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Heat-resistant steel bars and wire rods

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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 through deliberations at the Japanese Industrial Standards Committee as the result of proposal for revision of Japanese Industrial Standard submitted by Japan Stainless Steel Association (JSSA)/Japanese Standards Association (JSA) 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 4311:2011** is replaced with this Standard.

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Heat-resistant steel bars and wire rods

Introduction

This Japanese Industrial Standard has been prepared based on **ISO 4955** : 2016, Edition 4, and **ISO 683-15** : 1992, Edition 2, with some modifications of the technical contents.

The vertical lines on both sides indicate changes from the corresponding International Standards. A list of modifications with the explanations is given in Annex JB.

1 Scope

This Japanese Industrial Standard specifies requirements for heat-resistant steel bars (hereafter referred to as bars as a general term for heat-resistant steel round bars, square bars, hexagonal bars and flat bars) and heat-resistant steel wire rods (hereafter referred to as wire rods).

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

ISO 4955 : 2016 *Heat-resistant steels*

ISO 683-15 : 1992 *Heat-treatable steels, alloy steels and free-cutting steels — Part 15 : Valve steels for internal combustion engines* (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

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 B 0401-2 *Geometrical product specifications (GPS) — ISO code system for tolerances on linear sizes — Part 2 : Tables of standard tolerance classes and limit deviations for holes and shafts*

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 Z 2241 *Metallic materials — Tensile testing — Method of test at room temperature*
- JIS Z 2242 *Method for Charpy pendulum impact test of metallic materials*
- JIS Z 2243-1 *Brinell hardness test — Part 1 : Test method*
- JIS Z 2244 *Vickers hardness test — Test method*
- JIS Z 2245 *Rockwell hardness test — Test method*
- JIS Z 8401 *Guide to the rounding of numbers*

3 Symbol of grade

Bars and wire rods are classified into 35 grades. The classification and the symbol of grade shall be as given in Table 1.

Table 1 Classification and symbol of grade

Classification	Symbol of grade a), b)	Classification	Symbol of grade a), b)
Austenitic series	SUH31	Ferritic series	SUH446
	SUH35		SUS405-HR
	SUH36		SUS410L-HR
	SUH37		SUS430-HR
	SUH38	Martensitic series	SUH1
	SUH309		SUH3
	SUH310		SUH4
	SUH330		SUH11
	SUH660		SUH600
	SUH661		SUH616
SUS304-HR	SUS403-HR		
SUS309S-HR	SUS410-HR		
SUS310S-HR	SUS410J1-HR		
SUS316-HR	SUS431-HR		
SUS316Ti-HR	Precipitation hard- ening series	SUS630-HR	
SUS317-HR		SUS631-HR	
SUS321-HR			
SUS347-HR			
SUSXM15J1-HR			
Notes a) When the use of symbols is required to indicate that the product is a bar, -B (hot finished steel bars) or -CB (cold finished steel bars) shall be suffixed to the symbol of grade. Examples : Hot finished steel bar SUH309-B, SUS304-HR-B Cold finished steel bar SUH309-CB, SUS304-HR-CB			
b) When the use of symbols is required to indicate that the product is a wire rod, -WR shall be suffixed to the symbol of grade. Examples : SUH11-WR, SUS304-HR-WR			

4 Manufacturing method

The manufacturing method shall be as follows.

- a) Bars shall be heat treated after hot working such as hot rolling and hot forging. Heat treatment may be omitted to supply products as hot worked by agreement between the purchaser and the manufacturer.
- b) When heat treatment is applied, the type of the heat treatment shall be agreed upon between the purchaser and the manufacturer. The heat treatment conditions shall be selected so that the product quality conforms to the requirements specified in Clause 6.

NOTE Typical heat treatment conditions are shown in Annex JA for reference. Other heat treatment conditions than those in Annex JA may be selected.

- c) Cold finished steel bars shall be manufactured by cold drawing, grinding, cutting or a combination of these.

Unless otherwise specified by the purchaser, heat treatment shall not be applied after cold finishing.

- d) Wire rods shall be as hot rolled; however, some heat treatment may be applied, if necessary.
- e) Black scales generated by heat treatment shall be removed, if necessary, by pickling, cutting or other suitable means.
- f) Symbols expressing the condition of heat treatment and the surface finishing method shall be as given in Table 2.

