 mm or over: ± 0.8 % For the pipe 350 mm 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	Under 40 mm: ± 0.3 mm	Under 2 mm: ± 0.2 mm 2 mm or over: ± 10 %	—
	40 mm or over: ± 0.8 % For the pipe 350 mm 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 %.		

Remarks 1. The wall thickness deviation means the ratio of the difference between the maximum and the minimum of the wall thickness measured in the same section to the specified wall thickness. The wall thickness deviation shall not be applied to the pipe under 5.6 mm in wall thickness.

2. 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 $\pi = 3.1416$

3. In the case where the tolerances on wall thickness are con-
firmed 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

Appearance shall be as follows:

(1) The pipe shall be practically straight, and its both ends shall be at
right angles 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

Method of manufacture shall be as follows:

(1) The pipe shall be manufactured from killed steel by the seamless
process.

(2) The pipe shall be subjected to the heat treatment specified in Table
5-1 or Table 5-2. The heat treatment other than those specified in
Table 5-1 or Table 5-2 shall be agreed upon by the purchaser and the
manufacturer.

(3) When required by the purchaser, the pipe may be furnished with a
bevel end([2]).

Note ([2]) Unless otherwise specified, the shape of the bevel end shall
be as shown in Fig. 1.

Fig. 1. Shape of Bevel End
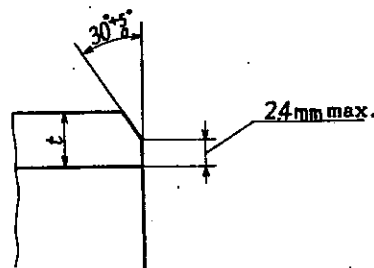
t : thickness, 22 mm max.

Table 5-1. Heat Treatment

(Applicable to the end of 1990)

Letter symbol of grade	Hot-finished seamless steel pipe	Cold-finished seamless steel pipe
STS 38 STS 42	As manufactured. However, low temperature annealing or normalizing may be applied, as necessary.	Low temperature annealed or normalized
STS 49	Low temperature annealed or normalized	

Table 5-2. Heat Treatment

(Applicable on and after Jan. 1, 1991)

Letter symbol of grade	Hot-finished seamless steel pipe	Cold-finished seamless steel pipe
STS 370 STS 410	As manufactured. However, low temperature annealing or normalizing may be applied, as necessary.	Low temperature annealed or normalized
STS 480	Low temperature annealed or normalized	

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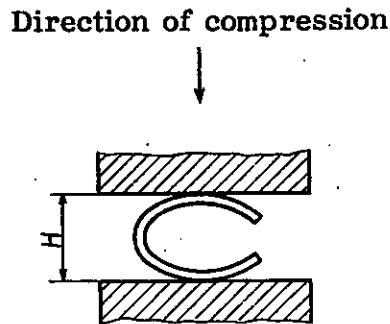
9.2.2 Test Method   The test method shall be in accordance with JIS Z 2241.

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. From the pipe whose wall thickness is 15 % and over of the outside diameter, a C-shape test piece may be prepared by removing a part of the circumference of the full-section test piece may be used.

9.3.2 Test Method   The test piece shall be placed between two flat plates at ordinary temperatures and flattened by compression until the distance between the plates comes to the specified value, and examined for the occurrence of flaws or cracks on its wall surface. In this case, the C-shape test piece shall be placed as shown in Fig. 2.

Fig. 2. Flattening Test (for C-Shape Test Piece)

Direction of compression

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 examined for the occurrence of flaws or cracks on its wall surface.

9.5 Hydrostatic Test or Nondestructive Examination   The hydrostatic test or nondestructive examination shall be in accordance with 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 follows:

   (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 examination 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 2, Z 3, Z 4 or Z 5.

   (3)   Either the hydrostatic test or the nondestructive examination shall be performed for each pipe.

   (4)   The number of specimens for the product analysis shall be as agreed upon by the purchaser and the manufacturer.

