NAS 185N (UNS S31254)

NAS High Corrosion Resistant Super Stainless Steel

NAS 185N (SUS 312L, UNS S31254) 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 this product in plate, sheet and strip form.

Steel Grade/Standard

NAS	JIS G4304/4305	ASTM A240	EN 10088-2/10028-7
NAS 185N	SUS 312L	UNS S31254	1.4547

Chemical Composition

[wt %]

	C	Si	Mn	P	S	Ni	Cr	Mo	Cu	N
Specification (SUS 312L)	≦0.020	≦0.80	≦1.00	≦0.030	≦0.015	17.50~ 19.50	19.00~ 21.00	6.00~ 7.00	0.50~ 1.00	0.16~ 0.25
Specification (UNS S31254)	≦0.020	≦0.80	≦1.00	≦0.030	≦0.010	17.5~ 18.5	19.5~ 20.5	6.0~ 6.5	0.50~ 1.00	0.18~ 0.22

Physical Properties

Density	[g/cm³]		8.02
Specific heat	[J/kg · K]	20°C	464
Electrical resistivity	[μΩ · cm]		89.4
Thermal conductivity	[W/m · K]		12.3
Average coefficient of thermal expansion	[10^{-6}/°C]	20~100°C	15.3
		20~200°C	15.7
		20~300°C	16.1
		20~400°C	16.4
Young's modulus	[MPa]		19.7 × 10^4
Magnetism			None
Melting range	[°C]		1360~1405

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Mechanical Properties

Mechanical Properties at Room Temperature

			0.2% proof stress [MPa]	Tensile strength [MPa]	Elongation [%]	Hardness [Hv]	Hardness [HB]
Specification (SUS 312L)			≧300	≧650	≧35	≦230	≦223
Specification (UNS S31254)		Sheet and strip	≧310	≧690	≧35	—	≦223
		Plate	≧310	≧655	≧35	—	≦223
Example	Cold-rolled sheet	1.5mm^t	379	744	41	182	—
	Hot-rolled sheet	8mm^t	361	707	53	—	187

Corrosion Resistance

NAS 185N is a high Cr, high Mo stainless steel which provides excellent pitting corrosion resistance and crevice corrosion resistance in high Cl environments. As a high Ni steel, it also offers excellent stress corrosion cracking 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 185N	○	○	70

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)
NAS 255	10
NAS 329J3L	25
NAS 64	30
NAS 185N	40

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)
NAS 255	×	×	×	×	○	○	○	○
NAS 329J3L	×	×	×	×	×	×	○	○
NAS 64	×	×	×	×	×	×	○	○
NAS 185N	×	×	×	×	○	○	○	○

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%
NAS 255	<0.01	<0.01	0.78	2.95	0.48	5.01
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
NAS 185N	0.02	0.04	1.32	2.89	3.20	4.78

Test time: 24h

Alloy	Corrosion rate in hydrochloric acid at 80°C (mm/y)			
	0.1%	1%	2%	3%
NAS 255	<0.01	0.01	2.70	3.72
NAS 329J3L	0.02	0.03	31.10	60.62
NAS 64	0.01	0.01	12.94	30.51
NAS 185N	0.01	0.02	4.20	7.21

Test time: 24h

(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 185N	SUS 312L	S31254	20Cr-18Ni-6Mo-0.8Cu-0.2N

Workability

The hot and cold workability of NAS 185N is basically the same as that of standard austenitic stainless steels such as Type 304, Type 316, etc. However, the fact that this is a high strength material must be considered in both cold and hot working.

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. Alloy 276 welding consumable should be used.

Machinability

As a feature of high Ni stainless steels, although machining is difficult in comparison with the standard austenitic stainless steels, it is easier than with Ni-based alloys. A ultrahard tool should be used in machining if at all possible. It is also advisable to use a slower feed rate and deeper cutting depth.

Heat Treatment

Solution annealing of NAS 185N 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 mixture of nitric acid and hydrofluoric acid is used in pickling. However, due to the high corrosion resistance of NAS 185N, scale is somewhat difficult to remove in comparison with Type 304. Therefore, the material should be immersed in an alkaline solution before pickling, or if possible, shot blasting is extremely effective.

Applications

- Seawater environments: Marine structures, seawater desalination systems, heat exchangers using seawater, condenser tubes, etc.
- Pulp and paper plants: Various types of bleaching systems, scrubbers, etc.
- Medical and pharmaceutical product plants: Centrifugal separators, reaction tanks, etc.

Certification

It is possible to manufacture UNS S31254 in accordance with the NORSOK standard below. The thickness is up to 40mm.

- NORSOK M-650
- NORSOK M-630 MDS R15

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