

## JIS G3459 Stainless Steel Pipes

### 1. Scope

The Japanese Industrial Standard specifies the 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 purchaser may designate a part or all of the special quality requirements of Z2, Z3, Z4, Z6 and Z7 specified in Annex, in addition to the items specified in this text.

Annex Z2 Elevated temperature yield point or proof stress

Annex Z3 Ultrasonic examination

Annex Z4 Eddy current examination

Annex Z6 Corrosion test

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

### 2. Grade and symbol

Pipes shall be classified into 29 grades, and their symbols shall be as given in Table 1.

Table 1 Grade and symbol

Classification		Symbol of grade	Solution treatment °C
Austenitic pipes	SUS 304	SUS304TP	1010 min. rapid cooling
	SUS 304H	SUS304HTP	1040 min. rapid cooling
	SUS 304L	SUS304LTP	1010 min. rapid cooling
	SUS 309	SUS309TP	10300 min. rapid cooling
	SUS 309S	SUS309STP	1030 min. rapid cooling
	SUS 310	SUS310TP	1030 min. rapid cooling
	SUS 310S	SUS310STP	1030 min. rapid cooling
	SUS 316	SUS316TP	1010 min. rapid cooling
	SUS 316H	SUS316HTP	1040 min. rapid cooling
	SUS 316L	SUS316LTP	1010 min. rapid cooling
	SUS 316Ti	SUS316TiTP	920 min. rapid cooling
	SUS 317	SUS317TP	1010 min. rapid cooling

	SUS 317L	SUS317LTP	1010 min. rapid cooling
	SUS 836L	SUS836LTP	1030 min. rapid cooling
	SUS 890L	SUS890LTP	1030 min. rapid cooling
	SUS 321	SUS321TP	920 min. rapid cooling
	SUS 321H	SUS321HTP	Cold-finished 1095 min, rapid cooling
			Hot-finished 1050 min, rapid cooling
	SUS 347	SUS347TP	980 min, min
	SUS 347H	SUS347HTP	cold-finished 1095 min, rapid cooling
Hot-finished 1050 min, rapid cooling			
Austenitic-ferritic pipes	SUS 329J1	SUS329J1TP	950 min, rapid cooling
	SUS 329J3L	SUS329J3LTP	950 min, rapid cooling
	SUS 329J4L	SUS329J4LTP	950 min, rapid cooling
Ferritic pipes	SUS 405	SUS405TP	Annealing 700 min, air-cooling or slow cooling
	SUS 409L	SUS409LTP	Annealing 700 min, air-cooling or slow cooling
	SU S430	SUS430TP	Annealing 700 min, air-cooling or slow cooling
	SUS 430LX	SUS430LXTP	Annealing 700 min, air-cooling or slow cooling
	SUS 430J1L	SUS430J1LTP	Annealing 720 min, air-cooling or slow cooling
	SUS 436L	SUS436LTP	Annealing 720 min, air-cooling or slow cooling
	SUS 444	SUS444TP	Annealing 700 min, air-cooling or slow cooling

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 3576	STS304TP	A312	TP304	G-3459	SUS304TP	17455	X5Cr Ni	3605	304S18, 25
		A376	TP304			17456		4127	302S17

STS304HTP	A312 A376	TP304 H TP304 H	SUS304HTP	-	-	3605	304S59
STS304LTP	A312	TP304 L	SUS304LTP	17455	X2Cr Ni1911	3605	304S14
		TP304N TP304LN		17456			304S22
STS309TP	A312	TP309H	SUS309TP	-	-	-	-
STS309STP	A312	TP309S	SUS309STP	-	-	-	-
		TP309Scd TP309cd		-	-	-	-
STS310TP	A312	TP310H	SUS310TP				
		TP310Scd					
STS310STP	A312	TP310S	SUS310STP				
		TP310cd					
STS316TP	A312 A376	TP316 TP316	SUS316TP	17455 17456	X5Cr Ni Mo17122	3605	316S18 316S26
STS316HTP	A312 A376	TP316H TP316H	SUS316HTP	-	-	-	-
STS316LTP	A312	TP316L	SUS316LTP	17455 17456	X2Cr Ni Mo17132	3605	316S14 316S22
	A312	TP316N	SUS316TiTP	-	-	-	-
		TP316LN		-	-	-	-
STS317TP	A312	TP317	SUS317TP	-	-	-	-
STS317LTP	A312	TP317L	SUS317LTP	-	-	-	-
-	-	-	SUS836LTP	-	-	-	-
-	-	-	SUS890LTP	-	-	-	-
STS321TP	A312 A376	TP321 TP321	SUS321TP	17455 17456	X6Cr NiTi1810	3605	321S18 321S22

