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(JSSA/JSA)

**Corrosion-resistant and heat-resistant
superalloy, nickel and nickel alloy —
Plate, sheet and strip**

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Foreword

This Japanese Industrial Standard has been revised by the Minister of Economy, Trade and Industry through deliberations at the Japanese Industrial Standards Committee as the result of proposal for revision of Japanese Industrial Standard submitted by Japan Stainless Steel Association (JSSA)/Japanese Standards Association (JSA) with a draft being attached, based on the provision of Article 12, paragraph (1) of the Industrial Standardization Act applied mutatis mutandis pursuant to the provision of Article 16 of the said Act. This edition replaces the previous edition (**JIS G 4902:1991**), which has been technically revised, and **JIS H 4551:2000**, which has been withdrawn.

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It should be noted that being in conformance with this Standard may come under the use of the patent rights and other rights held by the following:

Symbol of grade	Patent holder	Title of invention	Patent number	Registration date of establishment of patent right
NCF354	Nippon Yakin Kogyo Co., Ltd.	Stainless steel for use in environments containing organic acids and salt	4325141	19 June 2009
NCF020	Nippon Yakin Kogyo Co., Ltd.	Fe-Ni-Cr alloy superior in sulfuric acid corrosion resistance, intergranular corrosion resistance and surface properties, and method for producing the same	5950306	17 June 2016
NW6210	Hitachi Metals, Ltd.	Ni-base alloy with excellent hot forgeability and corrosion resistance	5725630	10 April 2015

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NOTE Based on Article 9 of the Supplementary Provisions to the Unfair Competition Prevention Act etc., any submission of proposal, or employment of procedures such as deliberation by the Japanese Industrial Standards Committee under the previous Industrial Standardization Act shall be deemed to have been conducted pursuant to the provision of Article 12, paragraph (1) of the revised Industrial Standardization Act.

Corrosion-resistant and heat-resistant superalloy, nickel and nickel alloy — Plate, sheet and strip

1 Scope

This Japanese Industrial Standard specifies requirements for corrosion-resistant and heat-resistant superalloy, nickel and nickel alloy plates and sheets (hereafter referred to as plates and sheets) and strips (hereafter referred to as strips) manufactured by hot-rolling or cold-rolling.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this Standard. The most recent editions of the standards (including amendments) indicated below shall be applied.

- JIS G 0320 *Standard test method for heat analysis of steel products*
- JIS G 0321 *Product analysis and its tolerance for wrought steel*
- JIS G 0404 *Steel and steel products — General technical delivery requirements*
- JIS G 0415 *Steel and steel products — Inspection documents*
- JIS G 0551 *Steels — Micrographic determination of the apparent grain size*
- JIS G 0567 *Method of elevated temperature tensile test for steels and heat-resisting alloys*
- JIS G 0802 *Ultrasonic testing of stainless steel plates*
- JIS H 1270 *Nickel and nickel alloys — Sampling and general rules for analytical methods*
- JIS Z 2241 *Metallic materials — Tensile testing — Method of test at room temperature*
- JIS Z 2243-1 *Brinell hardness test — Part 1 : Test method*
- JIS Z 2244 *Vickers hardness test — Test method*
- JIS Z 2245 *Rockwell hardness test — Test method*
- JIS Z 2343-1 *Non-destructive testing — Penetrant testing — Part 1 : General principles — Method for liquid penetrant testing and classification of the penetrant indication*

3 Symbol of grade

Plates, sheets, and strips are classified into 27 grades. The classification and the symbols of grades shall be as given in Table 1.

Table 1 Classification and symbols of grades

Classification	Symbols of grades ^{a), b), c), d)}	Classification	Symbols of grades ^{a), b), c), d)}
Corrosion-resistant and heat-resistant superalloy (NCF)	NCF600	Nickel and nickel alloy (NW)	NW2200
	NCF601		NW2201
	NCF625		NW4400
	NCF690		NW4402
	NCF718		NW5500
	NCF750		NW0001
	NCF751		NW0665
	NCF80A		NW0276
	NCF800		NW6455
	NCF800H		NW6022
	NCF825		NW6210
	NCF020		NW6007
	NCF354		NW6985
			NW6002
Notes ^{a)} To indicate as necessary that the product is a hot-rolled plate or sheet, the symbol “-HP” shall be attached after the symbol of grade. Example 1 NCF600-HP			
^{b)} To indicate as necessary that the product is a hot-rolled strip, the symbol “-HS” shall be attached after the symbol of grade. Example 2 NCF600-HS			
^{c)} To indicate as necessary that the product is a cold-rolled plate or sheet, the symbol “-CP” shall be attached after the symbol of grade. Example 3 NCF600-CP			
^{d)} To indicate as necessary that the product is a cold-rolled strip, the symbol “-CS” shall be attached after the symbol of grade. Example 4 NCF600-CS			

4 Manufacturing process

The manufacturing process shall be as follows.

