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# Steel pipes for low temperature service



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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 3460** : 2018), which has been technically revised.

However, **JIS G 3460** : 2018 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 May 2023.



Attention is drawn to the possibility that some parts of this Standard may conflict with patent rights, published patent application or utility model rights. The relevant Minister is not responsible for identifying any of such patent rights, published patent application or utility model rights.

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# Steel pipes for low temperature service

## Introduction

This Japanese Industrial Standard has been prepared based on **ISO 9329-3** : 1997, Edition 1, and **ISO 9330-3** : 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 Standard. A list of modifications with the explanations is given in Annex JB.

## 1 Scope

This Standard specifies requirements for the steel pipes (hereafter referred to as pipes) used for piping at extremely low temperatures of freezing point or under.

NOTE 1 The dimensional range covered by this Standard is generally outside diameter 10.5 mm (nominal diameter 6A or $\frac{1}{8}$ B) to 660.4 mm (nominal diameter 650A or 26B) (see Table 9).

NOTE 2 Austenitic stainless steel pipes specified in **JIS G 3459** [1] and **JIS G 3468** [2] are used as steel pipes for low temperature service.

NOTE 3 The International Standard corresponding to this Standard and the symbol of degree of correspondence are as follows.

ISO 9329-3 : 1997 *Seamless steel tubes for pressure purposes — Technical delivery conditions — Part 3 : Unalloyed and alloyed steels with specified low temperature properties*

ISO 9330-3 : 1997 *Welded steel tubes for pressure purposes — Technical delivery conditions — Part 3 : Electric resistance and induction welded unalloyed and alloyed steel tubes with specified low temperature properties* (overall evaluation : MOD)

In addition, symbols which denote the degree of correspondence in the contents between the relevant International Standard 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 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 2242 *Method for Charpy pendulum impact test of metallic materials*

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 Symbol of grade

Pipes are classified into three grades. The classification, symbols of grade and symbols for manufacturing method shall be as given in Table 1.

**Table 1 Classification, symbols of grade and symbols for manufacturing method**

| Classification | Symbol of grade | Symbol for manufacturing method | | |
|---|---|---|---|---|
| | | Pipe manufacturing method | Finishing method | Marking |
| Carbon steel pipe | STPL380 | Seamless : S<br>Electric resistance welded : E | Hot finished : H<br>Cold finished : C<br>As electric resistance welded : G | As given in **14 b**). |
| Nickel steel pipe | STPL450 | Seamless : S | | |
| | STPL690 | | | |

## 5 Manufacturing method

The manufacturing method shall be as follows.

a) Pipes shall be manufactured from fine-grained killed steels by combination of the pipe manufacturing method and the finishing method which are indicated in Table 1. The symbol for manufacturing method shall be as given in Table 1.

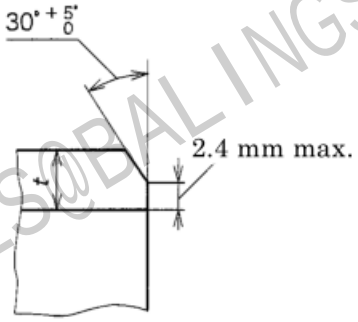
b) Pipes shall be heat treated in accordance with Table 2. Other heat treatment than given in the table may be performed upon agreement between the purchaser and

the manufacturer. Cold finished pipes shall be heat treated after the cold-finishing.

**Table 2 Heat treatment**

| Symbol of grade | Heat treatment |
|---|---|
| STPL380 | Normalizing, normalizing followed by tempering, or quenching followed by tempering |
| STPL450 | |
| STPL690 | Normalizing twice followed by tempering, or quenching followed by tempering |

c) Pipes shall be finished with plain ends unless otherwise specified. When the purchaser specifies bevel end finishing, the shape of the bevel end shall be as agreed between the purchaser and the manufacturer. The shape of bevel end for pipes with a wall thickness of 22 mm or under shall be in accordance with Figure 1, unless otherwise specified.




Key
$t$ : wall thickness 22 mm max.

**Figure 1 Shape of bevel end**

d) When pipes are manufactured by electric resistance welding, the weld beads on internal and external surfaces shall be removed to smooth the surface along the contour of the pipe, unless otherwise specified. However, if removing internal weld beads is difficult, the pipe may be supplied as welded.

## 6 Chemical composition

Pipes shall be tested in accordance with **12.1**, and the obtained heat analysis values shall conform to Table 3. When the product analysis is requested by the purchaser, the test shall be carried out in accordance with **12.1**, and the obtained product analysis values shall be as follows.

a) The product analysis values of seamless steel pipes of STPL380 shall satisfy the requirements in Table 3 within tolerances given in Table 3 of **JIS G 0321**.

b) The product analysis values of electric resistance welded steel pipes of STPL380 shall satisfy the requirements in Table 3 within tolerances given in Table 2 of **JIS G 0321**.

c) The product analysis values of seamless steel pipes of STPL450 and STPL690 shall satisfy the requirements in Table 3 within tolerances given in Table 4 of **JIS G 0321**.

