

# NAS 329J3L (UNS S32205, S31803)

## NAS High Corrosion Resistant Duplex Stainless Steel

NAS 329J3L (SUS 329J3L, UNS S32205, S31803) is an Austenitic-ferritic stainless steel, which has superior corrosion resistance and high strength. It has better localized corrosion resistance than Type 316L and 317L, and the steel is applied in the industrial fields like chemical plant, seawater desalination plant, seawater pump, and so on. Nippon Yakin supplies this product in plate, sheet and strip form.

### Steel Grade/Standard

NAS	JIS G4304/4305	ASTM A240	EN 10088-2/10028-7
NAS 329J3L	SUS 329J3L	UNS S32205/S31803	1.4462

### Chemical Composition

	C	Si	Mn	P	S	Ni	Cr	Mo	N
Specification (SUS 329J3L)	≤0.030	≤1.00	≤2.00	≤0.040	≤0.030	4.50~6.50	21.00~24.00	2.50~3.50	0.08~0.20
Specification (UNS S32205)	≤0.030	≤1.00	≤2.00	≤0.030	≤0.020	4.5~6.5	22.0~23.0	3.0~3.5	0.14~0.20
Specification (UNS S31803)	≤0.030	≤1.00	≤2.00	≤0.030	≤0.020	4.5~6.5	21.0~23.0	2.5~3.5	0.08~0.20

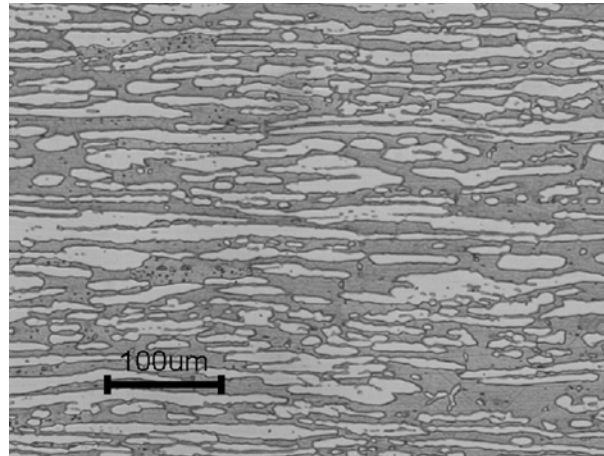
[wt %]

### Physical Properties

Density	[g/cm <sup>3</sup> ]	7.80
Specific heat	[J/kg · K]	460
Electrical resistivity	[μΩ · cm]	87.0
Thermal conductivity	[W/m · K]	13.9
Average coefficient of thermal expansion [10 <sup>-6</sup> /°C]	20~100°C	12.7
	20~200°C	13.1
	20~300°C	13.5
	20~400°C	13.8
Young's modulus	[MPa]	19.5 × 10 <sup>4</sup>
Magnetism		Y (magnetizable)
Melting range	[°C]	1420~1465

Microstructure

It consists of 40~50% of ferritic phase and the rest of austenitic phase. (Grey part is ferritic phase and white part is austenitic phase)



A cross sectional microstructure of 16mm thick plate

Mechanical Properties

Mechanical Properties at Room Temperature

		0.2% proof stress [MPa]	Tensile strength [MPa]	Elongation [%]	Hardness	
					[Hv]	[HB]
Specification (SUS 329J3L)		≥ 450	≥ 620	≥ 18	≤ 320	≤ 302
Specification (UNS S32205)		≥ 450	≥ 655	≥ 25	—	≤ 293
Specification (UNS S31803)		≥ 450	≥ 620	≥ 25	—	≤ 293
Example	Hot-rolled plate 16mm <sup>t</sup>	563	780	35	—	222
	Cold-rolled sheet 2mm <sup>t</sup>	630	828	28	253	—

Corrosion Resistance

Local corrosion resistance such as pitting, crevice, and stress corrosion cracking of NAS 329J3L is better than conventional stainless steel such as type 304 and 316L. General corrosion resistance in acidic environment is good if the acid content is low.

Pitting Corrosion Resistance

Alloy	ASTM G48 Method A		ASTM G48 Method C
	22°C	50°C	Critical pitting corrosion temperature CPT (°C)
SUS 304	×	×	10
SUS 316L	×	×	15
NAS 329J3L	○	×	50

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)
SUS 304	<-10
SUS 316L	<-10
NAS 329J3L	25

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)
SUS 304	x	x	x	x	x	x	x	x
SUS 316L	x	x	x	x	x	x	x	○
NAS 329J3L	x	x	x	x	x	x	○	○

Test conditions • Immersion in boiling MgCl<sub>2</sub> solution      ○: No stress corrosion cracking  
 • Test time: 300h      ×: Stress corrosion cracking  
 • U-bend test specimen is used.

### Acid Resistance

Alloy	Corrosion rate in sulfuric acid at 80°C (mm/y)					
	5%	10%	20%	40%	60%	80%
SUS 304	1.93	14.59	195.2	1347	231.8	151.4
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

Test time: 24h

Alloy	Corrosion rate in hydrochloric acid at 80°C (mm/y)			
	0.1%	1%	2%	3%
SUS 304	0.02	2.42	7.16	18.99
SUS 316L	0.02	2.73	6.75	14.88
NAS 329J3L	0.02	0.03	31.10	60.62

Test time: 24h

(Reference)

Nippon Yakin	JIS	UNS No.	Chemical composition
SUS 304	SUS 304	S30400	18Cr-8Ni
SUS 316L	SUS 316L	S31603	17Cr-12Ni-2Mo
NAS 329J3L	SUS 329J3L	S32205	22Cr-5.3Ni-3.2Mo-0.16N

### 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 UNS S32205 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 329J3L should be performed at 1040°C and higher 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

- Chemical Plant, Chemical Tanker
- Seawater desalination Plant, Seawater pump
- Thermal power plant flue gas desulfurization plants
- Pulp and paper plants
- Bridge

### Certification

It is possible to manufacture UNS S32205/S31803 in accordance with the NORSOK standard below. The thickness is up to 50mm.

- NORSOK M-650
- NORSOK M-630 MDS D45

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