

JIS G3460 Steel Pipes for Low Temperature Service

1. Scope

This Japanese Industrial Standard specifies the steel pipes, hereinafter referred to as the "pipes", used for piping at exceptionally low temperatures of freezing point or under.

Remarks
 1. When previously agreed upon by the manufacturer, the purchaser may designate part or all of the supplementary quality requirements Z 3 and Z 4 specified in Appendix, in addition to the items specified in this text.

Appendix Z3 Ultrasonic Examination

Appendix Z4 Eddy Current Examination

2. The pipes specified in JIS G 3459 with the exception of SUS 329 J 1 TP, SUS 329 J 2 LTP and SUS 405 TP and the pipes specified in JIS G 3468 with the exception of SUS 329 J 1 TRY may be also used. In these cases, the impact test may be omitted.

3. 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.

2. Grade and Designation

The pipe shall be classified into 3 grades and their letter symbols shall be as given in Table 1.

Table 1

Classification		Letter symbol of grade
Carbon steel pipe	STPL 380	STPL 39
Nickel steel pipe	STPL 450	STPL 46
	STPL 690	STPL 70

World Standard Conferens Table

KS		ASTM		JIS		DIN		BS	
Grade number	GRADE	Grade number	GRADE	Grade number	GRADE	Grade number	GRADE	Grade number	GRADE
D 3569	SPLT 380 SPLT 39	A333	Gr 1	G-3460	STPL 380 (new) STPL 39 (old)	17173 17174	TTSt 35N TTSSt 35N	3603	HFS410LT50 CFS410LT50 ERW410LT50 CEW410LT50
	SPLT 450 SPLT 46				Gr 3				STPL 450 (new) STPL 46 (old)

	SPLT 690 SPLT 70		Gr 8		STPL 690 (new) STPL 70 (old)		X8Ni9 X8Ni9		HFS509LT196 CFS509LT196
			Gr 4 Gr 6 Gr 9 Gr 10 Gr 11						

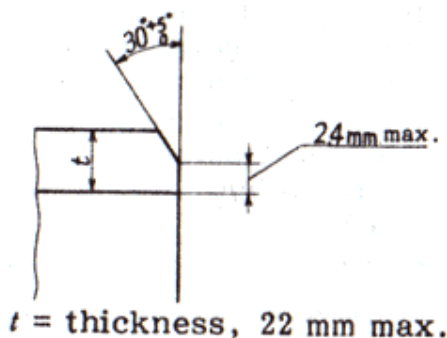
3. Method of Manufacture

3.1 The pipe of STPL 380 shall be manufactured by the seamless or electric resistance welding process and that of STPL 450 and 690 by the seamless process, and all the pipes shall be made from the fine-grained killed steel.

3.2 The pipe of STPL 380 and STPL 450 shall be subjected to normalizing or normalizing followed by tempering, and that of STPL 690 shall be double normalized followed by tempering or quenched and tempered. However, the heat treatments other than mentioned above shall be agreed upon by the purchaser and the manufacturer.

3.3 When requested by the purchaser, the pipe may be furnished with the bevel end(1)

Note (1) 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 shall conform to Table 2.

Table 2

Letter symbol of grade	Chemical Composition %					
	C	Si	Mn	P	S	Ni
STPL 380	0.25 max.	0.35 max.	1.35 max.	0.035 max.	0.035 max.	

STPL 450	0.18 max.	0.10~0.35	0.30~0.60	0.030 max.	0.030 max.	3.20 ~ 3.80
STPL 690	0.13 max.	0.10~0.35	0.90 max.	0.030 max.	0.030 max.	8.50 ~ 9.50

Remarks

1. When it is practically difficult to apply the impact test due to the dimensions of a pipe, STPL 39 shall, by way of compensation, contain 0.010 % or more of acid soluble aluminum, or alternatively, 0.015 % or more of total aluminum.
2. When product analysis is required by the purchaser, the tolerances for the values given in the above table shall be as specified in Table 1 in JIS G 0321 for the seamless steel pipe of STPL 39, likewise in Table 1 for the electric resistance welded steel pipe, and in Table 3 for the pipe of STPL 46 and STPL 70.

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 resulting tensile strength, yield point or proof stress, and elongation of the pipe shall comply with Table 3.

