NAS601 (UNS N06601)

Heat-Resistant Nickel Alloy

NAS601 (NCF601, UNS N06601) is a nickel-chromium alloy with an addition of aluminum that provides high mechanical properties at elevated temperatures, and superior resistance to oxidation, carburization and sulfurization. It excels particularly in descaling resistance in cyclic oxidation applications with a high temperature variation, and is therefore used in various parts for heat treatment furnaces, diesel vehicle glow plugs, and the like. Nippon Yakin supplies this product in plate, sheet, and strip forms.

Grade/Standard

Nippon Yakin Grade	JIS G 4902	ASTM B168	EN 10095
NAS601	NCF601	UNS N06601	2.4851

Chemical Composition

[wt %]

	C	Si	Mn	P	S	Ni	Cr	Cu	Al	Ti	B	Fe
Specification (NCF601)	≦0.10	≦0.50	≦1.00	≦0.030	≦0.015	58.00~63.00	21.00~25.00	≦1.00	1.00~1.70	–	–	Bal.
Specification (UNS N06601)	≦0.10	≦0.5	≦1.0	–	≦0.015	58.0~63.0	21.0~25.0	≦1.00	1.0~1.7	–	–	Bal.
Specification (EN 2.4851)	0.03~0.10	≦0.50	≦1.00	≦0.020	≦0.015	58.00~63.00	21.00~25.00	≦0.50	1.00~1.70	≦0.50	≦0.006	≦18.00

Physical Properties

Density	[g/cm³]		8.07
Specific heat	[J/kg · K]		451
Electrical resistivity	[μΩ · cm]		119
Thermal conductivity	[W/m · K]		11.1
Average coefficient of thermal expansion	[10^{-6}/°C]	30~100°C	13.6
		30~300°C	14.6
		30~500°C	15.1
		30~700°C	15.9
		30~900°C	16.7
Young's modulus	[MPa]		20.5 x 10^4
Magnetism			None
Melting range	[°C]		1345~1384

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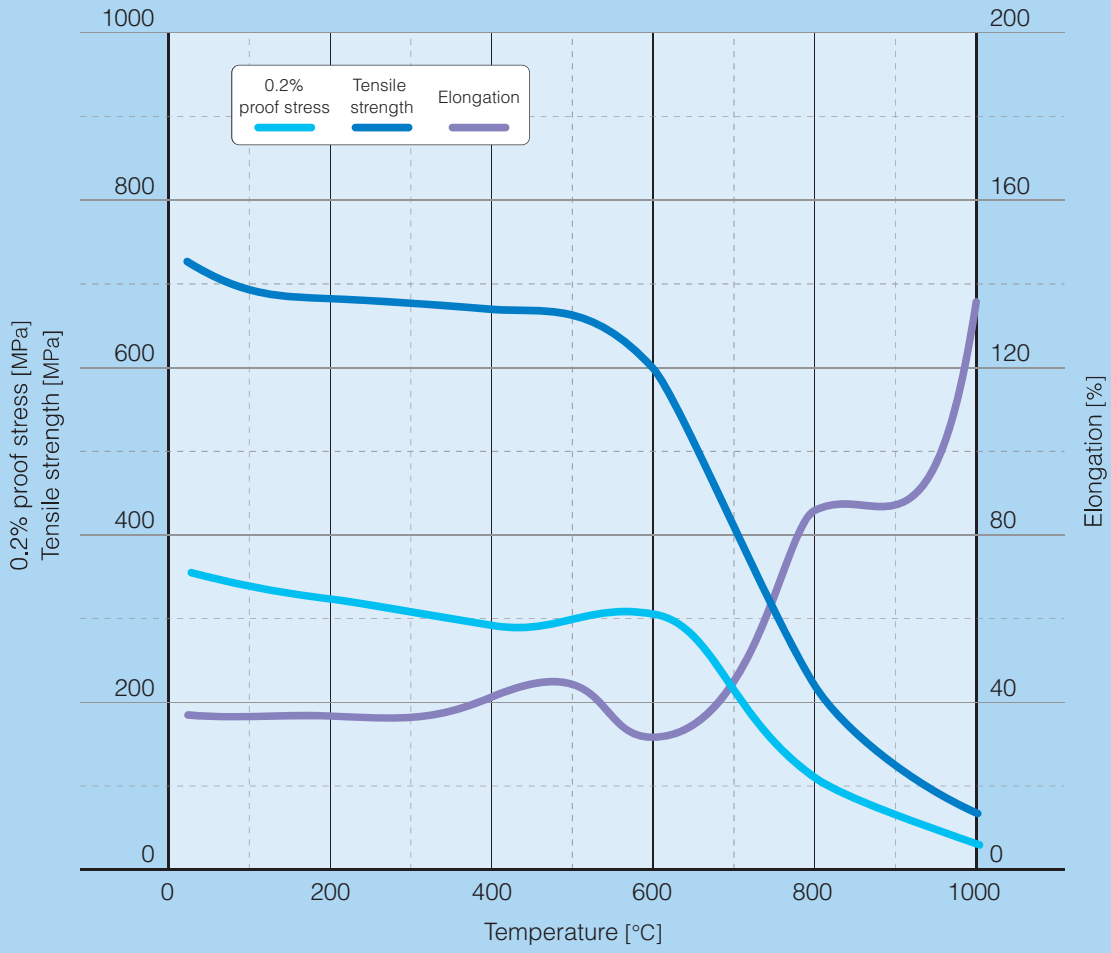
Mechanical Properties

