JIS G3468 Arc Welded Large Diameter Stainless Steel Pipes

1. Scope

This Japanese Industrial Standard specifies the large diameter welded stainless steel pipes (Hereafter referred to as "pipes") used for the pipings for corrosion resistance, low-temperature service, high temperature service, etc

Remarks

1. With previous agreement with the manufacturer, the purchase may designate a part or all of the special quality requirements Z2, Z6 , Z7, Z8, Z9 and Z10 specified in Annex, in addition to the items specified in this text.

Annex z2 Elevated temperature yield point or proof stress

Annex z6 Corrosion test

Annex z7 Radiographic examination of weld zone

Annex z8 Liquid penetrant examination of weld zone

Annex z9 Guide bend test of weld zone

Annex z10 Height or weld reinforcement

2. The standards cited in in this Standard are shown in Attached Table 3.

2. Grade and symbol

Pipes shall be classified into 11 grades and their symbols shall be as given in Table 1.

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 3588	STS 304 TPY	A358 A409	TP304	JIS G3468	SUS304TPY			3605	304S11
	STS 304 LTPY	A358 A409	TP304L		SUS304LTPY				304S31
	STS 309 STPY	A358 A409	TP309S		SUS309STPY				
	STS 310 STPY	A358 A409	TP310S		SUS310STPY				

	STS 316 TPY	A358 A409	TP316		SUS316TPY				316S11
	STS 316 LTPY	A358 A409	TP316L TP316N		SUS316LTPY				316S31
	STS 317 TPY	A409	TP317		SUS317TPY				
	STS 317 LTPY	-	-		SUS317LTPY				
	STS 321 TPY	A358 A409	TP321		SUS321TPY				321S31
	STS 347 TPY	A358 A409	TP347		SUS347TPY				347S31
	STS 329 J1 TPY	-	-		SUS329J1TPY				
		A358	TP304H						
		A358	TP304LH						
		A358	TP304H						
		A358 A409	TP309cb						
		A358	TP309						
		A358	TP310						
		A358 A409	TP310cb						
		A358	TP316N						
		A358	TP316LN						316S13
		A358	TP316M						316S33
		A358 A409	TP348						
		A358	TPXM-19						
		A358	TPXM-29						

3. Materials and method of manufacture

3.1 Materials

The steel plate of strip used for the pipe shall comply with either of the following standards. However, in the case where solution treatment is conducted for the pipe, heat treatments in the stage of a plate or a strip may be omitted.

JIS G 4303, JIS G 4305

The chemical composition related to those standards in shown as Informative reference Table 1.

3.2 Method of manufacture

Pipes shall be manufactured by an automatic arc welding or a laser welding process. However, for the automatic arc welding, a filler metal shall , as a rule, be used.

3.3 Heat treatment Pipes shall, as a rule, be delivered as manufactured. When a heat treatment is especially required by the purchaser, the pipes shall be subjected to the solution treatment specified in Table 1 followed by picking or equivalent treatments. However, heat treatment other than those specified in Table 1 shall be as agreed upon between the purchaser and supplier.

When the pipes are subjected to a solution treatment, the symbol of heat treatment shall be "5".