	STS321HTP	A312 A376	TP321H TP321H		SUS321HTP	-	-	3605	321S59
	STS347TP	A312 A376	TP347 TP347		SUS347TP	17455 17456	X6Cr Ni Mo 1810	3605	347S18 347S17
	STS347HTP	A312 A376	TP347H TP347H		SUS347HTP	-	-	3605	347S59
			TP348 TP348H						
D 3576	STS329J1TP		TPXM-10	G-3459	SUS329J1TP	-	-	-	-
	-		TPXM-11		SUS329J3TP	-	-	-	-
	-		TPXM-19		SUS329J4TP	-	-	-	-
D 3576	STS405TP		TPXM-29	G-3459	SUS405TP	-	-	-	-
	-	-	-		SUS409LTP	-	-	-	-
	-	-	-		SUS430TP	-	-	-	-
	-	-	-		SUS430LXTP	-	-	-	-
	-	-	-		SUS430JILTP	-	-	-	-
	-	-	-		SUS436LTP	-	-	-	-
	-	-	-		SUS444TP	-	-	-	-
	-	-	-						

### 3. Method of manufacture

3.1 Pipes shall be manufactured by a seamless process, an automatic arc welding process, a laser welding process, or an electric resistance welding process.

3.2 The pipes shall be subjected to the solution treatment or annealing specified in Table and then pickled or similarly treated. However, heat treatments not specified in Table shall be made as agreed upon between the purchaser and supplier.

Table. Heat treatment

Symbol of grade	Soultion treatment <sup>n</sup>
SUS 304TP	1010 min, rapid cooling
SUS 304HTP	1040 min, rapid cooling
SUS 304LTP	1010 min, rapid cooling

SUS 309TP	10300 min, rapid cooling
SUS 309STP	1030 min, rapid cooling
SUS 310TP	1030 min, rapid cooling
SUS 310STP	1030 min, rapid cooling
SUS 316TP	1010 min, rapid cooling
SUS 316HTP	1040 min, rapid cooling
SUS 316LTP	1010 min, rapid cooling
SUS 316TiTP	920 min, rapid cooling
SUS 317TP	1010 min, rapid cooling
SUS 317LTP	1010 min, rapid cooling
SUS 836LTP	1030 min, rapid cooling
SUS 890LTP	1030 min, rapid cooling
SUS 321TP	920 min, rapid cooling
SUS 321HTP	Cold-finished 1095 min, rapid cooling
	Hot-finished 1050 min, rapid cooling
SUS 347TP	980 min, rapid cooling
SUS 347HTP	Cold-finished 1095 min, rapid cooling
	Hot-finished 1050 min, rapid cooling
SUS 329J1TP	950 min, rapid cooling
SUS 329J3LTP	950 min, rapid cooling
SUS 329J4LTP	950 min, rapid cooling
SUS 405TP	Annealing 700 min, air cooling or slow cooling
SUS 409LTP	Annealing 700 min, air cooling or slow cooling
SUS 430TP	Annealing 700 min, air cooling or slow cooling
SUS 430LXTP	Annealing 700 min, air cooling or slow cooling
SUS 430J1LTPP	Annealing 720 min, air cooling or slow cooling

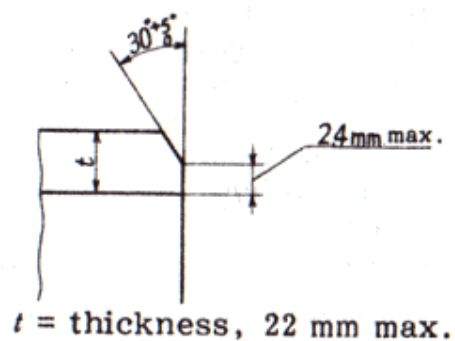
SUS 436LTPTP	Annealing 720 min, air cooling or slow cooling
SUS 444TP	Annealing 700 min, air cooling or slow cooling

## Remarks

For the pipes of SUS321TP, SUS316TiTP and SUS347TP, stabilizing treatment may be specified. In this case, the temperature of heat treatment shall be from 850n to n.