**Table 3 Chemical composition**

Unit: %

| Symbol of grade | C | Si | Mn | P | S | Ni |
|---|---|---|---|---|---|---|
| STPL380 a) | 0.25 max. | 0.35 max. | 1.35 max. | 0.035 max. | 0.035 max. | b) |
| STPL450 | 0.18 max. | 0.10 to 0.35 | 0.30 to 0.60 | 0.030 max. | 0.030 max. | 3.20 to 3.80 |
| STPL690 | 0.13 max. | 0.10 to 0.35 | 0.90 max. | 0.030 max. | 0.030 max. | 8.50 to 9.50 |

Alloy elements not listed in this table may be added as necessary.

Note a) If the impact test for the STPL380 pipe is omitted in accordance with **7.4 c)**, the pipe shall contain an acid soluble aluminium of 0.010 % or more. Alternatively, the total aluminium content may be analysed to determine the content to be 0.015 % or more.

Note b) When Ni is added where necessary, it shall not be added to such a degree that the specified values of other grades are satisfied, making the grades no longer discernible.

## 7 Mechanical properties

### 7.1 Tensile strength, yield point or proof stress, and elongation

Pipes shall be tested in accordance with **12.2**, and the tensile strength, yield point or proof stress, and elongation shall be as given in Table 4. However, when the tensile test is performed on Test piece No. 12 or Test piece No. 5 taken from the pipe under 8 mm in wall thickness, the elongation shall be in accordance with Table 5.

**Table 4 Tensile strength, yield point or proof stress, and elongation**

| Symbol of grade | Tensile strength N/mm² | Yield point or proof stress N/mm² | Elongation [a] % | | | |
|---|---|---|---|---|---|---|
| | | | Tensile test piece and tensile test 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 | Parallel to pipe axis | Perpendicular to pipe axis |
| STPL380 | 380 min. | 205 min. | 35 min. | 25 min. | 30 min. | 22 min. |
| STPL450 | 450 min. | 245 min. | 30 min. | 20 min. | 24 min. | 16 min. |
| STPL690 | 690 min. | 520 min. | 21 min. | 15 min. | 16 min. | 10 min. |

NOTE 1 N/mm² = 1 MPa

Note [a] The elongation value in this table shall not be applied to the pipes under 40 mm in outside diameter; however, the test results shall be recorded. The value of elongation may be specified upon agreement between the purchaser and the manufacturer.

Note [b] The tensile direction shall be the direction parallel to the pipe axis. If test pieces can be taken in the direction perpendicular to the pipe axis, the tensile direction may be the direction perpendicular to the pipe axis.

**Table 5 Elongation of Test piece No. 12 (parallel to the pipe axis) and Test piece No. 5 (perpendicular to the pipe axis) taken from pipes under 8 mm in wall thickness**

Unit: %

| Symbol of grade | Test piece | Wall thickness | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Over 1 mm up to and incl. 2 mm | Over 2 mm up to and incl. 3 mm | Over 3 mm up to and incl. 4 mm | Over 4 mm up to and incl. 5 mm | Over 5 mm up to and incl. 6 mm | Over 6 mm up to and incl. 7 mm | Over 7 mm to and excl. 8 mm |
| STPL380 | Test piece No. 12 | 26 min. | 28 min. | 29 min. | 30 min. | 32 min. | 34 min. | 35 min. |
| | Test piece No. 5 | 16 min. | 18 min. | 19 min. | 20 min. | 22 min. | 24 min. | 25 min. |
| STPL450 | Test piece No. 12 | 21 min. | 22 min. | 24 min. | 26 min. | 27 min. | 28 min. | 30 min. |
| | Test piece No. 5 | 11 min. | 12 min. | 14 min. | 16 min. | 17 min. | 18 min. | 20 min. |
| STPL690 | Test piece No. 12 | 12 min. | 14 min. | 15 min. | 16 min. | 18 min. | 20 min. | 21 min. |
| | Test piece No. 5 | 6 min. | 8 min. | 9 min. | 10 min. | 12 min. | 14 min. | 15 min. |

NOTE The elongation values in this table are calculated by subtracting 1.5 % from the elongation value given in Table 4 for each 1 mm decrease of wall thickness from 8 mm, and by rounding the result to an integer according to Rule A of **JIS Z 8401**.

### 7.2 Flattening property

When the pipe is tested in accordance with **12.2**, the test piece shall not generate cracks until the distance between the platens ($H$) reaches the value given by Formula (1).

The purchaser may specify the bendability instead of flattening property for the pipes with an outside diameter of 50 mm or under.

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

where, $H$: distance between platens (mm)
$t$ : wall thickness of pipe (mm)
$D$: outside diameter of pipe (mm)
$e$ : constant 0.08

NOTE For the flattening test, see **12.2.4**.

### 7.3 Bendability

When the purchaser specifies bendability instead of flattening property for pipes 50 mm or under in outside diameter, bendability shall be tested in accordance with **12.2**, and the test piece shall be free from cracks. Pipes shall be bent to the angle [1)] of at least 90° and not more than the angle formed when the inside radius is 6 times the outside diameter.

Note [1)] The bending angle shall be the angle from the position where the bending starts.

