NAS 825 (UNS N08825)

NAS High Corrosion Resistant Nickel Alloy

NAS 825 (NCF 825, UNS N08825) is a high-Ni nickel alloy with high corrosion resistance, and possesses extremely high corrosion resistance against oxidizing and non-oxidizing acids. Nippon Yakin supplies this product in plate, sheet and strip form.

Steel Grade/Standard

NAS	JIS G4902	ASTM B424	DIN 17750
NAS 825	NCF 825	UNS N08825	2.4858

Chemical Composition

[wt %]

	C	Si	Mn	P	S	Ni	Cr	Fe	Mo	Cu	Al	Ti
Specification (NCF 825)	≦0.05	≦0.50	≦1.00	≦0.030	≦0.015	38.00~46.00	19.50~23.50	Bal.	2.50~3.50	1.50~3.00	≦0.20	0.60~1.20
Specification (UNS N08825)	≦0.05	≦0.5	≦1.0	—	≦0.03	38.0~46.0	19.5~23.5	≧22.0	2.5~3.5	1.5~3.0	≦0.2	0.6~1.2

Physical Properties

Density	[g/cm³]		8.14
Specific heat	[J/kg · K]	20°C	444
Electrical resistivity	[μΩ · cm]		112
Thermal conductivity	[W/m · K]		10.9
Average coefficient of thermal expansion	[10^{-6}/°C]	20~100°C	13.4
		20~200°C	14.1
		20~500°C	15.1
		20~900°C	16.9
Young's modulus	[MPa]		19.7 × 10^4
Magnetism			None
Melting range	[°C]		1370~1400

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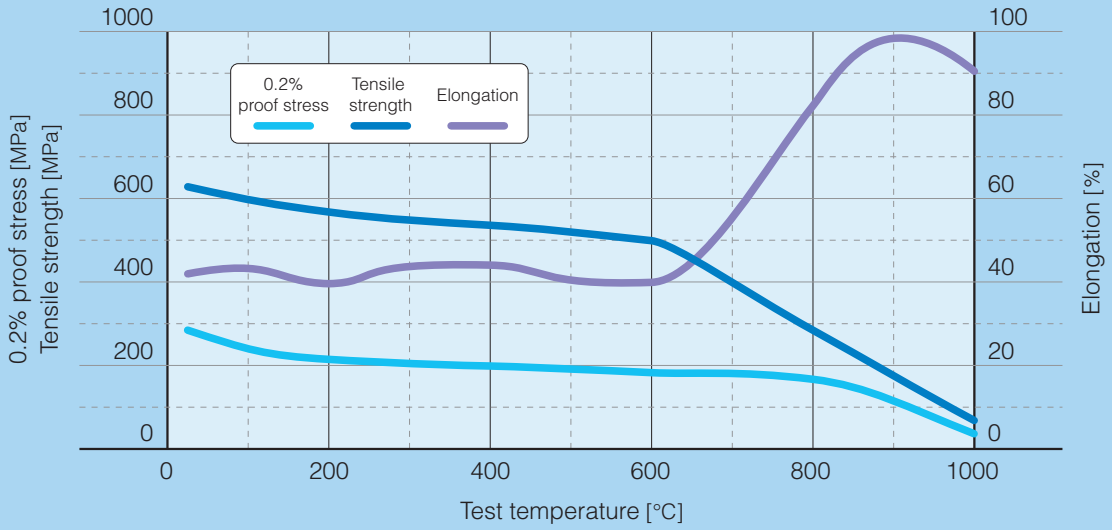
Mechanical Properties

Mechanical Properties at Room Temperature

		0.2% proof stress [MPa]	Tensile strength [MPa]	Elongation [%]	Hardness [HB]
Specification (NCF 825)		≧235	≧580	≧30	≦207
Specification (UNS N08825)		≧241	≧586	≧30	—
Example	Cold-rolled sheet 1.0mm^t	262	612	47	—
	Hot-rolled plate 8.0mm^t	253	615	54	144
	Hot-rolled plate 33.5mm^t	255	616	48	137

High Temperature Strength

Results of high temperature tensile test



Corrosion Resistance

Because NAS 825 has high contents of chromium, molybdenum, and copper, it provides excellent general (overall) corrosion resistance against oxidizing and non-oxidizing acids. Corrosion resistance against sulfuric acid is particularly good. Due to its high contents of chromium, molybdenum, and nickel, pitting corrosion resistance, crevice corrosion resistance, and stress corrosion cracking (SCC) resistance under chloride environments are also excellent in comparison with Type 316L. Because the carbon content of NAS 825 is held to an extremely low level, sensitization during welding is minimal, and this is also an alloy with low grain boundary corrosion sensitivity.

