

JIS

JAPANESE INDUSTRIAL STANDARD

Heat-resisting steel plates and sheets

☞ JIS G 4312—1991

Translated and Published

by

Japanese Standards Association

In the event of any doubt arising,
the original Standard in Japanese is to be final authority.

JAPANESE INDUSTRIAL STANDARD
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Heat-resisting steel plates and sheets

May, 1996

ERRATA

Page	Position	Wrong	Correct
19	Clause 8, in the 7th and 8th lines	...in Remarks of Table 18)...	...in Table 20)...
21	Clause 12, in the 2nd line from the bottom	...Table 5,...	...Table 3,...

Remarks: This errata is for correcting the first edition of this Standard.
Japanese Standards Association



JAPANESE INDUSTRIAL STANDARD

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Heat-resisting steel plates and sheets

G 4312-1991

1. Scope

This Japanese Industrial Standard specifies the heat-resisting steel plates and sheets (hereafter referred to as plates and sheets). The plates and sheets include those in strip (hereafter referred to as strip).

Further, the plates and sheets given in Table 1 with the symbol of SUS among classes specified in JIS G 4304 and JIS G 4305, may be used as heat-resisting steel, for which corrosion tests are not required.

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

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

ISO 4955-1983 Heat-resisting steels and alloys

2. Classes and symbols

The plates and sheets shall be classified into 28 classes, and their symbols and classification shall be as given in Table 1.

Table 1. Symbol of class and classification

Symbol of class	Classification	Symbol of class	Classification
SUH309	Austenitic series	SUS317	Austenitic series
SUH310		SUS321	
SUH330		SUS347	
SUH660		SUSXM151J1	
SUH661		SUS405	Ferritic series
SUH21	Ferritic series	SUS410L	
SUH409		SUS430	
SUH409L		SUS430J1L	
SUH446		SUS436J1L	
SUS302B	Austenitic series	SUS403	Martensitic series
SUS304		SUS410	
SUS309S		SUS630	Precipitation hardening series
SUS310S		SUS631	
SUS316			
SUS316Ti			

Remarks 1. Plates and sheets with the symbol of SUS shall be in accordance with JIS G 4304 and JIS G 4305.

2. In the case where it is necessary to indicate with a symbol that the products are plates or sheets, -HP (hot rolled steel plate or sheet) or -CP (cold rolled steel plate or sheet) shall be suffixed to the symbol of class.

Example: SUH 309-HP

3. In the case where it is necessary to indicate with a symbol that the product is strip, -HS (hot rolled steel strip) or -CS (cold rolled steel strip) shall be suffixed to the symbol of class.

Example: SUH409-CS.

3. Chemical composition

3.1 Ladle analysis Plates and sheets shall be subjected to the analytical test specified in 9.1, and the ladle analysis shall be as given in Tables 2 and 3.

3.2 Product analysis If required by the purchaser, plates and sheets shall be subjected to the analytical test of 9.1, and the values of permissible variation shall be as given in Table 4 of JIS G 0321. However, the values of the elements and chemical composition which are not specified in this table shall be as agreed upon between the parties concerned with delivery.

Table 2. Chemical composition of austenitic series

Symbol of class	C	Si	Mn	P	S	Ni	Cr	Mo	W	Co	Others
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 V 0.10 to 0.50 Al 0.35 max. B 0.001 to 0.010
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	2.00 to 3.00	18.50 to 21.00	N 0.10 to 0.20 Nb 0.75 to 1.25

Unit: %

Table 3. Chemical composition of ferritic series

Symbol of class	C	Si	Mn	P	S	Cr	N	Others	Unit: %
SUH21	0.10 max.	1.50 max.	1.00 max.	0.040 max.	0.030 max.	17.00 to 21.00	—	Al 2.00 to 4.00	
SUH409	0.08 max.	1.00 max.	1.00 max.	0.040 max.	0.030 max.	10.50 to 11.75	—	Ti 6 x C % to 0.75	
SUH409L	0.030 max.	1.00 max.	1.00 max.	0.040 max.	0.030 max.	10.50 to 11.75	—	Ti 6 x C % to 0.75	
SUH446	0.20 max.	1.00 max.	1.50 max.	0.040 max.	0.030 max.	23.00 to 27.00	0.25 max.	—	

Remarks 1. 0.60 % max. of Ni may be contained.