### 7.4 Charpy absorbed energy

The absorbed energy shall be as follows.

a) Pipes shall be tested in accordance with **12.2**, and the absorbed energy obtained in the Charpy impact test shall conform to Table 6. The test temperature shall be as given in Table 7. The test temperatures lower than those specified may be determined upon agreement between the purchaser and the manufacturer.

b) Electric resistance welded steel pipes shall be subjected to the Charpy impact test on the weld in addition to the Charpy impact test specified in **a**), and the absorbed energy obtained shall conform to Table 6. In this case, the test temperature shall be –45 °C. The test temperature lower than –45 °C may be determined upon agreement between the purchaser and the manufacturer.

c) The impact test shall be omitted for pipes having dimensions insufficient to take a test piece of 10 mm × 5 mm.

**Table 6 Absorbed energy in Charpy impact test**

| Dimension of test piece mm | Absorbed energy in Charpy impact test J | | Test piece |
|---|---|---|---|
| | Average value of 3 test pieces | Value of each test piece [a] | |
| 10 × 10 | 21 min. | 14 min. | V-notch test piece |
| 10 × 7.5 | 18 min. | 12 min. | |
| 10 × 5 | 14 min. | 10 min. | |
| Note [a] | The values of two test pieces among three shall be equal to or higher than the average value of three test pieces in this table. | | |

**Table 7 Temperature for Charpy impact test**

Unit: °C

| Symbol of grade | Test temperature |
|---|---|
| STPL380 | –45 |
| STPL450 | –100 |
| STPL690 | –196 |

## 8 Selection of hydraulic test characteristics or non-destructive test characteristics

Pipes shall be subjected to hydraulic test or non-destructive test in accordance with **12.3** or **12.4**, respectively, and their characteristics shall be as follows. Which characteristics to be tested shall be specified by the purchaser. If not specified, it shall be left to the discretion of the manufacturer.

a) **Hydraulic test characteristics**, as follows.

1) When the purchaser does not specify the test pressure, pipes shall be subjected to the test pressure not less than the minimum hydraulic test pressure given in Table 8 and shall withstand it without leakage. In this case, the schedule number of pipes shall be as given in Table 9. For pipes having dimensions other than those given in Table 9, the minimum hydraulic test pressure to be applied shall be determined as follows.

1.1) For pipes with outside diameter within the range specified in Table 9, the smaller value of the applicable outside diameters in this table shall be selected.

1.2) When the pipe has the wall thickness within the range of schedule numbers corresponding to the outside diameter selected in **1.1)**, the greater value of the applicable wall thicknesses in Table 9 shall be selected.

1.3) The minimum hydraulic test pressure shall be selected from Table 8 according to the outside diameter and the schedule number of wall thickness selected in **1.1)** and **1.2)**.

1.4) For pipes which do not satisfy the conditions in **1.1)** and **1.2)** and have dimensions other than those given in Table 9, the hydraulic test pressure to be applied shall be as agreed between the purchaser and the manufacturer.

1.5) When the minimum hydraulic test pressure of the schedule number selected in **1.2**) exceeds the test pressure $P$ obtained by Formula (2), the pressure $P$ shall be applied as the minimum hydraulic test pressure instead of the minimum hydraulic test pressure selected from Table 8. In this case, the hydraulic test pressure value shall be rounded off to the nearest 0.5 MPa for values lower than 10 MPa and to the nearest 1 MPa for values 10 MPa or higher.

**Table 8 Minimum hydraulic test pressure**

Unit: MPa

| Nominal thickness | Schedule number : Sch | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 10 | 20 | 30 | 40 | 60 | 80 | 100 | 120 | 140 | 160 |
| Minimum hydraulic test pressure | 2.0 | 3.5 | 5.0 | 6.0 | 9.0 | 12 | 15 | 18 | 20 | 20 |

2) When the purchaser specifies the test pressure, that pressure shall be taken as the minimum hydraulic test pressure, and the pipe shall withstand the pressure not less than the minimum hydraulic test pressure without leakage. If the pressure value specified by the purchaser is greater than either the value $P$ calculated by Formula (2) or 20 MPa, the test pressure to be applied shall be as agreed between the purchaser and the manufacturer. The specified test pressure shall be rounded off to the nearest 0.5 MPa for values lower than 10 MPa and to the nearest 1 MPa for values 10 MPa or higher. Values calculated by Formula (2) shall be rounded off to the nearest 0.5 MPa or 1 MPa in the same manner.

$$P = \frac{2st}{D} \quad \cdots\cdots (2)$$

where,
$P$ : test pressure (MPa)
$t$ : wall thickness of pipe (mm)
$D$ : outside diameter of pipe (mm)
$s$ : 60 % of the specified minimum value of yield point or proof stress given in Table 4 (N/mm²)

b) **Non-destructive test characteristics** Pipes shall be tested by either the ultrasonic examination or the eddy current examination, and their non-destructive test characteristics shall be as follows. In place of these examinations, other non-destructive tests specified in Japanese Industrial Standards may be carried out upon agreement between the purchaser and the manufacturer, in which case the judgement criteria shall be at least equal to that applied in the ultrasonic examination or the eddy current examination.

1) For the ultrasonic examination characteristics, the signals from the reference sample containing Category UD reference standard specified in **JIS G 0582** shall be regarded as alarm level, and there shall be no signals equivalent to or greater

than the alarm level. When the pipe to be tested is finished by other methods than the cold finishing, the minimum depth of square notch shall be 0.3 mm.

2) For the eddy current examination characteristics, the signals from the reference sample containing Category EY reference standard specified in **JIS G 0583** shall be regarded as alarm level, and there shall be no signals equivalent to or greater than the alarm level.

