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Carbon steel tubes for boiler and heat
exchanger

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In the event of any doubts arising as to the contents,
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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 3461** : 2019), which has been technically revised.

However, **JIS G 3461** : 2019 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 December 2024.

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Carbon steel tubes for boiler and heat exchanger

Introduction

This Japanese Industrial Standard has been prepared based on **ISO 9329-2** : 1997, Edition 1, and **ISO 9330-2** : 1997, Edition 1, with some modifications of the technical contents.

Annex JA and Annex JB are unique to **JIS** and not given in the corresponding International Standards. 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 JC.

1 Scope

This Standard specifies requirements for the carbon steel tubes used for exchanging heat between the inside and outside of the tube (hereafter referred to as tubes), such as water tubes, smoke tubes, superheater tubes, tubes used for air preheater, etc. of boilers, and heat exchanger tubes, condenser tubes and catalyser tubes, etc. used in chemical and petroleum industries. It is not applicable to the steel tubes for fired heater and steel heat exchanger tubes for low temperature service.

NOTE 1 This Standard is generally applicable to tubes of outside diameters 15.9 mm to 139.8 mm.

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

ISO 9329-2 : 1997 *Seamless steel tubes for pressure purposes — Technical delivery conditions — Part 2 : Unalloyed and alloyed steels with specified elevated temperature properties*

ISO 9330-2 : 1997 *Welded steel tubes for pressure purposes — Technical delivery conditions — Part 2 : Electric resistance and induction welded unalloyed and alloyed steel tubes with specified elevated temperature properties* (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 0567 *Method of elevated temperature tensile test for steels and heat-resisting alloys*
 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 2245 *Rockwell hardness test — Test method*
 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

Tubes are classified into 3 grades. The symbols of grade and symbols for manufacturing method are as given in Table 1.

Table 1 Symbols of grade and symbols for manufacturing method

Symbol of grade	Symbol for manufacturing method		
	Tube manufacturing method	Finishing method	Marking
STB340 STB410 STB510	Seamless : S Electric resistance welded : E	Hot-finished : H Cold-finished : C As electric resistance welded : G	As given in 15 b).

5 Manufacturing method

The manufacturing method shall be as follows.

- Tubes shall be manufactured from the killed steel and by a combination of the tube manufacturing method and the finishing method which is given in Table 1. Symbols for manufacturing method are as given in Table 1.
- Tubes shall be subjected to the heat treatment given in Table 2. Other heat treat-

ments may be applied upon agreement between the purchaser and the manufacturer.

- c) Tubes shall be finished with plain ends unless otherwise specified.
- d) When tubes are manufactured by electric resistance welding, the weld beads on external and internal surfaces shall be removed to smooth the surfaces along the contour of the tube. The weld beads on internal surface may be left unremoved if so agreed between the purchaser and the manufacturer.

Table 2 Heat treatment

Symbol of grade	Heat treatment				
	Hot-finished seamless steel tube	Cold-finished seamless steel tube	As electric resistance welded steel tube	Hot-finished electric resistance welded steel tube	Cold-finished electric resistance welded steel tube ^{a)}
STB340	As manufactured. Low temperature annealing or normalizing may be performed as necessary.	Low temperature annealing, normalizing or full annealing	Normalizing	As manufactured. Low temperature annealing or normalizing may be performed as necessary.	Normalizing
STB410	As manufactured. Low temperature annealing or normalizing may be performed as necessary.	Low temperature annealing, normalizing or full annealing	Normalizing	Low temperature annealing	Normalizing
STB510	Normalizing				
Note ^{a)}	The cold-finished electric resistance welded steel tube which has been normalized prior to cold finishing may be finished by low temperature annealing or full annealing.				

6 Chemical composition

Tubes shall be tested in accordance with 13.1 and the obtained heat analysis values shall satisfy the requirements given in Table 3. When the product analysis is requested by the purchaser, the test shall be carried out in accordance with 13.1. The obtained product analysis values shall satisfy the requirements in Table 3 within tolerances given below.

- a) For seamless steel tubes, tolerances given in Table 3 of **JIS G 0321** shall apply.
- b) For electric resistance welded steel tubes, tolerances in Table 2 of **JIS G 0321** shall

apply.

Table 3 Chemical composition

Unit: %

Symbol of grade	C	Si ^{a)}	Mn	P	S
STB340	0.18 max.	0.35 max.	0.30 to 0.60	0.035 max.	0.035 max.
STB410	0.32 max.	0.35 max.	0.30 to 0.80	0.035 max.	0.035 max.
STB510	0.25 max.	0.35 max.	1.00 to 1.50	0.035 max.	0.035 max.
Alloy elements not listed in this table may be added as necessary. Note ^{a)} Si content may be in a range of 0.10 % to 0.35 %, as specified by the purchaser.					

7 Mechanical properties

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

Tubes shall be tested in accordance with 13.2.1, 13.2.2 and 13.2.3, and the tensile strength, yield point or proof stress, and elongation shall be as given in Table 4. When the tensile test is carried out on Test piece No. 12 for the tube 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 ^{a)}	Yield point or proof stress ^{b)}	Elongation %		
			Outside diameter		
			Under 10 mm	10 mm or over to and excl. 20 mm	20 mm or over
			Test piece		
			Test piece No. 11	Test piece No. 11	Test piece No. 11 or Test piece No. 12
			Tensile test direction		
	N/mm ²	N/mm ²	Parallel to tube axis	Parallel to tube axis	Parallel to tube axis
STB340	340 min.	175 min.	27 min.	30 min.	35 min.
STB410	410 min.	255 min.	17 min.	20 min.	25 min.
STB510	510 min.	295 min.	17 min.	20 min.	25 min.

NOTE 1 N/mm² = 1 MPa

Note ^{a)} Exclusively for the heat exchanger tubes, the purchaser may, where necessary, specify the maximum value of tensile strength. In this case, the maximum tensile strength value shall be the value obtained by adding 120 N/mm² to the value in this table.

Note ^{b)} Unless otherwise specified, the yield point to be determined shall be the upper yield point, R_{eH} , or, wherever this is not pronounced, the 0.2 % proof stress, $R_{p0.2}$.