2. Alloying elements other than those given in Table 3 may be added to SUH 21, as required.

4. Mechanical properties

Plates and sheets shall be subjected to the mechanical test of 9.2 and the resultant mechanical properties shall be as follows.

- (1) Mechanical properties of austenitic series The proof stress, tensile strength, elongation, and hardness of solution treated plates and sheets and of the plates and sheets which are aging treated after solution treatment shall be as given in Table 4. The proof stress, however, shall apply only when designated by the purchaser.

Table 4. Mechanical properties in solution treated condition and in aging treated condition after solution treatment (austenitic series)

Symbol of class	Heat treatment		Proof stress N/mm ²	Tensile strength N/mm ²	Elongation %	Hardness		
	Classification	Symbol				HB	HRB	HV
SUH309	Solution treatment	S	205 min.	560 min.	40 min.	201 max.	95 max.	210 max.
SUH310		S	205 min.	590 min.	35 min.	201 max.	95 max.	210 max.
SUH330		S	205 min.	560 min.	35 min.	201 max.	95 max.	210 max.
SUH660	Solution treatment	S	—	730 min.	25 min.	192 max.	91 max.	202 max.
	Aging treatment after solution treatment	H	590 min.	900 min.	15 min.	248 min.	HRC 24 min.	261 max.
SUH661	Solution treatment	S	315 min.	690 min.	35 min.	248 max.	100 max.	261 max.
	Aging treatment after solution treatment	H	345 min.	760 min.	30 min.	192 min.	91 min.	202 min.

- (2) Mechanical properties of ferritic series The proof stress, tensile strength, elongation, hardness, and bendability of annealed plates and sheets shall be as given in Table 5. The proof stress, however, shall apply only when designated by the purchaser.

Further, for bendability, no crack shall be generated on the outside of the bent portion.

Table 5. Mechanical properties in annealed condition
(ferritic series)

Symbol of class	Proof stress N/mm ²	Tensile strength N/mm ²	Elongation %	Hardness			Bendability	
				HB	HRB	HV	Bending angle	Inside radius
SUH21	245 min.	440 min.	15 min.	210 max.	95 max.	220 max.	—	—
SUH409	175 min.	360 min.	22 min.	162 max.	80 max.	175 max.	180°	0.5 times the thickness for under 8 mm in thickness, 1.0 time the thickness for 8 mm or over in thickness
SUH409L	175 min.	360 min.	25 min.	162 max.	80 max.	175 max.	180°	
SUH446	275 min.	510 min.	20 min.	201 max.	95 max.	210 max.	135°	

5. Surface finish

The surface finish of plates and sheets shall be as given in Table 6.

Table 6. Surface finish

Symbol for surface finish	Remarks
No. 1	Finish by heat treatment, pickling or other equivalent treatments after hot rolling.
No. 2 D	Finish by heat treatment, pickling or other equivalent treatments after cold rolling, including finish by final light cold rolling with dull surfaced roll.
No. 2 B	Finish by final light cold rolling to obtain adequate luster surface after heat treatment, pickling or other equivalent treatment to cold rolled plates and sheets.