Table 1.Solution treatment

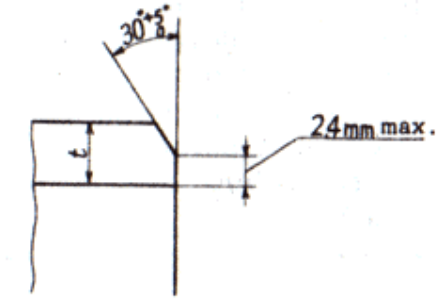
<table>
<tr><td></td><td>Solution treatment °C</td><td>Symbol of grade</td><td>Solution treatment °C</td></tr>
<tr><td>SUS 304TPY</td><td rowspan="2">1010 min., rapid cooling</td><td>SUS 317TPY</td><td>1010 min., rapid cooling</td></tr>
<tr><td>SUS 304LTPY</td><td>SUS 317LTPY</td><td>1010 min., rapid cooling</td></tr>
<tr><td>SUS 309STPY</td><td>1030 min</td><td>SUS 321TPY</td><td>920 min., rapid cooling</td></tr>
<tr><td>SUS 310STPY</td><td>1030 over , min., rapid cooling</td><td>SUS 347TPY</td><td>980 min., rapid cooling</td></tr>
<tr><td>SUS 316TPY</td><td>1010 over, min., rapid cooling</td><td rowspan="2">SUS 329J1TPY</td><td rowspan="2">950 min., rapid cooling</td></tr>
<tr><td rowspan="2">SUS 316LTPY</td><td rowspan="2">1010 over, min., rapid cooling</td></tr>
<tr><td></td><td></td></tr>
</table>

Remarks

1. For pipes of SUS 321and SUS 347, a stabilizing treatment may be specified.

In this case, temperature of the heat treatment shall be 850 to 930∩.

2. the symbols excepting the tail TPY of the symbol of grade in standards cited in 3. (1)



4. Mechanical properties

4.1 Tensile strength, proof stress, and elongation

When especially specified by the purchaser of subjected to heat treatment, the pipes shall be tested in accordance with 8.1 and the resulted tensile strength, proof stress, and elongation of the pipes shall comply with Table 2.

Table 2. Mechanical properties

Symbol of grade	Tensile strength	Proof stress	Elongation %	
	kgf/mm^2 {N/mm^2}	kgf/mm^2 {N/mm^2}	No. 12 test piece	No. 5 test piece
			Longitudinal direction	Transverse direction
SUS 304TPY	53{520} min.	21{206} min.	35 min.	25 min.
SUS 304LTPY	49{481} min.	18{177} min.	35 min.	25 min.
SUS 309STPY	53{520} min.	21{206} min.	35 min.	25 min.
SUS 310STPY	53{520} min.	21{206} min.	35 min.	25 min.
SUS 316TPY	53{520} min.	21{206} min.	35 min.	25 min.
SUS 316LTPY	49{481} min.	18{177} min.	35 min.	25 min.
SUS 317TPY	53{520} min.	21{206} min.	35 min.	25 min.
SUS 317LTPY	49{481} min.	21{206} min.	35 min.	25 min.
SUS 321TPY	53{520} min.	21{206} min.	35 min.	25 min.
SUS 347TPY	53{520} min.	21{206} min.	35 min.	25 min.

SUS 329 J1TPY	60{588} min.	40{392} min.	18 min.	13 min.

Remarks

1. For pipes under 8 mm in wall thickness, the minimum elongation shall be calculated by subtracting 1.5% from the elongation given in Table 2 for each decrease of 1 mm from the wall thickness, and rounded off to an integer in compliance with JIS z 8401. Examples of calculation are given in Informative reference Table 2.
2. No. 5 test piece may be taken from the transverse direction of the pipe.
3. A test piece shall be taken from the portion not containing welded seams.

Informative reference Table 1.

