

# NAS335X (UNS N08020)

## High Corrosion Resistant Stainless Steel

NAS335X is a stainless steel with extremely high corrosion resistance to sulfuric acid. It can be used in a wide range of sulfuric acid environments, including high concentration, high temperature environments. It possesses excellent intergranular corrosion resistance and stress corrosion cracking resistance. Nippon Yakin supplies this product in plate, sheet and strip forms.

### Steel Grade/Standard

Nippon Yakin Grade	JIS G 4902	ASTM A240/B463	EN
NAS335X	NCF020	UNS N08020	—

### Chemical Composition

	C	Si	Mn	P	S	Ni	Cr	Mo	Cu	Nb
Specification (NCF020)	≤0.07	≤1.00	≤2.00	≤0.045	≤0.035	32.00~38.00	19.00~21.00	2.00~3.00	3.00~4.00	8×C~1.00
Specification (ASTM A240)	≤0.07	≤1.00	≤2.00	≤0.045	≤0.035	32.0~38.0	19.0~21.0	2.00~3.00	3.0~4.0	8×C~1.00
Specification (ASTM B463)	≤0.07	≤1.00	≤2.00	≤0.045	≤0.035	32.00~38.00	19.00~21.00	2.00~3.00	3.00~4.00	8×C~1.00

### Physical Properties

Density	[g/cm <sup>3</sup> ]	8.08
Specific heat	[J/kg · K]	470
Electrical resistivity	[μΩ · cm]	105
Thermal conductivity	[W/m · K]	11.4
Average coefficient of thermal expansion [10 <sup>-6</sup> /°C]	20~100°C	14.6
	20~200°C	15.9
	20~300°C	15.8
	20~400°C	16.0
Young's modulus	[MPa]	18.9 × 10 <sup>4</sup>
Magnetism		None
Melting range	[°C]	1340~1389

Mechanical Properties

Mechanical Properties at Room Temperature

			0.2% proof stress [MPa]	Tensile strength [MPa]	Elongation [%]	Hardness [HBW]
Specification (NCF020)			≥240	≥550	≥30	≤217
Specification (ASTM A240)			≥240	≥550	≥30	≤217
Example	Cold-rolled sheet	2.0mm <sup>t</sup>	431	698	38	176
	Hot-rolled plate	6.5mm <sup>t</sup>	359	666	40	137
	Hot-rolled plate	50mm <sup>t</sup>	315	581	42	156

Corrosion Resistance

NAS335X is a high Ni, Mo and Cu added stainless steel which displays extremely high sulfuric acid resistance. As a low C, Nb added material, it also has excellent intergranular corrosion resistance.

Pitting Corrosion Resistance

Alloy	ASTM G48 Method A		ASTM G48 Method C
	22°C	50°C	Critical pitting corrosion temperature CPT (°C)
SUS316L	×	×	15
NAS64	○	○	55
NAS254N	○	○	80
NAS335X	○	×	30

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)
SUS316L	<-10
NAS64	30
NAS254N	45
NAS335X	<0

Test conditions

ASTM G48 Method D

- Test solution: 6%FeCl<sub>3</sub> + 1%HCl
- Test time: 72h

Acid Resistance

Alloy	Corrosion rate in sulfuric acid at 80°C (mm/y)					
	5%	10%	20%	40%	60%	80%
SUS316L	1.67	4.69	71.91	764.9	704.5	33.74
NAS64	<0.01	0.02	1.07	191.9	1054	60.72
NAS254N	0.02	0.05	1.02	2.11	2.16	7.76
NAS335X	0.01	0.02	0.31	0.12	0.09	2.15

Test time: 24h

Alloy	Corrosion rate in boiling sulfuric acid (mm/y)			
	5%	10%	20%	40%
SUS316L	8.19	24.61	178.9	3129
NAS64	0.35	1.65	17.68	2829
NAS254N	1.17	3.30	7.90	24.65
NAS335X	0.44	0.68	0.52	0.64

Test time: 24h

(Reference)

Alloy	JIS	UNS No.	Chemical composition
SUS316L	SUS316L	S31603	17Cr-12Ni-2Mo
NAS64	SUS329J4L	S32506	25Cr-6.5Ni-3.3Mo-0.17N
NAS254N	SUS836L	S32053	23Cr-25Ni-5.5Mo-0.2N
NAS335X	NCF020	N08020	20Cr-33Ni-2.5Mo-3Cu-0.4Nb

**Workability**

The hot workability and cold workability of NAS335X are basically the same as those of standard austenitic stainless steels.

**Weldability**

TIG welding, MIG welding, and shielded metal arc welding are applicable in the same manner as with standard austenitic stainless steels. However, because NAS335X is an Nb-added stainless steel, the welding heat input should be reduced as far as possible.

Use of ER320 or ER320LR welding electrodes is recommended.

**Machinability**

The machinability of NAS335X is basically the same as that of standard austenitic stainless steels. In machining, a high speed steel tool or ultrahard tool should be used. It is also advisable to use a slower feed rate and deeper cutting depth.

**Heat Treatment**

Stabilizing heat treatment of NAS335X should be performed at the temperature range from 925 to 1010°C followed by being quenched in water or rapidly cooled by other means. (Conditions provided in ASTM A480/A480M)

**Pickling**

Pickling is performed under the same conditions as with Type 304, using a mixture acid of nitric acid and hydrofluoric acid.

**Applications**

Chemical plants, Heat exchangers, Sulfuric acid-related equipment.

**For more information, please contact:**

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