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**Structural steels with specified  
hardenability bands**

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## Foreword

This translation has been made based on the original Japanese Industrial Standard revised by the Minister of Economy, Trade and Industry through deliberations at the Japanese Industrial Standards Committee as the result of proposal for revision of Japanese Industrial Standard submitted by The Japan Iron and Steel Federation (JISF) with the draft being attached, based on the provision of Article 12 Clause 1 of the Industrial Standardization Law applicable to the case of revision by the provision of Article 14.

Consequently **JIS G 4052:2008** is replaced with this Standard.

However, **JIS G 4052:2008** may be applied in the **JIS** mark certification based on the relevant provisions of Article 19 Clause 1, etc. of the Industrial Standardization Law until November 20, 2017.

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

Attention is drawn to the possibility that some parts of this Standard may conflict with patent rights, applications for a patent after opening to the public or utility model rights. The relevant Minister and the Japanese Industrial Standards Committee are not responsible for identifying any of such patent rights, applications for a patent after opening to the public or utility model rights.

# Structural steels with specified hardenability bands

## Introduction

This Japanese Industrial Standard has been prepared based on the first edition of **ISO 683-2** published in 2012 and the first edition of **ISO 683-3** published in 2014 with some modifications of the technical contents.

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 steels mainly intended for machine structural use with specified hardenability bands (hereafter referred to as steel products) which are manufactured by hot rolling, hot forging and hot extruding. This Standard applies to steel products with a uniform cross-section, which are generally supplied for use after further processes of forging, cutting and heat treatment. This Standard is not applicable to steel tubes<sup>1)</sup>.

The manufacturing method and quality requirements for hot-extruded sections are given in Annex JA.

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

ISO 683-2:2012 *Heat-treatable steels, alloy steels and free-cutting steels—Part 2: Alloy steels for quenching and tempering*

ISO 683-3:2014 *Heat-treatable steels, alloy steels and free-cutting steels—Part 3: Case-hardening steels* (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**.

Note <sup>1)</sup> Steel tubes are covered in **JIS G 3479** (Steel tubes for machine structure with specified hardenability bands).

## 2 Normative references

The following standards contain provisions which, 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 0320 *Standard test method for heat analysis of steel products*

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

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

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

- JIS G 0551 *Steels—Micrographic determination of the apparent grain size*  
 JIS G 0561 *Method of hardenability test for steel (End quenching method)*  
 JIS G 3191 *Dimensions, mass and permissible variations of hot rolled steel bars and bar in coil*  
 JIS G 3192 *Dimensions, mass and permissible variations of hot rolled steel sections*

### 3 Classification and symbols

The steels are classified into 24 grades, and their respective symbols are shown in Table 1.

**Table 1 Symbols of grades**

| Classification           | Symbol of grade                             | Classification                   | Symbol of grade                                                        |
|--------------------------|---------------------------------------------|----------------------------------|------------------------------------------------------------------------|
| Manganese steel          | SMn420H, SMn433H, SMn438H, SMn443H          | Chromium molybdenum steel        | SCM415H, SCM418H, SCM420H, SCM425H, SCM435H, SCM440H, SCM445H, SCM822H |
| Manganese chromium steel | SMnC420H, SMnC443H                          |                                  |                                                                        |
| Chromium steel           | SCr415H, SCr420H, SCr430H, SCr435H, SCr440H | Nickel chromium steel            | SNC415H, SNC631H, SNC815H                                              |
|                          |                                             | Nickel chromium molybdenum steel | SNCM220H, SNCM420H                                                     |

### 4 Manufacturing method

The manufacturing method shall be as follows. The manufacturing method for hot-extruded sections is specified in **JA.1**.

- The steel products shall be manufactured from killed steel.
- The steel products shall be manufactured by hot working such as rolling and forging with a forging ratio of not less than 4S. The forging ratio may be less than 4S if the purchaser is to perform further hot working such as rolling or forging on the steels, provided that a prior agreement is made between the purchaser and the manufacturer.
- The steel products shall normally be supplied as hot-rolled or hot-forged, but may be given heat treatment if specified by the purchaser <sup>2)</sup>.

