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JIS G 4303 : 1998

Stainless steel bars

ICS 77.140.20; 77.140.60

Descriptors : stainless steels, corrosion-resistant steels, steels, bars (materials), materials by form, metal sections

Reference number : **JIS G 4303 : 1998 (E)**

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Foreword

This translation has been made based on the original Japanese Industrial Standard revised by the Minister of International Trade and Industry through deliberations at Japanese Industrial Standards Committee in accordance with the Industrial Standardization Law. Consequently JIS G 4303:1991 is replaced with JIS G 4303:1998.

Date of Establishment: 1959-12-01

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Divisional Council on Iron and Steel

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

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Stainless steel bars

Introduction This Standard comes to today through seven revisions since established in 1959. This revision is reflected technical improvement and change of demands structure since the revision in 1991.

On this revision, though study is advanced to achieve conformance with International Standards, the object International Standards (**ISO 683-13, ISO 683-16**) are decided to be annulled at **TC17/SC4** in June, 1996, which are to be newly revised to two standards flat product and long product but the contents are not yet agreed upon. Therefore, this revision is advanced by considering that corresponding International Standards etc. opting the standard on dimensional tolerances (**ISO 1035**, *Hot-rolled steel bars-Part 4: Tolerances*) do not exist.

Principal revised points are as follows.

a) **Grade and symbol** Two steel kinds of SUS303Cu and SUS 316F are added to obtain 60 steel kinds as total by request of domestic consumers. Chemical compositions and mechanical properties are additively stated.

b) Steel kind names of SUS317J4L and SUS317J5L are respectively changed to SUS836L and SUS890L.

c) **Mechanical properties** The standard for the reduction of area of flat bars is eliminated conforming to the quality specification of flat products of **JIS** and International Standard.

d) **Dimensional tolerance on hot rolled product** Dimensional tolerances of round bars, square bars, hexagonal bars and flat bars are conformed to **ISO 1035**.

e) **Dimensional tolerances on cut materials of round bars** Are newly established by request of domestic consumers.

f) **Manufacturing method** The manufacturing method is separated into items of manufacturing method and heat treatment, and temperature on the like of heat treatment is stated in Annex as informative reference.

1 Scope This Japanese Industrial Standard specifics the hot-finished stainless steel bars (round bars, square bars, hexagonal bars and flat bars hereafter generically referred to as "bars") .

2 Normative references The following standards contain provisions which, through reference in this Standard, constitute provisions of this Standard. The most recent editions of the standards indicated below shall be applied.

3 Grades and symbols Bars shall be classified into 60 grades, and the symbols and classification thereof shall be a given in Table 1.

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Table 1 Symbol of grade and classification

Symbol of grade	Classification	Symbol of grade	Classification
SUS201	Austenitic series	SUS329J1	Austenitic-ferritic series
SUS202		SUS329J3L	
SUS301		SUS329J4L	
SUS302		SUS405	Ferritic series
SUS303		SUS410L	
SUS303Se		SUS430	
SUS303Cu		SUS430F	
SUS304		SUS434	
SUS304L		SUS447J1	
SUS304N1		SUSXM27	
SUS304N2		SUS403	Martensitic series
SUS304LN		SUS410	
SUS304J3		SUS410J1	
SUS305		SUS410F2	
SUS309S		SUS416	
SUS310S		SUS420J1	
SUS316		SUS420J2	
SUS316L		SUS420F	
SUS316N		SUS420F2	
SUS316LN		SUS431	
SUS316Ti		SUS440A	
SUS316J1		SUS440B	
SUS316J1L		SUS440C	
SUS316F		SUS440F	
SUS317		SUS630	Precipitation hardening series
SUS317L		SUS631	
SUS317LN			
SUS317J1			
SUS836L			
SUS890L			
SUS321			
SUS347			
SUSXM7			
SUSXM15J1			

Remarks: When it is necessary to indicate with a symbol that the products are bars, the letter –B shall be suffixed to the symbol of grade.

Example: SUS304–B

4 Chemical composition

4.1 Ladle analysis value Bars shall be tested in accordance with **11.1** and the ladle analysis value thereof shall conform to Tables 2 to 6.

4.2 Product analysis value Bars shall be subjected, when required by the purchaser, to the product analysis test specified in **11.1** and the values of permissible variations in Table 4 of **JIS G 0321** shall be applied. However, the values of elements and chemical components not specified in this table shall be as agreed upon between the parties concerned with delivery.

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Table 2 Chemical composition of austenitic bars

Unit: %

Symbol of grade	C	Si	Mn	P	S	Ni	Cr	Mo	Cu	N		Symbol of grade
SUS201	0.15 max.	1.00 max.	5.50 to 7.50	0.060 max.	0.030 max.	3.50 to 5.50	16.00 to 18.00	–	–	0.25 max.	–	SUS201
SUS202	0.15 max.	1.00 max.	7.50 to 10.00	0.060 max.	0.030 max.	4.00 to 6.00	17.00 to 19.00	–	–	0.25 max.	–	SUS202
SUS301	0.15 max.	1.00 max.	2.00 max.	0.045 max.	0.030 max.	6.00 to 8.00	16.00 to 18.00	–	–	–	–	SUS301
SUS302	0.15 max.	1.00 max.	2.00 max.	0.045 max.	0.030 max.	8.00 to 10.00	17.00 to 19.00	–	–	–	–	SUS302
SUS303	0.15 max.	1.00 max.	2.00 max.	0.20 max.	0.15 min.	8.00 to 10.00	17.00 to 19.00	(1)	–	–	–	SUS303
SUS303Se	0.15 max.	1.00 max.	2.00 max.	0.20 max.	0.060 max.	8.00 to 10.00	17.00 to 19.00	–	–	–	Se 0.15 min.	SUS303Se
SUS303Cu	0.15 max.	1.00 max.	3.00 max.	0.20 max.	0.15 min.	8.00 to 10.00	17.00 to 19.00	(1)	1.50 to 3.50	–	–	SUS303Cu
SUS304	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	–	–	–	–	SUS304
SUS304L	0.030 max.	1.00 max.	2.00 max.	0.045 max.	0.030 max.	9.00 to 13.00	18.00 to 20.00	–	–	–	–	SUS304L
SUS304N1	0.08 max.	1.00 max.	2.50 max.	0.045 max.	0.030 max.	7.00 to 10.50	18.00 to 20.00	–	–	0.10 to 0.25	–	SUS304N1
SUS304N2	0.08 max.	1.00 max.	2.50 max.	0.045 max.	0.030 max.	7.50 to 10.50	18.00 to 20.00	–	–	0.15 to 0.30	Nb 0.15 max.	SUS304N2
SUS304LN	0.030 max.	1.00 max.	2.00 max.	0.045 max.	0.030 max.	8.50 to 11.50	17.00 to 19.00	–	–	0.12 to 0.22	–	SUS304LN
SUS304J3	0.08 max.	1.00 max.	2.00 max.	0.045 max.	0.030 max.	8.00 to 10.50	17.00 to 19.00	–	1.00 to 3.00	–	–	SUS304J3
SUS305	0.12 max.	1.00 max.	2.00 max.	0.045 max.	0.030 max.	10.50 to 13.00	17.00 to 19.00	–	–	–	–	SUS305
SUS309S	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	–	–	–	–	SUS309S
SUS310S	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	–	–	–	–	SUS310S
SUS316	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	–	–	–	SUS316
SUS316L	0.030 max.	1.00 max.	2.00 max.	0.045 max.	0.030 max.	12.00 to 15.00	16.00 to 18.00	2.00 to 3.00	–	–	–	SUS316L
SUS316N	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	–	0.10 to 0.22	–	SUS316N
SUS316LN	0.030 max.	1.00 max.	2.00 max.	0.045 max.	0.030 max.	10.50 to 14.50	16.50 to 18.50	2.00 to 3.00	–	0.12 to 0.22	–	SUS316LN
SUS316Ti	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.	SUS316Ti
SUS316J1	0.08 max.	1.00 max.	2.00 max.	0.045 max.	0.030 max.	10.00 to 14.00	17.00 to 19.00	1.20 to 2.75	1.00 to 2.50	–	–	SUS316J1
SUS316J1L	0.030 max.	1.00 max.	2.00 max.	0.045 max.	0.030 max.	12.00 to 16.00	17.00 to 19.00	1.20 to 2.75	1.00 to 2.50	–	–	SUS316J1L
SUS316F	0.08 max.	1.00 max.	2.00 max.	0.045 max.	0.10 min.	10.00 to 14.00	16.00 to 18.00	2.00 to 3.00	–	–	–	SUS316F
SUS317	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	–	–	–	SUS317
SUS317L	0.030 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	–	–	–	SUS317L
SUS317LN	0.030 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	–	0.10 to 0.22	–	SUS317LN
SUS317J1	0.040 max.	1.00 max.	2.50 max.	0.045 max.	0.030 max.	15.00 to 17.00	16.00 to 19.00	4.00 to 6.00	–	–	–	SUS317J1
SUS836L	0.030 max.	1.00 max.	2.00 max.	0.045 max.	0.030 max.	24.00 to 26.00	19.00 to 24.00	5.00 to 7.00	–	0.25 max.	–	SUS836L
SUS890L	0.020 max.	1.00 max.	2.00 max.	0.045 max.	0.030 max.	23.00 to 28.00	19.00 to 23.00	4.00 to 5.00	1.00 to 2.00	–	–	SUS890L
SUS321	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.	SUS321
SUS347	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.	SUS347
SUSXM7	0.08 max.	1.00 max.	2.00 max.	0.045 max.	0.030 max.	8.50 to 10.50	17.00 to 19.00	–	3.00 to 4.00	–	–	SUSXM7
SUSXM15J1	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	–	–	–	–	SUSXM15J1

Note (1) 0.60 % max. of Mo may be added.

Remarks: Alloying elements other than those given in Table 2 may be added to SUSXM15J1 as required.

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Table 3 Chemical composition of austenitic-ferritic bars

Unit: %

Symbol of grade	C	Si	Mn	P	S	Ni	Cr	Mo	N
SUS329J1	0.08 max.	1.00 max.	1.50 max.	0.040 max.	0.030 max.	3.00 to 6.00	23.00 to 28.00	1.00 to 3.00	—
SUS329J3L	0.030 max.	1.00 max.	2.00 max.	0.040 max.	0.030 max.	4.50 to 6.50	21.00 to 24.00	2.50 to 3.50	0.08 to 0.20
SUS329J4L	0.030 max.	1.00 max.	1.50 max.	0.040 max.	0.030 max.	5.50 to 7.50	24.00 to 26.00	2.50 to 3.50	0.08 to 0.30

Remarks: Alloying element other than those given in Table 3 may be added as required.

Table 4 Chemical composition of ferritic bars

Unit: %

Symbol of grade	C	Si	Mn	P	S	Cr	Mo	N	Al
SUS405	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	0.030 max.	1.00 max.	1.00 max.	0.040 max.	0.030 max.	11.00 to 13.50	—	—	—
SUS430	0.12 max.	0.75 max.	1.00 max.	0.040 max.	0.030 max.	16.00 to 18.00	—	—	—
SUS430F	0.12 max.	1.00 max.	1.25 max.	0.060 max.	0.15 min.	16.00 to 18.00	(1)	—	—
SUS434	0.12 max.	1.00 max.	1.00 max.	0.040 max.	0.030 max.	16.00 to 18.00	0.75 to 1.25	—	—
SUS447J1	0.010 max.	0.40 max.	0.40 max.	0.030 max.	0.020 max.	28.50 to 32.00	1.50 to 2.50	0.015 max.	—
SUSXM27	0.010 max.	0.40 max.	0.40 max.	0.030 max.	0.020 max.	25.00 to 27.50	0.75 to 1.50	0.015 max.	—

Note (1) 0.60 % max. of Mo may be added.

