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Stainless steel pipes

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Foreword

This Japanese Industrial Standard has been revised by the Minister of Economy, Trade and Industry based on the provision of Article 14, paragraph (1) of the Industrial Standardization Act applied mutatis mutandis pursuant to the provision of Article 16 of the said Act in response to a proposal for revision of Japanese Industrial Standard with a draft being attached, submitted by The Japan Iron and Steel Federation (JISF), an accredited standards development organization. This edition replaces the previous edition (**JIS G 3459:2020**), which has been technically revised.

However, **JIS G 3459: 2020** may be applied in the **JIS** mark certification based on the relevant provisions of Article 30, paragraph (1), etc. of the Industrial Standardization Act until 19 April 2022.

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— Address: 1-8-2 Marunouchi, Chiyoda-ku, Tokyo-to

Symbol of grade	Title of invention	Patent number	Registration date of establishment of patent right
SUS821L1TP	Alloy-saving duplex stainless steel with good corrosion resistance and toughness of weld heat affected zone	5345070	23 August 2013

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Stainless steel pipes

Introduction

This Japanese Industrial Standard has been prepared based on **ISO 9329-4** : 1997, Edition 1, and **ISO 9330-6** : 1997, Edition 1, with some modifications of the technical contents.

Annex JA is unique to **JIS** and not given in the corresponding International Standard. The vertical lines on both sides and dotted underlines indicate changes from the corresponding International Standards. A list of modifications with the explanations is given in Annex JB.

1 Scope

This Standard specifies requirements for the stainless steel pipes (hereafter referred to as pipes) used for piping for corrosion resistance, low temperature service, elevated temperature service, fire-fighting service or the like.

NOTE 1 This Standard generally applies to pipes of outside diameter 10.5 mm (nominal diameter 6A or 1/8B) to 660.4 mm (nominal diameter 650A or 26B) (see **10.1**).

NOTE 2 The International Standards corresponding to this Standard and the symbol of degree of correspondence are as follows.

ISO 9329-4 : 1997 *Seamless steel tubes for pressure purposes — Technical delivery conditions — Part 4 : Austenitic stainless steels*

ISO 9330-6 : 1997 *Welded steel tubes for pressure purposes — Technical delivery conditions — Part 6 : Longitudinally welded austenitic stainless steel tubes* (Overall evaluation : MOD)

In addition, symbols which denote the degree of correspondence in the contents between the relevant International Standards and **JIS** are IDT (identical), MOD (modified), and NEQ (not equivalent) according to **ISO/IEC Guide 21-1**.

2 Normative references

Part or all of the provisions of the following standards, through reference in this text, constitute provisions of this Standard. The most recent editions of the standards (including amendments) indicated below shall be applied.

JIS G 0201 *Glossary of terms used in iron and steel (Heat treatment)*

JIS G 0202 *Glossary of terms used in iron and steel (Testing)*

JIS G 0203 *Glossary of terms used in iron and steel (Products and quality)*

JIS G 0320 *Standard test method for heat analysis of steel products*

JIS G 0321 *Product analysis and its tolerance for wrought steel*

JIS G 0404 *Steel and steel products — General technical delivery requirements*

JIS G 0415 *Steel and steel products — Inspection documents*

JIS G 0551 *Steels — Micrographic determination of the apparent grain size*

JIS G 0567 *Method of elevated temperature tensile test for steels and heat-resisting alloys*

JIS G 0571 *Method of oxalic acid etching test for stainless steels*

JIS G 0572 *Method of ferric sulfate-sulfuric acid test for stainless steel*

JIS G 0573 *Method of 65 per cent nitric acid test for stainless steels*

JIS G 0575 *Method of copper sulfate-sulfuric acid test for stainless steels*

JIS G 0582 *Automated ultrasonic examination of steel pipes and tubes*

JIS G 0583 *Automated eddy current examination of steel pipes and tubes*

JIS Z 2241 *Metallic materials — Tensile testing — Method of test at room temperature*

JIS Z 3106 *Methods of radiographic examination for welded joints in stainless steel*

JIS Z 3122 *Methods of bend test for butt welded joint*

JIS Z 8401 *Rounding of numbers*

3 Terms and definitions

For the purpose of this Standard, the terms and definitions given in JIS G 0201, JIS G 0202 and JIS G 0203 apply.

4 Symbols of grade

This Standard covers pipes of 34 steel grades. Their symbols are shown in Table 1.

