

JIS

JAPANESE
INDUSTRIAL
STANDARD

Translated and Published by
Japanese Standards Association

JIS G 3106 : 2020

(JISF)

Rolled steels for welded structure

ICS 25.160.01 ; 77.140.01 ; 77.140.10

Reference number : JIS G 3106 : 2020 (E)

G 3106 : 2020

Date of Establishment: 1952-11-25

Date of Revision: 2020-12-21

Date of Public Notice in Official Gazette: 2020-12-21

Developed by: The Japan Iron and Steel Federation

Investigated by: The Japan Iron and Steel Federation,
Standardization Center

JIS G 3106 : 2020, First English edition published in 2021-03

Translated and published by: Japanese Standards Association
Mita MT Building, 3-13-12, Mita, Minato-ku, Tokyo, 108-0073 JAPAN

In the event of any doubts arising as to the contents,
the original JIS is to be the final authority.

© JSA 2021

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from the publisher.

Printed in Japan

HN

PROTECTED BY COPYRIGHT

Contents

| | Page |
|---|------|
| Introduction | 1 |
| 1 Scope | 1 |
| 2 Normative references | 1 |
| 3 Terms and definitions | 2 |
| 4 Symbols of grade and applicable thicknesses | 2 |
| 5 Chemical composition | 3 |
| 6 Heat treatment and symbols of heat treatment | 4 |
| 6.1 Heat treatment | 4 |
| 6.2 Symbol of heat treatment | 4 |
| 7 Carbon equivalent and weld-crack sensitivity composition | 5 |
| 7.1 Carbon equivalent and weld-crack sensitivity composition for SM570 | 5 |
| 7.2 Carbon equivalent and weld-crack sensitivity composition for steel plates/sheets manufactured by thermo-mechanical control process | 5 |
| 8 Mechanical properties | 6 |
| 8.1 Yield point or proof stress, tensile strength and elongation | 6 |
| 8.2 Charpy absorbed energy | 6 |
| 9 Shape, dimensions, mass and tolerances | 9 |
| 10 Appearance | 9 |
| 11 Tests | 9 |
| 11.1 Chemical analysis | 9 |
| 11.2 Mechanical tests | 9 |
| 12 Inspection | 11 |
| 13 Reinspection | 11 |
| 14 Marking | 11 |
| 15 Report | 12 |
| Annex JA (normative) Chemical composition and tensile properties of steel plates/sheets agreed between the purchaser and the manufacturer | 13 |
| Annex JB (normative) Mechanical properties of sections with a leg length under 40 mm and of flats with a width under 40 mm | 15 |
| Annex JC (normative) Quality requirements for hot extruded sections | 16 |

G 3106 : 2020

Annex JD (informative) Comparison table between **JIS** and corresponding
International Standards 20

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 3106:2017**), which has been technically revised.

However, **JIS G 3106: 2017** 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 20 December 2021.

This **JIS** document is protected by the Copyright Act.

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.

Blank

Rolled steels for welded structure

Introduction

This Japanese Industrial Standard has been prepared based on **ISO 630-1** : 2011, Edition 1, **ISO 630-2** : 2011, Edition 2, and **ISO 630-3** : 2012, Edition 1, with some modifications of the technical contents.

Annex JA to Annex JC are 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 JD.

1 Scope

This Standard specifies requirements for highly weldable hot rolled steels used for welded structures such as bridges, ships, rolling stock, petroleum storage tanks and containers (hereafter referred to as steel products) and highly weldable hot extruded sections.

The quality requirements for hot extruded sections are given in Annex JC.

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

ISO 630-1 : 2011 *Structural steels — Part 1 : General technical delivery conditions for hot-rolled products*

ISO 630-2 : 2011 *Structural steels — Part 2 : Technical delivery conditions for structural steels for general purposes*

ISO 630-3 : 2012 *Structural steels — Part 3 : Technical delivery conditions for fine-grain structural steels* (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*

2

G 3106 : 2020

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

JIS G 0415 Steel and steel products — Inspection documents

JIS G 0416 Steel and steel products — Location and preparation of samples and test pieces for mechanical testing

JIS G 3192 Dimensions, mass and permissible variations of hot rolled steel sections

JIS G 3193 Dimensions, shape, mass and permissible variations of hot rolled steel plates, sheets and strips

JIS G 3194 Dimensions, shape, mass and permissible variations of hot rolled flat steel

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

3 Terms and definitions

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

3.1

quenching

rapid cooling of steel using water

Note to entry 1 This includes direct quenching.

3.2

hot extrusion

forming of a steel product by extruding heated billets through a die

3.3

forging ratio

ratio of the cross-sectional area of a cast slab or a bloom to that after extrusion

4 Symbols of grade and applicable thicknesses

The steel products are classified into 11 grades, and their symbols and applicable thicknesses are as given in Table 1.