Remarks 1 Ferritic bars other than SUS447J1 and SUSXM27 may contain 0.60 % max. of Ni.

2 SUS447J1 and SUSXM27 may contain 0.50 % max. of Ni, 0.20 % max. of Cu, and 0.50 % max. of Ni+Cu.

Further, alloying elements other than those given in Table 4 may be added as required.

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Table 5 Chemical composition of martensitic bars

Unit: %

Symbol of grade	C	Si	Mn	P	S	Ni	Cr	Mo	Pb
SUS403	0.15 max.	0.50 max.	1.00 max.	0.040 max.	0.030 max.	(2)	11.50 to13.00	–	–
SUS410	0.15 max.	1.00 max.	1.00 max.	0.040 max.	0.030 max.	(2)	11.50 to13.50	–	–
SUS410J1	0.08 to 0.18	0.60 max.	1.00 max.	0.040 max.	0.030 max.	(2)	11.50 to14.00	0.30 to0.60	–
SUS410F2	0.15 max.	1.00 max.	1.00 max.	0.040 max.	0.030 max.	(2)	11.50 to13.50	–	0.05 to 0.30
SUS416	0.15 max.	1.00 max.	1.25 max.	0.060 max.	0.15 min.	(2)	12.00 to14.00	(1)	–
SUS420J1	0.16 to 0.25	1.00 max.	1.00 max.	0.040 max.	0.030 max.	(2)	12.00 to14.00	–	–
SUS420J2	0.26 to 0.40	1.00 max.	1.00 max.	0.040 max.	0.030 max.	(2)	12.00 to14.00	–	–
SUS420F	0.26 to 0.40	1.00 max.	1.25 max.	0.060 max.	0.15 min	(2)	12.00 to14.00	(1)	–
SUS420F2	0.26 to 0.40	1.00 max.	1.00 max.	0.040 max.	0.030 max.	(2)	12.00 to14.00	–	0.05 to 0.30
SUS431	0.20 max.	1.00 max.	1.00 max.	0.040 max.	0.030 max.	1.25 to 2.50	15.00 to17.00	–	–
SUS440A	0.60 to 0.75	1.00 max.	1.00 max.	0.040 max.	0.030 max.	(2)	16.00 to18.00	(3)	–
SUS440B	0.75 to 0.95	1.00 max.	1.00 max.	0.040 max.	0.030 max.	(2)	16.00 to18.00	(3)	–
SUS440C	0.95 to 1.20	1.00 max.	1.00 max.	0.040 max.	0.030 max.	(2)	16.00 to18.00	(3)	–
SUS440F	0.95 to 1.20	1.00 max.	1.25 max.	0.060 max.	0.15 min.	(2)	16.00 to18.00	(3)	–

Notes (1) 0.60 % max. of Mo may be added.
(2) 0.60 % max. of Ni may be contained.
(3) 0.75 % max. of Mo may be added.

Table 6 Chemical composition of precipitation hardening bars

Unit: %

Symbol of grade	C	Si	Mn	P	S	Ni	Cr	Cu	Others
SUS630	0.07 max.	1.00 max.	1.00 max.	0.040 max.	0.030 max.	3.00 to5.00	15.00 to17.50	3.00 to5.00	Nb 0.15 to0.45
SUS631	0.09 max.	1.00 max.	1.00 max.	0.040 max.	0.030 max.	6.50 to7.75	16.00 to18.00	–	Al 0.75 to1.50

5 Mechanical properties Bars shall be tested in accordance with **11.2** and the mechanical properties shall be as follows.

5.1 Mechanical properties of austenitic bars The proof stress, tensile strength, elongation, reduction of area and hardness of austenitic bars solution-treated shall be as specified in Table 7. In that case, the test specimen shall be prepared according to class A specified in **JIS G 0303**. The proof stress, however, shall be applied only when specified by the purchaser.

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Table 7 Mechanical properties of solution-treated condition (Austenitic bars)

Symbol of grade	Proof stress N/mm²	Tensile strength N/mm²	Elongation %	Reduction of area (4) %	Hardness		
					HB	HRB	HV
SUS201	275 min.	520 min.	40 min.	45 min.	241 max.	100 max.	253 max.
SUS202	275 min.	520 min.	40 min.	45 min.	207 max.	95 max.	218 max.
SUS301	205 min.	520 min.	40 min.	60 min.	207 max.	95 max.	218 max.
SUS302	205 min.	520 min.	40 min.	60 min.	187 max.	90 max.	200 max.
SUS303	205 min.	520 min.	40 min.	50 min.	187 max.	90 max.	200 max.
SUS303Se	205 min.	520 min.	40 min.	50 min.	187 max.	90 max.	200 max.
SUS303Cu	205 min.	520 min.	40 min.	50 min.	187 max.	90 max.	200 max.
SUS304	205 min.	520 min.	40 min.	60 min.	187 max.	90 max.	200 max.
SUS304L	175 min.	480 min.	40 min.	60 min.	187 max.	90 max.	200 max.
SUS304N1	275 min.	550 min.	35 min.	50 min.	217 max.	95 max.	220 max.
SUS304N2	345 min.	690 min.	35 min.	50 min.	250 max.	100 max.	260 max.
SUS304LN	245 min.	550 min.	40 min.	50 min.	217 max.	95 max.	220 max.
SUS304J3	175 min.	480 min.	40 min.	60 min.	187 max.	90 max.	200 max.
SUS305	175 min.	480 min.	40 min.	60 min.	187 max.	90 max.	200 max.
SUS309S	205 min.	520 min.	40 min.	60 min.	187 max.	90 max.	200 max.
SUS310S	205 min.	520 min.	40 min.	50 min.	187 max.	90 max.	200 max.
SUS316	205 min.	520 min.	40 min.	60 min.	187 max.	90 max.	200 max.
SUS316L	175 min.	480 min.	40 min.	60 min.	187 max.	90 max.	200 max.
SUS316N	275 min.	550 min.	35 min.	50 min.	217 max.	95 max.	220 max.
SUS316LN	245 min.	550 min.	40 min.	50 min.	217 max.	95 max.	220 max.
SUS316Ti	205 min.	520 min.	40 min.	50 min.	187 max.	90 max.	200 max.
SUS316J1	205 min.	520 min.	40 min.	60 min.	187 max.	90 max.	200 max.
SUS316J1L	175 min.	480 min.	40 min.	60 min.	187 max.	90 max.	200 max.
SUS316F	205 min.	520 min.	40 min.	50 min.	187 max.	90 max.	200 max.
SUS317	205 min.	520 min.	40 min.	60 min.	187 max.	90 max.	200 max.
SUS317L	175 min.	480 min.	40 min.	60 min.	187 max.	90 max.	200 max.
SUS317LN	245 min.	550 min.	40 min.	50 min.	217 max.	95 max.	220 max.
SUS317J1	175 min.	480 min.	40 min.	45 min.	187 max.	90 max.	200 max.
SUS836L	205 min.	520 min.	35 min.	40 min.	217 max.	96 max.	230 max.
SUS890L	215 min.	490 min.	35 min.	40 min.	187 max.	90 max.	200 max.
SUS321	205 min.	520 min.	40 min.	50 min.	187 max.	90 max.	200 max.
SUS347	205 min.	520 min.	40 min.	50 min.	187 max.	90 max.	200 max.
SUSXM7	175 min.	480 min.	40 min.	60 min.	187 max.	90 max.	200 max.
SUSXM15J1	205 min.	520 min.	40 min.	60 min.	207 max.	95 max.	218 max.

Note (4) The reduction of area is not applied to flat bars. When specified by the purchaser, it shall be as agreed upon between the purchaser and the supplier.

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Remarks: The values specified in Table 7 shall be applied to bars of 180 mm or under in diameter, side length, width across flat, or thickness. The values exceeding 180 mm shall be as agreed upon between the parties concerned with delivery.

5.2 Mechanical properties of austenitic ferritic bars The proof stress, tensile strength, elongation, reduction of area and hardness of austenitic ferritic bars solution-treated shall be as specified in Table 8. In that case, the test specimen shall be prepared according to class A specified in **JIS G 0303**. However, the proof stress shall be applied only when specified by the purchaser.

Table 8 Mechanical properties of solution-treated condition (Austenitic-ferritic bars)

Symbol of grade	Proof stress N/mm²	Tensile strength N/mm²	Elongation %	Reduction of area (5) %	Hardness		
					HB	HRC	HV
SUS329J1	390 min.	590 min.	18 min.	40 min.	277 max.	29 max.	292 max.
SUS329J3L	450 min.	620 min.	18 min.	40 min.	302 max.	32 max.	320 max.
SUS329J4L	450 min.	620 min.	18 min.	40 min.	302 max.	32 max.	320 max.

Note (5) The reduction of area is not applied to flat bars. When specified by the purchaser, it shall be as agreed upon between the purchaser and the supplier.

Remarks: The values specified in Table 8 shall be applied to bars of 75 mm or under in diameter, side length, width across flat, or thickness. The values exceeding 75 mm shall be as agreed upon between the parties concerned with delivery.

5.3 Mechanical properties of ferritic bars The proof stress, tensile strength, elongation, reduction of area, impact value, and hardness of ferritic bars annealed shall be as specified in Table 9. In that case, the test specimen shall be prepared according to class A specified in **JIS G 0303**. However, the proof stress shall be applied only when specified by the purchaser.

Table 9 Mechanical properties in annealed condition (Ferritic bars)

Symbol of grade	Proof stress N/mm²	Tensile strength N/mm²	Elongation %	Reduction of area (6) %	Charpy impact value J/cm²	Hardness HB
SUS405	175 min.	410 min.	20 min.	60 min.	98 min.	183 max.
SUS410L	195 min.	360 min.	22 min.	60 min.	–	183 max.
SUS430	205 min.	450 min.	22 min.	50 min.	–	183 max.
SUS430F	205 min.	450 min.	22 min.	50 min.	–	183 max.
SUS434	205 min.	450 min.	22 min.	60 min.	–	183 max.
SUS447J1	295 min.	450 min.	20 min.	45 min.	–	228 max.
SUSXM27	245 min.	410 min.	20 min.	45 min.	–	219 max.

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Note (6) The reduction of area is not applied to flat bars. When specified by the purchaser, it shall be as agreed upon between the purchaser and the supplier.

Remarks 1 The values specified in Table 9 shall be applied to bars of 75 mm or under in diameter, side length, width across flat, or thickness. The values for bars of over 75 mm shall be as agreed upon between the parties concerned with delivery.

2 The Charpy impact values shall be applied to bars of dimensions capable of sampling No. 3 test piece specified in **JIS Z 2202**. In the case where No. 3 test piece can not be obtainable, the test piece and impact value to be applied may be as agreed upon between the parties concerned with delivery.

