

# NAS 224N (UNS S32050)

## NAS High Corrosion Resistant Super Stainless Steel

NAS 224N (UNS S32050) is a high corrosion resistant austenitic stainless steel with a high nickel, high chromium, high molybdenum alloy design, and provides excellent corrosion resistance in severe corrosion environments such as high temperature seawater. Depending on the environment, this stainless steel offers high economy combined with corrosion resistance comparable to that of Nickel alloy and pure titanium. Nippon Yakin supplies NAS 224N in plate, sheet and strip forms.

### Steel Grade/Standard

NAS	JIS	ASTM A240
NAS 224N	—	UNS S32050

### Chemical Composition

	C	Si	Mn	P	S	Ni	Cr	Mo	Cu	N
Specification (UNS S32050)	≤0.030	≤1.00	≤1.50	≤0.035	≤0.020	20.0~23.0	22.0~24.0	6.0~6.8	≤0.40	0.21~0.32

### Physical Properties

Density	[g/cm <sup>3</sup> ]	8.04	
Specific heat	[J/kg · K]	455	
Electrical resistivity	[μΩ · cm]	95.2	
Thermal conductivity	[W/m · K]	11.5	
Average coefficient of thermal expansion	[10 <sup>-6</sup> /°C]	20~100°C	15.0
		20~200°C	15.4
		20~300°C	15.7
		20~400°C	16.1
Young's modulus	[MPa]	21.6 × 10 <sup>4</sup>	
Magnetism		None	
Melting range	[°C]	1350~1400	

Mechanical Properties

Mechanical Properties at Room Temperature

			0.2% proof stress [MPa]	Tensile strength [MPa]	Elongation [%]	Elongation [HB]
Specification: Cold-rolled sheet (UNS S32050)			≥ 330	≥ 675	≥ 40	≤ 250
Example	Cold-rolled sheet	0.7mm <sup>t</sup>	401	800	46	193 (Hv)

Corrosion Resistance

Due to its high contents of chromium and molybdenum, NAS 224N has extremely high pitting resistance and crevice corrosion resistance in high concentration chloride environments. As a high Ni stainless steel, it also possesses excellent stress corrosion cracking (SCC) resistance.

Pitting Corrosion Resistance

Alloy	ASTM G48 Method A		ASTM G48 Method C
	22°C	50°C	Critical pitting corrosion temperature CPT (°C)
NAS 255	○	×	50
NAS 329J3L	○	×	50
NAS 64	○	○	55
NAS 224N	○	○	95

Test conditions ASTM G48 Method A (○: No pitting corrosion, ×: Pitting corrosion)

- Test solution: 6%FeCl<sub>3</sub>
- Test temperature: 22°C, 50°C (Recommended temperature in this test)
- Test time: 72h

ASTM G48 Method C

- Test solution: 6%FeCl<sub>3</sub> + 1%HCl
- Test time: 72h

Crevice Corrosion Resistance

Alloy	ASTM G48 Method D
	Critical crevice corrosion temperature CCT (°C)
NAS 255	10
NAS 329J3L	25
NAS 64	30
NAS 224N	45

Test conditions ASTM G48 Method D

- Test solution: 6%FeCl<sub>3</sub> + 1%HCl
- Test time: 72h

## Stress Corrosion Cracking Resistance

Alloy	MgCl <sub>2</sub> 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 255	×	×	×	×	○	○	○	○
NAS 329J3L	×	×	×	×	×	×	○	○
NAS 64	×	×	×	×	×	×	○	○
NAS 224N	×	×	×	×	○	○	○	○

Test conditions

- Immersion in boiling MgCl<sub>2</sub> solution
- Test time: 300h
- U-bend test specimen is used.

○: No stress corrosion cracking  
×: Stress corrosion cracking

(Reference)

Nippon Yakin	JIS	UNS No.	Chemical composition
NAS 255	SUS 890L	N08904	20Cr-24Ni-4.3Mo-1.5Cu
NAS 329J3L	SUS 329J3L	S32205	22Cr-5.3Ni-3.2Mo-0.16N
NAS 64	SUS 329J4L	S32506	25Cr-6.5Ni-3.3Mo-0.17N
NAS 224N	—	S32050	23Cr-22Ni-6Mo-0.25N

**Workability**

Cold and hot workability of NAS 224N is basically the same as that of Type 304, 316, and other standard austenitic stainless steels. However, the fact that this is a high strength material must be considered in both cold and hot working.

**Weldability**

Welding is possible by shielded metal arc welding, TIG welding, and plasma welding, in the same manner as with standard austenitic stainless steels. Alloy 276 welding consumables should be used. Preheating and post-heating are not required.

**Machinability**

As a distinctive feature of high Ni stainless steels, machining is difficult in comparison with standard austenitic stainless steels, but is easier than with Ni-based alloys. Cemented carbide cutting tools should be used if possible. Use of a slower feed rate in combination with greater cutting depth is recommended.

**Heat Treatment**

Solution annealing of NAS 224N should be performed at 1150°C and higher followed by being quenched in water or rapidly cooled by other means. (Conditions provided in ASTM A480/A480M)

**Pickling**

A mixed acid of nitric acid and hydrofluoric acid is used in pickling. Descaling is somewhat more difficult than with Type 304, corresponding to the higher corrosion resistance of NAS 224N. Before pickling, brief immersion in an alkaline solution, and if possible, shot blasting, is extremely effective for improving descaling.

**Applications**

- Seawater environments: Seawater desalination systems, seawater heat exchangers, condenser tubes
- High concentration chloride ion environments: Pulp and paper plant, various types of bleaching systems

**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](mailto:inquiry@nyk.jp)  
 URL: <http://www.nyk.co.jp/en/>

**Note regarding the handling of property data:**

The technical information contained in this product guide is representative values obtained in property tests and other items used to explain the performance of the product. With the exception of items specifically mentioned as provisions of a "Standard," the contents do not represent guaranteed upper limit or lower limit values. The respective data given on this technical information are typical examples and may be different in some cases from the data obtained from the actual product. No responsibility shall, therefore, be assumed for damages arising from using the technical information data. This information is also subject to change in the future without notice. To obtain the most recent information, please contact Nippon Yakin.