Table 1 Symbols of grade and applicable thicknesses

| | | Unit: mm |
|---|---|------------------------------------|
| Symbol of grade | Shape of steel product | Applicable thickness ^{a)} |
| SM400A | Plate/sheet ^{b)} , strip in coil, section and flat | ≤200 |
| SM400B | | |
| SM400C | Plate/sheet ^{b)} , strip in coil and section | ≤100 |
| | Flat ^{c)} | ≤50 |
| SM490A | Plate/sheet ^{b)} , strip in coil, section and flat | ≤200 |
| SM490B | | |
| SM490C | Plate/sheet ^{b)} , strip in coil and section | ≤100 |
| | Flat ^{c)} | ≤50 |
| SM490YA | Plate/sheet ^{b)} , strip in coil, section and flat | ≤100 |
| SM490YB | | |
| SM520B | Plate/sheet ^{b)} , strip in coil, section and flat | ≤100 |
| SM520C | Plate/sheet ^{b)} , strip in coil and section | ≤100 |
| | Flat ^{c)} | ≤40 |
| SM570 | Plate/sheet ^{b)} , strip in coil and section | ≤100 |
| | Flat | ≤40 |
| Note ^{a)} The thickness of sections shall be t or t_2 in Table 3 and t_2 in Table 4 of JIS G 3192 . | | |
| Note ^{b)} For steel plates/sheets, the following applicable thickness may be applied upon agreement between the purchaser and the manufacturer. SM400A : ≤450 SM490A : ≤300 SM400B, SM400C, SM490B and SM490C : ≤250 SM490YA, SM490YB, SM520B, SM520C and SM570 : ≤150 | | |
| Note ^{c)} For flats, the following applicable thickness may be applied upon agreement between the purchaser and the manufacturer. SM400C and SM490C : ≤75 SM520C : ≤50 | | |

5 Chemical composition

Steel products shall be tested in accordance with 11.1, and their heat analysis values shall conform to Table 2. The heat analysis values of steel plates/sheets agreed between the purchaser and the manufacturer according to Note ^{b)} to Table 1 shall conform to Table JA.1.

Table 2 Chemical composition ^{a)}

Unit: %

| Symbol of grade | Thickness ^{b)} | C | Si | Mn | P | S |
|--|-------------------------|-------|-------|------------------------|--------|--------|
| SM400A | ≤50 mm | ≤0.23 | — | ≥2.5 × C ^{c)} | ≤0.035 | ≤0.035 |
| | >50 ≤200 mm | ≤0.25 | | | | |
| SM400B | ≤50 mm | ≤0.20 | ≤0.35 | 0.60 to 1.50 | ≤0.035 | ≤0.035 |
| | >50 ≤200 mm | ≤0.22 | | | | |
| SM400C | ≤100 mm | ≤0.18 | ≤0.35 | 0.60 to 1.50 | ≤0.035 | ≤0.035 |
| SM490A | ≤50 mm | ≤0.20 | ≤0.55 | ≤1.65 | ≤0.035 | ≤0.035 |
| | >50 ≤200 mm | ≤0.22 | | | | |
| SM490B | ≤50 mm | ≤0.18 | ≤0.55 | ≤1.65 | ≤0.035 | ≤0.035 |
| | >50 ≤200 mm | ≤0.20 | | | | |
| SM490C | ≤100 mm | ≤0.18 | ≤0.55 | ≤1.65 | ≤0.035 | ≤0.035 |
| SM490YA | ≤100 mm | ≤0.20 | ≤0.55 | ≤1.65 | ≤0.035 | ≤0.035 |
| SM490YB | | | | | | |
| SM520B | ≤100 mm | ≤0.20 | ≤0.55 | ≤1.65 | ≤0.035 | ≤0.035 |
| SM520C | | | | | | |
| SM570 | ≤100 mm | ≤0.18 | ≤0.55 | ≤1.70 | ≤0.035 | ≤0.035 |
| Note ^{a)} Elements in the table with no limit values or elements not given in the table may be added as necessary. | | | | | | |
| Note ^{b)} The thickness of sections shall be <i>t</i> or <i>t</i> ₂ in Table 3 and <i>t</i> ₂ in Table 4 of JIS G 3192 . | | | | | | |
| Note ^{c)} For the value of carbon, the heat analysis value shall be applied. | | | | | | |

6 Heat treatment and symbols of heat treatment

6.1 Heat treatment

As necessary, steel products may be subjected to normalizing, tempering, or quenching and tempering. All steel products may be subjected to thermo-mechanical control process or other heat treatment according to the agreement between the purchaser and the manufacturer (referred to as “agreement” in the following subclause 6.2).

6.2 Symbols of heat treatment

Heat treated steel products shall be given the following heat treatment symbols.

The following symbols shall be suffixed to the symbol of grade given in Table 1.

- a) Normalizing by agreement : N
- b) Tempering by agreement : T
- c) Quenching and tempering : Q
- d) Thermo-mechanical control process on steel products by agreement : TMC
- e) Proper heat treatment on steel products by agreement : Symbol agreed

Example : SM490CN, SM570TMC

7 Carbon equivalent and weld-crack sensitivity composition

7.1 Carbon equivalent and weld-crack sensitivity composition for SM570

The carbon equivalent and weld-crack sensitivity composition for SM570 shall be as follows.

The carbon equivalent shall apply to quenched and tempered steel products.