Note <sup>2)</sup> Mechanical properties values for heat-treated products may be agreed between the purchaser and the manufacturer.

### 5 Chemical composition

When tested in accordance with **8.1**, the steel products shall satisfy the heat analysis values given in Table 2. If a product analysis is agreed between the purchaser and the manufacturer, the steel products shall be tested in accordance with **8.1** and shall satisfy the requirements in Table 2 within the tolerances given in Table 4 of **JIS G 0321**.

**Table 2 Chemical composition**

Unit: %

| Symbol of grade | C               | Si              | Mn              | P             | S             | Ni              | Cr              | Mo              | Cu           |
|-----------------|-----------------|-----------------|-----------------|---------------|---------------|-----------------|-----------------|-----------------|--------------|
| SMn420H         | 0.16 to<br>0.23 | 0.15 to<br>0.35 | 1.15 to<br>1.55 | 0.030<br>max. | 0.030<br>max. | 0.25<br>max.    | 0.35<br>max.    | a)              | 0.30<br>max. |
| SMn433H         | 0.29 to<br>0.36 | 0.15 to<br>0.35 | 1.15 to<br>1.55 | 0.030<br>max. | 0.030<br>max. | 0.25<br>max.    | 0.35<br>max.    | a)              | 0.30<br>max. |
| SMn438H         | 0.34 to<br>0.41 | 0.15 to<br>0.35 | 1.30 to<br>1.70 | 0.030<br>max. | 0.030<br>max. | 0.25<br>max.    | 0.35<br>max.    | a)              | 0.30<br>max. |
| SMn443H         | 0.39 to<br>0.46 | 0.15 to<br>0.35 | 1.30 to<br>1.70 | 0.030<br>max. | 0.030<br>max. | 0.25<br>max.    | 0.35<br>max.    | a)              | 0.30<br>max. |
| SMnC420H        | 0.16 to<br>0.23 | 0.15 to<br>0.35 | 1.15 to<br>1.55 | 0.030<br>max. | 0.030<br>max. | 0.25<br>max.    | 0.35 to<br>0.70 | a)              | 0.30<br>max. |
| SMnC443H        | 0.39 to<br>0.46 | 0.15 to<br>0.35 | 1.30 to<br>1.70 | 0.030<br>max. | 0.030<br>max. | 0.25<br>max.    | 0.35 to<br>0.70 | a)              | 0.30<br>max. |
| SCr415H         | 0.12 to<br>0.18 | 0.15 to<br>0.35 | 0.55 to<br>0.95 | 0.030<br>max. | 0.030<br>max. | 0.25<br>max.    | 0.85 to<br>1.25 | a)              | 0.30<br>max. |
| SCr420H         | 0.17 to<br>0.23 | 0.15 to<br>0.35 | 0.55 to<br>0.95 | 0.030<br>max. | 0.030<br>max. | 0.25<br>max.    | 0.85 to<br>1.25 | a)              | 0.30<br>max. |
| SCr430H         | 0.27 to<br>0.34 | 0.15 to<br>0.35 | 0.55 to<br>0.95 | 0.030<br>max. | 0.030<br>max. | 0.25<br>max.    | 0.85 to<br>1.25 | a)              | 0.30<br>max. |
| SCr435H         | 0.32 to<br>0.39 | 0.15 to<br>0.35 | 0.55 to<br>0.95 | 0.030<br>max. | 0.030<br>max. | 0.25<br>max.    | 0.85 to<br>1.25 | a)              | 0.30<br>max. |
