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Carbon steels for machine structural use

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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 4051** : 2018), which has been technically revised.

However, **JIS G 4051** : 2018 may be applied in the **JIS** mark certification based on the relevant provisions of Article 30, paragraph (1), etc. of the Industrial Standardization Act until 21 May 2024.

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Carbon steels for machine structural use

Introduction

This Japanese Industrial Standard has been prepared based on **ISO 683-1** : 2016, Edition 3, and **ISO 683-3** : 2022, Edition 4, with some modifications of the technical contents.

Annex JA to Annex JD 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 JE.

1 Scope

This Standard specifies requirements for carbon steels for machine structural use (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 such as forging and cutting, and heat treatment. This Standard is not applicable to steel tubes ¹⁾.

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

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

ISO 683-1 : 2016 *Heat-treatable steels, alloy steels and free-cutting steels — Part 1 : Non-alloy steels for quenching and tempering*

ISO 683-3 : 2022 *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 Standards and **JIS** are IDT (identical), MOD (modified), and NEQ (not equivalent) according to **ISO/IEC Guide 21-1**.

Note ¹⁾ Steel tubes are covered in **JIS G 3478** [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	<i>Standard test method for heat analysis of steel products</i>
JIS G 0321	<i>Product analysis and its tolerance for wrought steel</i>
JIS G 0404	<i>Steel and steel products — General technical delivery requirements</i>
JIS G 0415	<i>Steel and steel products — Inspection documents</i>
JIS G 3191	<i>Dimensions, mass, shape and permissible variations of hot rolled steel bars and bar in coil</i>
JIS G 3192	<i>Dimensions, shape, mass and permissible variations of hot rolled steel sections</i>
JIS G 3193	<i>Dimensions, shape, mass and permissible variations of hot rolled steel plates, sheets and strips</i>
JIS G 3194	<i>Dimensions, shape, mass and permissible variations of hot rolled flat steel</i>

3 Terms and definitions

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

4 Symbol of grade

Steel products are classified into 27 grades, and their respective symbols shall be as given in Table 1.

Table 1 Symbol of grade

Classification	Symbol of grade
Carbon steel	S10C, S12C, S15C, S17C, S20C, S22C, S25C, S28C, S30C, S33C, S35C, S38C, S40C, S43C, S45C, S48C, S50C, S53C, S55C, S58C, S60C ^{a)} , S65C ^{a)} , S70C ^{a)} , S75C ^{a)}
Case hardening steel	S09CK, S15CK, S20CK
Note ^{a)} Only applicable to steel plates, sheets and strips.	

5 Manufacturing method

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

- Steel products shall be manufactured from killed steel.
- Steel products shall be manufactured by hot working such as rolling and forging with a forging ratio of 4S or over. The forging ratio may be under 4S if the purchaser is to perform further hot working such as rolling or forging on the steel products, provided that a prior agreement is made between the purchaser and the manufacturer.

Steel plates and sheets may be manufactured by the method given in Annex JD.

- c) Steel products shall normally be supplied as hot rolled or hot forged, but may be given heat treatment if specified by the purchaser ²⁾.

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

- d) Steel plates, sheets and strips which cannot be manufactured by hot rolling due to their required thickness may be manufactured by cold rolling upon agreement between the purchaser and the manufacturer. Cold-rolled steel plates, sheets and strips shall normally be annealed after rolling.

6 Chemical composition

When tested in accordance with Clause 9, the steel products shall satisfy the heat analysis values given in Table 2. If a product analysis is required by agreement between the purchaser and the manufacturer, the steel products shall be tested in accordance with Clause 9 and shall satisfy the requirements in Table 2 within the tolerances given in Table 3 of **JIS G 0321**.

Chemical composition requirements for S60C, S65C, S70C and S75C applicable to steel plates, sheets and strips only shall be as specified in Annex JB.

Table 2 Chemical composition

Symbol of grade	Unit: %								
	C	Si	Mn	P	S	Ni	Cr ^{a)}	Cu	Ni + Cr ^{b)}
S10C	0.08 to 0.13	0.15 to 0.35	0.30 to 0.60	0.030 max.	0.035 max.	0.20 max.	0.20 max.	0.30 max.	0.35 max.
S12C	0.10 to 0.15	0.15 to 0.35	0.30 to 0.60	0.030 max.	0.035 max.	0.20 max.	0.20 max.	0.30 max.	0.35 max.
S15C	0.13 to 0.18	0.15 to 0.35	0.30 to 0.60	0.030 max.	0.035 max.	0.20 max.	0.20 max.	0.30 max.	0.35 max.
S17C	0.15 to 0.20	0.15 to 0.35	0.30 to 0.60	0.030 max.	0.035 max.	0.20 max.	0.20 max.	0.30 max.	0.35 max.
S20C	0.18 to 0.23	0.15 to 0.35	0.30 to 0.60	0.030 max.	0.035 max.	0.20 max.	0.20 max.	0.30 max.	0.35 max.
S22C	0.20 to 0.25	0.15 to 0.35	0.30 to 0.60	0.030 max.	0.035 max.	0.20 max.	0.20 max.	0.30 max.	0.35 max.
S25C	0.22 to 0.28	0.15 to 0.35	0.30 to 0.60	0.030 max.	0.035 max.	0.20 max.	0.20 max.	0.30 max.	0.35 max.
S28C	0.25 to 0.31	0.15 to 0.35	0.60 to 0.90	0.030 max.	0.035 max.	0.20 max.	0.20 max.	0.30 max.	0.35 max.
S30C	0.27 to 0.33	0.15 to 0.35	0.60 to 0.90	0.030 max.	0.035 max.	0.20 max.	0.20 max.	0.30 max.	0.35 max.
S33C	0.30 to 0.36	0.15 to 0.35	0.60 to 0.90	0.030 max.	0.035 max.	0.20 max.	0.20 max.	0.30 max.	0.35 max.