- a) **Carbon equivalent** The carbon equivalent shall be calculated by Formula (1) using the heat analysis values obtained in 11.1 and shall conform to Table 3.

$$C_{eq} = C + \frac{Mn}{6} + \frac{Si}{24} + \frac{Ni}{40} + \frac{Cr}{5} + \frac{Mo}{4} + \frac{V}{14} \dots\dots\dots(1)$$

where, C_{eq} : carbon equivalent (%)

Table 3 Carbon equivalent

| Thickness mm | ≤50 | >50 ≤100 | >100 |
|-----------------------|-------|----------|---|
| Carbon equivalent (%) | ≤0.44 | ≤0.47 | As agreed between the purchaser and the manufacturer. |

- b) **Weld-crack sensitivity composition** The weld-crack sensitivity composition may be applied in place of the carbon equivalent by agreement between the purchaser and the manufacturer. The weld-crack sensitivity composition shall be calculated by Formula (2) using the heat analysis values in 11.1 and shall conform to Table 4.

$$P_{CM} = C + \frac{Si}{30} + \frac{Mn}{20} + \frac{Cu}{20} + \frac{Ni}{60} + \frac{Cr}{20} + \frac{Mo}{15} + \frac{V}{10} + 5B \dots\dots\dots(2)$$

where, P_{CM} : weld-crack sensitivity composition (%)

Table 4 Weld-crack sensitivity composition

| Thickness mm | ≤50 | >50 ≤100 | >100 |
|--------------------------------------|-------|----------|---|
| Weld-crack sensitivity composition % | ≤0.28 | ≤0.30 | As agreed between the purchaser and the manufacturer. |

7.2 Carbon equivalent and weld-crack sensitivity composition for steel plates/sheets manufactured by thermo-mechanical control process

For steel plates/sheets manufactured by thermo-mechanical control process as agreed between the purchaser and the manufacturer, the carbon equivalent, or alternatively, the weld-crack sensitivity composition applied by agreement shall be as follows.

- a) **Carbon equivalent** The carbon equivalent shall be calculated by Formula (1) in 7.1 using the heat analysis values obtained in 11.1 and shall conform to Table 5.

Table 5 Carbon equivalent

| Symbol of grade | | SM490A | SM490YA | SM520B | SM520C |
|---|----------------|--------|---------|--------|--------|
| | | SM490B | SM490YB | | |
| Applicable thickness ^{a)} | ≤50 mm | ≤0.38 | | ≤0.40 | |
| | >50 mm ≤100 mm | ≤0.40 | | ≤0.42 | |
| Note ^{a)} The carbon equivalent of steel plates/sheets with a thickness over 100 mm shall be as agreed between the purchaser and the manufacturer. | | | | | |

Unit: %

- b) **Weld-crack sensitivity composition** The weld-crack sensitivity composition shall be calculated by Formula (2) in 7.1 using the heat analysis values obtained in 11.1 and shall conform to Table 6.

Table 6 Weld-crack sensitivity composition

| Symbol of grade | | SM490A | SM490YA | SM520B | SM520C |
|--|----------------|--------|---------|--------|--------|
| | | SM490B | SM490YB | | |
| Applicable thickness ^{a)} | ≤50 mm | ≤0.24 | | ≤0.26 | |
| | >50 mm ≤100 mm | ≤0.26 | | ≤0.27 | |
| Note ^{a)} The weld-crack sensitivity composition of steel plates/sheets with a thickness over 100 mm shall be as agreed between the purchaser and the manufacturer. | | | | | |

Unit: %

8 Mechanical properties

8.1 Yield point or proof stress, tensile strength and elongation

Steel products shall be tested in accordance with 11.2, and satisfy the yield point or proof stress, tensile strength and elongation requirements as given in Table 7.

For steel plates/sheets agreed between the purchaser and the manufacturer as specified in Note ^{b)} to Table 1, the requirements given in Table JA.2 shall apply. For sections with a leg length under 70 mm and of flats with a width under 50 mm, the following shall apply.

- a) For sections with a leg length under 40 mm, requirements in Annex JB shall apply. For sections with a leg length 40 mm or over to and excluding 70 mm, requirements in Annex JB may be applied.
- b) For flats with a width under 40 mm, requirements in Annex JB shall apply. For flats with a width 40 mm or over to and excluding 50 mm, requirements in Annex JB may be applied.

8.2 Charpy absorbed energy

Steel products of symbols given in Table 8 having a thickness over 12 mm shall be

tested in accordance with **11.2**, and their Charpy absorbed energy shall conform to Table 8. The Charpy absorbed energy shall be the mean of results of three test pieces and shall be judged by **9.6** of **JIS G 0404**.

Table 7 Yield point or proof stress, tensile strength and elongation

| Symbol of grade | Yield point or proof stress N/mm ² | | | | | | Tensile strength N/mm ² | | Elongation | | |
|----------------------------|--|------------|------------|-------------|--------------|--------------|---------------------------------------|---------------|--|------------------------------------|--------------------------|
| | Thickness ^{a)} mm | | | | | | Thickness ^{a)} mm | | Thick- ness ^{a)} mm | Test piece | % |
| | ≤16 | >16 ≤40 | >40 ≤75 | >75 ≤100 | >100 ≤160 | >160 ≤200 | ≤100 | >100 ≤200 | | | |
| SM400A SM400B SM400C | ≥245 | ≥235 | ≥215 | ≥215 | ≥205 | ≥195 | 400 to 510 | 400 to 510 | ≤5 >5 ≤16 >16 ≤50 >40 ^{b)} | No. 5 No. 1A No. 1A No. 4 | ≥23 ≥18 ≥22 ≥24 |
| SM490A SM490B SM490C | ≥325 | ≥315 | ≥295 | ≥295 | ≥285 | ≥275 | 490 to 610 | 490 to 610 | ≤5 >5 ≤16 >16 ≤50 >40 ^{b)} | No. 5 No. 1A No. 1A No. 4 | ≥22 ≥17 ≥21 ≥23 |
| SM490YA SM490YB | ≥365 | ≥355 | ≥335 | ≥325 | — | — | 490 to 610 | — | ≤5 >5 ≤16 >16 ≤50 >40 ^{b)} | No. 5 No. 1A No. 1A No. 4 | ≥19 ≥15 ≥19 ≥21 |
| SM520B SM520C | ≥365 | ≥355 | ≥335 | ≥325 | — | — | 520 to 640 | — | ≤5 >5 ≤16 >16 ≤50 >40 ^{b)} | No. 5 No. 1A No. 1A No. 4 | ≥19 ≥15 ≥19 ≥21 |
| SM570 | ≥460 | ≥450 | ≥430 | ≥420 | — | — | 570 to 720 | — | ≤16 > 16 >20 ^{b)} | No. 5 No. 5 No. 4 | ≥19 ≥26 ≥20 |