6. Shape, dimensions, mass, and tolerances thereon

6.1 Standard dimensions The standard dimensions shall be as given in Table 7.

Table 7. Standard dimensions

		Unit: mm
Thickness		Width x length
3.0	12.0	1000 x 2000
4.0	15.0	1219 x 2438
5.0	20.0	1219 x 3048
6.0	25.0	1500 x 3000
7.0	30.0	1524 x 3048
8.0	35.0	
9.0		
10.0		

6.2 Mass of plates and sheets The mass of plates and sheets is, as a rule, in accordance with JIS G 4310.

6.3 Tolerances on thickness of hot rolled steel plates and sheets Tolerances on the thickness of hot rolled steel plates and sheets shall be as follows.

- (1) Tolerances (symbol A) on thickness of hot rolled steel plates and sheets shall be as given in Table 8. However, the purchaser may designate the tolerances on thickness (symbol B) of Table 9.

Further, the position for measuring the thickness shall be an arbitrary point not less than 15 mm inward from the edge of the plate and sheet in case of the cut edged plates and sheets. In case of mill edge plates and sheets, it shall be an arbitrary point not less than 25 mm inward from the edge of the plate and sheet cut in a length from strip, and at any point inside the planned cutting line of width for other plates and sheets.

Table 8. Tolerances on thickness (hot rolled plates and sheets)
(Symbol A)

Unit: mm

Thickness	Width						
	Under 1000	1000 or over to and excl. 1250	1250 or over to and excl. 1600	1600 or over to and excl. 2000	2000 or over to and excl. 2500	2500 or over to and excl. 3150	3150 or over to and excl. 4000
2.50 or over to and excl. 3.15	± 0.25	± 0.30	± 0.35	—	—	—	—
3.15 or over to and excl. 4.00	± 0.30	± 0.35	± 0.40	—	—	—	—
4.00 or over to and excl. 5.00	± 0.38	± 0.40	± 0.45	± 0.60	± 0.80	± 1.0	—
5.00 or over to and excl. 6.00	± 0.45	± 0.45	± 0.50	± 0.70	± 0.90	± 1.1	—
6.00 or over to and excl. 8.00	± 0.55	± 0.60	± 0.60	± 0.75	± 1.0	± 1.2	± 1.4
8.00 or over to and excl. 10.0	± 0.65	± 0.65	± 0.65	± 0.80	± 1.2	± 1.5	± 1.6
10.0 or over to and excl. 16.0	± 0.70	± 0.70	± 0.70	± 0.85	± 1.2	± 1.5	± 1.6
16.0 or over to and excl. 25.0	± 0.80	± 0.80	± 0.80	± 0.95	± 1.3	± 1.5	± 1.6
25.0 or over to and excl. 40.0	± 0.90	± 0.90	± 0.90	± 1.1	± 1.3	± 1.5	± 1.6
40.0 or over to and excl. 63.0	± 1.0	± 1.0	± 1.2	± 1.2	± 1.4	± 1.5	± 1.6
63.0 or over to and excl. 100	± 1.1	± 1.2	± 1.3	± 1.3	± 1.5	± 1.6	± 1.7

Table 8 (Continued)

Unit: mm

Thickness	Width						
	Under 1000	1000 or over to and excl. 1250	1250 or over to and excl. 1600	1600 or over to and excl. 2000	2000 or over to and excl. 2500	2500 or over to and excl. 3150	3150 or over to and excl. 4000
100 or over to and excl. 160	± 1.3	± 1.3	± 1.4	± 1.4	± 1.6	± 1.7	± 1.8
160 or over to and excl. 200	± 1.6	± 1.6	± 1.7	± 1.7	± 1.9	± 2.0	± 2.1

Table 9. Tolerances on thickness (hot rolled plates and sheets)
(Symbol B)