5.4 Mechanical properties of martensitic bars The mechanical properties of martensitic bars shall be as follows.

a) The proof stress, tensile strength, elongation, reduction of area, impact value, and hardness of quenched and tempered bars themselves or of their test pieces similarly treated shall be as specified in Table 10. In that case, specimen shall be prepared according to class A specified in **JIS G 0303**.

b) As for bars as rolled or as forged, and annealed, the mechanical properties of the test specimen of class B in **JIS G 0303** quenched and tempered, shall conform to Table 10.

c) The hardness of annealed bars themselves shall conform to Table 11. The hardness of bars annealed at the temperature of approx. 750 °C shall be as agreed upon between the parties concerned with delivery.

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Table 10 Mechanical properties in quenched and tempered condition (Martensitic bars)

Symbol of grade	Proof stress N/mm²	Tensile strength N/mm²	Elongation %	Reduction of area (7) %	Charpy impact J/cm²	Hardness	
						HB	HRC
SUS403	390 min.	590 min.	25 min.	55 min.	147 min.	170 min.	—
SUS410	345 min.	540 min.	25 min.	55 min.	98 min.	159 min.	—
SUS410J1	490 min.	690 min.	20 min.	60 min.	98 min.	192 min.	—
SUS410F2	345 min.	540 min.	18 min.	50 min.	98 min.	159 min.	—
SUS416	345 min.	540 min.	17 min.	45 min.	69 min.	159 min.	—
SUS420J1	440 min.	640 min.	20 min.	50 min.	78 min.	192 min.	—
SUS420J2	540 min.	740 min.	12 min.	40 min.	29 min.	217 min.	—
SUS420F	540 min.	740 min.	8 min.	35 min.	29 min.	217 min.	—
SUS420F2	540 min.	740 min.	5 min.	35 min.	29 min.	217 min.	—
SUS431	590 min.	780 min.	15 min.	40 min.	39 min.	229 min.	—
SUS440A	—	—	—	—	—	—	54 min.
SUS440B	—	—	—	—	—	—	56 min.
SUS440C	—	—	—	—	—	—	58 min.
SUS440F	—	—	—	—	—	—	58 min.

Note (7) The reduction of area is not applied to flat bars. When specified by the purchaser, it shall be as agreed upon between the purchaser and the supplier.

Remarks 1 The values specified in Table 10 shall be applied to bars of 75 mm or under in diameter, side length, width across flat, or thickness. Values for bars of over 75 mm shall be as agreed upon between the parties concerned with delivery.

2 The Charpy impact value shall be applied to a bar of a size capable of sampling No. 3 test piece specified in **JIS Z 2202**. In the case where No. 3 test piece can not be obtainable, the test piece and impact value to be applied may be as agreed upon between the parties concerned with delivery.

Table 11 Hardness in annealed condition (Martensitic bars)

Symbol of grade	Hardness HB	Symbol of grade	Hardness HB
SUS403	200 max.	SUS420F	235 min.
SUS410	200 max.	SUS420F2	235 min.
SUS410J1	200 max.	SUS431	302 max.
SUS410F2	200 max.	SUS440A	255 min.
SUS416	200 max.	SUS440B	255 max.
SUS420J1	223 max.	SUS440C	269 min.
SUS420J2	235 max.	SUS440F	269 max.

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5.5 Mechanical properties of precipitation hardening bars The proof stress, tensile strength, elongation, reduction of area and hardness of bars processed by solution treatment and those of bars or test pieces processed by precipitation hardening by designation of the purchaser shall be as given in Table 12. In that case, the test specimen shall be prepared according to class A specified in **JIS G 0303**. However, the proof stress shall be applied only when particularly designated by the purchaser.

Table 12 Mechanical properties of precipitation hardening bars

Symbol of grade	Symbol of heat treatment	Proof stress N/mm²	Tensile strength N/mm²	Elongation %	Reduction of area (8) %	Hardness	
						HBS or HBW	HRC
SUS630	S	–	–	–	–	363 max.	38 max.
	H900	1 175 min.	1 310 min.	10 min.	40 min.	375 min.	40 min.
	H1025	1 000 min.	1 070 min.	12 min.	45 min.	331 min.	35 min.
	H1075	860 min.	1 000 min.	13 min.	45 min.	302 min.	31 min.
	H1150	725 min.	930 min.	16 min.	50 min.	277 min.	28 min.
SUS631	S	380 max.	1 030 max	20 min.	–	229 max.	–
	RH950	1 030 min.	1 230 min.	4 min.	10 min.	388 min.	–
	TH1050	960 min.	1 140 min.	5 min.	25 min.	363 min.	–

Note (8) The reduction of area is not applied to flat bars. When requested by the purchaser, it shall be as agreed upon between the purchaser and the supplier.

Remarks 1 The values specified in Table 12 shall be applied to bars of 75 mm or under in diameter, side length, width across flat, or thickness. The values for bars of over 75 mm shall be as agreed upon between the parties concerned with delivery.

2 Mechanical properties of SUS630 heat treated by other methods than those given in Annex Table 5 may be as agreed upon between the parties concerned with delivery.

6 Corrosion resistance When the corrosion resistance by an intergranular corrosion test is particularly designated by the purchaser, a test method to be applied shall be selected from the test methods of **11.3** as agreed upon between the parties concerned with delivery. When the test is performed, the obtained corrosion resistance shall be as follows.

6.1 10% oxalic acid etching test The discrimination of the etched structure obtained by a 10 % oxalic acid etching test shall be as specified in Table 13.

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Table 13 Discrimination by 10 % oxalic acid etching test

Symbol of grade	Condition	Structure to which ferric sulfate-sulfuric acid corrosion test is applied	Structure to which 65 % nitric acid corrosion test is applied	Structure to which nitric-hydrofluoric acid corrosion test is applied	Structure to which copper sulfate-sulfuric acid corrosion test is applied
SUS304	As received (Solution-treated)	Ditch structure	Ditch structure Pit structure II	–	Ditch structure
SUS316 SUS316J1 SUS317			–	Ditch structure	
SUS304L	Sensitized	Ditch structure	Ditch structure Pit structure	–	Ditch structure
SUS316L SUS316J1L SUS317L			–	Ditch structure	
SUS321 SUS347		–		–	

6.2 Ferric sulfate-sulfuric acid corrosion test The corrosion rate by a ferric sulfate-sulfuric acid corrosion test shall be as specified in Table 14.

Table 14 Corrosion rate of ferric sulfate-sulfuric acid corrosion test

Symbol of grade	Condition	Corrosion rate g/m²·h
SUS304 SUS316 SUS316J1 SUS317	As received (Solution-treated)	To by as agreed upon between the parties concerned with delivery.
SUS304L SUS316L SUS316J1L SUS317L	Sensitized	To by as agreed upon between the parties concerned with delivery.

6.3 65 % nitric acid corrosion test The corrosion rate by a 65 % nitric acid corrosion test shall be as specified in Table 15.

Table 15 Corrosion rate of 65 % nitric acid corrosion test

Symbol of grade	Condition	Corrosion rate g/m²·h
SUS304	As received (Solution-treated)	To by as agreed upon between the parties concerned with delivery.
SUS304L	Sensitized	To by as agreed upon between the parties concerned with delivery.

6.4 Nitric-hydrofluoric acid corrosion test The corrosion ratio by a nitric-hydrofluoric acid corrosion test shall be as specified in Table 16.

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Table 16 Corrosion ration of nitric-hydrofluoric acid corrosion test

Symbol of grade	Corrosion ratio
SUS316 SUS316J1 SUS317	1.5 max.
SUS316L SUS316J1L SUS317L	1.5 max.

6.5 Copper sulfate-sulfuric acid corrosion test The conditions of bent surface by a copper sulfate-sulfuric acid corrosion test shall be as specified in Table 17.

Table 17 Condition of bent surface by copper sulfate-sulfuric acid corrosion test

Symbol of grade	Condition	Condition of bent surface
SUS304 SUS316 SUS316J1 SUS317	As received (Solution-treated)	To be free from intergranular corrosion cracks.
SUS304L SUS316L SUS316J1L SUS317L SUS321 SUS347	Sensitized	To be free from intergranular corrosion cracks.

7 Shape, dimensions and tolerances The shapes, dimensions, and tolerances shall be as follows.

7.1 The standard dimensions of hot rolled round bars and hexagonal bars shall be as specified in Table 18.

Table 18 Standard dimensions

Unit: mm

Diameter of round bar					Width across flat of hexagonal bar	
9	19	35	55	120	12	30
10	20	36	60	130	14	32
11	22	38	65	140	17	35
12	24	40	70	150	19	38
13	25	42	75	160	21	41
14	26	44	80	170	23	46
15	28	45	85	180	24	
16	30	46	90	190	26	
17	32	48	100	200	27	
18	34	50	110		29	

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7.2 The tolerance and permissible ovality or deviation in diameter, side length, or width across flat of hot rolled round, square and hexagonal bars shall be as specified in Table 19.

Table 19 Tolerance and permissible ovality or deviation of hot rolled round, square, and hexagonal bars

Unit: mm

Diameter, side length, or width across flat	Dimensional tolerance	Permissible ovality or deviation (9)
15 or under	±0.3	75 % or under of the full range of tolerances
Over 15 up to and incl. 25	±0.4	
Over 25 up to and incl. 35	±0.5	
Over 35 up to and incl. 50	±0.6	
Over 50 up to and incl. 80	±0.8	
Over 80 up to and incl. 100	±1.0	
Over 100 up to and incl. 120	±1.3	
Over 120 up to and incl. 160	±1.6	
Over 160 up to and incl. 200	±2.0	
Over 200	±1.2 %	

Note (9) The permissible ovality or deviation is expressed by the difference between the maximum value and the minimum value of the diameter, side length, or width across flat on the same section.

7.3 Tolerances on the thickness and width of hot rolled flat bars shall be as specified in Table 20 and Table 21.

Table 20 Thickness tolerances of flat bars

Unit: mm

Thickness	Thickness tolerances by width classification	
	50 or under width	Over 50 up to and incl. 150
20 or under	±0.4	±0.5
Over 20 up to and incl. 40	±0.8	±1.0
Over 40	–	±1.5

Remarks: Thickness tolerances of flat bars of over 150 mm width shall be as agreed upon between the purchaser and the supplier.

Table 21 Width tolerances of flat bars

Unit: mm

Division of width	Width tolerance
50 or under	±0.8
Over 50 up to and incl. 75	±1.2
Over 75 up to and incl. 100	±1.5
Over100 up to and incl. 125	±2.0
Over125 up to and incl. 150	±2.5

Remarks: Width tolerances of flat bars of over 150 mm width shall be as agreed upon between the purchaser and the supplier.

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7.4 Tolerance on the length of a bar shall be as specified in Table 22.

Table 22 Tolerance on length

Unit: mm

Length	Tolerance on length
7 000 max.	+40 0
Over 7 000	To add 5 to plus side tolerance above-mentioned for increase of every 1 000 or its fraction in length.

7.5 The tolerance on the bend of a bar shall be not more than 3 mm for every 1 m and shall be not more than 3 mm $\times \frac{\text{length (m)}}{1\text{ m}}$ for full length.

7.6 The dimensional tolerances of forged bars shall be as agreed upon between the parties concerned with delivery.

7.7 The dimensional tolerances of round bars shall be as given in Table 23.

Table 23 Dimensional tolerances of cutting material of round bars

Unit: mm

Dimension	Dimensional tolerance
Over 15 up to and incl. 25	+0.15/0
Over 25 up to and incl. 80	+0.25/0
Over 80 up to and incl. 125	+0.50/0
Over 125 up to and incl. 150	+1.0 /0
Over 150 up to and incl. 400	+2.0 /0

Remarks: Values in the cases of 15 mm or under and over 400 mm in dimension, shall be as agreed upon between the purchaser and the supplier.