NOTE 1 N/mm² = 1 MPa

Note ^{a)} For sections, the thickness shall be that at the location of test pieces.

Note ^{b)} For the elongation of No. 4 test piece of steel product with a thickness over 100 mm, subtract 1 from the values of this table for each increment of 25 mm or its fraction in thickness. The number subtracted shall not exceed 3.

Table 8 Charpy absorbed energy

| Symbol of grade | Test temperature ^{a)} °C | Charpy absorbed energy J | Test piece and sampling direction |
|-----------------|--------------------------------------|-----------------------------|---|
| SM400B | 0 | ≥27 | V-notch in rolling direction ^{b)} |
| SM400C | 0 | ≥47 | |
| SM490B | 0 | ≥27 | |
| SM490C | 0 | ≥47 | |
| SM490YB | 0 | ≥27 | |
| SM520B | 0 | ≥27 | |
| SM520C | 0 | ≥47 | |
| SM570 | -5 | ≥47 | |

Note ^{a)} A test temperature lower than specified above may be applied upon agreement between the purchaser and the manufacturer.

Note ^{b)} When the test is performed in the rolling direction and in the direction perpendicular thereto, the test performed in the rolling direction may be omitted upon approval by the purchaser.

9 Shape, dimensions, mass and tolerances

The shape, dimensions, mass and tolerances of steel products shall be in accordance with JIS G 3192, JIS G 3193 and JIS G 3194. Tolerances on width and length, unless otherwise specified, shall be as follows.

- a) For width of cut-edged plates/sheets and strips in coil, Tolerance A in Table 7 of JIS G 3193 shall apply.
- b) For length of plates/sheets, the tolerances given in Table 8 of JIS G 3193 shall apply.

10 Appearance

The appearance of steel products shall be in accordance with Clause 9 of JIS G 3192, Clause 7 of JIS G 3193 and Clause 8 of JIS G 3194.

Repair by welding of SM570 steel plates/sheets shall be previously agreed between the purchaser and the manufacturer.

11 Tests

11.1 Chemical analysis

The chemical analysis shall be as follows.

- a) **General requirements and sampling method** General requirements for chemical analysis and sampling method for heat analysis shall be in accordance with Clause 8 of JIS G 0404.
- b) **Analysis method** The heat analysis method shall be in accordance with JIS G 0320.

11.2 Mechanical tests

11.2.1 General

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

11.2.2 Number of test pieces

The number of tensile and impact test pieces shall be as follows.

- a) **Number of tensile test pieces** The number of tensile test pieces shall be as follows.
 - 1) **Plates/sheets (excluding cut lengths from strips in coil), and flats** Take one tensile test piece from each lot of plates/sheets or flats which belong to the same heat, and of which the maximum thickness is within two times the minimum thickness. When the mass of one lot exceeds 50 t, take two tensile test pieces from each lot. When the mass of one plate/sheet exceeds 50 t, take one tensile test piece from each plate/sheet.
 - 2) **Strips in coil or cut lengths therefrom** Take one tensile test piece from each lot

of strips in coil or cut lengths belonging to the same heat and rolled to the same thickness. When the mass of one lot exceeds 50 t, take two tensile test pieces from each lot.

- 3) **Sections** Take one tensile test piece from each lot of sections belonging to the same heat and rolled to the same sectional profile, of which the maximum thickness is within two times the minimum thickness. When the mass of one lot exceeds 50 t, take two tensile test pieces from each lot.
 - 4) **Heat treated steel products** Take the number of test pieces specified in 1), 2) or 3) from each lot of products grouped according to heat treatment conditions.
- b) **Number of impact test pieces** The number of impact test pieces shall be as follows.
- 1) **Plates/sheets, flats, strips in coil and cut lengths from strips in coil** Take one sample from a steel product of maximum thickness taken from a lot of steel products belonging to the same heat, and from this sample, take three test pieces in the rolling direction.
 - 2) **Sections** Take one sample from a steel product of maximum thickness taken from a lot of steel products belonging to the same heat and rolled to the same sectional profile, and from this sample, take three test pieces in the rolling direction.
 - 3) **Heat treated steel products** Take the number of test pieces specified in 1) or 2) from each lot of products grouped according to heat treatment conditions.

11.2.3 Location of test pieces

The location of tensile and impact test pieces shall be as follows.