## 9 Dimensions, unit mass and dimensional tolerances

### 9.1 Outside diameter, wall thickness and unit mass

The outside diameter, wall thickness and unit mass of pipes shall be in accordance with Table 9. Dimensions not specified in Table 9 may be used upon agreement between the purchaser and the manufacturer. In this case, the unit mass shall be calculated by the following formula assuming 1 $cm^3$ steel to be 7.85 g, and the result shall be rounded off to 3 significant figures according to Rule A of **JIS Z 8401**. If exceeding 1 000 kg/m, the calculated unit mass shall be rounded off to an integer.

$$W = 0.024\,66\,t\,(D - t)$$

where, $W$ : unit mass of pipe (kg/m)

$t$ : wall thickness of pipe (mm)

$D$ : outside diameter of pipe (mm)

0.024 66 : unit conversion factor for obtaining $W$

NOTE The unit mass values in Table 9 are the results of the calculation given above.

### 9.2 Dimensional tolerances

The tolerances on the outside diameter, wall thickness and eccentricity of pipes shall be as given in Table 10. The length of pipes shall be not less than the specified length.

For the weld of electric resistance welded steel pipes, minus tolerances (lower limit values) on wall thickness of electric resistance welded steel pipes given in Table 10 applies, but not plus tolerances (upper limit values).

## Table 9 Dimensions [a] and unit mass of steel pipes for low temperature service

| Nominal diameter | | Outside diameter mm | Nominal wall thickness (schedule number : Sch) | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 10 | | 20 | | 30 | | 40 | | 60 | | 80 | | 100 | | 120 | | 140 | | 160 | |
| A | B | | Wall thickness mm | Unit mass kg/m | Wall thickness mm | Unit mass kg/m | Wall thickness mm | Unit mass kg/m | Wall thickness mm | Unit mass kg/m | Wall thickness mm | Unit mass kg/m | Wall thickness mm | Unit mass kg/m | Wall thickness mm | Unit mass kg/m | Wall thickness mm | Unit mass kg/m | Wall thickness mm | Unit mass kg/m | Wall thickness mm | Unit mass kg/m |
| 6 | 1/8 | 10.5 | — | — | — | — | — | — | 1.7 | 0.369 | — | — | 2.4 | 0.479 | — | — | — | — | — | — | — | — |
| 8 | 1/4 | 13.8 | — | — | — | — | — | — | 2.2 | 0.629 | — | — | 3.0 | 0.799 | — | — | — | — | — | — | — | — |
| 10 | 3/8 | 17.3 | — | — | — | — | — | — | 2.3 | 0.851 | — | — | 3.2 | 1.11 | — | — | — | — | — | — | — | — |
| 15 | 1/2 | 21.7 | — | — | — | — | — | — | 2.8 | 1.31 | — | — | 3.7 | 1.64 | — | — | — | — | — | — | 4.7 | 1.97 |
| 20 | 3/4 | 27.2 | — | — | — | — | — | — | 2.9 | 1.74 | — | — | 3.9 | 2.24 | — | — | — | — | — | — | 5.5 | 2.94 |
| 25 | 1 | 34.0 | — | — | — | — | — | — | 3.4 | 2.57 | — | — | 4.5 | 3.27 | — | — | — | — | — | — | 6.4 | 4.36 |
| 32 | 1 1/4 | 42.7 | — | — | — | — | — | — | 3.6 | 3.47 | — | — | 4.9 | 4.57 | — | — | — | — | — | — | 6.4 | 5.73 |
| 40 | 1 1/2 | 48.6 | — | — | — | — | — | — | 3.7 | 4.10 | — | — | 5.1 | 5.47 | — | — | — | — | — | — | 7.1 | 7.27 |
| 50 | 2 | 60.5 | — | — | — | — | — | — | 3.9 | 5.44 | — | — | 5.5 | 7.46 | — | — | — | — | — | — | 8.7 | 11.1 |
| 65 | 2 1/2 | 76.3 | — | — | — | — | — | — | 5.2 | 9.12 | — | — | 7.0 | 12.0 | — | — | — | — | — | — | 9.5 | 15.6 |
| 80 | 3 | 89.1 | — | — | — | — | — | — | 5.5 | 11.3 | — | — | 7.6 | 15.3 | — | — | — | — | — | — | 11.1 | 21.4 |
| 90 | 3 1/2 | 101.6 | — | — | — | — | — | — | 5.7 | 13.5 | — | — | 8.1 | 18.7 | — | — | — | — | — | — | 12.7 | 27.8 |
| 100 | 4 | 114.3 | — | — | — | — | — | — | 6.0 | 16.0 | — | — | 8.6 | 22.4 | — | — | 11.1 | 28.2 | — | — | 13.5 | 33.6 |
| 125 | 5 | 139.8 | — | — | — | — | — | — | 6.6 | 21.7 | — | — | 9.5 | 30.5 | — | — | 12.7 | 39.8 | — | — | 15.9 | 48.6 |
| 150 | 6 | 165.2 | — | — | — | — | — | — | 7.1 | 27.7 | — | — | 11.0 | 41.8 | — | — | 14.3 | 53.2 | — | — | 18.2 | 66.0 |
| 200 | 8 | 216.3 | — | — | 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 | 409 | 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 |

Note [a] Pipes are designated by nominal diameter and nominal wall thickness (schedule number : Sch). The nominal diameter, selected from A and B in this table, shall be indicated by suffixing the letter A or B, whichever selected, to the numeral of the nominal diameter.