Letter symbol of grade	Table 3						
	Tensile strength	Yield point or proof stress	Elongation %				
	kgf/mm ² {N/mm ² }	kgf/mm ² {N/mm ² }	No. 11 or No. 12 test piece		No. 5 test piece	No. 4 test piece	
			Longitudinal		Transverse	Longitudinal	Transverse
STPL 380	39 {382}min.	21{206} min.	35 min.		25 min.	30 min.	22 min.
STPL 450	46{451}min	25{245} min.	30 min.		20 min.	24 min.	16 min.
STPL 690	70{686}min	53{520} min.	21 min.		15 min.	16 min.	10 min.

Remarks

1. When the tensile test is carried out on No. 12 or No.5 test piece for the pipe under 8mm in wall thickness, the minimum value of elongation shall be calculated by subtracting 1.5 % from the values of elongation given in Table 3 for each 1mm decrease in wall thickness, and rounding off the result to an integer in compliance with JIS Z 8401. Examples of calculation are given in Reference Table 1.
2. The value of elongation given in Table 3 shall not be applied to the pipe whose outside diameter is under 40mm. However, the value of elongation shall be recorded.
3. IN the case where the tensile test piece is taken from the electric resistance welded steel pie. No. 12 or No. 5 test piece shall be taken from a seamless portion.

Reference Table 1.

Calculation Examples of Elongation Applied to No. 12 (Longitudinal) and No. 5 (Transverse) Test Pieces for the Pipe under 8mm in Wall Thickness

Letter symbol of grade	Shape of test piece	Elongation value based on wall thickness %						
		Over 7mm, up to 8mm	Over 6mm, up to and incl. 7mm	Over 5mm, up to and incl. 6mm	Over 4mm, up to and incl. 5mm	Over 3mm, up to and incl. 4mm	Over 2mm, up to and incl. 3mm	Over 1mm, up to and incl. 2mm
STPL 380	No. 12 test piece	35	34	32	30	29	28	26

	No. 5 test piece	25	24	22	20	19	18	16
STPL 450	No. 12 test piece	30	28	27	26	24	22	21
	No. 5 test piece	20	18	17	16	14	12	11
STPL 690	No. 12 test piece	21	20	18	16	15	14	12
	No. 5 test piece	15	14	12	10	9	8	6

5.2 Flattening Resistance The pipe shall be tested in accordance with 9.3 and shall be free from flaws or cracks on its wall surfaces.

The distance between the flattening plates in this test 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 0.08

5.3 Bending Resistance For the pipe whose outside diameter is 50mm or under, the purchaser may specify the bend test instead of the flattening test. In this case, the pipe shall be free from the occurrence of flaws or cracks on its wall surface when the pipe is bent through 90° around an inside diameter that is 6 times the outside diameter.

5.4 The pipe shall be tested in accordance with 9.5 and the absorbed energy of the pipe in the Charpy impact test shall comply with Table 4. In this case, the testing temperature for the pipe of STPL 39, STPL 46 and STPL 70 shall be -45n, -100n and -196n, respectively.

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 out of 3	Value of each piece
10] 10	2.1 {20.6} min.	2.1 {20.6} min.	1.4 {13.7} min.
10] 7.5	1.8 {17.7} min.	1.8 {17.7} min.	1.2 {11.8} min.
10] 5	1.4 {13.7} min.	1.4 {13.7} min.	1.0 {9.81} min.

Remark

For the pipe not fit to provide a test piece 10 X 5 mm, the impact test shall not be applied.

5.5 The electric resistance welded steel pipe shall be subjected to the impact test for the weld in addition to the Charpy impact test specified in (1), and the absorbed energy obtained shall comply with Table 4.

In this case, the testing temperature shall be -45n.

6.

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	-	-	6.4	33.1	7.0	36.1	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	-	-	6.4	41.2	7.8	49.9	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	-	-	6.4	49.3	8.4	64.2	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	6.4	55.1	7.9	67.7	9.5	81.1	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	6.4	63.1	7.9	77.6	9.5	93.0	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	6.4	71.1	7.9	87.5	11.1	122	14.3	156	19.0	205	23.8	254	29.4	310	34.9	363	39.7	4.9	45.2	459	
500	20	508.0	6.4	79.2	9.5	117	12.7	155	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 pipe 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, and the letter A or B shall be suffixed to the figures of nominal diameter, respectively, for identification.

2. Calculate the value of mass from the following formula assuming 1K of steel to be 7,85 g and round off the result 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: wall thickness of pipe(mm)

3. When dimensions not given in the above table are necessary, agreement shall be made between the purchaser and the manufacturer.

