

### JIS G3455 Carbon Steel Pipes for High Pressure Service

#### 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℃

#### Remarks

1. With the previous agreement of the manufacturer, the purchaser may designate part or all of the supplementary quality requirements Z2, Z3, Z4 and Z5 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 un { } 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

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

World standard comparative table

KS		ASTM		JIS		DIN		BS	
Grade Number	GRADE	Grade Number	GRADE	Grade Number	GRADE	Grade Number	GRADE	Grade Number	GRADE
D 3564	SPPH 370	A524	Gr グ, ケ	G-3455	STS 370(New)	1630	St 37.4	-	-
	SPPH 38				STS 38 (Old)				
	SPPH 410	-	STS 410(New)		St 44.4				
	SPPH 42		STS 42 (Old)						

	SPPH 480				STS 480(New)		St 52.4		
	SPPH 49				STS 49 (Old)				

**3. Method of Manufacture**

Appearance shall be as follows:

3.1 The pipe shall be manufactured from killed steel by the seamless process

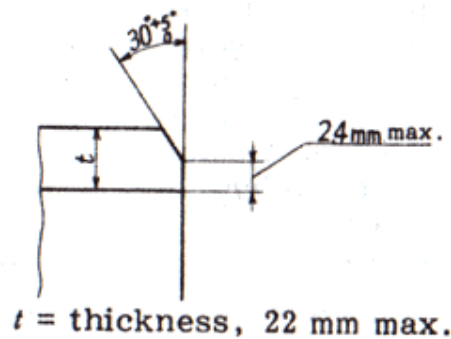
3.2 The pipe shall be subjected to the heat treatment specified in Table 5-1 of Table 5-2. The heat treatment other than those specified in Table 5-1 of Table 5-2 shall be agreed upon by the purchaser and the manufacturer.

Table 2

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

3.3 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.



**4. 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 of Table 2-2.

Table 3

Letter symbol of grade	Elongation %				
	C	Si	Mn	P	S

STS 370	0.25 max.	0.10~0.35	0.30~1.10	0.035 max.	0.035 max.
STS 410	0.30 max.	0.10~0.35	0.30~1.40	0.035 max.	0.035 max.
STS 480	0.33 max.	0.10~0.35	0.30~1.50	0.035 max.	0.035 max.

## Remark

When product analysis is required by the purchaser, the tolerances on the abovementioned values shall be as given in Table 2 in JIS G 0321

## 5. Mechanical Properties

## 5.1 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 of proof stress and elongation of the pipe obtained shall comply with Table 4-1 or Table 4-2.

Table 4

Letter symbol of grade	Mechanical Properties					
	Tensile strength	Yield point of proof stress	Elongation %			
	kgf/mm <sup>2</sup> {N/mm <sup>2</sup> }	kgf/mm <sup>2</sup> {N/mm <sup>2</sup> }	No.11 and No.12 test piece		No. 5 test piece	
			Longi- tudinal	Trans- tudinal	Longi- tudinal	Trans- tudinal
STS 370	38 {373} min.	22{216} min.	30 min.	25 min.	23 min.	28 min.
STS 410	42{412} min.	25{245} min.	25 min.	20 min.	19 min.	24 min.
STS 510	49{481} min.	28{275} min.	25 min.	20 min.	17 min.	22 min.

## Remarks

- When the tensile test is carried out for No. 12 of No. 5 test piece for the pipe under 8mm 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.
- 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

Letter symbol of grade	Shape of test piece	Elongation value relating to wall thickness %						
		Over 7mm up to and excl. 8mm	Over 6mm up to and excl. 7mm	Over 5mm up to and excl. 6mm	Over 4mm up to and excl. 5mm	Over 3mm up to and excl. 4mm	Over 2mm up to and excl. 3mm	Over 1mm up to and excl. 2mm
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	No.12 test piece	25	24	22	20	19	18	16
STS 480	No.5 test piece	20	18	17	16	14	12	11

## 5.2 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:

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

Where

$H$  : 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

## 5.3 Bending

For the pipe whose outside diameter is 50mm 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.

## 6. Hydrostatic Characteristic of Nondestructive Characteristic

The pipe shall be tested in accordance with 9.5 and the resulting hydrostatic characteristic of 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.

6.1 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 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 200kgf/P{196bar} shall be agreed upon by the purchaser and the manufacturer. In this case, the hydrostatic test pressure shall be expressed in each 5 kgf/P {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 5kgf/P{4.9 bar}.

$$P = 200st / D$$

Where

$P$ : test pressure [ kgf/P{10<sup>-1</sup>bar<sup>2</sup>} ]

$t$ : 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/mm<sup>2</sup>{N/mm<sup>2</sup>}]

Note (1) 1bar = 10<sup>5</sup>Pa

6.2 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.

7. Appearance

Appearance shall be as follows:

7.1 The pipe shall be practically straight, and its both ends shall be at right angles to its axis.

7.2 The inside and outside surfaces of the pipe shall be well-finished and free from defects that are detrimental to practical use.

8. Dimensions, Weight and Dimensional Tolerances

8.1 Dimensions and Weight

The outside diameter, wall thickness and mass of the pipe shall be as specified in Attached Table 5.

8.2 Dimensional Tolerances

The tolerances on the outside diameter, wall thickness and wall thickness deviation of the pipe shall conform to Table5.