(5) The method of sampling test specimens and the number of test pieces for tensile test and flattening test or bending test shall be as follows. For the pipe as-manufactured, take one pipe as the specimen from each 50 pipes or its fraction of the same dimensions([3]), while for the pipe to be heat-treated, take one pipe as the specimen from each 50 pipes or its fraction of the same dimensions([3]) and of the concurrent heat treatment, and then take one tensile test piece from the test specimen. Further, for the pipe up under 50 mm in outside diameter, take one test piece for the flattening test or the bending test, while for the pipe over 50 mm in outside diameter, take one flattening test piece.

Note ([3]) The term "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 requirements of 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, part of the items may be omitted.

(1) Letter symbol of grade

(2) Letter symbol indicating the manufacturing process([4])

(3) Dimensions([5])

(4) Manufacturer's name or its identifying brand

(5) Letter symbol Z indicating the supplementary quality specification

Notes ([4]) The letter symbol indicating the manufacturing process 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

([5]) The dimensions shall be expressed as follows:

Nominal dia. x nominal wall thickness or outside dia. x wall thickness

Example: 50 A x Sch 80

12. Report

The manufacturer shall, as a rule, submit to the purchaser the report carrying the test results, method of manufacture, ordered dimensions, quantity and work lot number traceable to the manufacturing conditions, etc.

Attached Table 1-1. Hydrostatic Test Pressure

(Applicable to the end of 1990)

Unit: kgf/cm²{bar}

Schedule number Sch	40	60	80	100	120	140	160
Hydrostatic test pressure	60 {59}	90 {88}	120 {118}	150 {147}	180 {177}	200 {196}	200 {196}

Remark: For the pipe whose dimension is other than those given in Attached Table 2, the hydrostatic test pressure shall conform to the following table depending on the division of the ratio (t/D) of the wall thickness to the outside diameter of the pipe.

Unit: kgf/cm² {bar}

t/D (%)	Over 0.80 up to and incl. 1.60	Over 1.60 up to and incl. 2.40	Over 2.40 up to and incl. 3.20	Over 3.20 up to and incl. 4.00	Over 4.00 up to and incl. 4.80	Over 4.80 up to and incl. 5.60	Over 5.60 up to and incl. 6.30	Over 6.30 up to and incl. 7.10	Over 7.10 up to and incl. 7.90	Over 7.90
Hydrostatic test pressure	20 {20}	40 {39}	60 {59}	80 {78}	100 {98}	120 {118}	140 {137}	160 {157}	180 {177}	200 {196}

Attached Table 1-2. Hydrostatic Test Pressure

(Applicable on and after Jan. 1, 1991)

Unit: MPa

Schedule number Sch	40	60	80	100	120	140	160
Hydrostatic test pressure	6.0	9.0	12	15	18	20	20

Remark: For the pipe whose dimension is other than those given in Attached Table 2, the hydrostatic test pressure shall conform to the following table depending on the division of the ratio (t/D) of the wall thickness to the outside diameter of the pipe.

Attached Table 1-2   (Continued)

Unit: MPa

t/D (%)	Over 0.80 up to and incl. 1.60	Over 1.60 up to and incl. 2.40	Over 2.40 up to and incl. 3.20	Over 3.20 up to and incl. 4.00	Over 4.00 up to and incl. 4.80	Over 4.80 up to and incl. 5.60	Over 5.60 up to and incl. 6.30	Over 6.30 up to and incl. 7.10	Over 7.10 up to and incl. 7.90	Over 7.90
Hydrostatic test pressure	2.0	4.0	6.0	8.0	10	12	14	16	18	20