- a) **Location of tensile test pieces** The location of tensile test pieces of steel products shall be in accordance with **JIS G 0416**. The centre of test pieces across the width of a plate/sheet, strip in coil or flat shall be 1/4 of the width from the edge of the width or as near this location as possible.
- b) **Location of impact test pieces** The location of impact test pieces of steel products shall be in accordance with **JIS G 0416**. The centre of test pieces across the width of a plate/sheet, strip in coil or flat shall be 1/4 of the width from the edge of the width or as near this location as possible. The location of test pieces in thickness of plate/sheet shall be as shown in Figure A.11 a) of **JIS G 0416** for thicknesses 28 mm or under, or as shown in Figure A.11 b) of **JIS G 0416** for thicknesses over 28 mm. If test pieces cannot be taken from the specified location, they shall be taken as near this location as possible.

11.2.4 Test pieces

The tensile and impact test pieces shall be as follows.

- a) The tensile test piece shall be No. 1A, 4, 5 or 14B specified in JIS Z 2241.
- b) The impact test piece shall be V-notch test piece specified in JIS Z 2242. The longitudinal axis of the notch shall be perpendicular to the rolled surface of the prod-

uct.

11.2.5 Test methods

The tensile test and the impact test shall be as follows.

- a) The tensile test shall be in accordance with JIS Z 2241.
- b) The impact test shall be in accordance with JIS Z 2242. For the pendulum, a striker of 2 mm radius shall be used.

NOTE ... Instead of the tests specified in this Standard, non-destructive tests such as those given in JIS G 0801 [1] or JIS G 0901 [2] may be conducted, in which case the necessary details including sampling method, test method, acceptance criteria are previously agreed between the purchaser and the manufacturer.

12 Inspection

The inspection shall be as follows.

- a) General requirements for inspection are specified in JIS G 0404.
- b) Chemical composition shall conform to the requirements in Clause 5.
- c) Carbon equivalent or weld-crack sensitivity composition shall conform to the requirements in Clause 7.
- d) Mechanical properties shall conform to the requirements in Clause 8.
- e) Shape, dimensions and mass shall conform to the requirements in Clause 9.
- f) Appearance shall conform to the requirements in Clause 10.

13 Reinspection

The reinspection shall be as follows.

- a) The steel products having failed in the tensile test may be subjected to the retest according to 9.8 of JIS G 0404 for further acceptance judgement.
- b) The steel products having failed in the impact test may be subjected to the retest according to 9.8 of JIS G 0404 for further acceptance judgement.
- c) The steel products having failed in the mechanical tests may be heat treated or re-heat treated, then subjected to the mechanical tests again for further acceptance judgement.

14 Marking

Each piece or bundle of steel products having passed the inspection shall be marked with the following information by a suitable means. Part of the following particulars may be omitted upon agreement between the purchaser and the manufacturer, as far as the identification of the product is possible.

- a) Symbol of grade and symbol of heat treatment specified in 6.2

12

G 3106 : 2020

NOTE In some cases, an additional mark specified by the order or the agreement between the purchaser and the manufacturer is suffixed to the symbol of grade to facilitate identification by the purchaser.

- b) Heat number or inspection number
- c) Dimensions. The marking of dimensions shall be in accordance with Clause 4 of JIS G 3192, Clause 3 of JIS G 3193 and Clause 4 of JIS G 3194.
- d) Quantity in or mass of each bundle (for plates/sheets and strips in coil)
- e) Manufacturer's name or its identifying brand

15 Report

Unless otherwise specified, the manufacturer shall submit an inspection document to the purchaser. The report shall be in accordance with Clause 13 of JIS G 0404. Unless otherwise specified in the order, the type of the inspection document shall be in accordance with 5.1 of JIS G 0415.

Where an alloy element(s) has been added according to Note ^{a)} to Table 2 or Note ^{a)} to Table JA.1, the analysis value(s) of the added element(s) shall be indicated in the report. If the carbon equivalent or weld-crack sensitivity composition has been applied, the analysis values of the alloy elements used for the calculation shall be reported.

Annex JA (normative)

Chemical composition and tensile properties of steel plates/sheets agreed between the purchaser and the manufacturer

JA.1 Application

This Annex specifies the chemical composition and tensile properties of steel plates/sheets agreed between the purchaser and the manufacturer according to Note ^{b)} to Table 1.

JA.2 Chemical composition

Steel plates/sheets agreed between the purchaser and the manufacturer according to Note ^{b)} to Table 1 shall be tested in accordance with 11.1, and their heat analysis values shall satisfy Table JA.1.

Table JA.1 Chemical composition ^{a)}

| | | | | | | Unit: % |
|--|--------------------|-------|-------|------------------------|--------|---------|
| Symbol of grade | Thickness | C | Si | Mn ^{b)} | P | S |
| SM400A | >200 mm ≤450 mm | ≤0.25 | — | ≥2.5 × C ^{c)} | ≤0.035 | ≤0.035 |
| SM400B | >200 mm ≤250 mm | ≤0.22 | ≤0.35 | ≥0.60 | ≤0.035 | ≤0.035 |
| SM400C | >100 mm ≤250 mm | ≤0.18 | ≤0.35 | — | ≤0.035 | ≤0.035 |
| SM490A | >200 mm ≤300 mm | ≤0.22 | ≤0.55 | — | ≤0.035 | ≤0.035 |
| SM490B | >200 mm ≤250 mm | ≤0.20 | ≤0.55 | — | ≤0.035 | ≤0.035 |
| SM490C | >100 mm ≤250 mm | ≤0.18 | ≤0.55 | — | ≤0.035 | ≤0.035 |
| SM490YA | >100 mm | ≤0.20 | ≤0.55 | — | ≤0.035 | ≤0.035 |
| SM490YB | ≤150 mm | | | | | |
| SM520B | >100 mm | ≤0.20 | ≤0.55 | — | ≤0.035 | ≤0.035 |
| SM520C | ≤150 mm | | | | | |
| SM570 | >100 mm ≤150 mm | ≤0.18 | ≤0.55 | — | ≤0.035 | ≤0.035 |
| Note ^{a)} Elements in the table with no limit values or elements not given in the table may be added as necessary. Note ^{b)} The upper limit of manganese shall be as agreed between the purchaser and the manufacturer. Note ^{c)} For the value of carbon, the heat analysis value shall be applied. | | | | | | |