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

Table 5. 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	50mm Under 【0.5mm	≤4mm Under	Within 20% of wall thickness
	50mm or over 200mm to and excl. 【1.6mm	+0.6mm -0.5mm	
	200mm of over 【0.8%	≤4mm or over	
	For the pipe 350mm of over, the tolerances on outside diameter may be determined by the measurement of the length of circumference. shall be 【0.5%.	+15% -12.5%	
Cold-finished seamless steel pipe	40mm Under 【0.3mm	≤2mm Under 【0.2mm	-
	40mm of over 【0.8%	≤2mm or over	

	For the pipe 350mm 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%.	【10%	
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## 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 the specified wall thickness, The wall thickness deviation shall not be applied to the pipe under 5.6mm 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 of 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 (ラ) shall be calculated reversibly from the following formula.

$$\text{ラ} = \text{キ} \cdot \text{D}$$

where キ=3.1416

3. 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.

## 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 1253

JIS G 1256

JIS G 1257

JIS G 1214

JIS G 1215

JIS G 1211

JIS G 1212

JIS G 1213

## 9.2 Tensile Test

## 9.2.1 Test piece

The test specimen shall be No. 11, No. 12A , No. 12B, No. 12C 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 specimen shall in accordance with JIS Z 2241

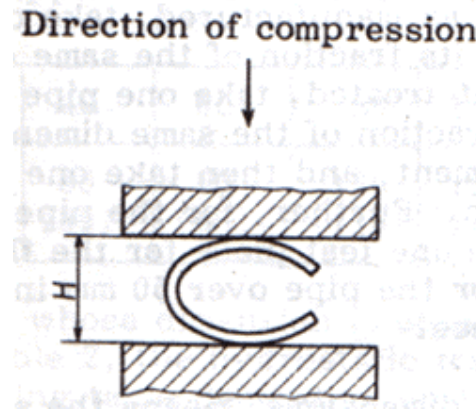
### 9.3 Flattening Test

#### 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 fence of flaws or cracks on its wall surface. In this case, the C-shape test piece shall be placed as shown in Fig. 2.



### 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 of Nondestructive Examination

The hydrostatic test of non destructive examination shall be in accordance shall be in accordance with one of the following:

9.5.1 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.

9.5.2 The test method of nondestructive examination shall be in accordance with either JIS G 0582 or JIS G 0583.

## 10. Inspection

Inspection shall be as follows:

10.1 General matters common to inspection shall be in accordance with JIS G 0303.

10.2 The chemical composition, mechanical properties, hydrostatic characteristic of 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 Z2, Z3, Z4 of Z5.

10.3 Either the hydrostatic test of the nondestructive examination shall be performed for each pipe.

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

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

Note <sup>(3)</sup> The term "same dimensions" means the same outside diameter as well as the same wall thickness.

## 11. Reinspection

The pipe may be determined for final acceptance by a retest requirements of 4.4 JIS G 0303.

## 12. Marking

Each pipe having passed the inspection shall be marked with the following items. However, the smaller pipes of 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<sup>(4)</sup>
- (3) Dimensions<sup>(5)</sup>
- (4) Manufacture's name or its identifying brand
- (5) Letter symbol Z indicating the supplementary quality specification

Notes <sup>(4)</sup>

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 pipes - S - C

Note <sup>(5)</sup>

The dimensions shall be expressed as follows:

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



Example : 50A ] Sch 80

**13. 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

Unit: kgf/P {bar}

Schedule number Sch	40	60	80	100	120	140	160
Hydrostatic Test Pressure	60 {59}	90 {88}	120 {118}	150 {147}	180 {176}	200{196}	200 {196}

Remark:

Attached Table2 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.

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 kgf/P{bar}	20 {20}	40 {39}	60 {59}	80 {79}	100 {98}	120 {118}	140 {137}	160 {157}	180 {176}	200 {196}

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

Nominal Diameter		Outside dia. mm	Nominal wall thickness													
			Schedule 40		Schedule 60		Schedule 80		Schedule 100		Schedule 120		Schedule 140		Schedule 160	
A	B		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	190	205	23.8	254	29.4	310	34.9	363	39.7	408	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	460	639	52.4	720	59.5	807
650	26	660.4	18.9	299	26.4	413	34.0	525	41.6	635	491	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 suffixed to the figures of nominal diameter for identification.

2. The mass value shall be calculated from the following formula assuming 1K of steel to be 7.85g 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.

$$W=0.02466 t (D - t)$$

Where

W: Unit mass of pipe (kg/m)

t: wall thickness of pipe (mm)

D: outside diameter of pipe (mm)

3. 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.

Z2 Elevated Temperature Yield Point or proof Stress The elevated temperature yield point or proof stress shall be as follows:

Z2.1 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.

Z2.2 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.

Z2.3 The method of sampling test specimens and the number of test piece shall be as follows. Take one test piece for each testing temperature.

#### Z3 Ultrasonic Examination

Ultrasonic Examination shall be as follows:

Z3.1 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.

Z3.2 The test method of the ultrasonic examination shall be in accordance with JIS G 0582

Z3.3 The ultrasonic examination shall be performed for each pipe and the results shall conform to the requirements specified in (1)

#### Z4 Eddy current Examination

Z4.1 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.

Z4.2 The test method of the eddy current examination shall be in accordance with JIS G 0583.

Z4.3 The eddy current examination shall be performed for each pipe and the results shall conform to the requirements specified in (1).

#### Z5. Charpy Impact Test

The Charpy impact test shall be as follows:

Z5.1 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  $-10^{\circ}\text{C}$ ,  $-20^{\circ}\text{C}$  or  $-30^{\circ}\text{C}$  by agreement between the purchaser and the manufacturer.

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 piece)	Each value of 2 pieces	Value of each piece
10 ] 10	2.1 {20.6} min.	2.1 {20.6} min.	1.4 {13.7} min.