**Table 10 Tolerances on outside diameter, wall thickness and eccentricity**

| Classification | Tolerance on outside diameter [a) b) c)] | | Tolerance on wall thickness | Tolerance on eccentricity [d)] |
|---|---|---|---|---|
| | Outside diameter | Tolerance | | |
| Hot finished seamless steel pipe | Under 50 mm | ±0.5 mm | Wall thickness under 4 mm : ±0.5 mm<br>Wall thickness 4 mm or over : ±12.5 % | 20 % max. of wall thickness |
| | 50 mm or over to and excl. 160 mm | ±1 % | | |
| | 160 mm or over to and excl. 200 mm | ±1.6 mm | | |
| | 200 mm or over | ±0.8 % | | |
| Cold finished seamless steel pipe and electric resistance welded steel pipe | Under 40 mm | ±0.3 mm | Wall thickness under 2 mm : ±0.2 mm<br>Wall thickness 2 mm or over : ±10 % | — |
| | 40 mm or over | ±0.8 % | | |

Note [a)] The tolerances on outside diameter in this table shall not apply to local repaired parts.

Note [b)] Tolerances on outside diameter of quenched and tempered pipes shall be ±1 % for hot finished seamless steel pipes with an outside diameter of 50 mm or over and cold finished seamless steel pipes with an outside diameter of 30 mm or over.

Note [c)] For pipes with an outside diameter of 350 mm or over, the tolerance on outside diameter may be based on circumferential length. When the circumferential length is used in determining the outside diameter, either the actual measured value of the circumferential length or the outside diameter converted from the measured circumferential length shall be used. In both cases, the same value (±0.5 %) shall be applied as the tolerances. The conversion between the outside diameter ($D$) and the circumferential length ($l$) shall be made as given in the following formula.

$$D = l / \pi$$

where, $D$ : outside diameter (mm)
$l$ : circumferential length (mm)
$\pi = 3.141\,6$

Note [d)] Eccentricity is expressed by the ratio, in percentage, of the difference between the maximum and minimum wall thicknesses measured on the same cross-section of the pipe to the wall thickness value specified in the order. However, the tolerance on eccentricity shall not apply to pipes under 5.6 mm in wall thickness.

## 10 Appearance

The appearance shall be as follows.

a) Pipes shall be straight and the both ends shall be at right angles to the pipe axis for practical purposes.

b) Both the internal and external surfaces of pipes shall be smoothly finished and free from defects detrimental to use.

c) Pipes may be repaired by grinding, machining or other methods, provided that the wall thickness of the product after repair is within the specified tolerance on wall thickness. Repair by welding is not permitted.

d) The surface of the repaired part shall be smooth along the contour of the pipe.

e) The external surface of the part where a weld bead was removed shall be smooth along the contour of the pipe.

## 11 Supplementary quality requirements

The supplementary quality requirements to be applied upon agreement between the purchaser and the manufacturer shall be as given in Annex JA.

## 12 Tests

### 12.1 Chemical analysis

#### 12.1.1 General requirements for chemical analysis and sampling method

General requirements for chemical analysis and sampling method shall be in accordance with Clause 8 of **JIS G 0404**. When the product analysis is requested by the purchaser, the sampling method shall be in accordance with Clause 4 of **JIS G 0321**.

#### 12.1.2 Analytical method

The heat analysis method shall be in accordance with **JIS G 0320**. The product analysis method shall be in accordance with **JIS G 0321**.

### 12.2 Mechanical test

#### 12.2.1 General requirements for mechanical tests

General requirements for mechanical tests shall be in accordance with Clause **7** and Clause **9** of **JIS G 0404**. The sampling method for mechanical tests shall be in accordance with Class A specified in **7.6** of **JIS G 0404**.

#### 12.2.2 Sampling method and number of test pieces

The sampling method for mechanical test and the number of test pieces shall be as follows.

a) For the tensile test and either flattening test or bend test, take one sample from each group of 50 pipes or its fraction that are of the same dimensions and of the same heat treatment batch. From each sample, take one tensile test piece and one flattening test piece. When the purchaser requests a bend test for pipes with an outside diameter of 50 mm or under, one bend test piece shall be taken instead of one flattening test piece. The “same dimensions” means same outside diameter and wall thickness. The “same heat treatment batch” of a continuous furnace means a unit of pipes from continuous furnace operation under consistent heat treating conditions. Pipes which are heat treated after any stop of furnace operation are not considered as belonging to the same heat treatment batch. For pipes of the same dimensions and from the same cast, “same heat treatment batch” may be replaced by “same heat treatment conditions”.