| SCr440H         | 0.37 to<br>0.44 | 0.15 to<br>0.35 | 0.55 to<br>0.95 | 0.030<br>max. | 0.030<br>max. | 0.25<br>max.    | 0.85 to<br>1.25 | a)              | 0.30<br>max. |
| SCM415H         | 0.12 to<br>0.18 | 0.15 to<br>0.35 | 0.55 to<br>0.95 | 0.030<br>max. | 0.030<br>max. | 0.25<br>max.    | 0.85 to<br>1.25 | 0.15 to<br>0.30 | 0.30<br>max. |
| SCM418H         | 0.15 to<br>0.21 | 0.15 to<br>0.35 | 0.55 to<br>0.95 | 0.030<br>max. | 0.030<br>max. | 0.25<br>max.    | 0.85 to<br>1.25 | 0.15 to<br>0.30 | 0.30<br>max. |
| SCM420H         | 0.17 to<br>0.23 | 0.15 to<br>0.35 | 0.55 to<br>0.95 | 0.030<br>max. | 0.030<br>max. | 0.25<br>max.    | 0.85 to<br>1.25 | 0.15 to<br>0.30 | 0.30<br>max. |
| SCM425H         | 0.23 to<br>0.28 | 0.15 to<br>0.35 | 0.55 to<br>0.95 | 0.030<br>max. | 0.030<br>max. | 0.25<br>max.    | 0.85 to<br>1.25 | 0.15 to<br>0.30 | 0.30<br>max. |
| SCM435H         | 0.32 to<br>0.39 | 0.15 to<br>0.35 | 0.55 to<br>0.95 | 0.030<br>max. | 0.030<br>max. | 0.25<br>max.    | 0.85 to<br>1.25 | 0.15 to<br>0.35 | 0.30<br>max. |
| SCM440H         | 0.37 to<br>0.44 | 0.15 to<br>0.35 | 0.55 to<br>0.95 | 0.030<br>max. | 0.030<br>max. | 0.25<br>max.    | 0.85 to<br>1.25 | 0.15 to<br>0.35 | 0.30<br>max. |
| SCM445H         | 0.42 to<br>0.49 | 0.15 to<br>0.35 | 0.55 to<br>0.95 | 0.030<br>max. | 0.030<br>max. | 0.25<br>max.    | 0.85 to<br>1.25 | 0.15 to<br>0.35 | 0.30<br>max. |
| SCM822H         | 0.19 to<br>0.25 | 0.15 to<br>0.35 | 0.55 to<br>0.95 | 0.030<br>max. | 0.030<br>max. | 0.25<br>max.    | 0.85 to<br>1.25 | 0.35 to<br>0.45 | 0.30<br>max. |
| SNC415H         | 0.11 to<br>0.18 | 0.15 to<br>0.35 | 0.30 to<br>0.70 | 0.030<br>max. | 0.030<br>max. | 1.95 to<br>2.50 | 0.20 to<br>0.55 | a)              | 0.30<br>max. |
| SNC631H         | 0.26 to<br>0.35 | 0.15 to<br>0.35 | 0.30 to<br>0.70 | 0.030<br>max. | 0.030<br>max. | 2.45 to<br>3.00 | 0.55 to<br>1.05 | a)              | 0.30<br>max. |
| SNC815H         | 0.11 to<br>0.18 | 0.15 to<br>0.35 | 0.30 to<br>0.70 | 0.030<br>max. | 0.030<br>max. | 2.95 to<br>3.50 | 0.55 to<br>1.05 | a)              | 0.30<br>max. |
| SNCM220H        | 0.17 to<br>0.23 | 0.15 to<br>0.35 | 0.60 to<br>0.95 | 0.030<br>max. | 0.030<br>max. | 0.35 to<br>0.75 | 0.35 to<br>0.65 | 0.15 to<br>0.30 | 0.30<br>max. |
| SNCM420H        | 0.17 to<br>0.23 | 0.15 to<br>0.35 | 0.40 to<br>0.70 | 0.030<br>max. | 0.030<br>max. | 1.55 to<br>2.00 | 0.35 to<br>0.65 | 0.15 to<br>0.30 | 0.30<br>max. |

**Table 2 (concluded)**

Elements not quoted shall not be intentionally added to steel, other than for the purpose of finishing the heat.

Note <sup>a)</sup> Shall not be intentionally added.

## 6 Quality of steels

### 6.1 Hardenability

The hardenability shall be as follows.