Symbol of grade	Chemical composition								
	C	Si	Mn	P	S	Ni	Cr	Mo	Other
SUS 304TPY	0.08 max.	1.00 max.	2.00 max.	0.045 max.	0.030 max.	8.00 to 10.50	18.00 to 20.00	-	-
SUS 304LTPY	0.030 max.	1.00 max.	2.00 max.	0.045 max.	0.030 max.	9.00 to 13.00	18.00 to 20.00	-	-
SUS 309STPY	0.08 max.	1.00 max.	2.00 max.	0.045 max.	0.030 max.	12.00 to 15.00	22.00 to 24.00	-	-
SUS 310STPY	0.08 max.	1.50 max.	2.00 max.	0.045 max.	0.030 max.	19.00 to 22.00	24.00 to 26.00	-	-
SUS 316TPY	0.08 max.	1.00 max.	2.00 max.	0.045 max.	0.030 max.	10.00 to 14.00	22.00 to 18.00	2.00 to 3.00	-
SUS 316LTPY	0.030 max.	1.00 max.	2.00 max.	0.045 max.	0.030 max.	12.00 to 15.00	16.00 to 18.00	2.00 to 3.00	-
SUS 317TPY	0.08 max.	1.00 max.	2.00 max.	0.045 max.	0.030 max.	11.00 to 15.00	18.00 to 20.00	3.00 to 4.00	-
SUS 317LTPY	0.030 max.	1.00 max.	2.00 max.	0.045 max.	0.030 max.	11.00 to 15.00	18.00 to 20.00	3.00 to 4.00	-
SUS 321TPY	0.08 max.	1.00 max.	2.00 max.	0.045 max.	0.030 max.	9.00 to 13.00	17.00 to 19.00	-	Ti5】C% min.
SUS 347TPY	0.08 max.	1.00 max.	2.00 max.	0.045 max.	0.030 max.	9.00 to 13.00	17.00 to 19.00	-	Nb10】C% min.
SUS 329 J1TPY	0.08 max.	1.00 max.	1.50 max.	0.0402 max.	0.030 max.	3.00 to 6.00	23.00 to 28.00	1.00 to 3.00	-

Remarks:

For grade SUS329JI, alloying elements other than those given in Informative reference Table 1 may be added, as necessary.

Informative reference Table 2

Calculation examples of elongation values for No. 12 test piece (Longitudinal) and No. 5 test piece (transverse) for pipes under 8 mm in wall thickness

Symbol of grade	Shape of test piece	Elongation value of each thickness division %

		Over 7mm to and excl. 8mm	Over 6mm to and excl. 7mm	Over 5mm to and excl. 6mm	Over 4mm to and excl. 5mm	Over 3mm to and excl. 4mm	Over 2mm to and excl. 3mm
SUS 329 J1TP	No.12 test piece	18	16	15	14	12	10
	No.5 test piece	13	12	10	8	7	6
Other grades	No.12 test piece	35	34	32	30	29	28
	No.5 test piece	25	24	22	20	19	18

4.2 Tensile strength of weld zone

Pipes shall be tested in accordance with 8.2 and the resulted tensile strength of weld zone shall conform to table 2.

5. Hydraulic test characteristic or nondestructive examination characteristic

Pipes shall be tested in accordance with 8.3 and the resulted hydraulic test characteristic or nondestructive examination characteristic shall conform to either of the following requirements and the preference shall be dependent upon the designation by the purchase or the discretion of the manufacturer.

5.1 Hydraulic test characteristic

The pipes shall withstand without leakage the hydraulic pressure designated, if any, by the purchaser or, in the absence of it, the hydraulic pressure specified in Attached Table1 In this case, by agreement between the purchaser and supplier, a hydraulic pressure higher or lower than those in Attached Table1 may be designated.

7. Dimensions, mass, and dimensional tolerances

7.1 Dimensions and mass

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

7.2 Dimensional tolerances

Tolerances on the outside diameter and wall thickness of the pipe shall be as specified in table3

Table 4. Tolerances on outside diameter and wall thickness

Division			Tolerances %
Outside diameter	300A or under in nominal diameter		【 1
	350A or over in nominal diameter		【 0.5 the measurement shall be based on the circumference.
Thickness	500A or over in nominal diameter	Under 8 mm	+ 15 / -12.5
		8 mm or over	+15 / -10
	550A or over in nominal diameter	Under 8 mm	+ not specified/ -12.5

		8 mm or over	+ not specified/ -10

Remarks:

1. To determine the tolerances on an outside diameter in the case where the circumference is employed to obtain the outside diameter, either the measured value of the circumference or the diameter converted from the measured value may be used. In this case, the outside diameter (D)and the circumference(l) shall be calculated reversely by using the following formula.