8.2 Dimensional Tolerances

The dimensional tolerances of the pipe shall be as follows.

The tolerances on outside diameter, wall thickness and deviation in wall thickness of the pipe shall conform to Table 5.

Further, in the case where the length of pipe is specified, the tolerances shall be on the plus side.

Table 5 Tolerances on Outside Diameter, Wall Thickness and Deviation in Wall Thickness

Division	Tolerance on outside diameter	Tolerance on wall thickness	Tolerances on deviation in wall thickness
Hot-finished seamless steel pipe	Up to 50 mm 【0.5mm	Up to 4mm 【0.5mm	Within 20% of wall thickness
	50mm or over, up to 160mm 【1%	4mm and over 【12.5%	
	160mm and over, up to 200mm 【1.6mm		
	200mm or over 【0.8%		
	However, for pipes 350mm or over in diameter, the length of circumference may be used as a bases for tolerance. In this case, the tolerances shall be 【0.5%		
Cold-finished seamless steel pipe, electric-resistance welded pipe	Up to 40mm 【0.3mm	Up to 2mm 【0.2mm	-
	40mm and over 【0.8%	2mm and over 【10%	
	However, for pipes 350mm or over in diameter, the length of circumference may be used as a bases for tolerances. In this case, the tolerance shall be 【0.5 %		

Remarks

1. The tolerances on the outside diameter of the quenched and tempered pipe of STPL 70 shall be $\pm 1\%$ in the case of the hot finished seamless steel pipe 50 mm or over in outside diameter and of the cold finished seamless steel pipe 30mm or over.

2. When the length of circumference is obtained as a basis for tolerances, either the measured value of the length of circumference itself or the diameter derived from the measured value may be used as the criteria.

In either case, the same value ($\pm 0.5\%$) shall be applied as the tolerances. 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 compliance with the tolerances on wall thickness in the above table is clearly confirmed in a local portion such as one under repairs, the tolerances on outside diameter in the above table shall not be applied.

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

9. Test

9.1 Chemical Analysis

9.1.1 Chemical Analysis

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

JIS G 1253

JIS G 1256

JIS G 1257

JIS G 1214

JIS G 1215

JIS G 1211

JIS G 1212

JIS G 1213

JIS G 1216

JIS G 1224

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 cut off from the pipe. The gauge length for No. 4 test piece shall be 50mm

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

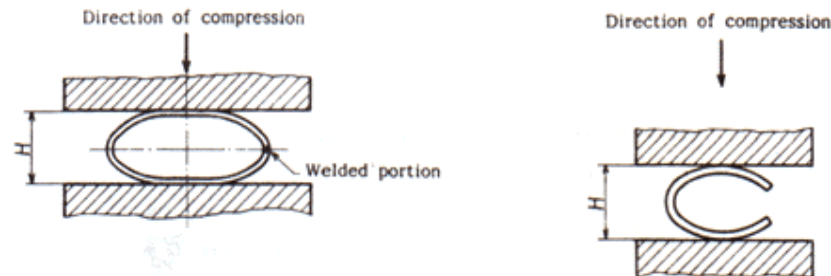
9.3 Flattening Test

9.3.1 Test Piece

A test piece 50mm or over in length shall be cut off from the end of a pipe. For the pipe whose wall thickness is 15 % or over of the outside diameter, a C-shape test piece made by removing part of the circumference of a whole test piece may be used.

9.3.2 Test method

The test piece shall be placed at ordinary temperature between two flat plates 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 as shown in Fig. 2, and the C-shape test piece shall be placed as shown in Fig. 3.



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

9.5 Charpy Impact Test

9.5.1 Test Piece

The Charpy impact test piece shall be No. 4 test piece specified in JIS Z 2202. However, the width of the test piece may be altered to 7.5mm or 5mm according to the dimensions of the pipe.

This is to be cut off longitudinally, while the Charpy impact test piece of the weld of electric-resistance welded steel pipe shall be taken transversely.

The finishing condition of the Charpy impact test piece for weld may be decided by agreement between the purchaser and the manufacturer, as necessary.

9.5.2 Test Method

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

9.6 Hydrostatic Test or Nondestructive Examination

Either a hydrostatic test or a nondestructive examination shall be made in accordance with (1) or (2).

9.6.1 The pipe shall be subjected to a hydrostatic pressure and kept at the specified pressure to see if it withstands the pressure without leakage.