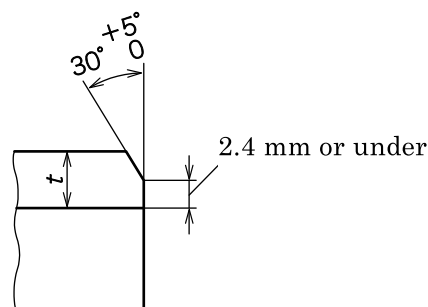
Table 1 Symbols of grade and manufacturing method

Classification	Symbol of grade	Symbol of manufacturing method		
		Pipe manufacturing method	Finishing method	Marking
Austenitic series	SUS304TP, SUS304HTP, SUS304LTP, SUS309TP, SUS309STP, SUS310TP, SUS310STP, SUS315J1TP, SUS315J2TP, SUS316TP, SUS316HTP, SUS316LTP, SUS316TiTP, SUS317TP, SUS317LTP, SUS836LTP, SUS890LTP, SUS321TP, SUS321HTP, SUS347TP, SUS347HTP	Seamless : S Automatic arc welded : A Laser welded : L Electric resistance welded : E	Hot-finished : H Cold-finished : C Weld work finished : B As electric resistance welded : G	The symbols of manufacturing method shall be in accordance with 15 b).
Austenitic-ferritic series	SUS821L1TP, SUS323LTP, SUS329J1TP, SUS329J3LTP, SUS329J4LTP, SUS327L1TP			
Ferritic series	SUS405TP, SUS409LTP, SUS430TP, SUS430LXTP, SUS430J1LTP, SUS436LTP, SUS444TP			

5 Manufacturing method

The manufacturing method shall be as follows.

- Pipes shall be manufactured by a selected combination of the pipe manufacturing method and finishing method from Table 1. The manufacturing methods are designated by the symbols given in Table 1. The use of filler metal in automatic arc welding shall be left to the discretion of the manufacturer.
- Pipes shall receive solution heat treatment or annealing heat treatment as given in Table 2, followed by pickling or similar treatment. Other heat treatment than shown in Table 2 may be performed upon agreement between the purchaser and the manufacturer. If the pipe has gone through bright heat treatment and has no surface scales, the pickling or similar treatment may be omitted.
- Pipes shall be finished with plain ends unless otherwise specified. If the purchaser specifies the bevel end finishing, the shape of the bevel end shall be as agreed between the purchaser and the manufacturer. For pipes with a wall thickness 22 mm or under, however, the bevel end shape shown in Figure 1 shall apply unless otherwise specified.



Key
t : wall thickness (22 mm or under)

Figure 1 Shape of bevel end

Table 2 Symbols of grade and heat treatment

Unit: °C

Classi- fication	Symbol of grade	Solution heat treatment	Classi- fication	Symbol of grade	Solution heat treat- ment
Austen- itic series ^{a)}	SUS304TP	1 010 or over, rapid cooling	Austen- itic series ^{a)}	SUS321HTP	Cold finishing 1 095 or over, rapid cooling
	SUS304HTP	1 040 or over, rapid cooling			Hot finishing 1 050 or over, rapid cooling
	SUS304LTP	1 010 or over, rapid cooling		SUS347TP ^{b)}	980 or over, rapid cooling
	SUS309TP	1 030 or over, rapid cooling		SUS347HTP	Cold finishing 1 095 or over, rapid cooling
	SUS309STP				Hot finishing 1 050 or over, rapid cooling
	SUS310TP		Austen itic-fer- ritic series	SUS821L1TP	940 or over, rapid cooling
	SUS310STP	SUS323LTP		950 or over, rapid cooling	
	SUS315J1TP	SUS329J1TP			
	SUS315J2TP	SUS329J3LTP			
	SUS316TP	SUS329J4LTP			
	SUS316HTP	1 040 or over, rapid cooling	SUS327L1TP	1 025 or over, rapid cooling	
	SUS316LTP	1 010 or over, rapid cooling	Classi- fication	Symbol of grade	Annealing heat treatment
	SUS316TiTP ^{b)}	920 or over, rapid cooling	Ferritic series	SUS405TP	700 or over, rapid or slow cooling
	SUS317TP	1 010 or over, rapid cooling		SUS409LTP	
SUS317LTP	SUS430TP				
SUS836LTP	1 030 or over, rapid cooling	SUS430LXTP		720 or over, rapid or slow cooling	
SUS890LTP	SUS430J1LTP				
SUS321TP ^{b)}	920 or over, rapid cooling	SUS436LTP			
		SUS444TP		700 or over, rapid or slow cooling	
Note ^{a)} For hot-finished seamless pipes made of austenitic stainless steels that are rapidly cooled after hot working at the temperature specified in this table, the solution heat treatment may be omitted unless otherwise specified by the purchaser.					
Note ^{b)} For pipes of SUS316TiTP, SUS321TP and SUS347TP, the purchaser may specify the stabilizing heat treatment. In this case, the temperature of heat treatment shall be 850 °C to 930 °C.					

6 Chemical composition

The results of heat analysis obtained according to **13.1** shall satisfy the composition given in Table 3. If a product analysis has been requested by the purchaser, the pipe shall be tested in accordance with **13.1** and the analysis results shall satisfy the composition given in Table 3 within the tolerances given in Table 5 of **JIS G 0321**.