8 Appearance The bars shall be excellently finished, and free from defects such as flaws, cracks, etc. harmful to ordinary use.

9 Manufacturing method Excepting cases where there is an agreement between the purchaser and the supplier in contract, the manufacturer shall manufacture the product by a suitable manufacturing method so as to conform to required quality. When requested by the purchaser, the manufacturer shall report the manufacturing method.

10 Heat treatment For the heat treatment of bars in delivery, excepting cases where the heat treatment is agreed upon between the supplier and the purchaser, the manufacturer shall select heat-treating conditions so as to conform to quality specified in Tables 7 to 17. Representative heat-treating conditions shall be as given in Annex Tables 1 to 5.

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The skin generated by heat treatment, when necessary, are removed by a suitable method such as pickling, cutting, etc.

Symbols expressing heat treating methods are given in Attached Table 2.

11 Tests

11.1 Chemical analysis The chemical analysis shall be as follows.

a) General matters of chemical analysis and method of sampling specimens for the ladle analysis shall be in accordance with **3** in **JIS G 0303**.

b) The method of sampling specimens for the product analysis shall be in accordance with **3** in **JIS G 0321**. The test piece fractured in the tensile test may be reused as a test specimen.

c) The analytical method shall be in accordance with any one of the following Standards:

JIS G 1211, JIS G 1212, JIS G 1213, JIS G 1214,
JIS G 1215, JIS G 1216, JIS G 1217, JIS G 1218,
JIS G 1219, JIS G 1223, JIS G 1224, JIS G 1228,
JIS G 1233, JIS G 1237, JIS G 1253, JIS G 1256,
JIS G 1257

11.2 Mechanical test

11.2.1 General matters General matters of the mechanical test shall be in accordance with **4** in **JIS G 0303**.

11.2.2 Sampling of specimens Take one specimen from each lot of the same ladle and the same heat treatment.

11.2.3 Number of test pieces Take one test piece from each specimen.

11.2.4 Test pieces The test pieces for tensile test, impact test, and hardness test shall be as follows.

a) For the tensile test piece, any one of No. 10, No. 13B, No. 14A, or No. 14B test piece specified in **JIS Z 2201** shall be used.

Further, either of No. 4 or No. 5 test piece may be used.

b) For the impact test piece, No. 3 test piece specified in **JIS Z 2202** shall be used. However, in the case where No. 3 test piece can not be sampled, the dimensions and shape of a test piece to be applied may be agreed upon between the parties concerned with delivery.

c) For the hardness test piece, a part of the tensile test piece may be used.

11.2.5 Test methods The methods for tensile test, impact test, and hardness test shall be as follows.

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a) The tensile test method shall be in accordance with **JIS Z 2241**. However, the standard test temperature shall be 23°C ±5°C, and for measuring tensile strength, the tensile speed shall be so arranged that the increasing rate of strain at the parallel part of the test piece maintains in the range of 40 % to 80 % per min.

b) The impact test method shall be in accordance with **JIS Z 2242**. However, the test temperature shall be 23°C ±2°C.

c) The hardness test method shall be in accordance with any one of the following Standards. However, the standard test temperature shall be 23°C ±5°C.

JIS Z 2243, **JIS Z 2244**, **JIS Z 2245**

11.3 Corrosion test

11.3.1 Sampling of specimens Take one specimen from each lot of the same ladle and the same heat treatment.

11.3.2 Number of test pieces Take one test pieces from each specimen.

11.3.3 Test method The test method shall be in accordance with any one of the following standards:

JIS G 0571, **JIS G 0572**, **JIS G 0573**, **JIS G 0574**, **JIS G 0575**

12 Inspection The inspection of a bar shall be as follows.

a) General matters for inspection shall be in accordance with **JIS G 0303**.

b) The chemical composition shall conform to the requirements specified in **4**.

c) The mechanical properties shall conform to the requirements specified in **5**. However, a part or all of the tensile test, import test, and hardness test may be omitted as agreed upon between the parties concerned with delivery.

d) The corrosion resistance shall conform to the requirements specified in **6**.

e) The shape and dimensions shall conform to the requirements specified in **7**.

f) The appearance shall conform to the requirements specified in **8**.

13 Making Each bar having passed the inspection shall be marked with the following items. However, bars of 30 mm or smaller in diameter, side length, width across flat, or thickness may be bundled together and marked for each bundle.

Further, a part of the items may be omitted as agreed upon between the parties concerned with delivery:

a) Symbol of grade

b) Dimensions

c) Symbols of heat treatment (for martensitic and precipitation hardening bars)(10)

d) Manufacturer's name or its abbreviation

e) Ladle number or inspection number

Note (10) The symbols of heat treatment shall be suffixed to the symbol of grade.

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14 Report When requested by the purchaser, the manufacturer shall submit a report of bars stating the results of the tests specified or designated and, as required, the dimensions, quantity, and delivery condition or the like.

Attached Table 1 Applicable Standards

JIS G 0303	*General rules for inspection of steel*
JIS G 0321	*Product analysis and its tolerance for wrought steel*
JIS G 0571	*Method of 10 per cent oxalic acid etch test for stainless steels*
JIS G 0572	*Method of ferric sulfate-sulfuric acid test for stainless steels*
JIS G 0573	*Method of 65 per cent nitric acid test for stainless steels*
JIS G 0574	*Method of nitric-hydrofluoric acid test for stainless steels*
JIS G 0575	*Method of copper sulfate-sulfuric acid test for stainless steels*
JIS G 1211	*Iron and steel — Methods for determination of carbon content*
JIS G 1212	*Methods for determination of silicon in iron and steel*
JIS G 1213	*Methods for determination of manganese in iron and steel*
JIS G 1214	*Methods for determination of phosphorus in iron and steel*
JIS G 1215	*Iron and steel — Methods for determination of sulfur content*
JIS G 1216	*Methods for determination of nickel in iron and steel*
JIS G 1217	*Methods for determination of chromium in iron and steel*
JIS G 1218	*Iron and steel — Methods for determination of molybdenum content*
JIS G 1219	*Methods for determination of copper in iron and steel*
JIS G 1223	*Methods for determination of titanium in iron and steel*
JIS G 1224	*Methods for determination of aluminium in iron and steel*
JIS G 1228	*Iron and steel — Methods for determination of nitrogen content*
JIS G 1233	*Steel — Method for determination of selenium content*
JIS G 1237	*Methods for determination of niobium in steel*
JIS G 1253	*Iron and steel — Method for spark discharge atomic emission spectrometric analysis*
JIS G 1256	*Method for X-ray fluorescence spectrometric analysis of iron and steel*
JIS G 1257	*Iron and steel — Methods for atomic absorption spectrometric analysis*
JIS Z 2201	*Test pieces for tensile test for metallic materials*
JIS Z 2202	*Test pieces for impact test for metallic materials*
JIS Z 2241	*Method of tensile test for metallic materials*
JIS Z 2242	*Method of impact test for metallic materials*
JIS Z 2243	*Method of Brinell hardness test*
JIS Z 2244	*Method of Vickers hardness test*
JIS Z 2245	*Method of Rockwell and Rockwell superficial hardness test*

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Attached Table 2 Symbols for heat treatments

Heat treatment method	Symbol
Annealing	A
Quenching and tempering	Q
Solution treatment	S
Precipitation hardening treatment	As specified in Annex Table 5.

Remarks: The heat treatment symbol can be separately determined as agreed upon between the purchaser and the supplier.

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Annex (informative) Heat treatment of stainless steels

Introduction This Annex (informative) complements matters related to the standard text and not a part of the specifications.

As for the heat treatment temperature of stainless steels, the stainless steels shall be treated with the temperature and cooling conditions which satisfy specified items such as mechanical properties, corrosion resistance, etc., which are specified JIS, but from the reason that the temperature range for stainless steels treatment based on the manufacturers' technical knowledge shall be adopted, the heat treatment temperatures are excluded from the standard body, and are stated in this Annex (informative).

Annex Table 1 Heat treatment of austenitic bars

Symbol of grade	Solution treatment °C	Symbol of grade	Solution treatment °C
SUS201	1010 to 1120 rapid cooling	SUS316L	1010 to 1150 rapid cooling
SUS202	1010 to 1120 rapid cooling	SUS316N	1010 to 1150 rapid cooling
SUS301	1010 to 1150 rapid cooling	SUS316LN	1010 to 1150 rapid cooling
SUS302	1010 to 1150 rapid cooling	SUS316Ti	920 to 1150 rapid cooling
SUS303	1010 to 1150 rapid cooling	SUS316J1	1010 to 1150 rapid cooling
SUS303Se	1010 to 1150 rapid cooling	SUS316J1L	1010 to 1150 rapid cooling
SUS303Cu	1010 to 1150 rapid cooling	SUS316F	1010 to 1150 rapid cooling
SUS304	1010 to 1150 rapid cooling	SUS317	1010 to 1150 rapid cooling
SUS304L	1010 to 1150 rapid cooling	SUS317L	1010 to 1150 rapid cooling
SUS304N1	1010 to 1150 rapid cooling	SUS317LN	1010 to 1150 rapid cooling
SUS304N2	1010 to 1150 rapid cooling	SUS317J1	1030 to 1180 rapid cooling
SUS304LN	1010 to 1150 rapid cooling	SUS836L	1030 to 1180 rapid cooling
SUS304J3	1010 to 1150 rapid cooling	SUS890L	1030 to 1180 rapid cooling
SUS305	1010 to 1150 rapid cooling	SUS321	920 to 1150 rapid cooling
SUS309S	1030 to 1150 rapid cooling	SUS347	980 to 1150 rapid cooling
SUS310S	1030 to 1180 rapid cooling	SUSXM7	1010 to 1150 rapid cooling
SUS316	1010 to 1150 rapid cooling	SUSXM15J1	1010 to 1150 rapid cooling

Remarks: For SUS316Ti, SUS321, and SUS347, the purchaser may specify a stabilizing heat treatment. In that case, the heat treatment temperature shall be 850 °C to 930 °C.

