NAS329J3L (UNS S32205, S31803)

High Corrosion Resistant Duplex Stainless Steel

NAS329J3L (SUS329J3L, 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 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

Nippon Yakin Grade	JIS G 4304/4305	ASTM A240	EN 10088-2/10028-7
NAS329J3L	SUS329J3L	UNS S32205/S31803	1.4462

Chemical Composition

[wt %]

	C	Si	Mn	P	S	Ni	Cr	Mo	N
Specification (SUS329J3L)	≦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

Physical Properties

Density	[g/cm³]		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	[10⁻⁶/°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 × 10⁴
Magnetism			Y (magnetizable)
Melting range	[°C]		1420~1465

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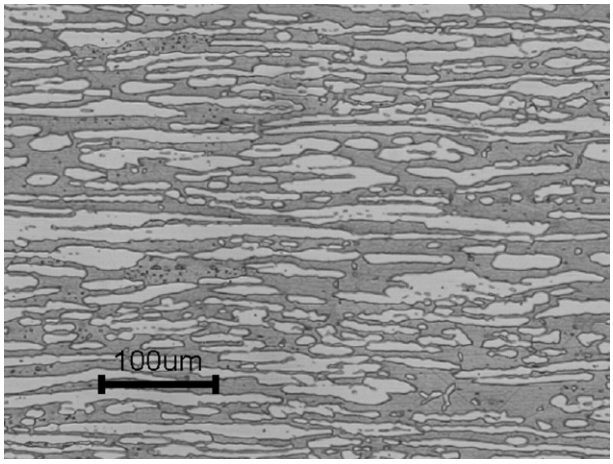
Microstructure

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]	Hardness [HBW]
Specification (SUS329J3L)		≧450	≧620	≧18	≦320	≦302
Specification (UNS S32205)		≧450	≧655	≧25	—	≦293
Specification (UNS S31803)		≧450	≧620	≧25	—	≦293
Example	Hot-rolled plate 16mm^t	563	780	35	—	222
Example	Cold-rolled sheet 2mm^t	630	828	28	253	—

Corrosion Resistance

Local corrosion resistance such as pitting, crevice, and stress corrosion cracking of NAS329J3L 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)
SUS304	×	×	10
SUS316L	×	×	15
NAS329J3L	○	×	50

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)
SUS304	<−10
SUS316L	<−10
NAS329J3L	25

Test conditions ASTM G48 Method D
- Test solution: 6%$FeCl_3$ + 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)
SUS304	×	×	×	×	×	×	×	×
SUS316L	×	×	×	×	×	×	×	○
NAS329J3L	×	×	×	×	×	×	○	○

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%
SUS304	1.93	14.59	195.2	1347	231.8	151.4
SUS316L	1.67	4.69	71.91	764.9	704.5	33.74
NAS329J3L	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%
SUS304	0.02	2.42	7.16	18.99
SUS316L	0.02	2.73	6.75	14.88
NAS329J3L	0.02	0.03	31.10	60.62

Test time: 24h

(Reference)

Alloy	JIS	UNS No.	Chemical composition
SUS304	SUS304	S30400	18Cr-8Ni
SUS316L	SUS316L	S31603	17Cr-12Ni-2Mo
NAS329J3L	SUS329J3L	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 NAS329J3L 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 plants, Environment-related equipment, Papermaking plants, Seawater pump, etc.

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

For more information, please contact:
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