JA.3 Yield point or proof stress, tensile strength and elongation

Steel plates/sheets agreed between the purchaser and the manufacturer according to Note ^{b)} to Table 1 shall be tested in accordance with 11.2 and satisfy the yield point or proof stress, tensile strength and elongation requirements given in Table JA.2. For tensile test, No. 4 test piece shall be used.

Table JA.2 Yield point or proof stress, tensile strength and elongation

| Symbol of grade | Thickness mm | Yield point or proof stress N/mm ² | Tensile strength N/mm ² | Elongation % |
|--|-----------------|---|---------------------------------------|-------------------|
| SM400A | >200 ≤450 | ≥195 | 400 to 510 | ≥21 |
| SM400B | >200 ≤250 | | | |
| SM400C | >100 ≤160 | ≥205 | | |
| | >160 ≤250 | ≥195 | | |
| SM490A | >200 ≤300 | ≥275 | 490 to 610 | ≥20 |
| SM490B | >200 ≤250 | | | |
| SM490C | >100 ≤160 | ≥285 | | |
| | >160 ≤250 | ≥275 | | |
| SM490YA | >100 ≤150 | ≥315 | 490 to 610 | ≥21 ^{a)} |
| SM490YB | >100 ≤150 | | | |
| SM520B | >100 ≤150 | ≥315 | 520 to 640 | ≥21 ^{a)} |
| SM520C | >100 ≤150 | | | |
| SM570 | >100 ≤150 | ≥410 | 570 to 720 | ≥20 ^{a)} |
| NOTE 1 N/mm ² = 1 MPa | | | | |
| Note ^{a)} For the elongation of steel plates/sheets with a thickness over 100 mm, subtract 1 from the elongation values of this table for each increment of 25 mm or its fraction in thickness. The number subtracted shall not exceed 3. | | | | |

Annex JB (normative)

Mechanical properties of sections with a leg length under 40 mm and of flats with a width under 40 mm

Sections with a leg length under 40 mm and flats with a width under 40 mm shall be tested in accordance with 11.2, and satisfy the yield point or proof stress, tensile strength and elongation requirements given in Table JB.1.

Table JB.1 Mechanical properties of sections with a leg length under 40 mm and of flats with a width under 40 mm

| Symbol of grade | Yield point or proof stress N/mm ² | | Tensile strength N/mm ² | Thickness ^{a)} mm | Tensile test piece | Elongation % |
|----------------------------|--|------------|---|-----------------------------------|--------------------|---------------------|
| | Thickness mm | | | | | |
| | ≤16 | >16 ≤40 | | | | |
| SM400A SM400B SM400C | ≥245 | ≥235 | 400 to 510 | ≥3 ≤5 | No. 5 | ≥23 |
| | | | | | No. 14B | ≥23 |
| | | | | >5 ≤16 | No. 5 | ≥28 |
| | | | | | No. 14B | ≥26 |
| | | | | >16 ≤40 | No. 5 | ≥35 |
| | | | | | No. 14B | ≥25 |
| SM490A SM490B SM490C | ≥325 | ≥315 | 490 to 610 | ≥3 ≤5 | No. 5 | ≥22 |
| | | | | | No. 14B | ≥22 |
| | | | | >5 ≤16 | No. 5 | ≥27 |
| | | | | | No. 14B | ≥24 |
| | | | | >16 ≤40 | No. 5 | ≥33 |
| | | | | | No. 14B | ≥24 |
| SM490YA SM490YB | ≥365 | ≥355 | 490 to 610 | ≥3 ≤5 | No. 5 | ≥19 |
| | | | | | No. 14B | ≥19 |
| | | | | >5 ≤16 | No. 5 | ≥24 |
| | | | | | No. 14B | ≥22 |
| | | | | >16 ≤40 | No. 5 | ≥30 |
| | | | | | No. 14B | ≥22 |
| SM520B SM520C | ≥365 | ≥355 | 520 to 640 | ≥3 ≤5 | No. 5 | ≥19 |
| | | | | | No. 14B | ≥19 |
| | | | | >5 ≤16 | No. 5 | ≥24 |
| | | | | | No. 14B | ≥22 |
| | | | | >16 ≤40 | No. 5 | ≥30 |
| | | | | | No. 14B | ≥22 |
| SM570 | ≥460 | ≥450 | 570 to 720 | ≥3 ≤5 | No. 5 | ≥19 |
| | | | | | No. 14B | ≥19 |
| | | | | >5 ≤16 | No. 5 | ≥19 |
| | | | | | No. 14B | ≥17 |
| | | | | >16 ≤40 | No. 5 | ≥26 |
| | | | | | No. 14B | ≥19 |

NOTE 1 N/mm² = 1 MPa

Note ^{a)} For sections, the thickness shall be that at the location of test pieces.