- a) After hot rolling or cold rolling, plates, sheets, and strips shall be heat treated, and then subjected to pickling or other similar treatment. The products may subsequently receive straightening, grinding, temper rolling or a combination of these treatments as required. Heat treatment after hot rolling may be omitted upon agreement between the purchaser and the manufacturer, in which case the product shall be marked with the symbol “AR”. For products given bright heat treatment, the pickling or other treatment may be omitted upon agreement between the purchaser and the manufacturer.

Delivery conditions shall be designated by the symbols given in Table 2. Typical heat treatment conditions are provided in Annex A for reference.

- b) For steel grades NCF601, NCF625, NCF718, NCF750, NCF751, NCF80A, and NW5500, the purchaser shall specify one of the symbols for delivery condition specified in Table 2, as well as whether the heat treatment is given on the product itself

or on the test piece.

Table 2 Symbols for delivery condition

Condition	Symbol
As rolled	AR
Solution treated	S, S1, S2
Annealed	A
Solution treated and aged	H, H1, H2
Hot rolled and aged	H3, H4

5 Chemical composition

5.1 Heat analysis values

When subjected to the analysis specified in **12.1**, the steel shall show the composition shown in Table 3.

5.2 Product analysis values

When requested by the purchaser, the plates, sheets, and strips shall be subjected to the analysis specified in **12.1**, and satisfy the given requirements within the tolerances agreed between the purchaser and the manufacturer.

6 Mechanical properties

6.1 Heat treated plates, sheets, and strips

When tested in accordance with **12.2**, the heat treated plates, sheets, and strips shall satisfy the requirements for mechanical properties specified in Tables 4 and 5. For the following products, the necessity of mechanical tests and required properties values shall be agreed between the purchaser and the manufacturer.

- a) Products with a thickness outside the applicable thickness range
- b) Products given other heat treatment than shown in Tables 4 and 5

6.2 As-rolled plates, sheets, and strips

For the plates, sheets and strips supplied as rolled (without heat treatment after hot-rolling), the necessity of mechanical tests and required properties values shall be agreed between the purchaser and the manufacturer.

NOTE This Standard does not specify requirements for mechanical properties of products which are heat treated after shipment from the manufacturer.

Table 3 Chemical composition

Symbol of grade	C	Si	Mn	P	S	Ni	Cr	Fe	Mo	Co	Cu	W	Al	Ti	Nb+Ta	Ta	V	B	N
NCF600	0.15 max.	0.50 max.	1.00 max.	0.030 max.	0.015 max.	72.00 min. ^{a)}	14.00 to 17.00	6.00 to 10.00	—	—	0.50 max.	—	—	—	—	—	—	—	—
NCF601	0.10 max.	0.50 max.	1.00 max.	0.030 max.	0.015 max.	58.00 to 63.00	21.00 to 25.00	Re-mainder	—	—	1.00 max.	—	1.00 to 1.70	—	—	—	—	—	—
NCF625	0.10 max.	0.50 max.	0.50 max.	0.015 max.	0.015 max.	58.00 min. ^{a)}	20.00 to 23.00	5.00 max.	8.00 to 10.00	—	—	—	0.40 max.	0.40 max.	3.15 to 4.15	—	—	—	—
NCF690	0.05 max.	0.50 max.	0.50 max.	0.030 max.	0.015 max.	58.00 min. ^{a)}	27.00 to 31.00	7.00 to 11.00	—	—	0.50 max.	—	—	—	—	—	—	—	—
NCF718	0.08 max.	0.35 max.	0.35 max.	0.015 max.	0.015 max.	50.00 to 55.00	17.00 to 21.00	Re-mainder	2.80 to 3.30	—	0.30 max.	—	0.20 to 0.80	0.65 to 1.15	4.75 to 5.50	—	—	0.006 max.	—
NCF750	0.08 max.	0.50 max.	1.00 max.	0.030 max.	0.015 max.	70.00 min. ^{a)}	14.00 to 17.00	5.00 to 9.00	—	—	0.50 max.	—	0.40 to 1.00	2.25 to 2.75	0.70 to 1.20	—	—	—	—
NCF751	0.10 max.	0.50 max.	1.00 max.	0.030 max.	0.015 max.	70.00 min. ^{a)}	14.00 to 17.00	5.00 to 9.00	—	—	0.50 max.	—	0.90 to 1.50	2.00 to 2.60	0.70 to 1.20	—	—	—	—
NCF80A	0.04 to 0.10	1.00 max.	1.00 max.	0.030 max.	0.015 max.	Re-mainder	18.00 to 21.00	1.50 max.	—	2.00 max.	0.20 max.	—	1.00 to 1.80	1.80 to 2.70	—	—	—	—	—
NCF800	0.10 max.	1.00 max.	1.50 max.	0.030 max.	0.015 max.	30.00 to 35.00	19.00 to 23.00	Re-mainder	—	—	0.75 max.	—	0.15 to 0.60	0.15 to 0.60	—	—	—	—	—

Unit : %

Table 3 (continued)