ラ = 卄・D where 卄=3.1416

8. Tests

8.1 Tensile test

8.1.1 Sampling of specimen and number of test piece

As for the sampling of a specimen and the number of test pieces from steel plate or strip, the relevant standard to each material shall be applied.

In the case of sampling form pipe, one specimen shall be sampled from each 120 m of the pipe of the same dimensions processed under the same heat treatment or its fraction, or one specimen of the same nominal wall thickness as the pipe processed under the same heat treatment condition per each 120 m or its fraction.

one tensile test piece shall be sampled from each specimen.

8.1.2 Test Piece

The test piece shall be No. 12B, No. 12C, or No.5 test piece specified in JIS Z 2201 and the sampling method shall be either of the following.

8.2 Tensile test of weld zone

8.2.1 Sampling of specimen and number of test pieces

For sampling of a specimen and the number of test pieces, when sampled from a pipe, one specimen shall be sampled from each 120 m of the pipe or its fraction of the same dimensions and heat treatment conditions.

One weld zone tensile test piece shall be sampled from respective specimens.

8.2.2 Test piece

The test piece shall be No. 1 test piece specified in JIS Z 3121 and sampled from either the pipe or the specimen sampled from the pipe end welded under the same condition as the full length of the pipe.

8.3 Hydraulic test or nondestructive examination

8.3.1 Number of specimens

Either the hydraulic test or the nondestructive examination shall be carried out per each one pipe.

8.3.2 Number of specimens

Either the hydraulic pressure is applied to the pipe and kept at a specified pressure for 5 s or more, whether it withstands the pressure without leakage shall be examined.

9. Inspection

9.1 Inspection

The inspection shall be as follows.

9.2 The mechanical properties shall conform to the requirements specified in 4.

9.3 The hydraulic test characteristic or the nondestructive examination characteristic shall conform to the requirements specified in 5. However, the nondestructive examination may be replaced by an appropriate nondestructive examination other than that in 8.3.3 as agreed upon between the purchaser and supplier.

9.4 The dimensions shall conform to the requirements specified in 6.

9.5 The appearance shall conform to the requirements specified in 7.

10. Reinspection

Pipes may be determined for acceptance or rejection by carrying out the retest specified in 4.4 of JIS G 0303.

11. Marking

Each pipe having passed the inspection shall be marked with the following items. The order of arranging the items is not specified. When approved by the purchaser, a part of the items may by omitted.

(1) Symbol of grade

(2) Symbol indicating the manufacturing method(2)

(3) Symbol of heat treatment

(4) Dimensions(3)

(5) Manufacturer's name or abbreviation

Note(^{2})

The symbol indicating the manufacturing method shall be as follows.

Nominal diameter】nominal wall thickness or outside diameter 】 wall thickness

Example : 500 A 】 Sch 10 S

12. Report

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

Attached Table 1.

Unit : kgf/ P {bar}

Schedule number Sch	5S	10S	20S	40S

Hydraulic test pressure	15 {15}	20 {20}	25 {25}

Remarks: 1 bar=10^5Pa

The hydraulic test pressure for the pipe whose dimension is not given in attached Table 2 shall be as agreed upon between the purchaser and supplier.

Attached Table 2. Dimensions and mass for large diameter welded stainless steel pipes