Unit: mm

Thickness	Width						
	Under 1000	1000 or over to and excl. 1250	1250 or over to and excl. 1600	1600 or over to and excl. 2000	2000 or over to and excl. 2500	2500 or over to and excl. 3150	3150 or over to and excl. 4000
2.50 or over to and excl. 3.15	+0.25	+0.35	+0.45	—	—	—	—
3.15 or over to and excl. 4.00	+0.35	+0.45	+0.55	—	—	—	—
4.00 or over to and excl. 5.00	+0.51	+0.55	+0.65	+0.95	+1.35	+1.75	—
5.00 or over to and excl. 6.00	+0.65	+0.65	+0.75	+1.15	+1.55	+1.95	—
6.00 or over to and excl. 8.00	+0.85	+0.95	+0.95	+1.25	+1.75	+2.15	+2.55
8.00 or over to and excl. 10.0	+1.05	+1.05	+1.05	+1.35	+2.15	+2.75	+2.95

Table 9 (Continued)

Unit: mm

Thickness	Width						
	Under 1000	1000 or over to and excl. 1250	1250 or over to and excl. 1600	1600 or over to and excl. 2000	2000 or over to and excl. 2500	2500 or over to and excl. 3150	3150 or over to and excl. 4000
10.0 or over to and excl. 16.0	+1.15	+1.15	+1.15	+1.45	+2.15	+2.75	+2.95
16.0 or over to and excl. 25.0	+1.35	+1.35	+1.35	+1.65	+2.35	+2.75	+2.95
25.0 or over to and excl. 40.0	+1.55	+1.55	+1.55	+1.95	+2.35	+2.75	+2.95
40.0 or over to and excl. 63.0	+1.75	+1.75	+2.15	+2.15	+2.55	+2.75	+2.95
63.0 or over to and excl. 100	+1.95	+2.15	+2.35	+2.35	+2.75	+2.95	+3.15
100 or over to and excl. 160	+2.35	+2.35	+2.55	+2.55	+2.95	+3.15	+3.35
160 or over to and excl. 200	+2.95	+2.95	+3.15	+3.15	+3.55	+3.75	+3.95

Remarks: Tolerances on the minus side shall be 0.25 mm.

- (2) In the case where the mass of plates and sheets is calculated using Table 9, the indicated thickness adding the numerical value given in Table 10 shall be used instead of the indicated thickness.

Table 10. Additional value to be used for calculation of mass

Unit: mm

Thickness	Width						
	Under 1000	1000 or over to and excl. 1250	1250 or over to and excl. 1600	1600 or over to and excl. 2000	2000 or over to and excl. 2500	2500 or over to and excl. 3150	3150 or over to and excl. 4000
2.50 or over to and excl. 3.15	0	0.05	0.10	—	—	—	—
3.15 or over to and excl. 4.00	0.05	0.10	0.15	—	—	—	—
4.00 or over to and excl. 5.00	0.13	0.15	0.20	0.35	0.55	0.75	—
5.00 or over to and excl. 6.00	0.20	0.20	0.25	0.45	0.65	0.85	—
6.00 or over to and excl. 8.00	0.30	0.35	0.35	0.50	0.75	0.95	1.15
8.00 or over to and excl. 10.0	0.40	0.40	0.40	0.55	0.95	1.25	1.35
10.0 or over to and excl. 16.0	0.45	0.45	0.45	0.60	0.95	1.25	1.35
16.0 or over to and excl. 25.0	0.55	0.55	0.55	0.70	1.05	1.25	1.35
25.0 or over to and excl. 40.0	0.65	0.65	0.65	0.85	1.05	1.25	1.35
40.0 or over to and excl. 63.0	0.75	0.75	0.95	0.95	1.15	1.25	1.35

Table 10 (Continued)

Unit: mm

Thickness	Width						
	Under 1000	1000 or over to and excl. 1250	1250 or over to and excl. 1600	1600 or over to and excl. 2000	2000 or over to and excl. 2500	2500 or over to and excl. 3150	3150 or over to and excl. 4000
63.0 or over to and excl. 100	0.85	0.95	1.05	1.05	1.25	1.35	1.45
100 or over to and excl. 160	1.05	1.05	1.15	1.15	1.35	1.45	1.55
160 or over to and excl. 200	1.35	1.35	1.45	1.45	1.65	1.75	1.85

6.4 Tolerances on thickness of cold rolled steel plates and sheets

Tolerances on the thickness of cold rolled steel plates and sheets shall be as given in Table 11. However, the purchaser may designate the tolerances on thickness (symbol ET) of Table 12.