Table 2 Symbol for condition of heat treatment and surface finishing method

Item	Symbol
As hot worked	R
Solution treatment	S
Aging treatment after solution treatment	H
Annealing	A
Quenching and tempering	Q
Pickling finish	P
Cold drawing	D
Cutting	T
Grinding	C
Symbols for the condition of heat treatment and the surface finishing method other than those in this table may be determined upon agreement between the purchaser and the manufacturer.	

5 Chemical composition

5.1 Heat analysis values

Bars and wire rods shall be tested in accordance with **11.1** and the heat analysis values shall be as given in Table 3 to Table 6.

5.2 Product analysis values

When the product analysis of bars and wire rods is requested by the purchaser, the test shall be performed in accordance with **11.1**. The resultant product analysis values shall satisfy the requirements in Table 3 to Table 6 within tolerances given in Table 5 of **JIS G 0321**. The tolerances for elements not given in Table 5 of **JIS G 0321** may be as agreed between the purchaser and the manufacturer.

Table 3 Chemical composition of austenitic series

Unit: %

Symbol of grade	C	Si	Mn	P	S	Ni	Cr	Mo	N	Others
SUH31	0.35 to 0.45	1.50 to 2.50	0.60 max.	0.040 max.	0.030 max.	13.00 to 15.00	14.00 to 16.00	—	—	W : 2.00 to 3.00
SUH35	0.48 to 0.58	0.35 max.	8.00 to 10.00	0.040 max.	0.030 max.	3.25 to 4.50	20.00 to 22.00	—	0.35 to 0.50	—
SUH36	0.48 to 0.58	0.35 max.	8.00 to 10.00	0.040 max.	0.040 to 0.090	3.25 to 4.50	20.00 to 22.00	—	0.35 to 0.50	—
SUH37	0.15 to 0.25	1.00 max.	1.00 to 1.60	0.040 max.	0.030 max.	10.00 to 12.00	20.50 to 22.50	—	0.15 to 0.30	—
SUH38	0.25 to 0.35	1.00 max.	1.20 max.	0.18 to 0.25	0.030 max.	10.00 to 12.00	19.00 to 21.00	1.80 to 2.50	—	B : 0.001 to 0.010
SUH309	0.20 max.	1.00 max.	2.00 max.	0.040 max.	0.030 max.	12.00 to 15.00	22.00 to 24.00	—	—	—
SUH310	0.25 max.	1.50 max.	2.00 max.	0.040 max.	0.030 max.	19.00 to 22.00	24.00 to 26.00	—	—	—
SUH330	0.15 max.	1.50 max.	2.00 max.	0.040 max.	0.030 max.	33.00 to 37.00	14.00 to 17.00	—	—	—
SUH660	0.08 max.	1.00 max.	2.00 max.	0.040 max.	0.030 max.	24.00 to 27.00	13.50 to 16.00	1.00 to 1.50	—	Ti : 1.90 to 2.35 Al : 0.35 max. B : 0.001 to 0.010 V : 0.10 to 0.50
SUH661	0.08 to 0.16	1.00 max.	1.00 to 2.00	0.040 max.	0.030 max.	19.00 to 21.00	20.00 to 22.50	2.50 to 3.50	0.10 to 0.20	Nb : 0.75 to 1.25 W : 2.00 to 3.00 Co : 18.50 to 21.00
SUS304-HR	0.08 max.	1.00 max.	2.00 max.	0.045 max.	0.030 max.	8.00 to 10.50	18.00 to 20.00	—	—	—
SUS309S-HR	0.08 max.	1.00 max.	2.00 max.	0.045 max.	0.030 max.	12.00 to 15.00	22.00 to 24.00	—	—	—
SUS310S-HR	0.08 max.	1.50 max.	2.00 max.	0.045 max.	0.030 max.	19.00 to 22.00	24.00 to 26.00	—	—	—
SUS316-HR	0.08 max.	1.00 max.	2.00 max.	0.045 max.	0.030 max.	10.00 to 14.00	16.00 to 18.00	2.00 to 3.00	—	—
SUS316Ti-HR	0.08 max.	1.00 max.	2.00 max.	0.045 max.	0.030 max.	10.00 to 14.00	16.00 to 18.00	2.00 to 3.00	—	Ti : 5 × C % min.
SUS317-HR	0.08 max.	1.00 max.	2.00 max.	0.045 max.	0.030 max.	11.00 to 15.00	18.00 to 20.00	3.00 to 4.00	—	—
SUS321-HR	0.08 max.	1.00 max.	2.00 max.	0.045 max.	0.030 max.	9.00 to 13.00	17.00 to 19.00	—	—	Ti : 5 × C % min.
SUS347-HR	0.08 max.	1.00 max.	2.00 max.	0.045 max.	0.030 max.	9.00 to 13.00	17.00 to 19.00	—	—	Nb : 10 × C % min.
SUSXM15J1-HR ^{a)}	0.08 max.	3.00 to 5.00	2.00 max.	0.045 max.	0.030 max.	11.50 to 15.00	15.00 to 20.00	—	—	—
Note ^{a)} For SUSXM15J1-HR, when either Cu, Mo, Nb, Ti or N, or a combination of these, which are not given in this Table, is added as required, the content rate of the added element(s) shall be re-reported.										