Annex Table 2 Heat treatment of austenitic ferritic bars

Symbol of grade	Solution treatment °C
SUS329J1	950 to 1100 rapid cooling
SUS329J3L	950 to 1100 rapid cooling
SUS329J4L	950 to 1100 rapid cooling

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Annex Table 3 Heat treatment of ferritic bars

Symbol of grade	Annealing °C
SUS405	780 to 830 air cooling or slow cooling
SUS410L	700 to 820 air cooling or slow cooling
SUS430	780 to 850 air cooling or slow cooling
SUS430F	680 to 820 air cooling or slow cooling
SUS434	780 to 850 air cooling or slow cooling
SUS447J1	900 to 1 050 rapid cooling
SUSXM27	900 to 1 050 rapid cooling

Annex Table 4 Heat treatment of martensitic bars

Symbol of grade	Heat treatment °C		
	Annealing	Quenching	Tempering
SUS403	800 to 900 slow cooling or approx. 750 rapid cooling	950 to 1 000 oil quenching	700 to 750 rapid cooling
SUS410	800 to 900 slow cooling or approx. 750 rapid cooling	950 to 1 000 oil quenching	700 to 750 rapid cooling
SUS410J1	830 to 900 slow cooling or approx. 750 rapid cooling	970 to 1 020 oil quenching	650 to 750 rapid cooling
SUS410F2	800 to 900 slow cooling or approx. 750 rapid cooling	950 to 1 000 oil quenching	700 to 750 rapid cooling
SUS416	800 to 900 slow cooling or approx. 750 rapid cooling	950 to 1 000 oil quenching	700 to 750 rapid cooling
SUS420J1	800 to 900 slow cooling or approx. 750 rapid cooling	920 to 980 oil quenching	600 to 750 rapid cooling
SUS420J2	800 to 900 slow cooling or approx. 750 air cooling	920 to 980 oil quenching	600 to 750 rapid cooling
SUS420F	800 to 900 slow cooling or approx. 750 air cooling	920 to 980 oil quenching	600 to 750 rapid cooling
SUS420F2	800 to 900 slow cooling or approx. 750 air cooling	920 to 980 oil quenching	600 to 750 rapid cooling
SUS431	Primary: approx. 750 rapid cooling, Secondary: approx. 650 rapid cooling	1 000 to 1 050 oil quenching	630 to 700 rapid cooling
SUS440A	800 to 920 slow cooling	1 010 to 1 070 oil quenching	100 to 180 air cooling
SUS440B	800 to 920 slow cooling	1 010 to 1 070 oil quenching	100 to 180 air cooling
SUS440C	800 to 920 slow cooling	1 010 to 1 070 oil quenching	100 to 180 air cooling
SUS440F	800 to 920 slow cooling	1 010 to 1 070 oil quenching	100 to 180 air cooling

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Annex Table 5 Heat treatment of precipitation hardening bars

Symbol of grade	Heat treatment		
	Classification	Symbol	Conditions
SUS630	Solution treatment	S	1020 °C to 1060 °C rapid cooling
	Precipitation hardening treatment	H900	After S treatment 470 °C to 490 °C air cooling
		H1025	After S treatment 540 °C to 560 °C air cooling
		H1075	After S treatment 570 °C to 590 °C air cooling
		H1150	After S treatment 610 °C to 630 °C air cooling
SUS631	Solution treatment	S	1 000 °C to 1 100 °C rapid cooling
	Precipitation hardening treatment	RH950	After S treatment, hold at 955°C ±10°C for 10 min, air cool down to room temperature, cool down to −73°C ±6°C within 24 h, hold for 8 h, hold at 510°C ±10°C for 60 min and air cool.
		TH1050	After S treatment, hold at 760°C ±15°C for 90 min, cool down to 15°C or under within 1 h, hold for 30 min, hold at 565°C ±10°C for 90 min and air cool.

Remarks: For SUS630, heat treatments other than those given in Annex Table 5 may be agreed upon between the parties concerned with delivery.

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JIS

JAPANESE INDUSTRIAL STANDARD

Stainless steel bars

JIS G 4303—1991

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JAPANESE INDUSTRIAL STANDARD

Stainless steel bars

JIS G 4303-1991

1. Scope

This Japanese Industrial Standard specifies the hot-finished stainless steel bars (round bars, square bars, hexagonal bars and flat bars, hereinafter generically referred to as the "bars").

Remarks 1. Applicable Standards in this Standard shall be as given in Attached Table 1.

2. Corresponding International Standards in this Standard shall be as follows.

ISO 683-13 : 1986	Heat-treatable steels, alloy steels and free-cutting steels—Part 13 : Wrought stainless steels
ISO 683-16 : 1976	Heat-treated steels, alloy steels and free-cutting steels—Part 16 : Precipitation hardening stainless steels

2. Grades and symbols

Bars shall be classified into 58 grades, and the symbols and classification thereof shall be a given in Table 1.

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Table 1. Symbol of grade and classification

Symbol of grade	Classification	Symbol of grade	Classification
SUS201	Austenitic series	SUS329J1	Austenitic-ferritic series
SUS202		SUS329J3L	
SUS301		SUS329J4L	
SUS302		SUS405	Ferritic series
SUS303		SUS410L	
SUS303Se		SUS430	
SUS304		SUS430F	
SUS304L		SUS434	
SUS304N1		SUS447J1	
SUS304N2		SUSXM27	
SUS304LN		SUS403	Mantensitic series
SUS304J3		SUS410	
SUS305		SUS410J1	
SUS309S		SUS410F2	
SUS310S		SUS416	
SUS316		SUS420J1	
SUS316L		SUS420J2	
SUS316N		SUS420F	
SUS316LN		SUS420F2	
SUS316Ti		SUS431	
SUS316J1		SUS440A	
SUS316J1L		SUS440B	
SUS317		SUS440C	
SUS317L		SUS440F	
SUS317LN		SUS630	Precipitation hardening series
SUS317J1		SUS631	
SUS317J4L			
SUS317J5L			
SUS321			
SUS347			
SUSXM7			
SUSXM15J1			

Remarks: When it is necessary to indicate with a symbol that the products are bars, the letter -B shall be suffixed to the symbol of grade.
Example: SUS304-B

3. Chemical composition

3.1 Ladle analysis value Bars shall be tested in accordance with 9.1 and the ladle analysis value thereof shall conform to Tables 2 to 6.

3.2 Product analysis value Bars shall be subjected, when required by the purchaser, to the product analysis test specified in 9.1 and the values of permissible variations in Table 4 of JIS G 0321 shall be applied. However, the values of elements and chemical components not specified in this table shall be as agreed upon between the parties concerned with delivery.

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Table 2. Chemical compositon of austenitic bars

Unit: %

Symbol of grade	C	Si	Mn	P	S	Ni	Cr	Mo	Cu	N	Others	Symbol of grade
SUS201	0.15 max.	1.00 max.	5.50 to 7.50	0.060 max.	0.030 max.	3.50 to 5.50	16.00 to 18.00	—	—	0.25 max.	—	SUS201
SUS202	0.15 max.	1.00 max.	7.50 to 10.00	0.060 max.	0.030 max.	4.00 to 6.00	17.00 to 19.00	—	—	0.25 max.	—	SUS202
SUS301	0.15 max.	1.00 max.	2.00 max.	0.045 max.	0.030 max.	6.00 to 8.00	16.00 to 18.00	—	—		—	SUS301
SUS302	0.15 max.	1.00 max.	2.00 max.	0.045 max.	0.030 max.	8.00 to 10.00	17.00 to 19.00	—	—		—	SUS302
SUS303	0.15 max.	1.00 max.	2.00 max.	0.20 max.	0.15 min.	8.00 to 10.00	17.00 to 19.00	(1)	—		—	SUS303
SUS303Se	0.15 max.	1.00 max.	2.00 max.	0.20 max.	0.060 max.	8.00 to 10.00	17.00 to 19.00	—	—		Se 0.15 min.	SUS303Se
SUS304	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	—	—		—	SUS304
SUS304L	0.030 max.	1.00 max.	2.00 max.	0.045 max.	0.030 max.	9.00 to 13.00	18.00 to 20.00	—	—		—	SUS304L
SUS304N1	0.08 max.	1.00 max.	2.50 max.	0.045 max.	0.030 max.	7.00 to 10.50	18.00 to 20.00	—	—	0.10 to 0.25	—	SUS304N1
SUS304N2	0.08 max.	1.00 max.	2.50 max.	0.045 max.	0.030 max.	7.50 to 10.50	18.00 to 20.00	—	—	0.15 to 0.30	Nb 0.15 max.	SUS304N2
SUS304LN	0.030 max.	1.00 max.	2.00 max.	0.045 max.	0.030 max.	8.50 to 11.50	17.00 to 19.00	—	—	0.12 to 0.22	—	SUS304LN
SUS304J3	0.08 max.	1.00 max.	2.00 max.	0.045 max.	0.030 max.	8.00 to 10.50	17.00 to 19.00	—	1.00 to 3.00	—	—	SUS304J3
SUS305	0.12 max.	1.00 max.	2.00 max.	0.045 max.	0.030 max.	10.50 to 13.00	17.00 to 19.00	—	—	—	—	SUS305
SUS309S	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	—	—	—	—	SUS309S
SUS310S	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	—	—	—	—	SUS310S
SUS316	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	—	—	—	SUS316
SUS316L	0.030 max.	1.00 max.	2.00 max.	0.045 max.	0.030 max.	12.00 to 15.00	16.00 to 18.00	2.00 to 3.00	—	—	—	SUS316L
SUS316N	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	—	0.10 to 0.22	—	SUS316N
SUS316LN	0.030 max.	1.00 max.	2.00 max.	0.045 max.	0.030 max.	10.50 to 14.50	16.50 to 18.50	2.00 to 3.00	—	0.12 to 0.22	—	SUS316LN
SUS316Ti	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.	SUS316Ti
SUS316J1	0.08 max.	1.00 max.	2.00 max.	0.045 max.	0.030 max.	10.00 to 14.00	17.00 to 19.00	1.20 to 2.75	1.00 to 2.50	—	—	SUS316J1
SUS316J1L	0.030 max.	1.00 max.	2.00 max.	0.045 max.	0.030 max.	12.00 to 16.00	17.00 to 19.00	1.20 to 2.75	1.00 to 2.50	—	—	SUS316J1L
SUS317	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	—	—	—	SUS317
SUS317L	0.030 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	—	—	—	SUS317L
SUS317LN	0.030 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	—	0.10 to 0.22	—	SUS317LN
SUS317J1	0.040 max.	1.00 max.	2.50 max.	0.045 max.	0.030 max.	15.00 to 17.00	16.00 to 19.00	4.00 to 6.00	—	—	—	SUS317J1
SUS317J4L	0.030 max.	1.00 max.	2.00 max.	0.045 max.	0.030 max.	24.00 to 26.00	19.00 to 24.00	5.00 to 7.00	—	0.25 max.	—	SUS317J4L
SUS317J5L	0.020 max.	1.00 max.	2.00 max.	0.045 max.	0.030 max.	23.00 to 28.00	19.00 to 23.00	4.00 to 5.00	1.00 to 2.00	—	—	SUS317J5L
SUS321	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.	SUS321
SUS347	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.	SUS347
SUSXM7	0.08 max.	1.00 max.	2.00 max.	0.045 max.	0.030 max.	8.50 to 10.50	17.00 to 19.00	—	3.00 to 4.00	—	—	SUSXM7
SUSXM15J1	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	—	—	—	—	SUSXM15J1

Note (1) 0.60 % max. of Mo may be added.

Remarks: Alloying elements other than those given in Table 2 may be added to SUSXM15J1 as required.

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Table 3. Chemical composition of austenitic-ferritic bars

Unit: %

Symbol of grade	C	Si	Mn	P	S	Ni	Cr	Mo	N
SUS329J1	0.08 max.	1.00 max.	1.50 max.	0.040 max.	0.030 max.	3.00 to 6.00	23.00 to 28.00	1.00 to 3.00	—
SUS329J3L	0.030 max.	1.00 max.	2.00 max.	0.040 max.	0.030 max.	4.50 to 6.50	21.00 to 24.00	2.50 to 3.50	0.08 to 0.20
SUS329J4L	0.030 max.	1.00 max.	1.50 max.	0.040 max.	0.030 max.	5.50 to 7.50	24.00 to 26.00	2.50 to 3.50	0.08 to 0.30

Remarks: Alloying element other than those given in Table 3 may be added as required.