Further, the measuring point of thickness shall be an arbitrary point not less than 15 mm inward from the edge of the plate and sheet.

Table 11. Tolerances on thickness (cold rolled plates and sheets)

Unit: mm

Thickness	Width	
	Under 1250	1250 or over to and excl. 1600
0.30 or over to and excl. 0.60	± 0.05	± 0.08
0.60 or over to and excl. 0.80	± 0.07	± 0.09
0.80 or over to and excl. 1.00	± 0.09	± 0.10
1.00 or over to and excl. 1.25	± 0.10	± 0.12
1.25 or over to and excl. 1.60	± 0.12	± 0.15
1.60 or over to and excl. 2.00	± 0.15	± 0.17
2.00 or over to and excl. 2.50	± 0.17	± 0.20
2.50 or over to and excl. 3.15	± 0.22	± 0.25
3.15 or over to and excl. 4.00	± 0.25	± 0.30
4.00 or over to and excl. 5.00	± 0.35	± 0.40
5.00 or over to and excl. 6.00	± 0.40	± 0.45
6.00 or over to and excl. 8.00	± 0.50	± 0.50
8.00 or over to and excl. 10.0	± 0.60	± 0.60
10.0 or over to and excl. 16.0	± 0.70	± 0.70
16.0 or over to and excl. 25.0	± 0.80	± 0.80

Table 12. Tolerances on thickness (cold rolled steel plates and sheets)
(Symbol ET)

Unit: mm

Thickness	Width					
	Under 160	160 or over to to and excl. 250	250 or over to to and excl. 400	400 or over to to and excl. 630	630 or over to to and excl. 1000	1000 or over to to and excl. 1250
Under 0.10	± 0.010	± 0.020	—	—	—	—
0.10 or over to and excl. 0.16	± 0.015	± 0.020	—	—	—	—
0.16 or over to and excl. 0.25	± 0.020	± 0.025	± 0.030	± 0.030	—	—
0.25 or over to and excl. 0.40	± 0.025	± 0.030	± 0.035	± 0.035	± 0.038	± 0.038
0.40 or over to and excl. 0.60	± 0.035	± 0.040	± 0.040	± 0.040	± 0.040	± 0.040
0.60 or over to and excl. 0.80	± 0.040	± 0.045	± 0.045	± 0.045	± 0.05	± 0.05
0.80 or over to and excl. 1.00	± 0.040	± 0.05	± 0.05	± 0.05	± 0.05	± 0.06
1.00 or over to and excl. 1.25	± 0.05	± 0.05	± 0.05	± 0.06	± 0.06	± 0.07
1.25 or over to and excl. 1.60	± 0.05	± 0.06	± 0.06	± 0.06	± 0.07	± 0.08
1.60 or over to and excl. 2.00	± 0.06	± 0.07	± 0.08	± 0.08	± 0.09	± 0.10
2.00 or over to and excl. 2.50	± 0.07	± 0.08	± 0.08	± 0.09	± 0.10	± 0.11
2.50 or over to and excl. 3.15	± 0.08	± 0.09	± 0.09	± 0.10	± 0.11	± 0.12
3.15 or over to and excl. 4.00	± 0.09	± 0.10	± 0.10	± 0.11	± 0.12	± 0.13

6.5 Tolerances on width of plates and sheets Tolerances on the width of plates and sheets shall be as given in Table 13 for cut edged plates and sheets, and it shall be as given in Table 14 for mill edged plates and sheets. The purchaser, however, may designate the tolerances on width (symbol EW) of Table 15 in the case of cold rolling.