Pitting Corrosion Resistance

Alloy	ASTM G48 Method A		ASTM G48 Method C
	22°C	50°C	Critical pitting corrosion temperature CPT (°C)
SUS 316L	×	×	15
NAS 329J3L	○	×	50
NAS 254N	○	○	80
NAS 825	○	×	30

Test conditions

ASTM G48 Method A (○: No pitting corrosion, ×: Pitting corrosion)
- Test solution: 6%$FeCl_3$
- Test temperature: 22°C, 50°C (Recommended temperature in this test)
- Test time: 72h

ASTM G48 Method C
- Test solution: 6%$FeCl_3$ + 1%HCl
- Test time: 72h

Crevice Corrosion Resistance

Alloy	ASTM G48 Method D
	Critical crevice corrosion temperature CCT (°C)
SUS 316L	<–10
NAS 329J3L	25
NAS 254N	45
NAS 825	10

Test conditions ASTM G48 Method D
- Test solution: 6%$FeCl_3$ + 1%HCl
- Test time: 72h

Stress Corrosion Cracking Resistance

Alloy	$MgCl_2$ concentration (boiling point (°C) are in brackets)			
	42% (143°C)	35% (126°C)	25% (110°C)	20% (108°C)
SUS 316L	×	×	×	○
NAS 329J3L	×	×	○	○
NAS 254N	×	○	○	○
NAS 825	×	○	○	○

Test conditions
- Immersion in boiling $MgCl_2$ solution
- Test time: 300h
- U-bend test specimen is used.

○: No stress corrosion cracking
×: Stress corrosion cracking

Acid Resistance

Alloy	Corrosion rate in sulfuric acid at 80°C (mm/y)					
	5%	10%	20%	40%	60%	80%
SUS 316L	1.67	4.69	71.91	764.9	704.5	33.74
NAS 329J3L	0.01	0.17	4.65	365.9	1456	106.4
NAS 254N	0.02	0.05	1.02	2.11	2.16	7.76
NAS 825	0.01	0.03	0.30	0.21	0.23	0.73

Test time: 24h

Alloy	Corrosion rate in hydrochloric acid at 80°C (mm/y)			
	0.1%	1%	2%	3%
SUS 316L	0.02	2.73	6.75	14.88
NAS 329J3L	0.02	0.03	31.10	60.62
NAS 254N	0.01	0.02	0.01	9.14
NAS 825	0.01	0.02	2.26	3.14

Test time: 24h

(Reference)

Nippon Yakin	JIS	UNS No.	Chemical composition
SUS 316L	SUS 316L	S31603	17Cr-12Ni-2Mo
NAS 329J3L	SUS 329J3L	S32205	22Cr-5.3Ni-3.2Mo-0.16N
NAS 254N	SUS 836L	S32053	23Cr-25Ni-5.5Mo-0.2N
NAS 825	NCF 825	N08825	40Ni-23Cr-3Mo-2Cu-0.7Ti

Workability

Cold and hot workability are approximately equal to those of standard austenitic stainless steels.

Weldability

Possible welding methods include shielded metal arc welding, TIG welding, and MIG welding, in the same manner as with standard austenitic stainless steels. As welding consumables, Alloy 625, DNiCrMo-3 should be used.

Machinability

NAS 825 has machinability approximately equivalent to standard austenitic stainless steels. In machining, use of a high speed steel tool or superhard tool and a slow feed speed and large cut depth are advised.

Heat Treatment

Solution annealing of NAS 825 is normally performed at the temperature range from 930 to 1030°C followed by being quenched in water or rapidly cooled by other means.

Pickling

A mixture of nitric acid and hydrofluoric acid is used in pickling. However, due to the high corrosion resistance of NAS 825, scale is somewhat difficult to remove in comparison with Type 304. Therefore, the material should be immersed in an alkaline solution before pickling, or if possible, shot blasting is extremely effective.

Applications

Oil drilling, chemical plants

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