3.3 When required by the purchaser, the pipes may be fabricated to the bevel end (1)

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



## 4. Chemical composition

Table 3 Chemical composition

Symbol of grade	Chemical composition								
	C	Si	Mn	P	S	Ni	Cr	Mo	Others
SUS 304 TP	0.08 max.	1.00 max.	2.00 max.	0.040 max.	0.030 max.	8.00~11.00	18.00~20.00	-	-
SUS 304 HTP	0.04~0.10	0.75max.	2.00 max.	0.040 max.	0.030 max.	8.00~11.00	18.00~20.00	-	-
SUS 304 LTP	0.030 max.	1.00 max.	2.00 max.	0.040 max.	0.030 max.	9.00~13.00	18.00~20.00	-	-
SUS 309 TP	0.15 max.	1.00 max.	2.00 max.	0.040 max.	0.030 max.	12.00~15.00	22.00~24.00	-	-
SUS 309 STP	0.08 max.	1.00 max.	2.00 max.	0.040 max.	0.030 max.	12.00~15.00	22.00~24.00	-	-
SUS 310 TP	0.15 max.	1.50 max.	2.00 max.	0.040 max.	0.030 max.	19.00~22.00	24.00~26.00	-	-
SUS 310 STP	0.08 max.	1.50 max.	2.00 max.	0.040 max.	0.030 max.	19.00~22.00	24.00~26.00	-	-
SUS 316TP	0.08 max.	1.00 max.	2.00 max.	0.040 max.	0.030 max.	10.00~14.00	16.00~18.00	2.00~3.00	-
SUS 316HTP	0.04~0.10	0.75 max.	2.00 max.	0.030 max.	0.030 max.	11.00~14.00	16.00~18.00	2.00~3.00	-

SUS 316LTP	0.030 max.	1.00 max.	2.00 max.	0.040 max.	0.030 max.	12.00~16.00	16.00~18.00	2.00~3.00	-
SUS 316TiTP	0.08 max.	1.00 max.	2.00 max.	0.040 max.	0.030 max.	10.00~14.00	16.00~18.00	2.00~3.00	Ti 5XC % min.
SUS 317TP	0.08 max.	1.00 max.	2.00 max.	0.040 max.	0.030 max.	11.00~15.00	18.00~20.00	3.00~4.00	-
SUS 317LTP	0.030 max.	1.00 max.	2.00 max.	0.040 max.	0.030 max.	11.00~15.00	18.00~20.00	3.00~4.00	-
SUS 836LTP	0.030 max.	1.00 max.	2.00 max.	0.040 max.	0.030 max.	24.00~26.00	19.00~24.00	5.00~7.00	N 0.25 min.
SUS 890LTP	0.020 max.	1.00 max.	2.00 max.	0.040 max.	0.030 max.	23.00~28.00	19.00~23.00	4.00~5.00	Cu 1.00~2.00
SUS 321TP	0.08 max.	1.00 max.	2.00 max.	0.040 max.	0.030 max.	9.00~13.00	17.00~19.00	-	Ti 5】 C% min.
SUS 321HTP	0.04~0.10	0.75 max.	2.00 max.	0.030 max.	0.030 max.	9.00~13.00	17.00~20.00	-	Ti 4】 C% ~ 0.6
SUS 347TP	0.08 max.	1.00 max.	2.00 max.	0.040 max.	0.030 max.	9.00~13.00	17.00~19.00	-	Nb 10】 C% min.
SUS 347HTP	0.04~0.10	1.00 max.	2.00 max.	0.030 max.	0.030 max.	9.00~13.00	17.00~20.00	-	Nb 8】 C% min.
SUS 329J1TP	0.08 max.	1.00 max.	1.50 max.	0.040 max.	0.030 max.	3.00~6.00	23.00~28.00	1.00~3.00	-
SUS 329J3TP	0.030 max.	1.00 max.	1.50 max.	0.040 max.	0.030 max.	4.50~6.50	21.00~24.00	2.50~3.50	N 0.08~0.20
SUS 329J4LTP	0.030 max.	1.00 max.	1.50 max.	0.040 max.	0.030 max.	5.50~7.50	24.00~26.00	2.50~3.50	N 0.08~0.30
SUS 405TP	0.08 max.	1.00 max.	1.00 max.	0.040 max.	0.030 max.	-	11.50~14.50	-	A1 0.10】 0.30
SUS 409LTP	0.030 max.	1.00 max.	1.00 max.	0.040 max.	0.030 max.	-	10.50~11.75	-	Ti 6XC%~0.75
SUS 430TP	0.012 max.	0.75 max.	1.00 max.	0.040 max.	0.030 max.	-	16.00~18.00	-	
SUS 430LXTP	0.030 max.	0.75 max.	1.00 max.	0.040 max.	0.030 max.	-	16.00~19.00	-	Ti Nb 0.10~1.00
SUS 430LXTP	0.025 max.	1.00 max.	1.00 max.	0.040 max.	0.030 max.	-	16.00~20.00	-	N 0.025 max. Nb 8 X (C%+N%)~8 Cu 0.30~0.80
SUS 436LTP	0.025 max.	1.00 max.	1.00 max.	0.040 max.	0.030 max.	-	16.00~19.00	-	N 0.025 max. Ti, Nb Zr or their combination 8X(C%+N%)~0.08
SUS 444TP	0.025 max.	1.00 max.	1.00 max.	0.040 max.	0.030 max.	-	16.00~20.00	-	N 0.025 max. Ti Nb,Zr or their combination 8X(C%+N%)~0.08