When the tensile test piece is taken from the electric resistance welded steel pipe, Test piece No. 12 or Test piece No. 5 shall be taken from a portion not containing welds.

b) For Charpy impact test, take one sample from each group of 100 pipes or its fraction that are of the same dimensions and of the same heat treatment batch. From each sample, take one set of three test pieces. For electric resistance welded steel pipes, take one set of three Charpy impact test pieces of weld in addition to the aforementioned Charpy impact test pieces. The "same dimensions" means same outside diameter and wall thickness. The "same heat treatment batch" of a continuous furnace means a unit of pipes from continuous furnace operation under consistent heat treating conditions. Pipes which are heat treated after any stop of furnace operation are not considered as belonging to the same heat treatment batch. For pipes of the same dimensions and from the same cast, "same heat treatment batch" may be replaced by "same heat treatment conditions".

**12.2.3 Tensile test**

The tensile test piece and the test method shall be as follows.

a) **Test piece and sampling direction** The test piece shall be Test piece No. 11, No. 12A, No. 12B, No. 12C, No. 4 or No. 5 specified in **JIS Z 2241** and shall be taken from the pipe. Test piece No. 4 shall be of diameter 14 mm (the gauge length 50 mm). The direction of sampling the test piece shall be as given in Table 4. The type of test piece to be used and the direction of sampling Test piece No. 4 shall be, unless otherwise specified, left to the discretion of the manufacturer.

b) **Test method**, in accordance with **JIS Z 2241**.

**12.2.4 Flattening test**

The flattening test piece and the test method shall be as follows.

The flattening test for seamless steel pipes may be omitted unless specified by the purchaser [2)].

Note [2)] It means that although the test may be omitted at the discretion of the manufacturer, the pipes shall satisfy the specified flattening property.

a) **Test piece** The test piece shall have a length of 50 mm or longer. For pipes of wall thickness 15 % or over of the outside diameter, C-shaped test piece prepared by removing a part of the circumference of a ring-shaped test piece may be used.

b) **Test method** At ordinary temperature (5 °C to 35 °C), place a test piece between two platens, and compress to flatten until the distance between the platens ($H$) reaches the value given by Formula (1) in **7.2**. Then examine the test piece for cracks. For testing the electric resistance welded steel pipe, place the test piece, as shown in Figure 2, such that the line connecting the weld and the centre of the pipe is perpendicular to the direction of compression. Place a C-shaped test piece as shown in Figure 3.

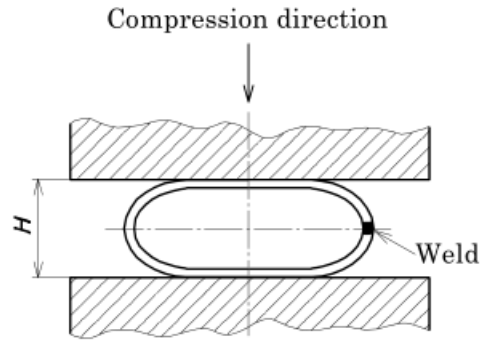



**Figure 2 Flattening test (ring test piece)**

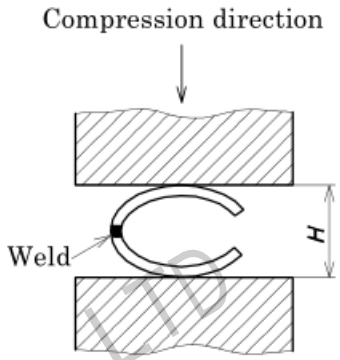



**Figure 3 Flattening test (C-shaped test piece)**

#### 12.2.5 Bend test

The bend test piece and the test method shall be as follows.

a) **Test piece** Cut a piece in adequate length from the sample to serve as a test piece.

b) **Test method** At ordinary temperature (5 °C to 35 °C), bend the test piece around a mandrel to at least the bend angle specified in **7.3** and not more than the angle formed with the inside radius specified in **7.3**, and examine for cracks. For testing the electric resistance welded steel pipe, place the test piece so that the weld is positioned at approximately 90° from the outermost part of the bend.

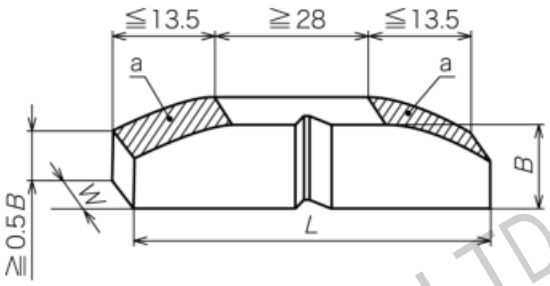
#### 12.2.6 Charpy impact test

The Charpy impact test piece and the test method shall be as follows.

a) **Test piece and sampling direction** The test piece to be used shall be a V-notch test piece specified in **JIS Z 2242**. However, the wall thickness of the test piece may be altered to 7.5 mm or 5 mm depending on the pipe dimensions. The sampling direction shall be parallel to the pipe axis for the part of steel product not including welds, or be perpendicular to the pipe axis for the Charpy impact test piece of the weld of the electric resistance welded steel pipe. Where necessary, the surface finishing (e.g. the length of the unmachined part of the pipe periphery shown by “a” in Figure 4) of the Charpy impact test piece of the weld may be agreed upon between the purchaser and the manufacturer.

NOTE The surface of the unmachined part of the Charpy impact test piece is generally finished within the dimensions given in Figure 4.