- The steel products shall be tested in accordance with **8.2.1**, and the hardenability at the specified distance shall be in accordance with Tables 10 to 33. If the distance from the quenched end is not shown in the table, the upper and lower limits of hardness shall be determined based on the values read off from the chart, upon agreement between the purchaser and the manufacturer.
- Hardenability shall be specified by the minimum and maximum hardnesses at the specified distance.

Example : When hardness is specified at A-A' shown in Figure 1, indicate "J 7 mm = 31/44".

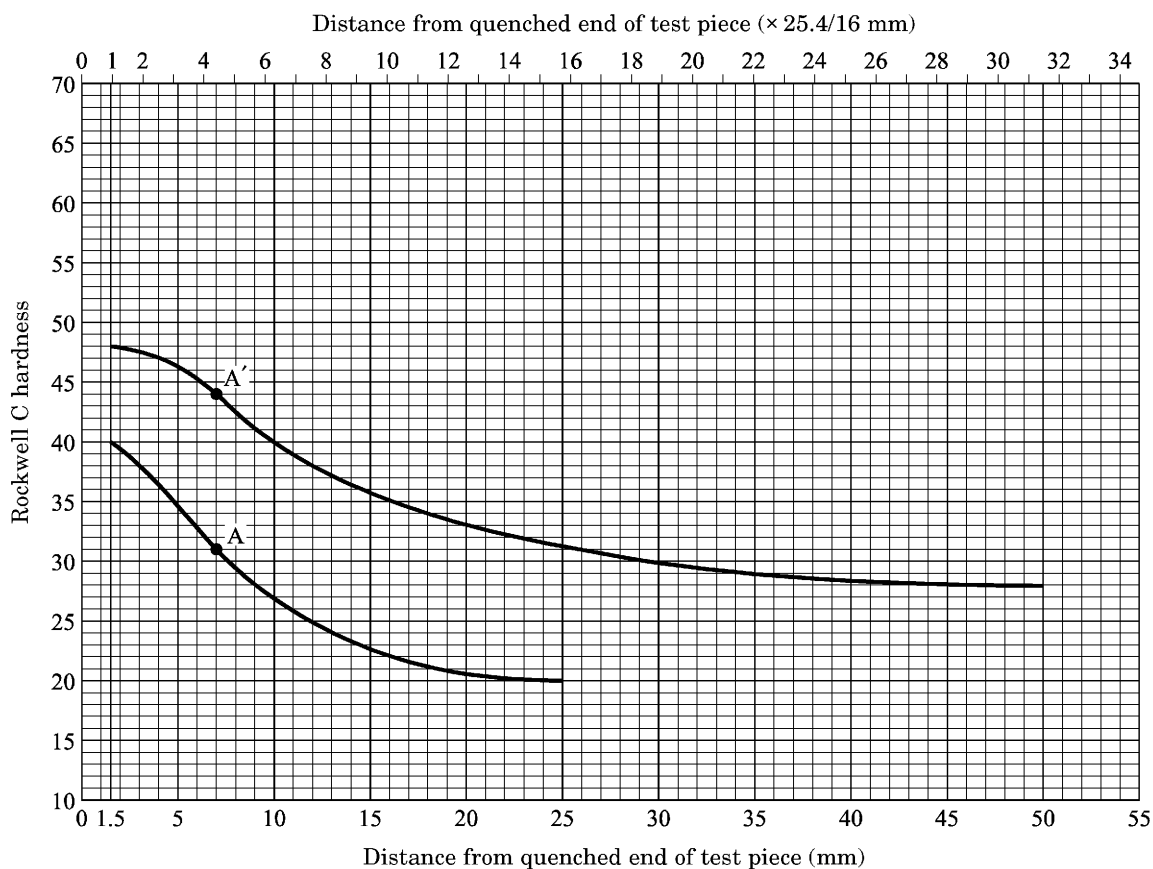


**Figure 1 Hardenability band**

## 6.2 Austenitic grain size

The steel products shall be tested in accordance with **8.2.2**, and their austenitic grain size shall conform to Table 3.