Table 13. Tolerances on width of cut edged plates and sheets

Classification by cutting method	Width Length		Under 2000			2000 or over		
			3500 or under	Over 3500 up to and incl. 6000	Over 6000	3500 or under	Over 3500 up to and incl. 6000	Over 6000
Mechanical cutting	Thickness							
	Under 10.0		+5 0	+15 0	+20 0	+15 0	+15 0	+25 0
	10.0 or over to and excl. 20.0		+10 0	+20 0	+20 0	+20 0	+20 0	+25 0
Flame cutting	20.0 or over up to and incl. 28.0		+15 0	+20 0	+20 0	+20 0	+20 0	+25 0
	2.50 or over to and excl. 100		+5 to +30	+5 to +45	+5 to +55	+5 to +45	+5 to +50	+5 to +60
	100 or over to and excl. 200		+5 to +60	+5 to +60	+5 to +60	+5 to +60	+5 to +60	+5 to +60

Unit: mm

Table 14. Tolerances on width of mill edged plates and sheets

Unit: mm		
Width	Cut plate and sheet from mill edged strip	Steel plate and sheet as rolled
Under 100	± 1	—
100 or over to and excl. 250	± 2	—
250 or over to and excl. 400	± 5	+ not specified 0
400 or over to and excl. 630	+20 0	+ not specified 0
630 or over to and excl. 1000	+25 0	+ not specified 0
1000 or over	+30 0	+ not specified 0

Table 15. Tolerances on width (cold rolled plates and sheets)
(symbol EW)

Unit: mm					
Thickness	Width				
	Under 160	160 or over to and excl. 250	250 or over to and excl. 400	400 or over to and excl. 630	630 or over to and excl. 1000
Under 0.60	± 0.15	± 0.20	± 0.25	± 0.30	± 0.50
0.60 or over to and excl. 1.00	± 0.20	± 0.25	± 0.25	± 0.30	± 0.50
1.00 or over to and excl. 1.60	± 0.20	± 0.30	± 0.30	± 0.40	± 0.60
1.60 or over to and excl. 2.50	± 0.25	± 0.35	± 0.35	± 0.50	± 0.70
2.50 or over to and excl. 4.00	± 0.30	± 0.40	± 0.40	± 0.50	± 0.80

6.6 Tolerances on lengths of plates and sheets Tolerances on the lengths of plates and sheets shall be as given in Table 16.

Unit: mm

Classification by cutting method	<i>Length</i>		<i>Width</i>		<i>Thickness</i>		Over 3500 up to and incl. 6000		Over 6000	
							Under 2000	2000 or over	Under 2000	2000 or over
Mechanical cutting	Under 10.0						+10 0	+15 0	+30 0	+35 0
	10.0 or over to and excl. 20.0						+15 0	+20 0	+35 0	+40 0
	20.0 or over up to and incl. 28.0						+15 0	+20 0	+35 0	+40 0
Flame cutting	2.50 or over to and excl. 100						+ 5 to +30	+ 5 to +45	+ 5 to +60	+ 5 to +60
	100 or over to and excl. 200						+ 5 to +60	+ 5 to +60	+ 5 to +60	+ 5 to +60

6.7 Flatness for plates and sheets The maximum value for flatness of plates and sheets shall be as given in Table 17.

Further, the purchaser may designate the flatness of symbol EF.

Table 17. Maximum value of flatness of plates and sheets

Unit: mm

Width	Length	Maximum value of flatness	Maximum value of flatness (symbol EF)
1000 or under	2000 or under	15	3
	Over 2000	20	6
Over 1000 up to and incl. 1600	2000 or under	20	6
	Over 2000	20	6
Over 1600 up to and incl. 2000	2000 or under	25	—
	Over 2000	35	—
Over 2000 up to and incl. 2500	Over 2000	40	—
Over 2500 up to and incl. 3150	Over 2500	45	—
Over 3150	Over 3150	50	—

Remarks 1. Table 17 applies to 3500 mm in length optionally taken. In the case of under 3500 mm in length, Table 17 shall apply to full length.