Symbol of grade	Unit : %													
	C	Si	Mn	P	S	Ni	Cr	Fe	Mo	Co	Cu	W	Al	Ti
NCF800H	0.05 to 0.10	1.00 max.	1.50 max.	0.030 max.	0.015 max.	30.00 to 35.00	19.00 to 23.00	Re-mainder	—	—	0.75 max.	—	0.15 to 0.60	0.15 to 0.60
NCF825	0.05 max.	0.50 max.	1.00 max.	0.030 max.	0.015 max.	38.00 to 46.00	19.50 to 23.50	Re-mainder	2.50 to 3.50	—	1.50 to 3.00	—	0.20 max.	0.60 to 1.20
NCF020	0.07 max.	1.00 max.	2.00 max.	0.045 max.	0.035 max.	32.00 to 38.00	19.00 to 21.00	Re-mainder	2.00 to 3.00	—	3.00 to 4.00	—	—	—
NCF354	0.030 max.	1.00 max.	1.00 max.	0.030 max.	0.010 max.	34.00 to 36.00	22.00 to 24.00	Re-mainder	7.00 to 8.00	—	—	—	—	—
NW2200	0.15 max.	0.35 max.	0.35 max.	—	0.010 max.	99.00 min. ^{b)}	—	0.40 max.	—	—	0.25 max.	—	—	—
NW2201	0.020 max.	0.35 max.	0.35 max.	—	0.010 max.	99.00 min. ^{b)}	—	0.40 max.	—	—	0.25 max.	—	—	—
NW4400	0.30 max.	0.50 max.	2.00 max.	—	0.024 max.	63.00 min. ^{a)}	—	2.50 max.	—	—	28.00 to 34.00	—	—	—
NW4402	0.04 max.	0.50 max.	2.00 max.	—	0.025 max.	63.00 min. ^{a)}	—	2.50 max.	—	—	28.00 to 34.00	—	—	—
NW5500	0.25 max.	0.50 max.	1.50 max.	—	0.010 max.	63.00 min. ^{a)}	—	2.00 max.	—	—	27.00 to 34.00	—	2.30 to 3.15	0.35 to 0.85
NW0001	0.05 max.	1.00 max.	1.00 max.	0.040 max.	0.030 max.	Re-mainder	1.00 max.	4.00 to 6.00	26.00 to 30.00	2.50 max.	—	—	—	0.20 to 0.40

Table 3 (concluded)

Symbol of grade	C	Si	Mn	P	S	Ni	Cr	Fe	Mo	Co	Cu	W	Al	Ti	Nb+Ta	Ta	V	B	N
NW0665	0.020 max.	0.10 max.	1.00 max.	0.040 max.	0.030 max.	Re-mainder	1.00 max.	2.00 max.	26.00 to 30.00	1.00 max.	—	—	—	—	—	—	—	—	—
NW0276	0.010 max.	0.08 max.	1.00 max.	0.040 max.	0.030 max.	Re-mainder	14.50 to 16.50	4.00 to 7.00	15.00 to 17.00	2.50 max.	—	3.00 to 4.50	—	—	—	—	0.35 max.	—	—
NW6455	0.015 max.	0.08 max.	1.00 max.	0.040 max.	0.030 max.	Re-mainder	14.00 to 18.00	3.00 max.	14.00 to 17.00	2.00 max.	—	—	—	0.70 max.	—	—	—	—	—
NW6022	0.015 max.	0.08 max.	0.50 max.	0.020 max.	0.020 max.	Re-mainder	20.00 to 22.50	2.00 to 6.00	12.50 to 14.50	2.50 max.	—	2.50 to 3.50	—	—	—	—	0.35 max.	—	—
NW6210	0.015 max.	0.08 max.	0.50 max.	0.020 max.	0.020 max.	Re-mainder	18.00 to 20.00	1.00 max.	18.00 to 20.00	1.00 max.	—	—	—	—	—	1.50 to 2.20	0.35 max.	—	—
NW6007	0.05 max.	1.00 max.	1.00 to 2.00	0.040 max.	0.030 max.	Re-mainder	21.00 to 23.50	18.00 to 21.00	5.50 to 7.50	2.50 max.	1.50 to 2.50	1.00 max.	—	—	1.75 to 2.50	—	—	—	—
NW6985	0.015 max.	1.00 max.	1.00 max.	0.040 max.	0.030 max.	Re-mainder	21.00 to 23.50	18.00 to 21.00	6.00 to 8.00	5.00 max.	1.50 to 2.50	1.50 max.	—	—	0.50 max.	—	—	—	—
NW6002	0.05 to 0.15	1.00 max.	1.00 max.	0.040 max.	0.030 max.	Re-mainder	20.50 to 23.00	17.00 to 20.00	8.00 to 10.00	0.50 to 2.50	—	0.20 to 1.00	—	—	—	—	—	—	—
Notes a) For Ni limit for NCF600, NCF625, NCF690, NCF750, NCF751, NW4400, NW4402, and NW5500, a value obtained by subtracting the total of other elements from 100 may apply.																			
b) For Ni limit for NW2200 and NW2201, a value obtained by subtracting the total of other elements from 100 applies.																			