**Table 3 Austenitic grain size**

| Symbol of grade                                                                                                                    | Austenitic grain size                                                                |
|------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|
| SMn433H, SMn438H, SMn443H,<br>SMnC443H, SCr430H, SCr435H,<br>SCr440H, SCM435H, SCM440H,<br>SCM445H, SNC631H                        | Average grain size number<br>obtained by heat-treated<br>grain size test<br>5.0 min. |
| SMn420H, SMnC420H, SCr415H,<br>SCr420H, SCM415H, SCM418H,<br>SCM420H, SCM425H, SCM822H,<br>SNC415H, SNC815H, SNCM220H,<br>SNCM420H | Average grain size number<br>obtained by carburized<br>grain size test<br>6.0 min.   |

## 7 Appearance, shape, dimensions and dimensional tolerances

### 7.1 Hot-rolled steel bars and wire rods

#### 7.1.1 Appearance

The hot-rolled steel bars and the wire rods shall be well finished and free from defects in appearance that are detrimental to service. The coiled products may contain some defects since it is generally difficult to inspect their surfaces throughout the length and treat the defects found. Treatment of any defects detected in coils that are found to be detrimental to service, if required, shall be agreed between the purchaser and the manufacturer.

#### 7.1.2 Limit of removal of surface imperfections and permissible depth of surface imperfections remaining after repair

The limit of removal of surface imperfections and permissible depth of surface imperfections remaining after repair shall be as follows.

- a) **Steel bars for general forging** The surface imperfections of the steel bars for general forging shall be removed so as to obtain a smooth surface and to a depth not exceeding 4 % (5 mm max.) of the nominal size, and the total width not exceeding 1/4 of the circumferential length of the same cross-section. If the dressed portion is within the dimensional tolerance, however, it shall not be considered as the flaw of the portion dressed.

The maximum permissible depth of surface imperfections remaining after repair shall be as agreed between the purchaser and the manufacturer.

- b) **Round bars for direct cutting** Removal of surface imperfections from round bars for direct cutting is not generally performed. The permissible depth of surface imperfections based on the nominal size shall be as given in Table 4. If removal of surface imperfections is to be performed, the limit of removal shall be in accordance with the agreement between the purchaser and the manufacturer.

**Table 4 Permissible depth of surface imperfections based on the nominal size, for round bars for direct cutting**

| Diameter<br>mm                                                                                                                               | Permissible depth of surface imperfections<br>based on the nominal size |
|----------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------|
| Under 16                                                                                                                                     | Not exceeding 4 % of the nominal size, with the maximum being 0.5 mm    |
| 16 or over to and excl. 50                                                                                                                   | Not exceeding 3 % of the nominal size, with the maximum being 1.0 mm    |
| 50 or over to and excl. 100                                                                                                                  | Not exceeding 2 % of the nominal size, with the maximum being 1.5 mm    |
| 100 or over up to and incl. 200                                                                                                              | Not exceeding 1.5 % of the nominal size                                 |
| For sizes greater than 200 mm, the permissible depth of surface imperfections shall be as agreed between the purchaser and the manufacturer. |                                                                         |

- c) **Steel bars for cold drawing** The surface imperfections of the steel bars for cold drawing shall be removed so as to obtain a smooth surface, and the limit of depth of surface imperfections to remove, based on the lowest limit of dimensional tolerance (see Table 7), shall be as given in Table 5. The maximum permissible depth of surface imperfections remaining after repair shall be as agreed between the purchaser and the manufacturer.

**Table 5 Limit of depth of surface imperfections to remove, based on the lowest limit of dimensional tolerance, for steel bars for cold drawing**

| Diameter or width across flats<br>mm                                                                     | Limit of depth of surface imperfections to remove,<br>based on the lowest limit of dimensional tolerance |
|----------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------|
| Under 16                                                                                                 | 0.15 mm max.                                                                                             |
| 16 or over to and excl. 50                                                                               | Not exceeding 1 % of the nominal size, with the maximum being 0.35 mm                                    |
| 50 or over to and excl. 100                                                                              | Not exceeding 0.7 % of the nominal size, with the maximum being 0.50 mm                                  |
| 100 or over up to and incl. 130                                                                          | Not exceeding 0.5 % of the nominal size                                                                  |
| For sizes greater than 130 mm, this limit shall be as agreed between the purchaser and the manufacturer. |                                                                                                          |

- d) **Other steel bars** Surface imperfections removal of other steel bars, if required, shall be as agreed between the purchaser and the manufacturer.
- e) **Wire rods** The maximum permissible depth of surface imperfections for wire rods shall be as agreed between the purchaser and the manufacturer.