Nominal diameter		Outside diameter mm	Nominal wall thickness							
			Schedule 5S				Schedule 10S			
A	B		Wall thickness mm	Unit mass kg/m			Wall thickness mm	Unit mass kg/m		
				Grade				Grade		
				SUS 304TPY SUS 304LTPY SUS 321TPY	SUS 309STPY SUS 310STPY SUS 316TPY SUS 316LTPY SUS 317TPY SUS 317LTPY SUS 347TPY	SUS 329J1TPY		SUS 304TPY SUS 304LTPY SUS 321TPY	SUS 309STPY SUS 310STPY SUS 316TPY SUS 316LTPY SUS 317TPY SUS 317LTPY SUS 347TPY	SUS 329J1TPY
150	6	165.2	2.8	11.3	11.4	11.1	3.4	13.7	13.8	13.5
200	8	216.3	2.8	14.9	15.0	14.6	4.0	21.2	21.3	20.8
250	10	267.4	3.4	22.4	22.5	22.0	4.0	26.2	26.4	25.8
300	12	318.5	4.0	31.3	31.5	30.8	4.5	35.2	35.4	34.6
350	14	355.6	4.0	35.0	35.3	34.5	5.0	43.7	43.9	42.9
400	16	406.4	4.5	45.1	45.3	44.3	5.0	50.0	50.3	49.2
450	18	457.2	4.5	50.7	51.1	49.9	5.0	56.3	56.7	55.4
500	20	508.0	5.0	62.6	63.1	61.6	5.5	68.8	69.3	67.7
550	22	558.8	5.0	69.0	69.4	67.8	5.5	75.8	76.3	74.6
600	24	609.6	5.5	82.8	83.3	81.4	6.5	97.7	98.3	96.0
650	26	660.4	5.5	89.7	90.3	88.2	8.0	130	131	128

700	28	711.2	5.5	96.7	97.3	95.1	8.0	140	141	138
750	30	762.0	6.5	122	123	120	8.0	150	151	148
800	32	812.8	-	-	-	-	8.0	160	161	158
850	34	863.6	-	-	-	-	8.0	171	172	168
900	36	914.4	-	-	-	-	8.0	181	182	178
1000	40	1016.0	-	-	-	-	9.5	238	240	234

Nominal diameter		Outside diameter mm	Nominal wall thickness							
			Schedule 20S				Schedule 40S			
A	B		Wall thickness mm	Unit mass kg/m			Wall thickness mm	Unit mass kg/m		
				Grade				Grade		
				SUS 304TPY SUS 304LTPY SUS 321TPY	SUS 309STPY SUS 310STPY SUS 316TPY SUS 316LTPY SUS 317TPY SUS 317LTPY SUS 347TPY	SUS 329J1TPY		STS 304 TPY STS 304 LTPY STS 321 TPY	SUS 309STPY SUS 310STPY SUS 316TPY SUS 316LTPY SUS 317TPY SUS 317LTPY SUS 347TPY	SUS 329J1TPY
150	6	165.2	5.0	20.0	20.1	19.6	7.1	28.0	28.1	27.5
200	8	216.3	6.5	34.0	34.2	33.4	8.2	42.5	42.8	41.8
250	10	267.4	6.5	42.2	42.5	41.5	9.3	59.8	60.2	58.8
300	12	318.5	6.5	50.5	50.8	49.7	10.3	79.1	79.6	77.8
350	14	355.6	8.0	69.3	69.7	68.1	11.1	95.3	95.3	93.7
400	16	406.4	8.0	79.4	79.9	78.1	12.7	125	125	122
450	18	457.2	8.0	89.5	90.1	88.0	14.3	158	159	155
500	20	508.0	9.5	118	119	116	15.1	185	187	182
550	22	558.8	9.5	130	131	128	15.9	215	216	211

600	24	609.6	9.5	142	143	140	17.5	258	260	254
650	26	660.4	12.7	205	206	202	17.5	280	282	276
700	28	711.2	12.7	221	222	217	17.5	302	304	297
750	30	762.0	12.7	237	239	233	17.5	325	327	319
800	32	812.8	12.7	253	255	249	17.5	347	349	341
850	34	863.6	12.7	269	271	265	17.5	369	371	363
900	36	914.4	12.7	285	287	281	19.1	426	429	419
1000	40	1016.0	14.3	357	359	351	26.2	646	650	635

Remarks

1. The designation of the pipe shall be made 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 letter A or B shall be suffixed to the respective figures of nominal diameter for identification.