Unit: mm




Key
a : unmachined pipe periphery
*B* : wall thickness of test piece (10 mm, 7.5 mm, 5 mm)
*L* : length of test piece (= 55 mm)
*W* : width of test piece (10 mm)

**Figure 4 Dimensions of unmachined part of Charpy impact test piece**

b) **Test method** The test shall be performed in accordance with **JIS Z 2242**, using a pendulum striker of 2 mm radius.

### 12.3 Hydraulic test

#### 12.3.1 Test frequency

The hydraulic test shall be carried out on each pipe.

#### 12.3.2 Test method

Hold the pipe under the pressure not less than the minimum hydraulic test pressure specified in **8 a)** for at least 5 s, and examine if the pipe withstands the pressure without leakage.

### 12.4 Non-destructive test

#### 12.4.1 Test frequency

The non-destructive test shall be carried out on each pipe.

#### 12.4.2 Test method

The test method shall be as follows. Other non-destructive tests in accordance with **JIS**s, when performed, shall be as agreed between the purchaser and the manufacturer.

a) The ultrasonic examination shall be in accordance with **JIS G 0582**. The test may be performed by a category of reference standard stricter (shallower) than Category UD at the discretion of the manufacturer. The alarm level may be set lower (stricter) than the signals from the reference standard at the discretion of the manufacturer.

b) The eddy current examination shall be in accordance with **JIS G 0583**. The test may be performed by a category of reference standard stricter (smaller in diameter in the case of drill hole, and shallower in the case of square notch or recess) than

Category EY at the discretion of the manufacturer. The alarm level may be set lower (stricter) than the signals from the reference standard at the discretion of the manufacturer.

## 13 Inspection and reinspection

### 13.1 Inspection

The inspection shall be as follows.

a) General requirements of inspection shall be as specified in **JIS G 0404**.

b) The chemical composition shall conform to the requirements of Clause **6**.

c) The mechanical properties shall conform to the requirements of Clause **7**.

d) The hydraulic test characteristics or non-destructive test characteristics shall conform to the requirements of Clause **8**.

e) The dimensions and dimensional tolerances shall conform to the requirements of Clause **9**.

f) The appearance shall conform to the requirements of Clause **10**.

g) When part or all of the supplementary quality requirements in Annex JA are applied according to Clause **11**, the inspection results shall conform to the relevant requirements.

### 13.2 Reinspection

The reinspection shall be as follows.

a) Pipes having failed in the mechanical tests (excluding Charpy impact test) may be subjected to a retest according to **9.8** of **JIS G 0404** for further acceptance judgement.

b) Pipes having failed in the Charpy impact test may be retested for further acceptance judgement if the average values of absorbed energy satisfy the requirements and meet either of the following conditions.

1) The values of two test pieces are equal to or higher than the average value of the three test pieces given in Table 6, and only one test piece fails to meet the specified value of each test piece given in Table 6.

2) The values of two test pieces fail to satisfy the average value of the three test pieces given in Table 6 but satisfy the specified value of each test piece given in Table 6.

Retest shall be performed with one new set of three test pieces taken from the same sample, and each three value shall satisfy the average value of one set of test pieces specified in Table 6.

## 14 Marking

Each pipe having passed the inspection shall be marked with the following items.

When the marking on each pipe is difficult due to its small outside diameter, or when the purchaser makes a request, the marking may be given on each bundle of pipes by a suitable means. The order of items to be marked is not specified. When approved by the purchaser, part of the following particulars may be omitted as far as the product can still be identified.

a) Symbol of grade

b) Symbol for manufacturing method

The symbol for manufacturing method shall be as follows. The dash may be replaced with a blank.

1) Hot finished seamless steel pipe : –S–H

2) Cold finished seamless steel pipe : –S–C

3) As electric resistance welded steel pipe : –E–G

4) Hot finished electric resistance welded steel pipe : –E–H

5) Cold finished electric resistance welded steel pipe : –E–C

c) Dimensions, expressed by the nominal diameter and nominal wall thickness, or outside diameter and wall thickness.

Example 50A × Sch40, or 60.5 × 3.9

d) Manufacturer's name or identifying brand

e) Symbol Z indicating the supplementary quality requirement (if specified)

## 15 Information to be supplied by the purchaser

The purchaser shall provide the manufacturer, processor or intermediary with at least the following information at the time of ordering so as to ensure that the supplied products are in conformance with this Standard.

a) Symbol of grade (Table 1)

b) Manufacturing method and finishing method (Table 1)

c) Dimensions (Clause **9**)

## 16 Report

The manufacturer shall submit the inspection documents to the purchaser unless otherwise specified. The report shall be in accordance with Clause **13** of **JIS G 0404**. Unless otherwise specified at the time of ordering, the type of the inspection document to be submitted shall be in accordance with **5.1** of **JIS G 0415**.

When alloy elements not specified in Table 3 are intentionally added, or when Ni is added as given in Note [b] to Table 3, the content rate of the alloy element added shall be reported in the inspection document. When the impact test for the STPL380 pipe is omitted in accordance with **7.4 c)**, acid soluble aluminium content or total aluminium content shall be reported in the inspection document.

# Annex JA (normative)
# Supplementary quality requirements

## JA.1 Ultrasonic examination (Z3) [3)]

The ultrasonic examination shall be as follows.

a) The ultrasonic examination shall be in accordance with **JIS G 0582**.

b) For the standard detection sensitivity for the ultrasonic examination, the signals from Category UB reference standard or Category UC reference standard specified in **JIS G 0582** shall be regarded as alarm level, and there shall be no signals equivalent to or greater than the alarm level.

c) The ultrasonic examination shall be performed on each pipe, and the results shall conform to the requirements specified in **b**).

