

# NAS 64 (UNS S32506)

## NAS High Corrosion Resistant Duplex Stainless Steel

NAS 64 (SUS 329J4L, UNS S32506, ASME Code Case 2543) is an austenitic-ferritic stainless steel which was developed by Nippon Yakin, and provides excellent corrosion resistance against phosphoric acid, acetic acid, various sulfur compounds, etc. In particular, due to its ultra-low C, high Mo composition, its local corrosion resistance is particularly improved in comparison with Type 329J1. Nippon Yakin supplies this product in plate, sheet and strip form.

### Steel Grade/Standard

NAS	JIS G4304/4305	ASTM A240	EN
NAS 64	SUS 329J4L	UNS S32506	—

### Chemical Composition

	C	Si	Mn	P	S	Ni	Cr	Mo	N	W
Specification (SUS 329J4L)	≤0.030	≤1.00	≤1.50	≤0.040	≤0.030	5.50~7.50	24.00~26.00	2.50~3.50	0.08~0.30	—
Specification (UNS S32506)	≤0.030	≤0.90	≤1.00	≤0.040	≤0.015	5.5~7.2	24.0~26.0	3.0~3.5	0.08~0.20	0.05~0.30

### Physical Properties

Density	[g/cm <sup>3</sup> ]		7.80
Specific heat	[J/kg · K]	25°C	460
Electrical resistivity	[μΩ · cm]		88.7
Thermal conductivity	[W/m · K]	25°C	12.6
Average coefficient of thermal expansion	[10 <sup>-6</sup> /°C]	30~200°C	10.5
		30~300°C	11.4
		30~400°C	12.2
Young's modulus	[MPa]		19.6 × 10 <sup>4</sup>
Magnetism			Y (magnetizable)
Melting range	[°C]		1420~1462



### SCC Resistance

Test method: U-bend test piece, test time: 240~300hr; for NAS 64, 336hr

Test conditions Steel grade	20%NaCl+ (107°C)				1130ppm Cl <sup>-</sup>
	—	1% NaO <sub>2</sub>	1/4% CrCl <sub>3</sub>	1%Na <sub>2</sub> Cr <sub>2</sub> O <sub>7</sub> · 2H <sub>2</sub> O	250°C
Type 304	xx	x	xx	xx	xx
	(2/2)	(2/3)	(3/3)	(3/3)	(2/2)
Type 316	○	x	x	xx	—
	(0/2)	(1/3)	(1/3)	(3/3)	—
NAS 64	○	○	○	○	○
	(0/2)	(0/2)	(0/2)	(0/2)	(0/2)
Type 329J1	○	○	○	○	—
	(0/2)	(0/2)	(0/2)	(0/3)	—

xx: All pieces cracked x: Some pieces cracked ○: No cracking

Numbers in parentheses show No. of cracked test pieces/Total No. of test pieces.

### Acid Resistance

Corrosion rate: g/m<sup>2</sup>/hr

Test conditions Shape	5% sulfuric acid, boiling, 6hr	1% HCl, boiling, 6hr	49%P <sub>2</sub> O <sub>5</sub> , 0.5%F <sup>-</sup> 5%H <sub>2</sub> SO <sub>4</sub> , 0.05%Cl <sup>-</sup> 1.0%e <sup>3+</sup> , 80°C
NAS 64 Cold-rolled sheet (2.0mm)	0.36	<0.1	<0.1
NAS 64 Hot-rolled plate sheet (10.0mm)	0.53	<0.1	—
Type 316L	4.50	46.7	95.8
Type 329J1 Cold-rolled sheet (2.0mm)	1.26	<0.1	—