## Remarks

1. Even when a product analysis is required by the purchaser, the chemical composition given in Table 2 shall be applied. However, the carbon content for SUS 304 LTP, SUS 316 LTP SUS 317 LTP, SUS 836LTP, SUS 329J3LTP, SUS 329J4LTP, SUS 409LTP, SUS430LXTP shall be 0.035 % or under, The carbon content for SUS430J1LTP,SUS436LTP and SUS444TP shall be 0.030 % or under. The carbon content for SUS890LTP shall be 0.025 % or under.

2. To SUS 329 J1TP, SUS 329J3LTP, SUS 329J4LTP, alloying elements other than those given in Table 1 may be added, if necessary.
3. SUS 405TP, SUS 430TP, SUS 430LXTP, SUS430J1LTP, SUS 436LT, SUS 444TP may contain Ni 0.60 % or under.

**5. Mechanical properties**

5.1 Tensile strength, proof stress, and elongation Pipes shall be tested in accordance with 10.2 and their tensile strength, proof stress, and elongation shall be as given in Table 4.

Table 4 Mechanical properties

Symbol of grade							
	Tensile strength	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 test piece No. 12 test piece		No.5 test piece	No.4 test piece	
			Longitudinal direction	Transverse direction	Longitudinal direction	Transverse direction	
SUS 304TP	53{520}min.	21{206} min	35 min		25 min	30 min	22 min
SUS 304HTP	53{520}min.	21{206} min	35 min		25 min	30 min	22 min
SUS 304LTP	49{481}min.	18{177} min	35 min		25 min	30 min	22 min
SUS 309TP	53{520}min.	21{206} min	35 min		25 min	30 min	22 min
SUS 309STP	53{520}min.	21{206} min	35 min		25 min	30 min	22 min
SUS 310TP	53{520}min.	21{206} min	35 min		25 min	30 min	22 min
SUS 310STP	53{520}min.	21{206} min	35 min		25 min	30 min	22 min
SUS 316TP	53{520}min.	21{206} min	35 min		25 min	30 min	22 min
SUS 316HTP	53{520}min.	21{206} min	35 min		25 min	30 min	22 min
SUS 316LTP	49{481}min.	18{177} min	35 min		25 min	30 min	22 min
SUS 316TiTP	53{520}min.	21{206} min	35 min		25 min	30 min	22 min
SUS 317TP	53{520}min.	21{206} min	35 min		25 min	30 min	22 min
SUS 317LTP	49{481}min.	21{206} min	35 min		25 min	30 min	22 min
SUS 836LTP	53{520}min.	21{206} min	35 min		25 min	30 min	22 min
SUS 890LTP	49{4900}min.	21{216} min	35 min		25 min	30 min	22 min
SUS 321TP	53{520}min.	21{206} min	35 min		25 min	30 min	22 min



