

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 high Cr and Mo composition, its local corrosion resistance is particularly improved in comparison with Type 316L. 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 ³]		7.80
Specific heat	[J/kg · K]	25°C	460
Electrical resistivity	[μΩ · cm]		82.5
Thermal conductivity	[W/m · K]	25°C	13.0
Average coefficient of thermal expansion	[10 ⁻⁶ /°C]	30~200°C	10.5
		30~300°C	11.4
		30~400°C	12.2
Young's modulus	[MPa]		21.4 × 10 ⁴
Magnetism			Y (magnetizable)
Melting range	[°C]		1420~1462

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 ^t	732	853	23	258	248
	Hot-rolled plate 10mm ^t	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 particular, its pitting and crevice corrosion resistance is far superior.

Pitting Corrosion Resistance

Alloy	ASTM G48 Method A		ASTM G48 Method C
	22°C	50°C	Critical pitting corrosion temperature CPT (°C)
SUS 316L	x	x	15
NAS 329J3L	○	x	50
NAS 64	○	○	55

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

- Test solution: 6%FeCl₃
- Test temperature: 22°C, 50°C (Recommended temperature in this test)
- Test time: 72h

ASTM G48 Method C

- Test solution: 6%FeCl₃ + 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 64	30

Test conditions ASTM G48 Method D

- Test solution: 6%FeCl₃ + 1%HCl
- Test time: 72h

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)
SUS 316L	×	×	×	×	×	×	×	○
NAS 329J3L	×	×	×	×	×	×	○	○
NAS 64	×	×	×	×	×	×	○	○

- Test conditions
- Immersion in boiling MgCl₂ 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 64	<0.01	0.02	1.07	191.9	1054	60.72

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 64	0.01	0.01	12.94	30.51

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 64	SUS 329J4L	S32506	25Cr-6.5Ni-3.3Mo-0.17N

Workability

High temperature strength is similar to Type 430 in the range of 950~1150°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. Use of welding electrodes for SUS 329J4L is recommended. Preheating and postheating are not necessary. In welding, the interpass temperature should be no more than 100°C in order to prevent formation of intermetallic compounds.

Heat Treatment

Solution annealing of NAS 64 should be performed at the temperature range from 1020 to 1120°C followed by being quenched in water or rapidly cooled by other means. (Conditions provided in ASTM A480/A480M)

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

Various types of pollution prevention equipment, Chemical and petrochemical plant, Pulp and paper plant, Equipment handling sea water, Water gate, etc.

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