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

| Nominal diameter | | Outside dia. | Nominal wall thickness | | | | | | | | | | | | |
| | | | Schedule 40 | | Schedule 60 | | Schedule 80 | | Schedule 100 | | Schedule 120 | | Schedule 140 | | Schedule 160 | |
A	B	mm	Thickness mm	Unit mass kg/m	Thickness mm	Unit mass kg/m	Thickness mm	Unit mass kg/m	Thickness mm	Unit mass kg/m	Thickness mm	Unit mass kg/m	Thickness mm	Unit mass kg/m	Thickness mm	Unit mass kg/m
6	1/8	10.5	1.7	0.369	—	—	2.4	0.479	—	—	—	—	—	—	—	—
8	1/4	13.8	2.2	0.629	—	—	3.0	0.799	—	—	—	—	—	—	—	—
10	3/8	17.3	2.3	0.851	—	—	3.2	1.11	—	—	—	—	—	—	—	—
15	1/2	21.7	2.8	1.31	—	—	3.7	1.64	—	—	—	—	—	—	4.7	1.97
20	3/4	27.2	2.9	1.74	—	—	3.9	2.24	—	—	—	—	—	—	5.5	2.94
25	1	34.0	3.4	2.57	—	—	4.5	3.27	—	—	—	—	—	—	6.4	4.36
32	1 1/4	42.7	3.6	3.47	—	—	4.9	4.57	—	—	—	—	—	—	6.4	5.73
40	1 1/2	48.6	3.7	4.10	—	—	5.1	5.47	—	—	—	—	—	—	7.1	7.27
50	2	60.5	3.9	5.44	—	—	5.5	7.46	—	—	—	—	—	—	8.7	11.1
65	2 1/2	76.3	5.2	9.12	—	—	7.0	12.0	—	—	—	—	—	—	9.5	15.6
80	3	89.1	5.5	11.3	—	—	7.6	15.3	—	—	—	—	—	—	11.1	21.4
90	3 1/2	101.6	5.7	13.5	—	—	8.1	18.7	—	—	—	—	—	—	12.7	27.8
100	4	114.3	6.0	16.0	—	—	8.6	22.4	—	—	11.1	28.2	—	—	13.5	33.6
125	5	139.8	6.6	21.7	—	—	9.5	30.5	—	—	12.7	39.8	—	—	15.9	48.6
150	6	165.2	7.1	27.7	—	—	11.0	41.8	—	—	14.3	53.2	—	—	18.2	66.0
200	8	216.3	8.2	42.1	10.3	52.3	12.7	63.8	15.1	74.9	18.2	88.9	20.6	99.4	23.0	110
250	10	267.4	9.3	59.2	12.7	79.8	15.1	93.9	18.2	112	21.4	130	25.4	152	28.6	168
300	12	318.5	10.3	78.3	14.3	107	17.4	129	21.4	157	25.4	184	28.6	204	33.3	234
350	14	355.6	11.1	94.3	15.1	127	19.0	158	23.8	195	27.8	225	31.8	254	35.7	282
400	16	406.4	12.7	123	16.7	160	21.4	203	26.2	246	30.9	286	36.5	333	40.5	365
450	18	457.2	14.3	156	19.0	205	23.8	254	29.4	310	34.9	363	39.7	409	45.2	459
500	20	508.0	15.1	184	20.6	248	26.2	311	32.5	381	38.1	441	44.4	508	50.0	565
550	22	558.8	15.9	213	22.2	294	28.6	374	34.9	451	41.3	527	47.6	600	54.0	672
600	24	609.6	17.5	256	24.6	355	31.0	442	38.9	547	46.0	639	52.4	720	59.5	807
650	26	660.4	18.9	299	26.4	413	34.0	525	41.6	635	49.1	740	56.6	843	64.2	944

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 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. However, the values exceeding 1000 kg/m shall be rounded off to whole numbers in kg/m.

$$W = 0.024\,66\,t\,(D-t)$$

where W : unit mass of pipe (kg/m)

  t : wall thickness of pipe (mm)

  D : outside diameter of pipe (mm)

3. Dimensions other than those given in the above table, as required, shall be agreed upon by the purchaser and the manufacturer.

Appendix   Supplementary Quality Requirements

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

Z 2 Elevated Temperature Yield Point or Proof Stress   The elevated temperature yield point or proof stress shall be as follows:

(1) The value of elevated temperature yield point or proof stress and the testing temperature of the pipe shall be agreed upon by the purchaser and the manufacturer.

(2) The test piece and the test method shall be in accordance with JIS G 0567.

However, when it is practically difficult for a pipe to provide the test piece specified in JIS G 0567, the shape of the test piece shall be agreed upon by the purchaser and the manufacturer.