## Mechanical Properties

### Mechanical Properties at Room Temperature

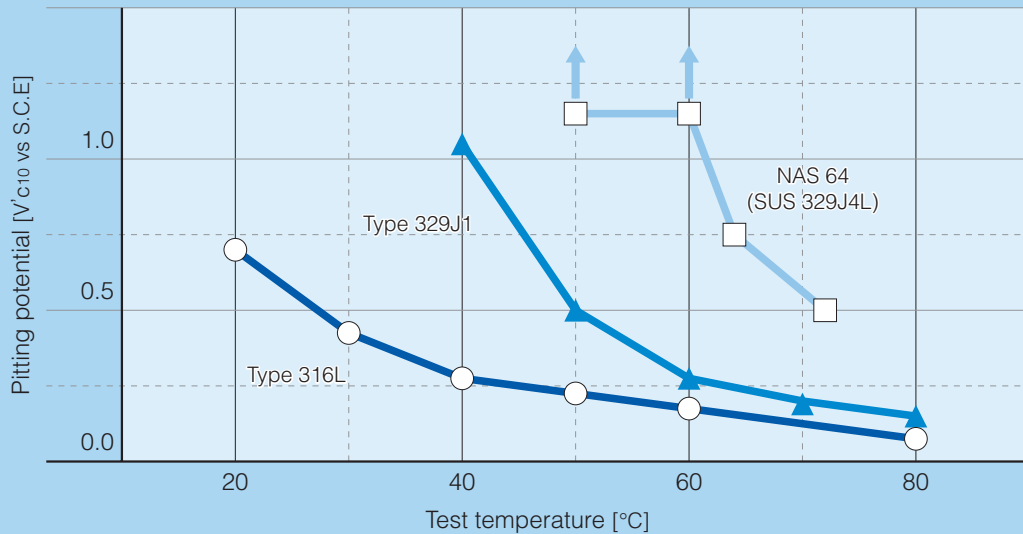
		0.2% proof stress [MPa]	Tensile strength [MPa]	Elongation [%]	Hardness	
					[Hv]	[HB]
Specification (SUS 329J4L)		≥ 450	≥ 620	≥ 18	≤ 320	≤ 302
Specification (UNS S32506)		≥ 450	≥ 620	≥ 18	—	≤ 302
Example	Cold-rolled sheet 1.6mm <sup>t</sup>	732	853	23	258	248
	Hot-rolled plate 10mm <sup>t</sup>	657	800	26	—	252

## Corrosion Resistance

NAS 64 has excellent local corrosion resistance, including pitting corrosion and stress corrosion cracking resistance, and can be used in environments which Type 316L cannot withstand. In comparison with Type 329J1, its pitting corrosion resistance is more than double, and in particular, its crevice corrosion resistance is far superior.

### Pitting Corrosion Resistance

Temperature dependency of pitting potential (in 4%NaCl, Ar degassing)



Pitting corrosion resistance of bead and HAZ after TIG welding

Steel grade	Test	Pitting corrosion resistance	
		V'c10 70°C 3.5% NaCl (V'c10 vs SCE)	10%FeCl <sub>3</sub> · 6H <sub>2</sub> O 40°C 4hr (g/m <sup>2</sup> /h)
NAS 64	Welding material/base material	0.39 / 0.68	< 0.1
Type 329J1	Welding material/base material	0.14 / 0.26	1.0~5.0

### Workability

High temperature strength is similar to Type 430 in the range of 1150~950°C. However the steel shows rapid increase in the strength below 900°C. Regarding cold workability, care is required as proof stress is high and elongation is low in comparison with Type 304.

### Weldability

Various welding methods are applicable in the same manner as with the standard austenitic stainless steels, including shielded metal arc welding, TIG welding, and plasma welding. Same duplex grade type welding consumable should be used.

### Heat Treatment

NAS 64 is not hardened by heat treatment. After heating to a solution treatment temperature of 1050~1080°C, quenching is necessary. Cooling must be performed as rapidly as possible so as to minimize the time when the material is exposed to the embrittlement temperature range (475°C embrittlement,  $\sigma$  phase embrittlement).

### 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

NAS 64 is suitable as material for a wide range of chemical equipment in environments which Type 316 cannot withstand, including various types of pollution prevention equipment and equipment handling petrochemicals, fibers, pulp, impure hot water, seawater, etc. Because it also possesses high strength, NAS 64 can be used in applications which require both mechanical strength and corrosion resistance, such as water gates, OCTG, geothermal power generation plants, etc.

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#### 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.co.jp](mailto:inquiry@nyk.co.jp)

URL: <http://www.nyk.co.jp/en/>

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