NAS NW276 (UNS N10276)

NAS High Corrosion Resistant Nickel Alloy

NAS NW276 is a Ni-Cr-Mo alloy with excellent corrosion resistance in both oxidizing and reducing atmospheres. In this alloy, carbide precipitation in the heat affected zone (HAZ) is suppressed and corrosion resistance is improved by reducing the contents of C and Si. Based on these features, NAS NW276 is widely used in materials under severe environments such as chemical plants. Nippon Yakin supplies this product in plate, sheet and strip forms.

Grade/Standard

NAS	JIS H4551	ASTM B575	DIN 17744/17750
NAS NW276	NW0276	UNS N10276	2.4819

Chemical Composition

[wt %]

	C	Si	Mn	P	S	Ni	Cr	Mo	Fe	Co	W	V
Specification (NW0276)	≦0.010	≦0.08	≦1.0	≦0.040	≦0.030	Balance	14.5~16.5	15.0~17.0	4.0~7.0	≦2.5	3.0~4.5	≦0.35
Specification (UNS N10276)	≦0.010	≦0.08	≦1.0	≦0.04	≦0.03	Balance	14.5~16.5	15.0~17.0	4.0~7.0	≦2.5	3.0~4.5	≦0.35

Physical Properties

Density	[g/cm³]		8.90
Specific heat	[J/kg · K]		400
Electrical resistivity	[μΩ · cm]		130.0
Thermal conductivity	[W/m · K]		9.9
Average coefficient of thermal expansion	[10^{-6}/°C]	20~100°C	12.1
		20~200°C	12.7
		20~300°C	13.0
		20~400°C	13.3
		20~500°C	13.5
Young's modulus	[MPa]		21.1 × 10^4
Magnetism			None
Melting range	[°C]		1325~1369

NIPPON YAKIN KOGYO CO., LTD.

Mechanical Properties

		0.2% proof stress [MPa]	Tensile strength [MPa]	Elongation [%]	Hardness [HRB]
Specification (NW0276)		≧275	≧690	≧40	—
Specification (UNS N10276)		≧283	≧690	≧40	≦100
Example	Hot-rolled plate sheet 14mm^t	372	763	71	83
	Cold-rolled sheet 2mm^t	366	785	61	86

In all cases, solution treated materials

Corrosion Resistance

Pitting Corrosion Resistance

Alloy	ASTM G48 Method A		ASTM G48 Method C
	22°C	50°C	Critical pitting corrosion temperature CPT (°C)
NAS 185N	○	○	70
NAS 254N	○	○	80
NAS NW276	○	○	>103

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

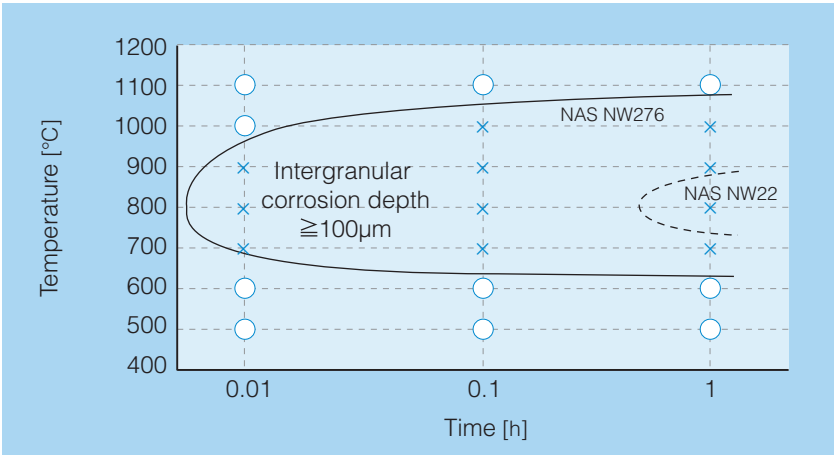
Crevice Corrosion Resistance

Alloy	ASTM G48 Method D
	Critical crevice corrosion temperature CCT (°C)
NAS 185N	40
NAS 254N	45
NAS NW276	103

Test conditions

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

Intergranular Corrosion Resistance



Test conditions: ASTM G28 Method A
Test time 24h,
boiling 50%H_2SO_4 - $Fe_2(SO_4)_3$ solution

Stress Corrosion Cracking Resistance

Alloy	$MgCl_2$ concentration (boiling point (°C) are in brackets)							
	45% (155°C)	42% (143°C)	40% (138°C)	38% (134°C)	35% (126°C)	30% (115°C)	25% (110°C)	20% (108°C)
NAS 185N	×	×	×	×	○	○	○	○
NAS 254N	×	×	×	○	○	○	○	○
NAS NW276	○	○	○	○	○	○	○	○

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%
NAS 185N	0.02	0.04	1.32	2.89	3.20	4.78
NAS 254N	0.02	0.05	1.02	2.11	2.16	7.76
NAS NW276	0.01	0.02	0.03	0.05	0.08	0.03

Test time: 24h

Alloy	Corrosion rate in hydrochloric acid at 80°C (mm/y)			
	0.1%	1%	2%	3%
NAS 185N	0.01	0.02	4.20	7.21
NAS 254N	0.01	0.02	0.01	9.14
NAS NW276	＜0.01	0.03	0.01	0.23

Test time: 24h

(Reference)

Nippon Yakin	JIS	UNS No.	Chemical composition
NAS 185N	SUS 312L	S31254	20Cr-18Ni-6Mo-0.8Cu-0.2N
NAS 254N	SUS 836L	S32053	23Cr-25Ni-5.5Mo-0.2N
NAS NW276	NW 0276	N10276	59Ni-15Cr-16Mo-4W-5Fe

Workability

Because the high-temperature strength of NAS NW276 is extremely higher than that of Type 304, care is required when hot working. The cold workability of NAS NW276 is basically the same as that of standard austenitic stainless steels such as Type 304, Type 316, etc. However, the fact that this is a high strength material must be considered in cold working.

Weldability

In welding, it is possible to apply ordinary welding methods in the same manner as with stainless steels. Matching composition welding consumables should be used. Post-weld heat treatment is not required.

Heat Treatment

Solution annealing of NAS NW276 is normally performed at the temperature range from 1150 to 1170°C followed by being quenched in water or rapidly cooled by other means.

Pickling

A mixture of nitric acid and fluoric acid is used in pickling. However, because descaling is somewhat difficult in comparison with Type 304, alkali immersion before acid pickling, and if possible, shot blasting are extremely effective.

Applications

Heat exchangers, centrifugal separators, driers, reaction vessels, salt manufacturing plants, flue gas desulfurization plants

For more information, please contact:
Nippon Yakin Kogyo Co., Ltd.
Material Solutions Sales Department
San-Ei Bldg., 5-8, 1-chome Kyobashi, Chuo-ku,
Tokyo 104-8365 Japan
TEL: +81-3-3273-4649 FAX: +81-3-3273-4642
E-Mail: inquiry@nyk.jp
URL: http://www.nyk.co.jp/en/

2016.6.10