SUS 321HTP	53{520}min.	21{206} min	35 min	25 min	30 min	22 min
SUS 347TP	53{520}min.	21{206} min	35 min	25 min	30 min	22 min
SUS 347HTP	53{520}min.	21{206} min	35 min	25 min	30 min	22 min
SUS 329J1TP	60{588}min.	40{392} min	18 min	13 min	14 min	10 min
SUS 329J3LTP	63{618}min.	46{451} min	18 min	13 min	14 min	10 min
SUS 329J4LTP	42{412}min.	21{206} min	20 min	14 min	14 min	10 min
SUS 405TP	42{412}min.	21{206} min	20 min	14 min	16 min	11 min
SUS 409LTP	360 min	175 min	20 min	14 min	16 min	11 min
SUS 430TP	410 min	245 min	20 min	14 min	16 min	11 min
SUS 430LXTP	360 min	175 min	20 min	14 min	16 min	11 min
SUS 430J1LTPP	390 min	205 min	20 min	14 min	16 min	11 min
SUS 436LTPTP	410 min	245 min	20 min	14 min	16 min	11 min
SUS 444TP	410 min	245 min	20 min	14 min	16 min	11 min

## Remarks

1. When a tensile test is carried out with No. 12 or No. 5 test piece for pipes of under 8mm in wall thickness, the minimum elongation shall be calculated by subtracting 1.5 % from the elongation given in Table 4 for each decrease of 1mm from 8mm in wall thickness, and rounded off to an integer in accordance with JIS Z 8401. Examples of calculation are given in Informative reference Table.
2. The elongation given in Table 4 shall not be applied to pipes of under 40mm in outside diameter. However, the value of elongation shall be recorded.
3. In the case where a tensile test piece is taken from automatic arc welded pipes, laser welded pipes, or electric resistance welded pipes, No. 12 or No. 5 test piece shall be taken from the portion having no welded seams.

## Informative reference Table

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

Classification	Shape of test piece	Elongation for each wall thickness division %						
		Over 7mm to and excl. 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
Austenitic-ferritic pipes	No. 12 test piece	18	16	15	14	12	10	9
	No.5 test piece	13	12	10	8	7	6	4
Ferritic pipes	No. 12 test piece	20	18	17	16	14	12	11

	No.5 test piece	14	12	11	10	8	6	5
Austenitic pipes	No. 12 test piece	35	34	32	30	29	28	26
	No.5 test piece	25	24	22	20	19	18	16

5.2 Flattening resistance Pipes shall be tested in accordance with 10.3 and the results shall be free from flaws and cracks on the wall of pipes. In this case, the distance between the two flat plates shall be calculated according to the following formula

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

Where

*H*: distance between flat plates (mm)

*t*: wall thickness of pipe (mm)

*D*: outside diameter of pipe (mm)

*e*: constant which differs according to the grade of pipe. 0.09 for austenitic pipes. 0.07 for austenitic-ferritic pipes, and ferritic pipes.

## 6. Hydraulic test characteristic or nondestructive examination characteristic

Pipes shall be tested in accordance with 10.6 and the resulted hydraulic test characteristic or nondestructive examination characteristic shall conform to either of the following requirements. The preference is committed to the specification by the purchaser or the discretion of the manufacturer.

6.1 Hydraulic test characteristic Pipes shall withstand, without leakage, the hydraulic pressure designated, if any, by the purchaser, or in absence of it the hydraulic pressure specified in Attached Table 1. In this case, the purchaser may specify a hydraulic pressure higher or lower than those in Attached Table 1.

In the case where the hydraulic test is conducted by the specification of the purchaser and the test pressure exceeds either of the value *P* calculated from the following formula or 20 MPa and in 1 MPa for 10 MPa or over. IN calculation, the value *P* in the following formula shall be obtained and rounded off to 0.5 MPa or 1MPa.

$$P = 200st / D$$

Where

*P*: test pressure [ kgf/cm<sup>2</sup> { 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 proof stress specified in Table 3 [ kgf/mm<sup>2</sup> { N/mm<sup>2</sup> } ]

Note (2) 1bar = 10<sup>5</sup>Pa

6.2 There shall be no signal equal to or greater than the signals produced by the artificial flaws of the reference test piece of the working sensitivity division UD specified in JIS G 0582.