### 7.1.3 Standard dimensions

The standard dimensions shall be as follows.

- a) The standard dimensions for diameter and width across flats of the hot-rolled steel bars (round, square, and hexagonal) and wire rods shall be as given in Table 6.
- b) The length <sup>3)</sup> of the hot-rolled steel bars (round, square, and hexagonal) shall be as agreed between the purchaser and the manufacturer.

Note <sup>3)</sup> Depending on the intended purpose of the product, the bars may be cut to an equal length specified or within a specified length range (from the minimum length to the maximum length).

**Table 6 Standard dimensions for diameter and width across flats of hot-rolled steel bars and wire rods**

Unit: mm

| Round bar (diameter)                           |      |    |       |       | Square bar<br>(width across flats) |       |     | Hexagonal bar<br>(width across flats) |      | Wire rod<br>(diameter) |      |    |
|------------------------------------------------|------|----|-------|-------|------------------------------------|-------|-----|---------------------------------------|------|------------------------|------|----|
| (10)                                           | 22   | 42 | 85    | 160   | 40                                 | 95    | 200 | (12)                                  | 41   | 5.5                    | (15) | 30 |
| 11                                             | (24) | 44 | 90    | (170) | 45                                 | 100   |     | 13                                    | 46   | 6                      | 16   | 32 |
| (12)                                           | 25   | 46 | 95    | 180   | 50                                 | (105) |     | 14                                    | 50   | 7                      | (17) | 34 |
| 13                                             | (26) | 48 | 100   | (190) | 55                                 | 110   |     | 17                                    | 55   | 8                      | (18) | 36 |
| (14)                                           | 28   | 50 | (105) | 200   | 60                                 | (115) |     | 19                                    | 60   | 9                      | 19   | 38 |
| (15)                                           | 30   | 55 | 110   |       | 65                                 | 120   |     | 22                                    | 63   | 9.5                    | (20) | 40 |
| 16                                             | 32   | 60 | (115) |       | 70                                 | 130   |     | 24                                    | 67   | (10)                   | 22   | 42 |
| (17)                                           | 34   | 65 | 120   |       | 75                                 | 140   |     | 27                                    | 71   | 11                     | (24) | 44 |
| (18)                                           | 36   | 70 | 130   |       | 80                                 | 150   |     | 30                                    | (75) | (12)                   | 25   | 46 |
| 19                                             | 38   | 75 | 140   |       | 85                                 | 160   |     | 32                                    | (77) | 13                     | (26) | 48 |
| (20)                                           | 40   | 80 | 150   |       | 90                                 | 180   |     | 36                                    | (81) | (14)                   | 28   | 50 |
| Use of values in parentheses is not desirable. |      |    |       |       |                                    |       |     |                                       |      |                        |      |    |

#### 7.1.4 Shape and dimensional tolerances

The shape and dimensional tolerances for the hot-rolled steel bars and wire rods shall be in accordance with **a)** to **c)**. For heat-treated hot-rolled steel bars and wire rods, the shape and dimensional tolerances shall be as agreed between the purchaser and the manufacturer.

The tolerance on length shall be applicable to hot-rolled steel bars (round, square and hexagonal) cut to an equal length specified.

- a) The shape and dimensional tolerances for the hot-rolled round bars and square bars shall be as given in Table 7.