2. Table 17 applies to the plates and sheets cut in a length from mill edge strip and to the cut edged plates and sheets.

6.8 Shapes, dimensions, and tolerances thereon of strip The shapes, dimensions and tolerances thereon of strip shall be in accordance with 7. (shapes, dimensions, mass and tolerances) of JIS G 4304 or 7. (shapes, dimensions, mass, and tolerances) of JIS G 4305.

7. Appearance

Plates and sheets shall be free from defects detrimental to practical use. However, strip may include some irregular parts, since there is no opportunity in general to remove such defective parts.

8. Manufacturing method

After hot rolling or cold rolling, plates and sheets shall be heat-treated in accordance with Table 18 or Table 19 and shall be put to pickling or other equivalent process. Thereafter, they shall be suitably levelled, if necessary.

Further, treatments such as pickling or the like may be omitted as agreed upon between the parties concerned with delivery. However, as for the heat treatment of SUH 660 and SUH 661, the purchaser shall preliminarily designate the class of heat treatment (heat treatment symbol in Remark of Table 18) and also designate either the plates and sheets themselves or the test piece to be heat treated.

The manufacturer may vary the upper limit of the temperature range as given in Table 18 and Table 19 in order to obtain specific mechanical properties if necessary.

Further, symbols for heat treatment shall be as given in Table 20.

Table 18. Heat treatment of austenitic series

Symbol of class	Heat treatment °C	
	Solution treatment	Aging treatment
SUH 309	1030 to 1150 rapid cooling	—
SUH 310	1030 to 1180 rapid cooling	—
SUH 330	1030 to 1180 rapid colling	—
SUH 660	965 to 995 rapid cooling	700 to 760 x 16 h air cooling or slow cooling
SUH 661	1130 to 1200 rapid cooling	780 to 830 x 4 h air cooling or slow cooling

Table 19. Heat treatment of ferritic series

Symbol of class	Annealing °C
SUH 21	780 to 950 rapid cooling or slow cooling
SUH 409	780 to 950 rapid cooling or slow cooling
SUH 409 L	780 to 950 rapid cooling or slow cooling
SUH 446	780 to 880 rapid cooling

Table 20. Symbols for heat treatment

Heat treatment method	Symbol
Solution treatment	S
Aging treatment after solution treatment	H

9. Tests

9.1 Analytical test The analytical test shall be as follows.

- (1) General matters for analytical test and the sampling method for ladle analysis shall be in accordance with 3. (chemical composition) of JIS G 0303.
- (2) The sampling method for product analysis shall be in accordance with 3. (sampling method for analysis) of JIS G 0321. Further, a tensile test piece after rupture may be used as a specimen.
- (3) The analytical method shall comply 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 1220, JIS G 1221, JIS G 1222, JIS G 1223, JIS G 1224, JIS G 1227, JIS G 1228, JIS G 1237, JIS G 1253, JIS G 1256, JIS G 1257

9.2 Mechanical test

9.2.1 Tests in general General matters for mechanical tests shall be in accordance with 4. (mechanical properties) of JIS G 0303.

9.2.2 Sampling of test specimen One test specimen shall be sampled for each lot of the same ladle steel under the same heat treatment conditions.

9.2.3 Number of test pieces As to the number of test pieces, one test piece shall be taken from each test specimen.

9.2.4 Test piece The tensile test piece, hardness test piece, and bend test piece shall be as follows:

- (1) For the tensile test piece, any one of No. 10 test piece, No. 13 B test piece, No. 14 A test piece, and No. 14 B test piece of JIS Z 2201 shall be used.
Further, No. 4 test piece or No. 5 test piece may be used.
- (2) For the hardness test piece, a part of the tensile test piece or bend test piece may be used.
- (3) For the bend test piece, No. 3 test piece or No. 5 test piece of JIS Z 2204 shall be used.