There shall be no signal equal to or greater than the signals produced by the artificial flaws of the reference test piece of the working sensitivity division EY specified in JIS G 0583

## 7. Appearance

7.1 Pipes shall be straight for practical purposes, and their both ends shall be at right angles to the axis.

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

## 8. Dimensions, mass and dimensional tolerances

### 8.1 Dimensions and mass

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

### 8.2 Dimensional tolerances

The tolerances on outside diameter, wall thickness, and eccentricity of pipe shall be as specified in Table 5.

Table 5 Tolerances on outside diameter, wall thickness and eccentricity

Division	Tolerances on outside diameter	Tolerances on wall thickness	Tolerances on eccentricity
Hot-finished seamless pipe	Under 50mm 【0.5mm	Under 4mm 【0.5mm	At most 20 % of wall thickness
	50mm or over 【1%	4mm or over 【12.5%	
Cold-finished seamless pipe, automatic arc welded pipe, electric resistance welded pipe, and laser welded pipe	Under 30mm 【0.3mm	Under 2mm 【0.2mm	-
	30mm or over 【1%	2mm or over 【10%	

### Remarks

1. The eccentricity means the ratio of the difference between maximum and minimum wall thickness measured in the same section to the specified wall thickness, and this shall not be applied to pipes under 5.6mm in wall thickness..

2. As for the portions locally ground or the like, the above tolerance on outside diameter shall not be applied if it is confirmed that the wall thickness is within the tolerance range given in the above table.

8.3 In the case where the pipe length is specified, the tolerances on pipe length shall be applied on the plus side only.

## 9. Tests

### 9.1 Chemical analysis

#### 9.1.1 Chemical analysis

General matters common to chemical analysis and the 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 any one of the following standards

JIS G 1211, JIS G 1212, JIS G 1213, JIS G 1214, JIS G 1215, JIS G 1216,

JIS G 1217, JIS G 1218, JIS G 1223, JIS G 1224, JIS G 1237, JIS G 1253,

JIS G 1256, JIS G 1257

## 9.2 Tensile test

### 9.2.1 Test piece

The test piece shall be any one of No.11, No. 12A, No. 12B, No.12C, No.4 or No. 5 specified in JIS Z 2201 to be cut off from the pipe. IN the case of No. 4 test piece, the gauge length shall be 50mm.

### 9.2.2 Test method

The test method shall be in accordance with JIS Z 2241

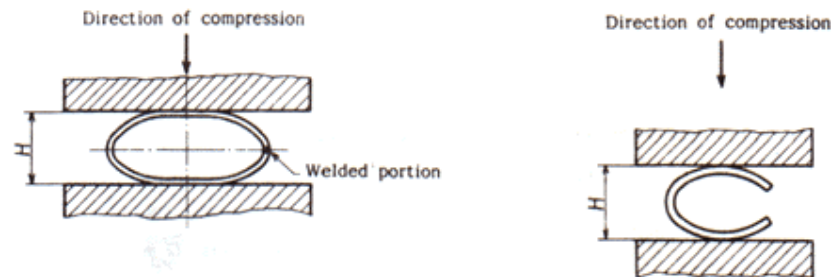
## 9.3 Flattening test

### 9.3.1 Test piece

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

### 9.3.2 Test method

Place the test piece at ordinary temperature between two flat plates and flatten by compression until the distance between the flat plates reaches the specified value, and examine for the occurrence of flaws or cracks on the wall surface of the test piece. In the cases of the automatic arc welded pipe, laser welded pipe, and electric resistance welded pipe, the weld zone 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 Austenitic grain size test

### 9.4.1 Test piece

A 20mm long pipe shall be cut off from the pipe end to serve as a test piece..

### 9.4.2 Test method

The austenitic grain size number shall be measured in accordance with JIS G 0551.

## 9.5 Hydraulic test or nondestructive examination

### 9.5.1 Hydraulic test

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

### 9.5.2 Nondestructive examination

The test method of a nondestructive examination shall be in accordance with JIS G 0582, JIS G 0583 or JIS Z 3106.

## 10. Inspection

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

10.2 The chemical composition shall conform to the requirements specified in 4.

10.3 The mechanical properties shall conform to the requirements specified in 5.

10.4 The austenitic grain size number of SUC321HTP shall conform to the requirements specified in 6.

10.5 The hydraulic test characteristic or nondestructive examination characteristic shall conform to the requirements specified in 7. However, the nondestructive examination may be replaced by other appropriate nondestructive examinations other than 10.6.3 subjected to the agreement between the purchaser and supplier.