**Table 7 Shape and dimensional tolerances for hot-rolled round bars and square bars**

| Item                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                     | Shape and dimensional tolerance                                                                                                   |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|-----------------------------------------------------------------------------------------------------------------------------------|
| Tolerance on diameter or width across flats                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                     | $\pm 1.5 \%$ , or $\pm 0.4$ mm when the absolute value of tolerance is less than 0.4 mm.                                          |
| Out-of-round/out-of-square <sup>a)</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                     | Not exceeding 70 % of the specified range of tolerance on diameter or width across flats.                                         |
| Tolerances on length <sup>b)</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Length 7 m or under | +40<br>0 mm                                                                                                                       |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Length over 7 m     | Add 5 mm to plus tolerance for every increase of 1 m or its fraction. Minus tolerance shall be 0 mm.                              |
| Corner radius <sup>c)</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                     | Not exceeding 20 % of the width across flats.                                                                                     |
| Twist <sup>d)</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                     | Not detrimental to practical service.                                                                                             |
| Bend                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                     | Not exceeding 3 mm per metre, and not exceeding $3 \text{ mm} \times \frac{\text{Length (m)}}{1 \text{ m}}$ for the whole length. |
| <p>Notes <sup>a)</sup> Out-of-roundness is the difference between the maximum and minimum diameters measured at the same cross-section of a round bar. Out-of-square is the difference between the maximum and minimum widths across flats, measured at the same cross-section of a square bar.</p> <p><sup>b)</sup> Plus tolerance may be as agreed between the purchaser and the manufacturer.</p> <p><sup>c)</sup> Corner radius does not apply to round bars.</p> <p><sup>d)</sup> Twist does not apply to round bars.</p> |                     |                                                                                                                                   |

b) The shape and dimensional tolerances for the hot-rolled hexagonal bars shall be given in Table 8.

**Table 8 Shape and dimensional tolerances for hot-rolled hexagonal bars**

| Item                                                                                                                                                                                                                                                                 |                        | Width across flats<br>mm                                                                                                             |                               |                               |            |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|--------------------------------------------------------------------------------------------------------------------------------------|-------------------------------|-------------------------------|------------|
|                                                                                                                                                                                                                                                                      |                        | Under 19                                                                                                                             | 19 or over to<br>and excl. 32 | 32 or over to<br>and excl. 55 | 55 or over |
| Tolerance on width across<br>flats mm                                                                                                                                                                                                                                |                        | ± 0.7                                                                                                                                | ± 0.8                         | ± 1.0                         | ± 1.2      |
| Out-of-hexagon <sup>a)</sup> mm                                                                                                                                                                                                                                      |                        | 1.0 max.                                                                                                                             | 1.1 max.                      | 1.4 max.                      | 1.7 max.   |
| Tolerances<br>on length <sup>b)</sup>                                                                                                                                                                                                                                | Length 7 m<br>or under | +40<br>0 mm                                                                                                                          |                               |                               |            |
|                                                                                                                                                                                                                                                                      | Length over<br>7 m     | Add 5 mm to plus tolerance for every increase of 1 m or its fraction.<br>Minus tolerance shall be 0 mm.                              |                               |                               |            |
| Twist                                                                                                                                                                                                                                                                |                        | Not detrimental to practical service.                                                                                                |                               |                               |            |
| Bend                                                                                                                                                                                                                                                                 |                        | Not exceeding 3 mm per metre, and not exceeding $3 \text{ mm} \times \frac{\text{Length (m)}}{1 \text{ m}}$<br>for the whole length. |                               |                               |            |
| Notes <sup>a)</sup> Out-of-hexagon is the difference between the maximum and minimum widths across flats,<br>measured at the same cross-section of a hexagonal bar.<br><br><sup>b)</sup> Plus tolerance may be as agreed between the purchaser and the manufacturer. |                        |                                                                                                                                      |                               |                               |            |

- c) The dimensional tolerances for the hot-rolled wire rods shall be as given in Table 9.