Annex JC (normative)

Quality requirements for hot extruded sections

JC.1 Application

This Annex specifies the quality requirements for hot extruded sections of specially ordered shape to be used for construction components, coupling components for steel sheet piles, steel pipe sheet piles and the like.

Hot extruded sections shall be applied by agreement between the purchaser and the manufacturer.

JC.2 Symbols of grade and applicable dimensions

Hot extruded sections are classified into ten grades, and their symbols and applicable dimensions shall be as given in Table JC.1.

Table JC.1 Symbols of grade and applicable dimensions of hot extruded sections

| Symbol of grade | Applicable dimension |
|-----------------|-----------------------|
| SM400A | ≥5 mm in thickness |
| SM400B | ≤250 mm in leg length |
| SM400C | or height |
| SM490A | |
| SM490B | |
| SM490C | |
| SM490YA | |
| SM490YB | |
| SM520B | |
| SM520C | |

JC.3 Manufacturing method

Hot extruded sections shall be produced by hot extrusion at a minimum forging ratio of 4.

JC.4 Chemical composition

Hot extruded sections shall be tested in accordance with 11.1, and their heat analysis values shall conform to Table 2.

JC.5 Mechanical properties

JC.5.1 Location of tensile and impact test pieces

The location of tensile and impact test pieces of hot extruded sections shall be as agreed between the purchaser and the manufacturer. The location of test pieces across

the width shall be as follows.

- a) **Location of tensile test pieces across the width** The No.4 tensile test piece shall be taken at 1/4 of the thickness; if this is impracticable, it shall be taken as near this location as possible.
- b) **Location of impact test pieces in thickness direction** It shall be as shown in Figure A.3 of JIS G 0416.

JC.5.2 Yield point or proof stress, tensile strength and elongation

Hot extruded sections shall be tested in accordance with the test method for sections given in 11.2, and satisfy the yield point or proof stress, tensile strength and elongation requirements for sections given in Table 7 and Table JB.1. Where No.1A test piece cannot be taken due to the specific geometry of the hot extruded section, No.5 test piece may be taken. Elongation requirements for hot extruded sections are given in Table JC.2.

Table JC.2 Elongation of hot-extruded sections

| Symbol of grade | Elongation | | |
|--|--------------|-------------------|-----|
| | Thickness mm | Test piece | % |
| SM400A SM400B SM400C | ≤5 | No. 5 | ≥23 |
| | >5 ≤16 | No. 1A | ≥18 |
| | | No. 5 | ≥29 |
| | >16 ≤50 | No. 1A | ≥22 |
| | | No. 5 | ≥35 |
| > 40 | No. 4 | ≥24 ^{a)} | |
| SM490A SM490B SM490C | ≤5 | No. 5 | ≥22 |
| | >5 ≤16 | No. 1A | ≥17 |
| | | No. 5 | ≥27 |
| | >16 ≤50 | No. 1A | ≥21 |
| | | No. 5 | ≥33 |
| > 40 | No. 4 | ≥23 ^{a)} | |
| SM490YA SM490YB | ≤5 | No. 5 | ≥19 |
| | >5 ≤16 | No. 1A | ≥15 |
| | | No. 5 | ≥24 |
| | >16 ≤50 | No. 1A | ≥19 |
| | | No. 5 | ≥30 |
| > 40 | No. 4 | ≥21 ^{a)} | |
| SM520B SM520C | ≤5 | No. 5 | ≥19 |
| | >5 ≤16 | No. 1A | ≥15 |
| | | No. 5 | ≥24 |
| | >16 ≤50 | No. 1A | ≥19 |
| | | No. 5 | ≥30 |
| > 40 | No. 4 | ≥21 ^{a)} | |
| Note ^{a)} For the elongation of steel plates/sheets with a thickness over 100 mm, subtract 1 from the elongation values of this table for each increment of 25 mm or its fraction in thickness. The number subtracted shall not exceed 3. | | | |

JC.5.3 Charpy absorbed energy

Hot extruded sections of symbols given in Table 8 having a thickness over 12 mm shall be tested in accordance with 11.2, and their Charpy absorbed energy shall conform to Table 8. The test pieces shall be taken in the direction of extrusion. The Charpy absorbed energy shall be the mean of results of three test pieces and shall be judged by 9.6 of JIS G 0404.

JC.6 Shape, dimensions and tolerances

The shape of the hot extruded section shall be specified by the purchaser. If extrusion into the ordered shape is not possible, the purchaser shall specify a change of shape upon agreement with the manufacturer.

NOTE Hot extruded sections are used mainly as components specified in designing documents that are based on technical standards such as standard specifications for building operations and common specifications for port construction work.

The tolerances on shape and dimensions of hot extruded sections shall be as given in Table JC.3.

Table JC.3 Tolerances on shape and dimensions

| | | Unit: mm |
|--|-------------------------------|---|
| Division | | Tolerance |
| Leg length, height and thickness | < 50 | ±1.5 |
| | ≥50 < 100 | ±2.0 |
| | ≥100 < 200 | ±3.0 |
| | ≥200 | ±4.0 |
| Length | ≤7 m | +40 0 |
| | >7 m | For plus tolerance, add 5 mm to the above plus tolerance for each increment of 1 m or its fraction in length. Minus tolerance shall be 0 mm. |
| Squareness | ≤100 mm in maximum leg length | ≤1.6 |
| | >100 mm in maximum leg length | ≤3.0 |
| Bendability | | ≤0.5 % of length ^{a)} |
| Upon agreement between the purchaser and the manufacturer, the full spread of the above tolerance range may be moved to the plus or minus side, provided the lower limit when the range is moved to the plus side is not above zero and the upper limit when it is moved to the minus side is not below zero. Note ^{a)} Applicable to vertical and horizontal bending. | | |

JC.7 Appearance

The appearance of hot extruded sections shall be in accordance with Clause 9 of JIS G 3192.