Table 4. Chemical composition of ferritic bars

Unit: %

Symbol of grade	C	Si	Mn	P	S	Cr	Mo	N	Al
SUS405	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	0.030 max.	1.00 max.	1.00 max.	0.040 max.	0.030 max.	11.00 to 13.50	—	—	—
SUS430	0.12 max.	0.75 max.	1.00 max.	0.040 max.	0.030 max.	16.00 to 18.00	—	—	—
SUS430F	0.12 max.	1.00 max.	1.25 max.	0.060 max.	0.15 min.	16.00 to 18.00	(1)	—	—
SUS434	0.12 max.	1.00 max.	1.00 max.	0.040 max.	0.030 max.	16.00 to 18.00	0.75 to 1.25	—	—
SUS447J1	0.010 max.	0.40 max.	0.40 max.	0.030 max.	0.020 max.	28.50 to 32.00	1.50 to 2.50	0.015 max.	—
SUSXM27	0.010 max.	0.40 max.	0.40 max.	0.030 max.	0.020 max.	25.00 to 27.50	0.75 to 1.50	0.015 max.	—

Note (1) 0.60 % max. of Mo may be added.

Remarks 1. Ferritic bars other than SUS47J1 and SUSXM27 may contain 0.60 % max. of Ni.

2. SUS447J1 and SUSXM27 may contain 0.50 % max. of Ni, 0.20 % max. of Cu, and 0.50 % max. of Ni + Cu. Further, alloying elements other than those given in Table 4 may be added as required.

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Table 5. chemical composition of martensitic bars

Unit: %

Symbol of grade	C	Si	Mn	P	S	Ni	Cr	Mo	Pb
SUS403	0.15 max.	0.50 max.	1.00 max.	0.040 max.	0.030 max.	(2)	11.50 to 13.00	—	—
SUS410	0.15 max.	1.00 max.	1.00 max.	0.040 max.	0.030 max.	(2)	11.50 to 13.50	—	—
SUS410J1	0.08 to 0.18	0.60 max.	1.00 max.	0.040 max.	0.030 max.	(2)	11.50 to 14.00	0.30 to 0.60	—
SUS410F2	0.15 max.	1.00 max.	1.00 max.	0.040 max.	0.030 max.	(2)	11.50 to 13.50	—	0.05 to 0.30
SUS416	0.15 max.	1.00 max.	1.25 max.	0.060 max.	0.15 min.	(2)	12.00 to 14.00	(1)	—
SUS420J1	0.16 to 0.25	1.00 max.	1.00 max.	0.040 max.	0.030 max.	(2)	12.00 to 14.00	—	—
SUS420J2	0.26 to 0.40	1.00 max.	1.00 max.	0.040 max.	0.030 max.	(2)	12.00 to 14.00	—	—
SUS420F	0.26 to 0.40	1.00 max.	1.25 max.	0.060 max.	0.15 min.	(2)	12.00 to 14.00	(1)	—
SUS420F2	0.26 to 0.40	1.00 max.	1.00 max.	0.040 max.	0.030 max.	(2)	12.00 to 14.00	—	0.05 to 0.30
SUS431	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	—	—
SUS440A	0.60 to 0.75	1.00 max.	1.00 max.	0.040 max.	0.030 max.	(2)	16.00 to 18.00	(3)	—
SUS440B	0.75 to 0.95	1.00 max.	1.00 max.	0.040 max.	0.030 max.	(2)	16.00 to 18.00	(3)	—
SUS440C	0.95 to 1.20	1.00 max.	1.00 max.	0.040 max.	0.030 max.	(2)	16.00 to 18.00	(3)	—
SUS440F	0.95 to 1.20	1.00 max.	1.25 max.	0.060 max.	0.15 min.	(2)	16.00 to 18.00	(3)	—

Notes (1) 0.60 % max. of Mo may be added.
(2) 0.60 % max. of Ni may be contained.
(3) 0.75 % max. of Mo may be added.

Table 6. Chemical compositon of precipitation hardening bars

Unit: %

Symbol of grade	C	Si	Mn	P	S	Ni	Cr	Cu	Others
SUS630	0.07 max.	1.00 max.	1.00 max.	0.040 max.	0.030 max.	3.00 to 5.00	15.00 to 17.50	3.00 to 5.00	Nb 0.15 to 0.45
SUS631	0.09 max.	1.00 max.	1.00 max.	0.040 max.	0.030 max.	6.50 to 7.75	16.00 to 18.00	—	Al 0.75 to 1.50

4. Mechanical properties

Bars shall be tested in accordance with 9.2 and the mechanical properties shall be as follows.

(1) Mechanical properties of austenitic bars The proof stress, tensile strength, elongation, reduction of area and hardness of austenitic bars solution-treated shall be as specified in Table 7. In that case, the test specimen shall be prepared according to class A specified in JIS G 0303. The proof stress, however, shall be applied only when specified by the purchaser.

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Table 7. Mechanical properties of solution-treated condition (Austenitic bars)

Symbol of grade	Proof stress N/mm²	Tensile strength N/mm²	Elongation %	Reduction of area %	Hardness		
					HB	HRB	HV
SUS201	275 min.	520 min.	40 min.	45 min.	241 max.	100 max.	253 max.
SUS202	275 min.	520 min.	40 min.	45 min.	207 max.	95 max.	218 max.
SUS301	205 min.	520 min.	40 min.	60 min.	207 max.	95 max.	218 max.
SUS302	205 min.	520 min.	40 min.	60 min.	187 max.	90 max.	200 max.
SUS303	205 min.	520 min.	40 min.	50 min.	187 max.	90 max.	200 max.
SUS303Se	205 min.	520 min.	40 min.	50 min.	187 max.	90 max.	200 max.
SUS304	205 min.	520 min.	40 min.	60 min.	187 max.	90 max.	200 max.
SUS304L	175 min.	480 min.	40 min.	60 min.	187 max.	90 max.	200 max.
SUS304N1	275 min.	550 min.	35 min.	50 min.	217 max.	95 max.	220 max.
SUS304N2	345 min.	690 min.	35 min.	50 min.	250 max.	100 max.	260 max.
SUS304LN	245 min.	550 min.	40 min.	50 min.	217 max.	95 max.	220 max.
SUS304J3	175 min.	480 min.	40 min.	60 min.	187 max.	90 max.	200 max.
SUS305	175 min.	480 min.	40 min.	60 min.	187 max.	90 max.	200 max.
SUS309S	205 min.	520 min.	40 min.	60 min.	187 max.	90 max.	200 max.
SUS310S	205 min.	520 min.	40 min.	50 min.	187 max.	90 max.	200 max.
SUS316	205 min.	520 min.	40 min.	60 min.	187 max.	90 max.	200 max.
SUS316L	175 min.	480 min.	40 min.	60 min.	187 max.	90 max.	200 max.
SUS316N	275 min.	550 min.	35 min.	50 min.	217 max.	95 max.	220 max.
SUS316LN	245 min.	550 min.	40 min.	50 min.	217 max.	95 max.	220 max.
SUS316Ti	205 min.	520 min.	40 min.	50 min.	187 max.	90 max.	200 max.
SUS316J1	205 min.	520 min.	40 min.	60 min.	187 max.	90 max.	200 max.
SUS316J1L	175 min.	480 min.	40 min.	60 min.	187 max.	90 max.	200 max.
SUS317	205 min.	520 min.	40 min.	60 min.	187 max.	90 max.	200 max.
SUS317L	175 min.	480 min.	40 min.	60 min.	187 max.	90 max.	200 max.
SUS317LN	245 min.	550 min.	40 min.	50 min.	217 max.	95 max.	220 max.
SUS317J1	175 min.	480 min.	40 min.	45 min.	187 max.	90 max.	200 max.
SUS317J4L	205 min.	520 min.	35 min.	40 min.	217 max.	96 max.	230 max.
SUS317J5L	215 min.	490 min.	35 min.	40 min.	187 max.	90 max.	200 max.
SUS321	205 min.	520 min.	40 min.	50 min.	187 max.	90 max.	200 max.
SUS347	205 min.	520 min.	40 min.	50 min.	187 max.	90 max.	200 max.
SUSXM7	175 min.	480 min.	40 min.	60 min.	187 max.	90 max.	200 max.
SUSXM15J1	205 min.	520 min.	40 min.	60 min.	207 max.	95 max.	218 max.

Remarks: The values specified in Table 7 shall be applied to bars of 180 mm or under in diameter, side length, width across flat, or thickness. The values exceeding 180 mm shall be as agreed upon between the parties concerned with delivery.

(2) Mechanical properties of austenitic ferritic bars The proof stress, tensile strength, elongation, reduction of area and hardness of austenitic ferritic bars solution-treated shall be as specified in Table 8. In that case, the test specimen shall be prepared according to class A specified in JIS G 0303. However, the proof stress shall be applied only when specified by the purchaser.

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Table 8. Mechanical properties of solution-treated condition (Austenitic - ferritic bars)

Symbol of grade	Proof stress N/mm²	Tensile strength N/mm²	Elongation %	Reduction of area %	Hardness		
					HB	HRC	HV
SUS329J1	390 min.	590 min.	18 min.	40 min.	227 max.	29 max.	292 max.
SUS329J3L	450 min.	620 min.	18 min.	40 min.	302 max.	32 max.	320 max.
SUS329J4L	450 min.	620 min.	18 min.	40 min.	302 max.	32 max.	320 max.

Remarks: The values specified in Table 8 shall be applied to bars of 75 mm or under in diameter, side length, width across flat, or thickness. The values exceeding 75 mm shall be as agreed upon between the parties concerned with delivery.

(3) Mechanical propertieis of ferritic bars The proof stress, tensile strength, elongation, reduction of area, impact value, and hardness of ferritic bars annealed shall be as specified in Table 9. In that case, the test specimen shall be prepared according to class A specified in JIS G 0303. However, the proof stress shall be applied only when specified by the purchaser.

Table 9. Mechanical properties in annealed condition (Ferritic bars)

Symbol of grade	Proof stress N/mm²	Tensile strength N/mm²	Elongation %	Reduction of area %	Charpy impact value J/cm²	Hardness HB
SUS405	175 min.	410 min.	20 min.	60 min.	98 min.	183 max.
SUS410L	195 min.	360 min.	22 min.	60 min.	—	183 max.
SUS430	205 min.	450 min.	22 min.	50 min.	—	183 max.
SUS430F	205 min.	450 min.	22 min.	50 min.	—	183 max.
SUS434	205 min.	450 min.	22 min.	60 min.	—	183 max.
SUS447J1	295 min.	450 min.	20 min.	45 min.	—	228 max.
SUSXM27	245 min.	410 min.	20 min.	45 min.	—	219 max.

Remarks 1. The values specified in Table 9 shall be applied to bars of 75 mm or under in diameter, side length, width across flat, or thickness. The values for bars of over 75 mm shall be as agreed upon between the parties concerned with delivery.

2. The Charpy impact values shall be applied to bars of dimensions capable of sampling No. 3 test piece specified in JIS Z 2202. In the case where No. 3 test piece can not be obtainable, the test piece and impact value to be applied may be as agreed upon between the parties concerned with delivery.

(4) Mechanical properties of martensitic bars The mechanical properties of martensitic bars shall be as follows.

(a) The proof stress, tensile strength, elongation, reduction of area, impact value, and hardness of quenched and tempered bars themselves or of their test pieces similarly treated shall be as specified in Table 10. In that case, specimen shall be prepared according to class A specified in JIS G 0303.

(b) As for bars as rolled or as forged, and annealed, the mechanical properties of the test specimen of class B in JIS G 0303 quenched and tempered at a suitable temperature within the temperature range given in Table 26, shall conform to Table 10.