(3) The method of sampling test specimens and the number of test pieces shall be as follows. Take one test specimen from each heat, and then from one test specimen take one test piece for each testing temperature.

Z 3 Ultrasonic Examination   The ultrasonic examination shall be as follows:

(1) The criterion of the working sensitivity for the ultrasonic examination shall comply with the division UB or 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   The eddy current examination shall be as follows:

(1) The criterion of the working sensitivity for the eddy current examination shall comply with the division EV, EW, or EX 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).

Z 5 Charpy Impact Test   The Charpy impact test shall be as follows:

(1) The absorbed energy of the pipe in the Charpy impact test shall conform to the requirements given in Appendix Table 1 or Table 2. In this case, the test temperature shall be -10°C, -20°C or -30°C by agreement between the purchaser and the manufacturer.

Appendix Table 1. Absorption Energy in Charpy Impact Test

(Applicable to the end of 1990)

Dimensions of test piece mm	Absorbed energy in Charpy impact test kgf·m {J}		
	Average value of one set (3 pieces)	Each value of 2 pieces	Value of each piece
10 x 10	2.1 {20.6} min.	2.1 {20.6} min.	1.4 {13.7} min.
10 x 7.5	1.8 {17.7} min.	1.8 {17.7} min.	1.2 {11.8} min.
10 x 5	1.4 {13.7} min.	1.4 {13.7} min.	1.0 { 9.8} min.

Remark: The Charpy impact test shall not be imposed on the pipe not affording to provide a test piece 10 x 5 mm.

Appendix Table 2.   Absorption Energy in Charpy Impact Test

(Applicable on and after Jan. 1, 1991)

Dimensions of test piece mm	Absorbed energy in Charpy impact test J		
	Average value of one set (3 pieces)	Each value of 2 pieces	Value of each piece
10 x 10	21 min.	21 min.	14 min.
10 x 7.5	18 min.	18 min.	12 min.
10 x 5	14 min.	14 min.	10 min.

Remark: The Charpy impact test shall not be imposed on the pipe not affording to provide a test piece 10 x 5 mm.

(2)   The test piece shall be No. 4 test piece specified in JIS Z 2202 to be cut from a pipe in the longitudinal direction. However, the width of the test piece may be altered to 7.5 mm or 5 mm according to the dimensions of the pipe.

(3)   The test method shall be in accordance with the method of Charpy impact test specified in JIS Z 2242.

(4)   The test results of Charpy impact test shall conform to the requirements of (1).

(5)   The method of sampling the test specimens and the number of test pieces shall be as follows. Take one pipe as the specimen from each 100 pipes or its fraction of the concurrent heat treatment, and then from each specimen take one set (3 pieces) of test pieces.

(6)   Reinspection   When the test results fail to satisfy the requirements, a retest may be made to attain final acceptance provided that the average value of absorption energy already obtained satisfies the specified value and also the following conditions are met.

(a) Two of the three values are equal to or higher than the specified average value and only one fails to conform to the "value of each piece" given in Appendix Table.

(b) Two of the three values satisfy the "value of each piece" given in Appendix Table but fail to conform to the specified average value.

In these cases, one set (3 pieces) of test pieces shall be newly taken from the same lot to be retested, and each of the three individual tested values shall conform to the "average value of one set" given in Appendix Table.

Applicable Standards:

JIS G 0303-General Rules for Inspection of Steel

JIS G 0321-Product Analysis and its Tolerance for Wrought Steel

JIS G 0567-Method of High Temperature Tensile Test for Steels and Heat-Resisting Alloys

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-Methods for Atomic Absorption Spectrochemical Analysis of Iron and Steel

JIS Z 2201-Test Pieces for Tensile Test for Metallic Materials

JIS Z 2202-Test Pieces for Impact Test for Metallic Materials

JIS Z 2241-Method of Tensile Test for Metallic Materials

JIS Z 2242-Method of Impact Test for Metallic Materials

JIS Z 8401-Rules for Rounding off of Numerical Values