JC.8 Inspection

The inspection of hot extruded sections shall be in accordance with Clause 12.

JC.9 Reinspection

The reinspection of hot extruded sections shall be in accordance with Clause 13 a) and b).

JC.10 Marking

The marking of hot extruded sections shall be in accordance with Clause 14.

JC.11 Report

The report of hot extruded sections shall be in accordance with Clause 15.

Bibliography

- [1] JIS G 0801 *Ultrasonic testing of steel plates for pressure vessels*
- [2] JIS G 0901 *Classification of structural rolled steel plate and wide flat for building by ultrasonic test*

Annex JD (informative)

Comparison table between JIS and corresponding International Standards

| JIS G 3106 | | ISO 630-1 : 2011, ISO 630-2 : 2011, ISO 630-3 : 2012, (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 |
| 1 | ISO 630-3 1 | Alteration | JIS scope does not cover steel bars. | Steel bars are specified in another JIS. |
| 3 | ISO 630-1 3 | Deletion | JIS deletes the definition of the term “normalized-rolled” as the concept of this term is not used in JIS. | JIS corresponds to manufacturing methods used in Japan. |
| | | Addition | JIS adds definitions of terms relevant to products uniquely specified in JIS. | JIS corresponds to manufacturing methods used in Japan. |
| 4 | ISO 630-3 6 | Alteration | Steel grade designation in JIS is based on tensile strength while designation in ISO is based on yield point. | Difference in commercial practices. |
| 5 | ISO 630-3 6 | Alteration | ISO requirements on five alloy elements are in line with JIS requirements. | Most of JIS requirements have been incorporated into ISO. |
| 6 | ISO 630-3 6 | Alteration | ISO specifies quenching and tempering in ISO 630-4. | JIS corresponds to manufacturing methods used in Japan. |
| 7 | ISO 630-1 6 ISO 630-3 6 | Addition | JIS specifies a unique formula for calculation of C_{eq} instead of the IIW formula used in ISO. | A provision regarding P_{CM} has been incorporated into ISO based on proposal from Japan. |
| 8.1 | ISO 630-3 6 | Alteration | JIS requirements are essentially equivalent to ISO. | JIS aims to be in keeping with Japanese technical standards. No harmonization effort will be made. |
| 8.2 | ISO 630-1 4 ISO 630-3 6 | Alteration | JIS and ISO use slightly different values of temperature and energy. | Harmonization between JIS and ISO has progressed as ISO has incorporated proposals from JIS. |
| 9 | ISO 630-1 6 | Alteration | JIS specifies details of dimensional and shape requirements different from ISO. | Difference in commercial practices. No harmonization measures will be taken. |

| 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 |
|---|---|-----------------------------|---|--|
| 10 | ISO 630-1 6 | Alteration | JIS does not permit local insufficiency in plate thickness caused by removal of surface flaws, while ISO does. | JIS requirements are stricter than ISO. No harmonization measures will be taken. |
| 11.1 | ISO 630-1 9 | Alteration | JIS refers to other JISs for analysis requirements. | JIS specifies the heat analysis method to be adopted. |
| 11.2 | ISO 630-3 8 | Alteration | JIS and ISO use slightly different test units, but use the same location of test pieces. | Harmonization between JIS and ISO has progressed as ISO has incorporated proposals from JIS. |
| 13 | ISO 630-1 7.3 | Addition | JIS adds a matter to be agreed between the purchaser and the manufacturer regarding the re-inspection requirements. | Difference in commercial practices. No harmonization measures will be taken. |
| 14 | ISO 630-1 10 | Addition | ISO does not include “heat number” in the information to be marked, or provide specific instruction for marking dimensions. | Difference in commercial practices. No harmonization measures will be taken. |
| Annex JA (normative) | — | Addition | JIS specifies different applicable thicknesses for steel grades than ISO. | The specification is of unique necessity to Japan. No harmonization measures will be taken. |
| Annex JB (normative) | — | Addition | JIS specifies non-proportional test pieces as well while ISO only specifies proportional test pieces. | The specification is of unique necessity to Japan. No harmonization measures will be taken. |
| Annex JC (normative) | — | Addition | JIS adds product requirements intended only for building structures in Japan. | The specification is of unique necessity to Japan. No harmonization measures will be taken. |
| <p>NOTE 1 Symbols in sub-columns of classification by clause in the above table indicate as follows :</p> <ul style="list-style-type: none"> — 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). <p>NOTE 2 Symbol of overall degree of correspondence between JIS and International Standard(s) in the above table indicates as follows :</p> <ul style="list-style-type: none"> — MOD : Modify International Standard(s). | | | | |

Blank

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

For inquiry, please contact:

Publication and Information Unit, Japanese Standards Association Group

Mita MT Building, 3-13-12, Mita, Minato-ku, Tokyo, 108-0073 JAPAN

TEL. 03-4231-8550 FAX. 03-4231-8665