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(c) The hardness of annealed bars themselves shall conform to Table 11. The hardness of bars annealed at the temperature of approx. 750°C shall be as agreed upon between the partieis concerned with delivery.

Table 10. Mechanical properties in quenched and tempered condition (Martensitic bars)

Symbol of grade	Proof stress N/mm²	Tensile strength N/mm²	Elongation %	Reduction of area %	Charpy impact value J/cm²	Hardness	
						HB	HRC
SUS403	390 min.	590 min.	25 min.	55 min.	147 min.	170 min.	—
SUS410	345 min.	540 min.	25 min.	55 min.	98 min.	159 min.	—
SUS410J1	490 min.	690 min.	20 min.	60 min.	98 min.	192 min.	—
SUS410F2	345 min.	540 min.	18 min.	50 min.	98 min.	159 min.	—
SUS416	345 min.	540 min.	17 min.	45 min.	69 min.	159 min.	—
SUS420J1	440 min.	640 min.	20 min.	50 min.	78 min.	192 min.	—
SUS420J2	540 min.	740 min.	12 min.	40 min.	29 min.	217 min.	—
SUS420F	540 min.	740 min.	8 min.	35 min.	29 min.	217 min.	—
SUS420F2	540 min.	740 min.	5 min.	35 min.	29 min.	217 min.	—
SUS431	590 min.	780 min.	15 min.	40 min.	39 min.	229 min.	—
SUS440A	—	—	—	—	—	—	54 min.
SUS440B	—	—	—	—	—	—	56 min.
SUS440C	—	—	—	—	—	—	58 min.
SUS440F	—	—	—	—	—	—	58 min.

Remarks 1. The values specified in Table 10 shalll be applicd to bars of 75 mm or under in diameter, side length, width across flat, or thickness. Values for bars of over 75 mm shall be as agreed upon beween the parties concerned with delivery.

2. The Charpy impact value shall be applied to a bar of a size capable of sampling No. 3 test piecc specified in JIS Z 2202. In the case where No. 3 test piece can not be obtainable, the test piece and impact value to be applied may be as agreed upon between the parties concerned with delivery.

Table 11. Hardness in annealed condition (Martensitic bars)

Symbol of grade	Hardness HB	Symbol of grade	Hardness HB
SUS403	200 max.	SUS420F	235 max.
SUS410	200 max.	SUS420F2	235 max.
SUS410J1	200 max.	SUS431	302 max.
SUS410F2	200 max.	SUS440A	255 max.
SUS416	200 max.	SUS440B	255 max.
SUS420J1	223 max.	SUS440C	269 max.
SUS420J2	235 max.	SUS440F	269 max.

(5) Mechanical properties of precipitation hardening bars The proof stress, tensile strength, elongation, reduction of area and hardness of bars processed by solution treatment and those of bars or test pieces processed by precipitation hardening by designation of the purchaser shall be as given in Table 12. In that case, the test specimen shall bc prepared according to class A specified in JIS G 0303. However, the proof stress shall be applied only when particularly designated by the purchaser.

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Table 12. Mechanical properties of precipitation hardening bars

Symbol of grade	Symbol of heat treatment	Proof stress N/mm²	Tensile strength N/mm²	Elongation %	Reduction of area %	Hardness	
						HBS or HBW	HRC
SUS630	S	—	—	—	—	363 max.	38 max.
	H900	1175 min.	1310 min.	10 min.	40 min.	375 min.	40 min.
	H1025	1000 min.	1070 min.	12 min.	45 min.	331 min.	35 min.
	H1075	860 min.	1000 min.	13 min.	45 min.	302 min.	31 min.
	H1150	725 min.	930 min.	16 min.	50 min.	277 min.	28 min.
SUS631	S	380 max.	1030 max.	20 min.	—	229 max.	—
	TH1050	960 min.	1140 min.	5 min.	25 min.	363 min.	—
	RH950	1030 min.	1230 min.	4 min.	10 min.	388 min.	—

Remarks 1. The values specified in Table 12 shall be applied to bars of 75 mm or under in diameter, side length, width across flat, or thickness. The vaues of bars of over 75 mm shall be as agreed upon between the parties concerned with delivery.

2. Mechanical properties of SUS630 heat treated by other methods than those given in Table 26 may be as agreed upon between the parties concerned with delivery.

5. Corrosion resistance

When the corrosion resistance by an intergranular corrosion test is particularly designated by the purchaser, a test method to be applied shall be selected from the test methods of 9.3 as agreed upon between the parties concerned with delivery. When the test is performed, the obtained corrosion resistance shall be as follows.

(1) The discrimination of the etched structure obtained by a 10 % oxalic acid etching test shall be as specified in Table 13.

Table 13. Discrimination by 10 % oxalic acid etching test

Symbol of grade	Condition	Structure to which ferric sulfate-sulfuric acid corrosion test is applied	Structure to which 65 % nitric acid corrosion test is applied	Structure to which nitric-hydrofluoric acid corrosion test is applied	Structure to which copper sulfate-sulfuric acid corrosion test is applied
SUS304	As received (Solution-treated)	Ditch structure	Ditch structure Pit structure II	—	Ditch structure
SUS316 SUS316J1 SUS317			—	Ditch structure	
SUS304L	Sensitized	Ditch structure	Ditch structure Pit structure II	—	Ditch structure
SUS316L SUS316J1L SUS317L			—	Ditch structure	
SUS321 SUS347		—		—	

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(2) The corrosion rate by a ferric sulfate-sulfuric acid corrosion test shall be as specified in Table 14.

Table 14. Corrosion rate of ferric sulfate-sulfuric acid corrosion test

Symbol of grade	Condition	Corrosin rate $g/m^2 \cdot h$
SUS304 SUS316 SUS316J1 SUS317	As received (Solution-treated)	To be as agreed upon between the parties concerned with delivery.
SUS304L SUS316L SUS316J1L SUS317L	Sensitized	To be as agreed upon between the parties concerned with delivery.

(3) The corrosion rate by a 65 % nitric acid corrosion test shall be as specified in Table 15.

Table 15. Corrosion rate of 65 % nitric acid corrosion test

Symbol of grade	Condition	Corrosin rate $g/m^2 \cdot h$
SUS304	As received (Solution-treated)	To be as agreed upon between the parties concerned with delivery.
SUS304L	Sensitized	To be as agreed upon between the parties concerned with delivery.

(4) The corrosion ratio by a nitric-hydrofluoric acid corrosion test shall be as specified in Table 16.

Table 16. Corrosion ratio of nitric-hydrofluoric acid corrosion test

Symbol of grade	Corrosion ratio
SUS316 SUS316J1 SUS317	1.5 max.
SUS316L SUS316J1L SUS317L	1.5 max.

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(5) The conditions of bent surface by a copper sulfate-sulfuric acid corrosion test shall be as specified in Table 17.

Table 17. Condition of bent surface by copper sulfate-sulfuric acid corrosion test

Symbol of grade	Condition	Condition of bent surface
SUS304 SUS316 SUS316J1 SUS317	As received (Solution-treated)	To be free from intergranular corrosion cracks.
SUS304L SUS316L SUS316J1L SUS317L SUS321 SUS347	Sensitized	To be free from intergranular corrosion cracks.

6. Shape, dimensions and tolerances

The shapes, dimensions, and tolerances shall be as follows.

(1) The standard dimensions of hot rolled round bars and hexagonal bars shall be as specified in Table 18.

Table 18. Standard dimensions

Unit: mm

Diameter of round bar					Width across flat of hexagonal bar	
9	19	(35)	55	120	12	30
10	20	36	60	130	14	32
(11)	22	38	65	140	17	35
12	24	40	70	150	19	38
13	25	42	75	160	21	41
14	26	44	80	170	23	46
15	28	(45)	85	180	24	
16	30	46	90	190	26	
17	32	48	100	200	27	
(18)	34	50	110		29	

Remarks: In designing, the dimensions given in parentheses should preferably not be used.

(2) The tolerance and permissible ovality or deviation in diameter, side length, or width across flat of hot rolled round, square and hexagonal bars shall be as specified in Table 19.

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Table 19. Tolerance and permissible ovality or deviation of hot rolled round, square, and hexagonal bars

Unit: mm

Diameter, side length, or width across flat	Tolerance on diameter, side length, or width across flat	Permissible ovality or deviation(4)
28 max.	± 0.4	70 % or under of the full range of tolerances
Over 28	± 1.5 %	

Note (4) The permissible ovality or deivation is expressed by the difference between the maximum value and the minimum value of the diameter, side length, or width across flat on the same section.

(3) Tolerances on the thickness and width of hot rolled flat bars shall be as specified in Table 20.

Table 20. Dimensional tolerances of hot rolled flat bars

Unit: mm

Thickness	Tolerance on thickness	Width	Tolerance on width
Under 13	± 0.5	Under 25	± 0.7
		25 or over to and excl. 50	± 1.0
13 or over	± 4 %	50 or over up to and incl. 150	± 2 %

(4) Tolerance on the length of a bar shall be as specified in Table 21.

Table 21. Tolerance on length

Unit: mm

Length	Tolerance on length
7000 max.	$^{+40}_{0}$
Over 7000	To add 5 to plus side tolerance above-mentioned for increase of every 1000 or its fraction in length.

(5) The tolerance on the bend of a bar shall be not more than 3 mm for every 1 m and shall be not more than 3 mm × $\frac{\text{length (m)}}{1\text{ m}}$ for full length.

(6) The dimentional tolerances of forged bars shall be as agree upon between the parties concerned with delivery.

7. Appearance

The bars shall be free from defects detrimental to practical use.

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8. Manufacturing method

The bars shall be heat treated in accordance with Tables 22 to 26 after hot rolling or forging. For ferritic bars, however, annealing may be omitted by the specification of the purchaser. For martesitic bars, the purchaser shall previously specify either of annealing or quenching and tempering shall be conducted, or whether the heat treatment shall be omitted or not and also either the bars themselves or the test specimens shall be heat-treated. Regarding the heat treatment of precipitation hardening bars, the purchaser shall previously specify the class of heat treatment (heat treatment symbol in Table 26) and also either the bars themselves or the test specimens shall be test-treated. For austenitic bars, in the case where used as the material of cold finished stainless steel bar to be processed by solution treatment, the solution treatment may be omitted as agreed upon between the parties concerned with delivery.

The scales produced during a heat treatment shall be removed pickling or other suitable means.

Further, symbols for expressing heat treatment method shall be as given in Table 27.

Table 22. Heat treatment of austenitic bars

Symbol of grade	Solution treatment °C	Symbol of grade	Solution treatment °C
SUS201	1010 to 1120 rapid cooling	SUS316L	1010 to 1150 rapid cooling
SUS202	1010 to 1120 rapid cooling	SUS316N	1010 to 1150 rapid cooling
SUS301	1010 to 1150 rapid cooling	SUS316LN	1010 to 1150 rapid cooling
SUS302	1010 to 1150 rapid cooling	SUS316Ti	920 to 1150 rapid cooling
SUS303	1010 to 1150 rapid cooling	SUS316J1	1010 to 1150 rapid cooling
SUS303Se	1010 to 1150 rapid cooling	SUS316J1L	1010 to 1150 rapid cooling
SUS304	1010 to 1150 rapid cooling	SUS317	1010 to 1150 rapid cooling
SUS304L	1010 to 1150 rapid cooling	SUS317L	1010 to 1150 rapid cooling
SUS304N1	1010 to 1150 rapid cooling	SUS317LN	1010 to 1150 rapid cooling
SUS304N2	1010 to 1150 rapid cooling	SUS317J1	1030 to 1180 rapid cooling
SUS304LN	1010 to 1150 rapid cooling	SUS317J4L	1030 to 1180 rapid cooling
SUS304J3	1010 to 1150 rapid cooling	SUS317J5L	1030 to 1180 rapid cooling
SUS305	1010 to 1150 rapid cooling	SUS321	920 to 1150 rapid cooling
SUS309S	1030 to 1150 rapid cooling	SUS347	980 to 1150 rapid cooling
SUS310S	1030 to 1180 rapid cooling	SUSXM7	1010 to 1150 rapid cooling
SUS316	1010 to 1150 rapid cooling	SUSXM15J1	1010 to 1150 rapid cooling

Remarks: For SUS316Ti, SUS321, and SUS347, the purchaser may specify a stabilizing heat treatment. In that case, the heat treatment temperature shall be 850 to 930°C.