10.6 The dimensions shall conform to the requirements specified in 8.

10.7 The appearance shall conform to the requirements specified in 9.

10.8 When the special quality requirements given in Annex are specified subjected to the agreement between the purchaser and supplier, the results of inspection shall conform to the relevant requirements specified in Z2, Z3, Z4, Z6 and Z7.

## 11. Reinspection

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

## 12. Marking

Each pipe having passed the inspection shall be marked with the following items. However, in the case of either small pipes or a requirement from the purchaser, the pipes may be bundled and marked for each bundle by a suitable means. In either case, the order of arranging the items is not specified.

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

(1) Symbol of grade

(2) Symbol indicating the manufacturing method <sup>(3)</sup>

(3) Dimension <sup>(4)</sup>

(4) Manufacturer's name or abbreviation

(5) Symbol Z indicating the special quality requirement

Note <sup>(3)</sup>

The symbols indicating the manufacturing method shall be as follows. However, the sign of dash may be replaced by a space.

Hot-finished seamless pipe -S-H

Cold-finished seamless pipe -S-C

Automatic arc welded pipe -A

Cold-finished automatic arc welded pipe -A-C

Weld zone work finished automatic arc welded pipe -A-B

Laser welded pipe -L

Cold-finished laser welded pipe -L-D

Weld zone work finished laser welded pipe -L-B

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

Cold-finished electric resistance welded pipe -E-C

Note (4)

The dimensions shall be indicated as follows

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

Example : 50A × Sch 10S

### 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 condition, etc.

Annex Special quality requirements

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

Z2 Elevated temperature yield point or proof stress

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

Z2.2 The test piece and test method shall be as specified in JIS G 0567.

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

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

Z3 Ultrasonic examination

Z3.1 The criteria for working sensitivity of ultrasonic examination shall be UB or UC specified in JIS G 0582, and there shall be no signal greater than signals produced by the artificial flaws of a reference test piece.

Z3.2 The method form ultrasonic examination shall be as specified in JIS G 0582.

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

Z4 Eddy current examination

Z4.1 The criteria for working sensitivity of eddy current examination shall be EV, EW or EX specified in JIS G 0583, and there shall be no signal greater than the signals produced by the artificial flaws of a reference test piece.

Z4.2 The method for eddy current examination shall be as specified in JIS

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

Z.6 Corrosion test

Z6.1 Corrosion resistance The corrosion resistance of the pipe by an intergranular corrosion test shall comply with the following requirements. In this case, the detail of the intergranular corrosion test to be applied shall be subjected to the agreement between the purchaser and supplier.

(1) The evaluation according to an etch structure obtained by a 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 304 TP	As delivered (solution treatment)	Ditch structure	Ditch structure End grain pitting ケ	-	Ditch structure
SUS 316 TP			-	Ditch structure	
SUS 317 TP			-	-	
SUS 304 LTP	Sensitization	Ditch structure	Ditch structure End grain pitting ケ	-	Ditch structure
SUS 316 TP			-	Ditch structure	
SUS 317 LTP		-	-		
SUS 321 TP		-	-		
SUS 347 TP		-	-		

(2) The mass loss by a 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 <sup>2</sup> h)
SUS 304TP	As delivered (solution treatment)	To be agreed upon between the purchaser and supplier.
SUS 316TP		
SUS 317TP		
SUS 304LTP	Sensitization	To be agreed upon between the purchaser and supplier
SUS 316LTP		
SUS 317LTP		

(3) The mass loss by a 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 <sup>2</sup> h)
SUS 304TP	As delivered (solution treatment)	To be agreed upon between the purchaser and supplier.
SUS 304LTP	Sensitization	To be agreed upon between the purchaser and supplier.

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

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

Symbol of grade	Corrosion rate ratio
SUS 316TP	1.5 max.
SUS 317TP	
SUS 316LTP	
SUS 317LTP	

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

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

Symbol of grade	Condition	State of bent surface
SUS 304TP	As delivered (solution treatment)	To be free from inter-granular corrosion cracks.
SUS 316TP		
SUS 317TP		
SUS 304LTP	Sensitization	
SUS 316LTP		
SUS 317LTP		
SUS 321TP		
SUS 347TP		

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

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

Z6.5 The sampling of a test specimen and the number of test pieces shall be as given in the case of the grain size test in 10.5.1. of the main text. However, if required, the above-mentioned test piece shall be sampled for a lot of the pipes of the same cast steel produced under the same heat treatment.