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

10. Inspection

10.1 General matters of inspection shall be as specified in JIS G 0303.

10.2 The chemical composition, mechanical properties, hydrostatic or nondestructive characteristic, appearance and dimensions shall conform to the requirements specified in 3., 4., 5., 6., and 7. However, appropriate nondestructive examinations other than those specified in 9.6 (2) may substitute for the said nondestructive examination when 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 relevant requirements specified in Z 3 and Z 4.

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

10.4 The number of specimens for the product analysis shall be 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 or bending test shall be as follows. Take one pipe as the specimen from each 50 pipes or its fraction which are subjected to a concurrent heat treatment, then from the test specimen take one tensile test piece and one flattening test piece, and from the pipes 50mm or under in outside diameter if specified by the purchaser, take one bending test piece instead of a flattening test piece.

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

11. Reinspection

11.1 The pipe which fails to pass the tests specified in 9.2 to 9.4 may be retested in accordance with 4.4 in JIS G 0303 to determine whether it is acceptable or not.

11.2 When the pipe fails to pass the test specified in 9.5, but satisfies either of the following two conditions as well as the specified limit of the average value of the absorbed energy, a retest may be conducted to determine whether it is acceptable or not.

(1) In the case where two individual values out of the three are equal to or higher than the average value specified in Table 4 but the other one fails to satisfy it.

(2) In the case where two individual values out of the three satisfy the value specified for two pieces given in Table 4 but fail to satisfy the average value specified in Table 4.

In this case, three additional test pieces shall be taken from the same lot for a retest, and each value of the three test pieces shall conform to the average value of one set (3 pieces) specified in Table 4.

12. Marking

Each pipe having passed the inspection shall be marked with the following items. However, in the case of either smaller pipes or a request from the purchaser, the pipes may be

bundled together and marked for each bundle by suitable means. In both cases, the order of arranging the 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 process ⁽³⁾
- (3) Dimensions ⁽⁴⁾
- (4) Manufacturer's name or its abbreviation
- (5) Letter symbol denoting the supplementary quality requirement, Z

Note ⁽³⁾

The letter symbol indicating the manufacturing process shall be as follows, provided that the dash may be replaced by 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 or cold finished ones -E-G

Hot finished electric resistance welded steel pipe -E-C

Note ⁽⁴⁾

The dimensions shall be expressed as follows

Nominal diameter X nominal wall thickness or outside diameter X wall thickness

Example: 50A ×40

13. Report

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

Appendix. Supplementary Quality Requirements

The supplementary quality requirements shall apply only when requested by the purchaser, and shall be executed by the manufacturer on the designated items.

Z3 Ultrasonic Examination

Z3.1 The criteria of the working sensitivity in the ultrasonic examination shall be 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 as specified in 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 criteria of the working sensitivity in the eddy current examination shall be 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 as specified in 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).

Material Comparison Tables (ASTM, KS, JIS, DIN, BS, NBN, NF, UNI)

ASTM Standard	UNS NO.	KOREA/JAPANES			GERMAN				BRITISH			FRENCH			ITALIAN		
		KS/JIS Symbol	KS/JIS Number	Remarks	DIN Type	DIN Number	Material Number	Remarks	B.S Number	B.S Grade	Remarks	AFNOR Type	NF Number	Remarks	UNI Type	UNI Number	Remarks
A 333 Seamless and Welded Pipe for Low-Temperature Service																	
Grade 1	K03008	SPLT 39 / STPL 380	D3569 / G 3460	(16)	TT St 41N		1.0437	WBL-680(3b)			(3)	TU 42 BT	A49-230		C 15	5949	(6)Seamless Only
Grade 3	K31918	SPLT 46 / STPL 450	D3569 / G 3460	(16)	10 Ni 14		1.5637	WBL-680(3b)	3603	HFS 503 LT 100	CAT.2	TU 16 N 14	A49-230	(3c)	18 Ni 14	5949	Seamless Only
Grade 6	K03006			(3)	TT St 45 N		1.0456	WBL-680(3b)	3603	HFS 410 LT 50	CAT.2	TU 42 BT	A49-230		C 20	5949	Seamless Only
Grade 8	K81340	SPLT 70 / STPL 690	D3569 / G 3460	(16)	X8 Ni 9		1.5662	WBL-680(3b)	3603	HFS 590 LT 196	CAT.2	TU Z 11 N 9	A49-230	(6)	12 X Ni 09	5949	Seamless Only