2. The value of mass shall be calculated from the following formula and rounded off to 3 significant digits in accordance with JIS Z 8401. However, the mass exceeding 1000 kg/m shall be rounded to a whole number of kg/m.

Symbol of grade	Basic mass (4)kg	Formula (5)
SUS 304TPY SUS 304LTPY SUS 321TPY	7.93	W=0.024 91t(D-t)
SUS 309STPY SUS 310STPY SUS 316TPY SUS 316LTPY SUS 317TPY SUS 317LTPY SUS 347TPY	7.98	W=0.025 07t(D-t)
SUS 329J1TPY	7.80	W=0.024 50t(D-t)

Notes (4) The basic mass means the mass of stainless steel 1 mm in thickness and 1 m in area.

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

t: wall thickness of pipe(mm)

D: outside diameter of pipe(mm)

3. When dimensions other than those given in the above table are necessary, they shall be agreed upon between the purchaser and supplier.

5.2 Nondestructive examination characteristic

The pipes shall be subjected to the nondestructive examination by radiographic examination and the result shall be equal on superior to grade 3 of, JIS Z 3106.

6. Appearance

The appearance of pipe shall be as follows.

6.1 The pipes shall be straight for practical uses, and their both ends shall be at right angles to the axes.

6.2 The inside and outside surfaces of the pipes shall be well-finished, and free form defects detrimental to practical use.

Annex. Special quality requirements

The special quality requirements shall be applied only when requested by the purchaser, and the manufacturer shall execute on the specified items.

Z2 Elevated temperature yield point or proof stress

The elevated temperature yield point or proof stress shall be as follows.

Z2.1 The values of elevated temperature yield point or proof stress and the test temperature of the pipe shall be subject to the agreement between the purchaser and supplier.

Z2.2 The test piece and the test method shall be as follow.

When it is difficult to take the test piece of the shape specified in JIS G 0567, the shape of the test piece shall be subject to the agreement between the purchaser and supplier.

Z2.3 In respect of the sampling of a specimen and the number of test pieces, one specimen shall be taken from a lot of the same cast steel, and one test piece shall be taken from the specimen for each test temperature.

Z.6 Corrosion test

The corrosion test shall be as follows.

6.1 Corrosion resistance

The corrosion resistance of the pipe by an intergranular corrosion test shall comply with the following requirements. In this case, the intergranular corrosion test to be applied shall be subject to the agreement between the purchaser and supplier.

(1) Evaluation by etch structure obtained in 10% oxalic acid etch test shall be as specified in Annex Table 1.

Annex Table 1. Evaluation by 10 % oxalic acid etch test

Symbol of grade	Condition	Structure for ferric sulfate sulfuric acid test	Structure for 65 % nitric acid test	Structure for nitric hydrofluoric acid test	Structure for copper sulfate sulfuric acid test
SUS 304TPY	As delivered (Solution treatment)	Ditch structure	Ditch structure End grain pitting II	-	Ditch structure

SUS 316TPY			-	Ditch structure	
SUS 317TPY					
SUS 304LTPY	Sensitization	Ditch structure	Ditch structure End grain pitting II	-	Ditch structure
SUS 316LTPY			-	Ditch structure	
SUS 317LTPY					
SUS 321TPY		-		-	
SUS 347TPY					

(2) Mass loss by ferric sulfate-sulfuric acid test shall be as specified in Annex Table 2.

Annex Table 2. Mass loss by ferric sulfate-sulfuric acid test

Symbol of grade	Condition	Mass loss g/(m^2h)
SUS 304TPY	As delivered (Solution treatment)	To be as agreed upon between the purchaser and supplier.
SUS 316TPY		
SUS 317TPY		
SUS 304LTPY	Sensitization	To be as agreed upon between the purchaser and supplier.
SUS 316LTPY		
SUS 317LTPY		

(3) Mass loss by 65% nitric acid test shall be as specified in Annex Table 3.