Table 3 Chemical composition

Unit: %

Symbol of grade	C	Si	Mn	P	S	Ni	Cr	Mo	Other elements
SUS304TP	0.08 max.	1.00 max.	2.00 max.	0.045 max.	0.030 max.	8.00 to 11.00	18.00 to 20.00	—	—
SUS304HTP	0.04 to 0.10	0.75 max.	2.00 max.	0.040 max.	0.030 max.	8.00 to 11.00	18.00 to 20.00	—	—
SUS304LTP	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	—	—
SUS309TP	0.15 max.	1.00 max.	2.00 max.	0.040 max.	0.030 max.	12.00 to 15.00	22.00 to 24.00	—	—
SUS309STP	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	—	—
SUS310TP	0.15 max.	1.50 max.	2.00 max.	0.040 max.	0.030 max.	19.00 to 22.00	24.00 to 26.00	—	—
SUS310STP	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	—	—
SUS315J1TP	0.08 max.	0.50 to 2.50	2.00 max.	0.045 max.	0.030 max.	8.50 to 11.50	17.00 to 20.50	0.50 to 1.50	Cu : 0.50 to 3.50
SUS315J2TP	0.08 max.	2.50 to 4.00	2.00 max.	0.045 max.	0.030 max.	11.00 to 14.00	17.00 to 20.50	0.50 to 1.50	Cu : 0.50 to 3.50
SUS316TP	0.08 max.	1.00 max.	2.00 max.	0.045 max.	0.030 max.	10.00 to 14.00	16.00 to 18.00	2.00 to 3.00	—
SUS316HTP	0.04 to 0.10	0.75 max.	2.00 max.	0.030 max.	0.030 max.	11.00 to 14.00	16.00 to 18.00	2.00 to 3.00	—
SUS316LTP	0.030 max.	1.00 max.	2.00 max.	0.045 max.	0.030 max.	12.00 to 16.00	16.00 to 18.00	2.00 to 3.00	—
SUS316TiTP	0.08 max.	1.00 max.	2.00 max.	0.045 max.	0.030 max.	10.00 to 14.00	16.00 to 18.00	2.00 to 3.00	Ti : $5 \times C$ % min.
SUS317TP	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	—
SUS317LTP	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	—
SUS836LTP	0.030 max.	1.00 max.	2.00 max.	0.045 max.	0.030 max.	24.00 to 26.00	19.00 to 24.00	5.00 to 7.00	N : 0.25 max.
SUS890LTP	0.020 max.	1.00 max.	2.00 max.	0.045 max.	0.030 max.	23.00 to 28.00	19.00 to 23.00	4.00 to 5.00	Cu : 1.00 to 2.00
SUS321TP	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	—	Ti : $5 \times C$ % min.
SUS321HTP	0.04 to 0.10	0.75 max.	2.00 max.	0.030 max.	0.030 max.	9.00 to 13.00	17.00 to 20.00	—	Ti : $4 \times C$ % to 0.60
SUS347TP	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	—	Nb : $10 \times C$ % min.
SUS347HTP	0.04 to 0.10	1.00 max.	2.00 max.	0.030 max.	0.030 max.	9.00 to 13.00	17.00 to 20.00	—	Nb : $8 \times C$ % to 1.00

Table 3 (concluded)