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



ASTM Standard	UNS NO.	KOREA/JAPANESE			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 312 Seamless and Welded Austenitic Stainless Steel Pipe																	
TP 304	S30400	STS 304TP / SUS 304 TP	D3576 / G3459	(16)	X5CrNi 18 9	17440	1.4301	(3b)	3605	304S18		TU Z6 CN19-10	A 49-230		X5 CrNi 18 10	6904	(3b)
TP 304H	S30409	STS 304HTP / SUS 304HTP	D3576 / G3459	(16)				(3)	3605	304S59		TU Z6 CN19-10	A 49-214		X8 CrNi 19 10	6904	(3b)
TP 304L	S30403	STS 304LTP/SU	D3576 / G3459	(16)	X2 CrNi 19 9	17440	1.4306	(3b)	3605	304S14		TU Z2 CN19-11	A 49-230		X2 CrNi 18 11	6904	(3b)
TP 310	S31000	304LTP	D3576 / G3459	(16)				(3)							X22 Cr Ni 25 20	6904	(3b)(11)
TP 316	S31600	STS 310STP/SU	D3576 / G3459	(16)	X5 CrNiMo 18 10	17440	1.4401	(3b)	3605	316S18		Z 6 CND 17.11	A 35-573	(3b)	X5 CrNiMo 17 12	6904	(3b)
TP 316H	S34609	310STP	D3576 / G3459	(16)				(3)	3605	316S59		TUZ6CND17-12	A 49-230		X8 CrNiNb 17 12	6904	(3b)
TP 316L	S31603	STS 316TP / SUS 316TP	D3576 / G3459	(16)	X2 CrNiMo 18 10	17440	1.4404	(3b)	3605	316S14		TUNZ2CND17-12	A 49-230		X2 CrNiMo 17 12	6904	Dalmine 941(3b)
TP 321	S32100	STS 316HTP /SU	D3576 / G3459	(16)	X10 CrNiTi 18 9	17440	1.4541	(3b)	3605	321S18		Z6 CNT 18.11	A 49-230		X6 CrNiTi 18 11	6904	(3b)
TP 347	S34700	316HTP	D3576 / G3459	(16)	X5 CrNiNb 18 9		1.4543	(3b)	3605	347S18		Z6 CNNb 18.11	A 35-573	(3b)	X6 CrNiNb 18 11	6904	(3b)



	309STP	SUS															
	SUS		A312								A49-117	TUZ12 CN24.12	SUS	2604/2	TS68	SUS	
	310TP	SUS															
	310STP	SUS															
	SUS		A312	TP316	SUS	3605	316S18	SUS	2462	X5CrNiMo 1810	SUS	A49-117	TUZ6CND 17.11	SUS	1604/2	TS60	SUS
	316TP	SUS	A376	TP316	SUS	"			2643	X5CrNiMo 1810	SUS	A49-147	TUZ6CND 17.11	SUS	"	TS61	SUS
	316TPD	SUS	A651	TP316	SUS				"	X5CrNiMo 1812	SUS	A49-230	TUZ6CND 17.11	SUS			
										(17440)	SUS						
	SUS		A312	TP316H	SUS										2604/2	TS63	SUS
	316HTP	SUS	A376	TP316H	SUS												
	SUS		A312	TP316L	SUS	3605	316A14	SUS	2462	X2CrNiMo 1810	SUS				2604/3	TS63	SUS
	316LTP	SUS				"	316S22	SUS	"	X2CrNiMo 1812	SUS				"	TS58	SUS
									2463	X2CrNiMo 1810	SUS						
									"	X2CrNiMo 1812	SUS						
	SUS		A312	TP317	SUS												
	317TP	SUS															
	SUS		A312	TP317	SUS												
	317LTP	SUS															
	SUS		A312	TP321L	SUS	3605	321S18	SUS	2462	X10CrNi Ti189	SUS	A49-117	TUZ6CNT 1810	SUS	2604/2	TS53	SUS