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Table 4 Chemical composition of ferritic series

Unit: %

Symbol of grade	C	Si	Mn	P	S	Cr	N	Al
SUH446 ^{a)}	0.20 max.	1.00 max.	1.50 max.	0.040 max.	0.030 max.	23.00 to 27.00	0.25 max.	—
SUS405-HR	0.08 max.	1.00 max.	1.00 max.	0.040 max.	0.030 max.	11.50 to 14.50	—	0.10 to 0.30
SUS410L-HR	0.030 max.	1.00 max.	1.00 max.	0.040 max.	0.030 max.	11.00 to 13.50	—	—
SUS430-HR	0.12 max.	0.75 max.	1.00 max.	0.040 max.	0.030 max.	16.00 to 18.00	—	—

The Ni content shall not exceed 0.60 %.
Note ^{a)} For SUH446, the Cu content shall not exceed 0.30 %.

Table 5 Chemical composition of martensitic series

Unit: %

Symbol of grade	C	Si	Mn	P	S	Ni	Cr	Mo	N	Others
SUH1 ^{a), b)}	0.40 to 0.50	3.00 to 3.50	0.60 max.	0.030 max.	0.030 max.	—	7.50 to 9.50	—	—	—
SUH3 ^{a), b)}	0.35 to 0.45	1.80 to 2.50	0.60 max.	0.030 max.	0.030 max.	—	10.00 to 12.00	0.70 to 1.30	—	—
SUH4 ^{a)}	0.75 to 0.85	1.75 to 2.25	0.20 to 0.60	0.030 max.	0.030 max.	1.15 to 1.65	19.00 to 20.50	—	—	—
SUH11 ^{a), b)}	0.45 to 0.55	1.00 to 2.00	0.60 max.	0.030 max.	0.030 max.	—	7.50 to 9.50	—	—	—
SUH600 ^{a), b)}	0.15 to 0.20	0.50 max.	0.50 to 1.00	0.040 max.	0.030 max.	—	10.00 to 13.00	0.30 to 0.90	0.05 to 0.10	Nb : 0.20 to 0.60 V : 0.10 to 0.40
SUH616 ^{a)}	0.20 to 0.25	0.50 max.	0.50 to 1.00	0.040 max.	0.030 max.	0.50 to 1.00	11.00 to 13.00	0.75 to 1.25	—	W : 0.75 to 1.25 V : 0.20 to 0.30
SUS403-HR ^{b)}	0.15 max.	0.50 max.	1.00 max.	0.040 max.	0.030 max.	—	11.50 to 13.00	—	—	—
SUS410-HR ^{b)}	0.15 max.	1.00 max.	1.00 max.	0.040 max.	0.030 max.	—	11.50 to 13.50	—	—	—
SUS410J1-HR ^{b)}	0.08 to 0.18	0.60 max.	1.00 max.	0.040 max.	0.030 max.	—	11.50 to 14.00	0.30 to 0.60	—	—
SUS431-HR	0.20 max.	1.00 max.	1.00 max.	0.040 max.	0.030 max.	1.25 to 2.50	15.00 to 17.00	—	—	—

Notes ^{a)} For SUH1, SUH3, SUH4, SUH11, SUH600 and SUH616, the Cu content shall not exceed 0.30 %.

^{b)} The Ni content shall not exceed 0.60 % for those other than SUH4, SUH616 and SUS431-HR.