Unit: %

Symbol of grade	C	Si	Mn	P	S	Ni	Cr	Mo	Other elements
SUS821L1TP	0.030 max.	0.75 max.	2.00 to 4.00	0.040 max.	0.020 max.	1.50 to 2.50	20.50 to 21.50	0.60 max.	Cu : 0.50 to 1.50 N : 0.15 to 0.20
SUS323LTP	0.030 max.	1.00 max.	2.50 max.	0.040 max.	0.030 max.	3.00 to 5.50	21.50 to 24.50	0.05 to 0.60	Cu : 0.05 to 0.60 N : 0.05 to 0.20
SUS329J1TP	0.08 max.	1.00 max.	1.50 max.	0.040 max.	0.030 max.	3.00 to 6.00	23.00 to 28.00	1.00 to 3.00	—
SUS329J3LTP	0.030 max.	1.00 max.	1.50 max.	0.040 max.	0.030 max.	4.50 to 6.50	21.00 to 24.00	2.50 to 3.50	N : 0.08 to 0.20
SUS329J4LTP	0.030 max.	1.00 max.	1.50 max.	0.040 max.	0.030 max.	5.50 to 7.50	24.00 to 26.00	2.50 to 3.50	N : 0.08 to 0.30
SUS327L1TP	0.030 max.	0.80 max.	1.20 max.	0.035 max.	0.020 max.	6.00 to 8.00	24.00 to 26.00	3.00 to 5.00	Cu : 0.50 max. N : 0.24 to 0.32
SUS405TP	0.08 max.	1.00 max.	1.00 max.	0.040 max.	0.030 max.	0.60 max.	11.50 to 14.50	—	Al : 0.10 to 0.30
SUS409LTP	0.030 max.	1.00 max.	1.00 max.	0.040 max.	0.030 max.	0.60 max.	10.50 to 11.75	—	Ti : 6 × C % to 0.75
SUS430TP	0.12 max.	0.75 max.	1.00 max.	0.040 max.	0.030 max.	0.60 max.	16.00 to 18.00	—	—
SUS430LXTP	0.030 max.	0.75 max.	1.00 max.	0.040 max.	0.030 max.	0.60 max.	16.00 to 19.00	—	Ti or Nb : 0.10 to 1.00
SUS430J1LTP	0.025 max.	1.00 max.	1.00 max.	0.040 max.	0.030 max.	0.60 max.	16.00 to 20.00	—	N : 0.025 max. Nb : 8 × (C % + N %) to 0.80 Cu : 0.30 to 0.80
SUS436LTP	0.025 max.	1.00 max.	1.00 max.	0.040 max.	0.030 max.	0.60 max.	16.00 to 19.00	0.75 to 1.25	N : 0.025 max. Ti, Nb, Zr or a combination of these : 8 × (C % + N %) to 0.80
SUS444TP	0.025 max.	1.00 max.	1.00 max.	0.040 max.	0.030 max.	0.60 max.	17.00 to 20.00	1.75 to 2.50	N : 0.025 max. Ti, Nb, Zr or a combination of these : 8 × (C % + N %) to 0.80

Elements not listed or without limit values (marked as “—”) in this table may be added as necessary, but only to a degree where chemical composition of the grade concerned remains distinguishable from those of other grades.

7 Mechanical properties

7.1 Tensile strength, proof stress and elongation

Pipes shall be tested in accordance with **13.2**, and their tensile strength, proof stress and elongation shall conform to Table 4. For a tensile test of pipes under 8 mm in wall thickness using Test piece No. 12 or No. 5, the elongation requirement in Table 5 shall apply.

For pipes under 40 mm in outside diameter, the elongation requirements in Tables 4

and 5 do not apply, but the test results shall nevertheless be recorded. Other elongation value than given in the tables may be agreed upon between the purchaser and the manufacturer.

Table 4 Tensile strength, proof stress and elongation

Classification	Symbol of grade	Tensile strength	Proof stress	Elongation %			
				Tensile test piece and tensile direction			
				Test piece No. 11 or Test piece No. 12	Test piece No. 5	Test piece No. 4 ^{b)}	
						Parallel to pipe axis	Perpendicular to pipe axis
		N/mm ²	N/mm ²				
Austenitic series	SUS304TP	520 min.	205 min.	35 min.	25 min.	30 min.	22 min.
	SUS304HTP						
	SUS304LTP	480 min.	175 min.				
	SUS309TP	520 min.	205 min.				
	SUS309STP						
	SUS310TP						
	SUS310STP						
	SUS315J1TP						
	SUS315J2TP						
	SUS316TP						
	SUS316HTP						
	SUS316LTP	480 min.	175 min.				
	SUS316TiTP	520 min.	205 min.				
	SUS317TP						
	SUS317LTP	480 min.	175 min.				
	SUS836LTP	520 min.	205 min.				
	SUS890LTP	490 min.	215 min.				
	SUS321TP ^{a)}	520 min.	205 min.				
	SUS321HTP ^{a)}						
SUS347TP							
SUS347HTP							
Austenitic-ferritic series	SUS821L1TP	600 min.	400 min.	20 min.	14 min.	16 min.	11 min.
	SUS323LTP						
	SUS329J1TP	590 min.	390 min.	18 min.	13 min.	14 min.	10 min.
	SUS329J3LTP	620 min.	450 min.				
	SUS329J4LTP						
	SUS327L1TP	795 min.	550 min.	15 min.	10 min.	11 min.	7 min.
Ferritic series	SUS405TP	410 min.	205 min.	20 min.	14 min.	16 min.	11 min.
	SUS409LTP	360 min.	175 min.				
	SUS430TP	410 min.	245 min.				
	SUS430LXTP	360 min.	175 min.				
	SUS430J1LTP	390 min.	205 min.				
	SUS436LTP	410 min.	245 min.				
	SUS444TP						
NOTE	1 N/mm ² = 1 MPa						
Note ^{a)}	For hot-finished pipes of SUS321TP and SUS321HTP, the tensile strength may be 460 N/mm ² or over, and the proof stress may be 180 N/mm ² or over upon agreement between the purchaser and the manufacturer.						
Note ^{b)}	Normally taken in parallel to the pipe axis, but may be taken perpendicular to the pipe axis where possible.						