Table 23. Heat treatment of austenitic ferritic bars

Symbol of grade	Solution treatment °C
SUS329J1	950 to 1100 rapid cooling
SUS329J3L	950 to 1100 rapid cooling
SUS329J4L	950 to 1100 rapid cooling

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Table 24. Heat treatment of ferritic bars

Symbol of grade	Annealing °C
SUS405	780 to 830 air cooling or slow cooling
SUS410L	700 to 820 air cooling or slow cooling
SUS430	780 to 850 air cooling or slow cooling
SUS430F	680 to 820 air cooling or slow cooling
SUS434	780 to 850 air cooling or slow cooling
SUS447J1	900 to 1050 rapid cooling
SUSXM27	900 to 1050 rapid cooling

Table 25. Heat treatment of martensitic bars

Symbol of grade	Heat treatment °C		
	Annealing	Quenching	Tempering
SUS403	800 to 900 slow cooling or approx. 750 rapid cooling	950 to 1000 oil quenching	700 to 750 rapid cooling
SUS410	800 to 900 slow cooling or approx. 750 rapid cooling	950 to 1000 oil quenching	700 to 750 rapid cooling
SUS410J1	830 to 900 slow cooling or approx. 750 rapid cooling	970 to 1020 oil quenching	650 to 750 rapid cooling
SUS410F2	800 to 900 slow cooling or approx. 750 rapid cooling	950 to 1000 oil quenching	700 to 750 rapid cooling
SUS416	800 to 900 slow cooling or approx. 750 rapid cooling	950 to 1000 oil quenching	700 to 750 rapid cooling
SUS420J1	800 to 900 slow cooling or approx. 750 rapid cooling	920 to 980 oil quenching	600 to 750 rapid cooling
SUS420J2	800 to 900 slow cooling or approx. 750 air cooling	920 to 980 oil quenching	600 to 750 rapid cooling
SUS420F	800 to 900 slow cooling or approx. 750 air cooling	920 to 980 oil quenching	600 to 750 rapid cooling
SUSF20F2	800 to 900 slow cooling or approx. 750 air cooling	920 to 980 oil quenching	600 to 750 rapid cooling
SUS431	Primary: approx. 750 rapid cooling, Secondary: approx. 650 rapid cooling	1000 to 1050 oil quenching	630 to 700 rapid cooling
SUS440A	800 to 920 Slow cooling	1010 to 1070 oil quenching	100 to 180 air cooling
SUS440B	800 to 920 Slow cooling	1010 to 1070 oil quenching	100 to 180 air cooling
SUS440C	800 to 920 Slow cooling	1010 to 1070 oil quenching	100 to 180 air cooling
SUS440F	800 to 920 Slow cooling	1010 to 1070 oil quenching	100 to 180 air cooling

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Table 26. Heat treatment of precipitation hardening bars

Symbol of grade	Heat treatment		
	Classification	Symbol	Conditions
SUS630	Solution treatment	S	1020 to 1060°C rapid cooling
	Precipitation hardening treatment	H900	After S treatment 470 to 490°C air cooling
		H1025	After S treatment 540 to 560°C air cooling
		H1075	After S treatment 570 to 590°C air cooling
		H1150	After S treatment 610 to 630°C air cooling
SUS631	Solution treatment	S	1000 to 1100°C rapid cooling
	Precipitation hardening treatment	TH1050	After S treatment, hold at 760 ± 15°C for 90 min, cool down to 15°C or under within 1 h, hold for 30 min, hold at 565 ± 10°C for 90 min and air cool.
		RH950	After S treatment, hold at 955 ± 10°C for 10 min, air cool down to room temperature, cool down to − 73 ± 6°C within 24 h, hold for 8 h, hold at 510 ± 10°C for 60 min and air cool.

Remarks: For SUS630, heat treatments other than those given in Table 26 may be agreed upon between the parties concerned with delivery.

Table 27. Symbols for heat treatments

Heat treatment method	Symbol
Annealing	A
Quenching and tempering	Q
Solution tratment	S
Precipitation hardening treatment	As specified in Table 26.

9. Tests

9.1 Chemical analysis The chemical analysis shall be as follows.

(1) General matters of chemical analysis and method of sampling specimens for the ladle analysis shall be in accordance with 3. in JIS G 0303.

(2) The method of sampling specimens for the product analysis shall be in accordance with 3. in JIS G 0321. The test piece fractured in the tensle test may be reused as a test specimen.

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(3) The analytical method shall be in accordance with any one of the following Standards:

JIS G 1211, JIS G 1212, JIS G 1213, JIS G 1214,
JIS G 1215, JIS G 1216, JIS G 1217, JIS G 1218,
JIS G 1219, JIS G 1223, JIS G 1224, JIS G 1228,
JIS G 1233, JIS G 1237, JIS G 1253, JIS G 1256,
JIS G 1257

9.2 Mechanical test

9.2.1 General matters General matters of the mechanical test shall be in accordance with 4. in JIS G 0303.

9.2.2 Sampling of specimens Take one specimen from each lot of the same ladle and the same heat treatment.

9.2.3 Number of test pieces Take one test piece from each specimen.

9.2.4 Test pieces The test pieces for tensile test, impact test, and hardness test shall be as follows.

(1) For the tensile test piece, any one of No. 10, No. 13B, No. 14A, or No. 14B test piece specified in JIS Z 2201 shall be used.

Further, either of No. 4 or No. 5 test piece may be used.

(2) For the impact test piece, No. 3 test piece specified in JIS Z 2202 shall be used. However, in the case where No. 3 test piece can not be sampled, the dimensions and shape of a test piece to be applied may be agreed upon between the parties concerned with delivery.

(3) For the hardness test piece, a part of the tensile test piece may be used.

9.2.5 Test methods The methods for tensile test, impact test, and hardness test shall be as follows.

(1) The tensile test method shall be in accordance with JIS Z 2241. However, the standard test temperature shall be 20 ± 5°C, and for measuring tensile strength, the tensile speed shall be so arranged that the increasing rate of strain at the parallel part of the test piece maintains in the range of 40 to 80 % per min.

(2) The impact test method shall be in accordance with JIS Z 2242. However, the test temperature shall be 20 ± 2°C.

(3) The hardness test method shall be in accordance with any one of the following Standards. However, the standard test temperature shall be 20 ± 5°C.

JIS Z 2243, JIS Z 2244, JIS Z 2245

9.3 Corrosion test

9.3.1 Sampling of specimens Take one specimen from each lot of the same ladle and the same heat treatment.

9.3.2 Number of test pieces Take one test piece from each specimen.

9.3.3 Test method The test method shall be in accordance with any one of the following Standards:

JIS G 0571, JIS G 0572, JIS G 0573, JIS G 0574, JIS G 0575

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10. Inspection

The inspection of a bar shall be as follows.

(1) General matters for inspection shall be in accordance with JIS G 0303.

(2) The chemical composition shall conform to the requirements specified in 3.

(3) The mechanical properties shall conform to the requirements specified in 4. However, a past or all of the tensile test, import test, and hrdness test may be omitted as agreed upon between the parties concerned with delivery.

(4) The corrosion resistance shall conform to the requirements specified in 5.

(5) The shape and dimensions shall conform to the requirements specified in 6.

(6) The appearance shall conform to the requirements specified in 7.

11. Marking

Each bar having passed the inspection shall be marked with the following items. However, bars of 30 mm or smaller in diameter, side length, width across flat, or thickness may be bundled together and marked for each bundle.

Further, a part of the items may be omitted as agreed upon between the parties concerned with delibery:

(1) Symbol of grade

(2) Dimensions

(3) Symbols of heat rreatment (for martensitic and precipitation hardening bars)(^{5}).

(4) Manufacturer's name or its abbreviation

(5) Ladle number or inspection number

Note (^{5}) The symbols of heat treatment shall be suffixed to the symbol of grade.

12. Report

The manufacturer shall submit to the purchaser a report of bars stating the results of the tests specified or designated and, as required, the dimensions, quantity, and delivery condition or the like.

Further, when alloying elements are added according to the Remarks and Notes for Tables 2 to 5, the content of added elements shall be included in the test report.

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Attached Table 1. Applicable Standards

JIS G 0303-General Rules for Inspection of Steel

JIS G 0321-Product Analysis and Its Tolerance for Wrought Steel

JIS G 0571-Method of 10 Per Cent Oxalic Acid Etch Test for Stainless Steels

JIS G 0572-Method of Ferric Sulfate-Sulfuric Acid Test for Stainless Steels

JIS G 0573-Method of 65 Per Cent Nitric Acid Test for Stainless Steels

JIS G 0574-Method of Nitric-Hydrofluoric Acid Test for Stainless Steels

JIS G 0575-Method of Copper Sulfate-Sulfuric Acid Test for Stainless Steels

JIS G 1211-Methods for Determination of Carbon in Iron and Steel

JIS G 1212-Methods for Determination of Silicon in Iron and Steel

JIS G 1213-Methods for Determination of Manganese in Iron and Steel

JIS G 1214-Methods for Determination of Phosphorus in Iron and Steel

JIS G 1215-Methods for Determination of Sulfur in Iron and Steel

JIS G 1216-Methods for Determination of Nickel in Iron and Steel

JIS G 1217-Methods for Determination of Chromium in Iron and Steel

JIS G 1218-Methods for Determination of Molybdenum in Iron and Steel

JIS G 1219-Methods for Determination of Copper in Iron and Steel

JIS G 1223-Methods for Determination of Titanium in Iron and Steel

JIS G 1224-Methods for Determination of Aluminium in Iron and Steel

JIS G 1228-Methods for Determination of Nitrogen in Iron and Steel

JIS G 1233-Methods for Determination of Selenium in Steel

JIS G 1237-Methods for Determination of Niobium in Steel

JIS G 1253-Method for Photoelectric Emission Spectrochemical Analysis of Iron and Steel

JIS G 1256-Method for X-Ray Fluorescent Spectrometric Analysis of Iron and Steel

JIS G 1257-Methods for Atomic Absorption Spectrochemical Analysis of Iron and Steel

JIS Z 2201-Test Pieces for Tensile Test for Metallic Materials

JIS Z 2202-Test Pieces for Impact Test for Metallic Materials

JIS Z 2241-Method of Tensile Test for Metallic Materials

JIS Z 2242-Method of Impact Test for Metallic Materials

JIS Z 2243-Method of Brinell Hardness Test

JIS Z 2244-Method of Vickers Hardness Test

JIS Z 2245-Method of Rockwell and Rockwell Superficial Hardness Test

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