9.2.5 Test methods The methods for tensile test, hardness test, and bend test shall be as follows:

- (1) The tensile test method shall be in accordance with JIS Z 2241. However, a test temperature of $20 \pm 5^{\circ}\text{C}$ shall be made a standard, and for measurement of tensile strengths of plates and sheets, a tension speed at which the strain increasing rate of the parallel part of a test piece attains 40 to 80 % per minute shall be selected.
- (2) The hardness test method shall be in accordance with any one of the following standards. However, a test temperature of $20 \pm 5^{\circ}\text{C}$ shall be made a standard.
- (3) The bend test method shall be in accordance with JIS Z 2248. However, a test temperature of $20 \pm 5^{\circ}\text{C}$ shall be made a standard.

10. Inspection

The inspection for plates, sheets, and strip 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.
- (4) The shape and dimensions shall conform to the requirements specified in 6.
- (5) The appearance shall conform to the requirements specified in 7.
- (6) The purchaser may require a high temperature tensile test. However, the test method in this case shall be executed in accordance with JIS G 0567 and the criterion for acceptance or rejection shall be as agreed upon between the parties concerned with delivery.

11. Marking

The plates and sheets having passed the inspection shall be legibly marked on each plate and sheet or each bundle (package) with the following items. However, a part of the items may be omitted as agreed upon between the parties concerned with delivery.

- (1) Symbol of class
- (2) Dimensions
- (3) Symbol of tolerance (the tolerance symbols expressed by B, ET, EW and EF shall be clearly indicated.)
- (4) Symbol for surface finish
- (5) Symbol of heat treatment (exclusively for SUH 660 and SUH 661.)
- (6) Manufacturer's name or its abbreviation
- (7) Ladle number or inspection number

12. Report

The manufacturer shall submit to the purchaser the reports on the results of the tests specified or designated and, as required, on dimensions, quantity, delivery condition, etc. of plates, sheets or strips.

Further, in the case where alloying elements are added according to Remarks of Table 5, the contents of added elements shall be appended to the test report.

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 0567-Method of High Temperature Tensile Test for Steels and Heat-Resisting Alloys
- 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 1220-Methods for Determination of Tungsten in Iron and Steel
- JIS G 1221-Methods for Determination of Vanadium in Iron and Steel
- JIS G 1222-Methods for Determination of Cobalt 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 1227-Methods for Determination of Boron in Iron and Steel
- JIS G 1228-Methods for Determination of Nitrogen in Iron and 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 Fluorescence Spectrometric Analysis of Iron and Steel
- JIS G 1257-Methods for Atomic Absorption Spectrochemical Analysis of Iron and Steel
- JIS G 4304-Hot Rolled Stainless Steel Plates and Sheets
- JIS G 4305-Cold Rolled Stainless Steel Plates and Sheets
- JIS G 4310-Method of Mass Calculation of Stainless Steel Plates and Sheets

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

JIS Z 2204-Bend Test Pieces for Metallic Materials

JIS Z 2241-Method of Tensile 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

JIS Z 2248-Method of Bend Test for Metallic Materials

Reference Standard:

ISO 2604-4: 1975 Steel products for pressure purposes -
Quality requirements - Part 4: Plates

G 4312-1991
Edition 1

Japanese Text

Established by Minister of International Trade and Industry

Date of Establishment: 1964-09-01

Date of Revision: 1991-11-01

Date of Public Notice in Official Gazette: 1991-11-02

Investigated by: Japanese Industrial Standards Committee

Divisional Council on Iron and Steel

This English translation is published by:
Japanese Standards Association
1-24, Akasaka 4, Minato-ku,
Tokyo 107 Japan
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Printed in Tokyo by
Hohbunsha Co., Ltd.

