NAS 255 (UNS N08904)

NAS High Corrosion Resistant Stainless Steel

NAS 255 (UNS N08904, SUS 890L) is an austenitic stainless steel with superior corrosion resistance in comparison with Type 316L. Due to addition of Cu (1.5%), this material displays excellent corrosion resistance against reducing acids such as sulfuric acid and phosphoric acid. It is used in chemical plants and a wide range of other applications. Nippon Yakin supplies this product in plate, sheet and strip form.

Steel Grade/Standard

NAS	JIS G4304/4305	ASTM A240	EN
NAS 255	SUS 890L	UNS N08904	1.4539

Chemical Composition

[wt %]

	C	Si	Mn	P	S	Ni	Cr	Mo	Cu	N
Specification (SUS 890L)	≦0.020	≦1.00	≦2.00	≦0.045	≦0.030	23.00~ 28.00	19.00~ 23.00	4.00~ 5.00	1.00~ 2.00	—
Specification (UNS N08904)	≦0.020	≦1.00	≦2.00	≦0.045	≦0.035	23.0~ 28.0	19.0~ 23.0	4.0~ 5.0	1.0~ 2.0	≦0.10

Physical Properties

Density	[g/cm³]		8.05
Specific heat	[J/kg · K]		452
Electrical resistivity	[μΩ · cm]		97.2
Thermal conductivity	[W/m · K]		12.2
Average coefficient of thermal expansion	[10^{-6}/°C]	20~100°C	14.4
		20~200°C	14.9
		20~300°C	15.3
		20~400°C	15.7
Young's modulus	[MPa]		19.0 × 10^4
Magnetism			None
Melting range	[°C]		1360~1397

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Mechanical Properties

Mechanical Properties at Room Temperature

		0.2% proof stress [MPa]	Tensile strength [MPa]	Elongation [%]	Hardness [HRB]
Specification (SUS 890L)		≧215	≧490	≧35	≦90
Specification (UNS N08904)		≧220	≧490	≧35	≦90
Example	Hot-rolled plate 12mm^{t}	247	593	57	86
	Cold-rolled sheet 2mm^{t}	291	632	43	79

Corrosion Resistance

Because NAS255 contains high concentrations of chromium, nickel and molybdenum, it offers excellent pitting corrosion resistance, crevice corrosion resistance, stress corrosion cracking (SCC) resistance and acid resistance in comparison with Type 304 and Type 316L.

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 255	○	×	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)
SUS 304	<−10
SUS 316L	<−10
NAS 255	10

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)
SUS 304	×	×	×	×	×	×	×	×
SUS 316L	×	×	×	×	×	×	×	○
NAS 255	×	×	×	×	○	○	○	○

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%
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 255	<0.01	<0.01	0.78	2.95	0.48	5.01

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 255	<0.01	0.01	2.70	3.72

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 255	SUS 890L	N08904	20Cr-24Ni-4.3Mo-1.5Cu

Workability

Cold and hot workability are approximately equal to those of Type 304, 316, and other standard austenitic stainless steels.

Weldability

Weldability is on the same level as ordinary austenitic stainless steels. Preheating and post-heating are not necessary. As welding electrodes, in applications under severe corrosion environments, use of welding consumables with equal or higher corrosion resistance is recommended. When the corrosion environment is not severe, and when the purpose of welding is for joining, matching welding consumables may be used.

Heat Treatment

Solution annealing of NAS 255 should be performed at 1095°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 255, 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

Sulfuric acid and phosphoric acid plants, seawater heat exchangers, chemical plants, food plants, etc.

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

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