Annex Table 3. Mass loss by 65% nitric acid test

Symbol of grade	Condition	Mass loss g/(m^2h)
SUS 304TPY	As delivered (Solution treatment)	To be as agreed upon between the purchaser and supplier.
SUS 304LTPY	Sensitization	To be as agreed upon between the purchaser and supplier.

(4) The corrosion rate ration by nitric-hydrofluoric acid test shall be as specified in Annex Table 4.

Annex Table 4. Corrosion rate ration by nitric-hydrofluoric acid test

Symbol of grade	Corrosion rate ratio
SUS 316TPY	1.5 max.

SUS 317TPY	
SUS 316LTPY	
SUS 317LTPY	

(5) The state of the bent surface by copper sulfate-sulfuric acid test shall be as specified in Annex Table 5.

Annex Table 5. State of the bent surface by copper sulfate-sulfuric acid test

Symbol of grade	Condition	State of bent surface
SUS 304TPY	As delivered (Solution treatment)	Intergranular corrosion cracks shall not be generated.
SUS 316TPY		
SUS 317TPY		
SUS 304LTPY	Sensitization	
SUS 316LTPY		
SUS 317LTPY		
SUS 321TPY		
SUS 347TPY		

Z6.2 An appropriate length of a pipe shall be cut off from the end of the pipe to serve as a test piece.

Z6.3 The test method shall be in accordance with any one of the following standards.

JIS G 0571, JIS G 0572, JIS G 0573, JIS G 0574, JIS G 0575

Z6.4 The test results shall conform to the requirements specified in (1).

Z6.5 The sampling of a specimen and the number of test pieces shall be as given in the case of the tensile test in 8.1.1 of the text. However, when required, the abovementioned test piece shall be sampled for each lot of the pipes of the same cast steel processed under the same heat treament.

Z7. Radiographic examination of weld zone

The radiographic examination of weld zone shall be an follows.

Z7.1 The classification of radiographs in the radiographs examination of weld zone shall be grade 1or grade 2 specified in JIS Z 3106 in accordance with the specification by the purchaser.

Z7.2 The method of radiographs examination shall be as specified in JIS Z 3106. In this case, the pentameter sensitivity shall be normal grade or upwards in Table 3 of JIS Z 3106. The required density difference shall be normal grade in Table 5 or JIS Z 3106. However, the purchaser may designate special grade of the pentameter sensitivity and that of the required density difference, if especially needed.

Z7.3 The radiographs examination shall be carried out for the full length of the weld zone for each pipe, and the results obtained shall conform to the requirements specified in (1).

Z8 Liquid penetrate examination of weld zone

The liquid penetrate examination of weld zone shall be as follows.

Z8.1 The flaw indication in the liquid penetrate examination of weld zone shall comply with the following items as specified in JIS Z 2343.

(1) To be free form cracks or linear defects.

(2) The criteria for acceptance or rejection on circular flaws shall be subject to the agreement between the purchaser and supplier.

(3) The criteria for acceptance or rejection on scattering flaws shall be subject to the agreement between the purchaser and supplier.

Z8.2 The method for liquid penetrate examination of weld zone shall be as specified in JIS Z 2343.

Z8.3 The liquid penetrate examination shall be, as a rule, carried out for the full outside length of the weld zone for each pipe, and the results obtained shall conform to the requirements specified in (1)

Z9. Guide bend test of weld zone

The guide bend test of weld zone shall be as follows.

Z9.1 Guide bending of weld zone

Z9.1.1 For the guide bending of weld zone, when the wall thickness exceeds 12 mm or both sides are butt welded, the aide bend test shall be carried out. When the wall thickness is 12 mm or under (except the pipes with both sides butt-welded), the root bend test shall be carried out. In that case, when the guide bend test is carried out in accordance with JIS Z 3122, the test results shall conform to the following requirements.

Z9.1.2 The test piece and the test method shall be as specified in JIS Z 3122.

Z9.1.3 The sampling of a specimen and the number of test pieces shall be as given in the tensile test of weld zone in 8.2.1 of this text.