Note [3)] In transactions of pipes, the purchaser's request for ultrasonic examination may be expressed by symbol Z3.

## JA.2 Eddy current examination (Z4) [4)]

The eddy current examination shall be as follows.

a) The eddy current examination shall be in accordance with **JIS G 0583**.

b) For the standard detection sensitivity for the eddy current examination, the signals from Category EU, EV, EW or EX reference standard specified in **JIS G 0583** shall be regarded as alarm level, and there shall be no signals equivalent to or greater than the alarm level.

c) The eddy current examination shall be performed on each pipe, and the results shall conform to the requirement in **b**).

Note [4)] In transactions of pipes, the purchaser's request for eddy current examination may be expressed by symbol Z4.



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**Bibliography**

[1] JIS G 3459 *Stainless steel pipes*

[2] JIS G 3468 *Large diameter welded stainless steel pipes*

# Annex JB (informative)

# Comparison table between JIS and corresponding International Standards

| JIS G 3460 | ISO 9329-3 : 1997, ISO 9330-3 : 1997, (MOD) |
|---|---|

| a) No. of clause (**JIS**) | b) No. of clause (corresponding International Standard) | c) Classification by clause | d) Detail and justification of technical deviation | e) Future measures for the technical deviation |
|---|---|---|---|---|
| 2 | — | — | — | — |
| 3 | — | Addition | Specify terms and definitions necessary for **JIS**. | As required for **JIS**. **JIS** specification is retained. |
| 4 | 6.1 | Alteration | **JIS** specifies 3 steel grades while **ISO** specifies 10 steel grades. | Necessary steel grades for **JIS**. **JIS** specification is retained. |
| 5 | 5 | Alteration | **JIS** specifies seamless and electric resistance welding as pipe manufacturing method. **ISO 9329-3** specifies seamless, and **ISO 9330-3** specifies electric resistance welding. | **JIS** and **ISO** have different standard structures : **JIS** specifications by intended use and **ISO** specifications by manufacturing method. **JIS** specification is retained. |
| 6 | 6.1 | Alteration | Chemical composition requirements are specified for 3 steel grades in **JIS** and for 10 steel grades in **ISO**. | Chemical composition requirements for three steel grades in **JIS** have been conventionally used. **JIS** specification is retained. |
| 7 | 6.2 | Deletion | **JIS** specifies tensile strength, flattening property, bendability, and impact property. **ISO** specifies tensile strength, flattening property, bendability, impact property, drift expansion property and ring expansion property. | Necessary characteristics for **JIS**. **JIS** specification is retained. |
| 8 a) | 9.8 | Alteration | **JIS** specifies test pressure by schedule number, while **ISO** specifies pressure by formula. | **JIS** adopts the schedule number system. **JIS** specification is retained. |
| 8 b) | — | Addition | Specify the details of non-destructive test characteristics. | As required for **JIS**. **JIS** specification is retained. |
| 9 | 7 | Alteration | The dimensional system differs between **JIS** and **ISO**. | Conventional dimensional system is maintained for the convenience of users. |

| a) No. of clause (**JIS**) | b) No. of clause (corresponding International Standard) | c) Classification by clause | d) Detail and justification of technical deviation | e) Future measures for the technical deviation |
|---|---|---|---|---|
| **11** | — | Addition | Add necessary information for JIS. | Necessary for transactions in Japan. JIS specification is retained. |
| 12.1 | 9.10.1 | Addition | Specify the details of analytical method. | Necessary information for **JIS**. **JIS** specification is retained. |
| 12.2.2 | 9.2, 9.3, 9.4 | Alteration | The sampling frequency differs between **JIS** and **ISO**. | Necessary frequency for **JIS**. **JIS** specification is retained. |
| 13 | 9 | Addition | Add the requirements for inspection relating to the supplementary quality requirements. | The supplementary quality requirements are added in **JIS**. **JIS** specification is retained. |
| 14 | 10 | Alteration | Some differences in marking items between **JIS** and **ISO**. | Conventional marking items are maintained for the convenience of users. |
| 15 | 4 | Alteration | Add items to be confirmed at the order. | Necessary items for **JIS**. **JIS** specification is retained. |
| 16 | 9.1 | Addition | Add the requirements for reports of the content rate of the alloy element(s) intentionally added and the content rate of Al when the impact test is not performed on pipes of STPL380. | Necessary requirements for **JIS**. **JIS** specification is retained. |

NOTE 1 Symbols in sub-columns of classification by clause in the above table indicate as follows :
— Deletion : Delete the specification item(s) or content(s) of International Standard(s).
— Addition : Add the specification item(s) or content(s) which are not included in International Standard(s).
— Alteration : Alter the specification content(s) or structure of International Standard(s).

NOTE 2 Symbol of overall degree of correspondence between **JIS** and International Standard(s) in the above table indicates as follows :
— MOD : Modify International Standard(s).

Errata for **JIS** (English edition) can be downloaded in PDF format at Webdesk (purchase information page) of our website (https://www.jsa.or.jp/).

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