**Table 9 Dimensional tolerances for hot-rolled wire rods**

Unit: mm

| Diameter                                                                                                                                          | Tolerance on diameter | Out-of-roundness <sup>a)</sup> |
|---------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|--------------------------------|
| 15 or under                                                                                                                                       | $\pm 0.3$             | 0.4 max.                       |
| Over 15 up to and incl. 25                                                                                                                        | $\pm 0.4$             | 0.5 max.                       |
| Over 25 up to and incl. 32                                                                                                                        | $\pm 0.5$             | 0.6 max.                       |
| Over 32 up to and incl. 50                                                                                                                        | $\pm 0.6$             | 0.7 max.                       |
| Dimensional tolerances for wire rods of diameter over 50 mm shall be as agreed between the purchaser and the manufacturer.                        |                       |                                |
| Note <sup>a)</sup> Out-of-roundness is the difference between the maximum and minimum diameters measured at the same cross-section of a wire rod. |                       |                                |

## 7.2 Hot-extruded sections

The appearance, shape, dimensions and dimensional tolerances of the hot-extruded sections shall be in accordance with **JA.2**.

## 7.3 Other steel products

For steel products with a uniform cross-section that are not specified in **7.1** and **7.2**, the appearance, limit of removal of surface imperfections, maximum permissible depth of surface imperfections remaining after repair, shape, dimensions and dimensional tolerances shall be as agreed between the purchaser and the manufacturer. Steel tubes do not fall under this category.

NOTE : Products under this category include forged steel bars and rolled sections, etc.

# 8 Tests

## 8.1 Chemical analysis

The chemical analysis shall be as follows.

- The chemical composition of products shall be determined by heat analysis. The general requirements for the chemical analysis and the sampling method for the heat analysis are specified in clause **8** of **JIS G 0404**.
- The sampling method for the product analysis shall be in accordance with clause **4** of **JIS G 0321**.
- The heat analysis method shall be in accordance with **JIS G 0320**. The product analysis shall be in accordance with **JIS G 0321**.

## 8.2 Metallographic test

### 8.2.1 Hardenability test

The hardenability test shall be as follows.

- a) The preparation of test piece and the test method shall be in accordance with **JIS G 0561**.

The samples shall be taken from each unit of products originating from the same heat. The number of test pieces, unless specified by the purchaser, shall be at the discretion of the manufacturer.

- b) When the hardness is measured at the positions specified in Tables 10 to 33 and the hardness at the intermediate position is required, it may be obtained by proportional calculation using the measured values obtained at the adjacent measurement positions, in accordance with the agreement between the purchaser and the manufacturer.

### 8.2.2 Austenitic grain size test

The austenitic grain size test shall be as follows.

- a) The sampling method and the number of test pieces shall be as agreed between the purchaser and the manufacturer.
- b) The test method shall be in accordance with **JIS G 0551**.

Unless otherwise specified, the heat-treated grain size test shall be performed by either the quenching and tempering method or the oxidizing method.

NOTE : Where required, an ultrasonic testing may also be carried out. In this case, the test method or other related matters shall be agreed between the purchaser and the manufacturer.

## 9 Inspection

The inspection on steel products shall be as follows.

- a) The general requirements of the inspections are specified in **JIS G 0404**.
- b) The chemical composition shall conform to the requirements in clause 5.
- c) The hardenability and the austenitic grain size shall conform to the requirements in clause 6. Steel products which failed the hardenability test may be re-tested according to 9.8 of **JIS G 0404** to be judged further for acceptance.
- d) The appearance, shape, dimensions and dimensional tolerances shall conform to the requirements in clause 7.

## 10 Marking

Each steel product having passed the inspection shall be marked with the following information by a suitable means. Steel bars with a diameter or width across flats less than 30 mm may be bound together in bundles, and the marking given on each bundle by a suitable means. For steel bars 30 mm or over in diameter or width across flats, this may be done upon agreement between the purchaser and the manufacturer. 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

- b) Heat number or other manufacture (inspection) number
- c) Name of manufacturer or its identifying brand
- d) Dimensions. The marking of dimensions shall be in accordance with **JIS G 3191** or **JIS G 3192**. For wire rods, see the method of expression of dimensions for bars in coil specified in **JIS G 3191**.

## 11 Report

Upon request from the purchaser, the manufacturer shall submit an inspection report containing information on the specified items. The report shall be in accordance with clause **13** in **JIS G 0404**. Unless otherwise specified in the order, the type of the inspection document to be submitted shall be in accordance with **5.1** of **JIS G 0415**.