Z9.2 The results of the guide bend test of weld zone shall conform to the requirements specified in (1.1).

Z9.3 Reinspection

When the rejection is caused by defects other than those of weld zone, a retest may be carried out to obtain the acceptance.

Z10 Height of weld reinforcement

The height of weld reinforcement shall be as follows.

Z10.1 The height of weld reinforcement in the weld zone shall be as specified in Annex Table 6.

Annex Table 6. Height of weld reinforcement

Unit: mm

Division			height of weld reinforcement
No. 1	Thickness of base metal	12 max. over 12 up to and incl. 25 over 23 up to and incl. 50	1.5 max. 2.5 max. 3.0 max.
No. 2		-	3.0 max.

Z10.2 The surface of weld reinforcement shall be smooth ,and the thickness of the deposited metal shall be at least that of the base metal.

Z10.3 the height of weld reinforcement shall conform to the requirements specified in (1) and (2).

Z10.4 The weld reinforcement can be removed partially or wholly.

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 358 Electric Fusion Welded Austenitic Cr-Ni Alloy steel Pipe for High-Temperature Service																	
Grade 304	S30400	STS 304TPY / SUS 310STPY	D3588 / G3468		X5 CrNi 18 9	17440	1.4301	(3b)	3605	304S25	LWHT(3b)	Z6 CN 18.09	A36-209	(3b)	X6 CrNi 18 10	8317	(3b)
Grade 310	S31000	STS 310STPY/SUS310STPY	D3588 / G3468		X 12 CrNi 25 21		1.4845	WBL-470(3b)			(3)		A36-209		X22 CrNi 25 20	6900	(3b)(11)
Grade 316	S31600	STS 316TPY / SUS316TPY	D3588 / G3468		X5 CrNiMo 18 10	17440	1.4401	(3b)	3605	316S26	LWHT(3b)	Z6 CND 17.11	A36-209	(3b)	X6CrNiMo 17 12	8317	(3b)
Grade 321	S32100	STS 321TPY / SUS 321TPY	D3588 / G3468		X10 CrNiTi 18 9	17440	1.4541	(3b)(17)	3605	321S22	LWHT(3b)	Z6 CNT 18.10	A36-209	(3b)	X6 CrNiTi 18 10	8317	(3b)
Grade 347	S34700	STS 347TPY / SUS 347TPY	D3588 / G3468		X10 CrNiNb 18 9	17440	1.4550	(3b)(17)	3605	347S17	LWHT(3b)	Z6 CN Nb 18.10	A36-209	(3b)	X6 CrNiNb 18 10	8317	(3b)

JIS Number and Corresponding Foreign Standards

JIS			ASTM			BS			ISO			Index Number
Standard Number	Grade	Type	Standard Number	Grade	Type	Standard Number	Grade	Type	Standard Number	Grade	Type	

G3468		A409	TP304	SUS					2604/5	TW47	SUS	C009
304TPY	SUS	A358	304	SUS								
SUS		A409	TP304L	SUS					2604/5	TW46	SUS	
304LTPY	SUS	A358	304L	SUS								
SUS		A358	309	SUS								
309STPY	SUS											
SUS		A358	309	SUS								
310STPY	SUS											
SUS		A409	TP316	SUS					2604/5	TW60	SUS	
316TPY	SUS	A358	316	SUS					"	TW61	SUS	
SUS		A409	TP316L	SUS					2604/5	TW57	SUS	
316LTPY	SUS	A358	316L	SUS								
SUS		A409	TP317	SUS								
317TPY	SUS											
SUS												
317LTPY	SUS											
SUS		A409	TP321	SUS								
321TPY	SUS	A778	TP321	SUS								
		321	SUS									
	SUS		A409	TP347	SUS					TW50	SUS	
	347TPY	SUS	A778	TP347	SUS							
		SUS	A358	347	SUS							
	SUS											
	329JITPY	SUS										