Mechanical Properties at Room Temperature

			0.2% proof stress [MPa]	Tensile strength [MPa]	Elongation [%]	Hardness [HBW]	[HRBW]
Specification (NCF601 annealing)			≧195	≧550	≧30	—	—
Specification (NCF601 solution treatment)			≧205	≧550	≧30	—	—
Specification (UNS N06601)			≧205	≧550	≧30	—	—
Specification (EN 2.4851)			≧205	550~750	≧30	≦220	—
Example	Hot-rolled plate	10 mm^t	287	635	53	153	—
	Coled-rolled sheet	2 mm^t	351	682	44	—	85

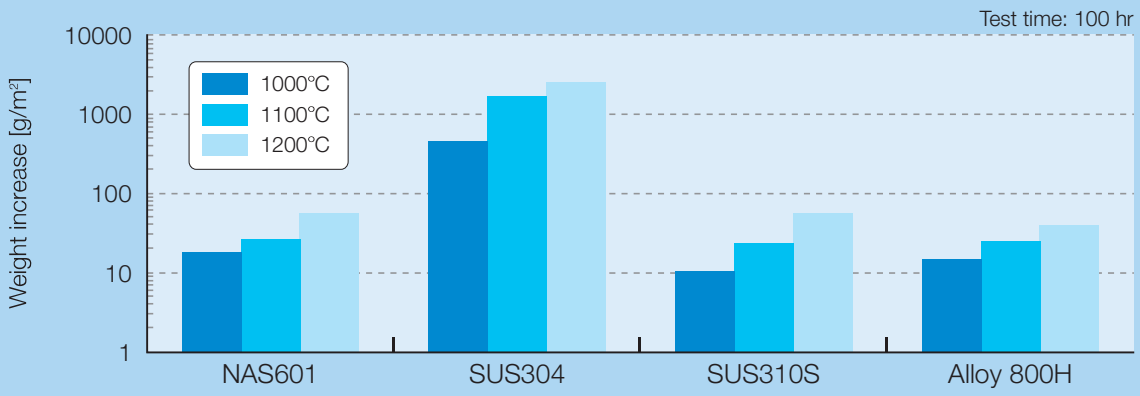
High Temperature Strength

Results of high-temperature tensile test



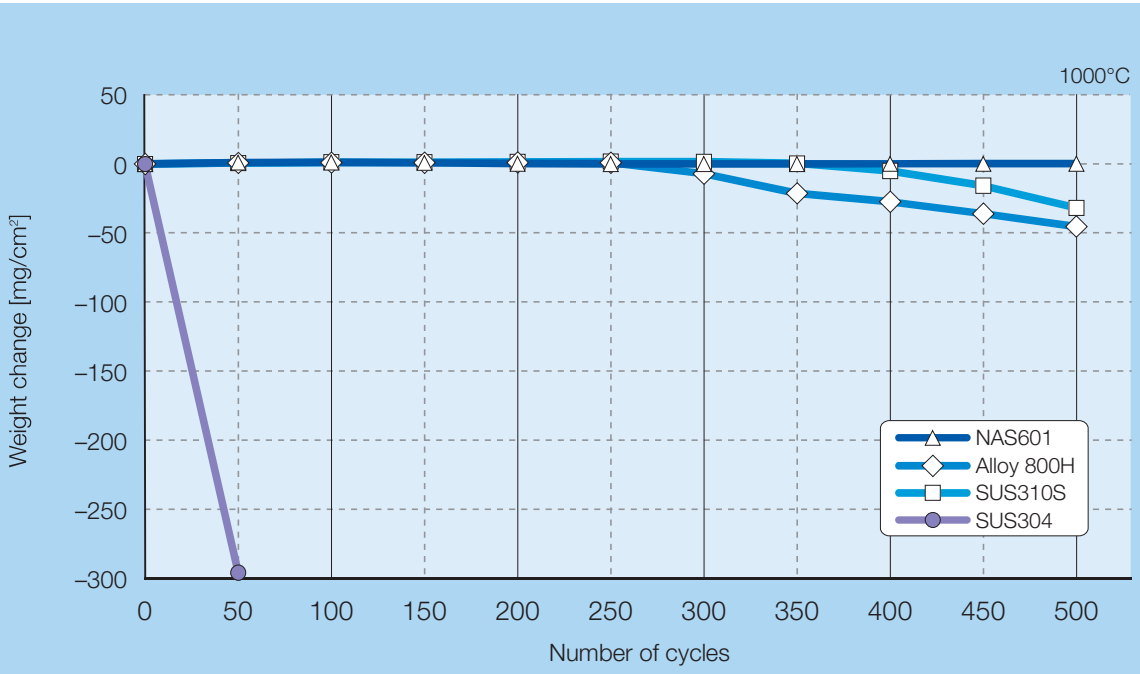
Heat Resistance

Continuous Oxidation Properties



Cyclic Oxidation Properties

Cyclic oxidation properties for NAS601 are superior to Type 310S and Alloy 800H. This makes NAS601 optimal for use in environments subjected to repeated heating and cooling.



Test cycles consisted of 30 minutes at the test temperature followed by 10 minutes cooling.

Workability

Hot working is relatively easy with NAS601. For hot working, temperature should be between 1050 and 1200°C, although light work may be done at temperature as low as 850°C. The temperature range between 650 and 850°C should be avoided as cracking may occur. After hot working, we also recommend cooling through the temperature range of 500 to 800°C as fast as possible to avoid carbide precipitation. NAS601 has superior cold workability, similar to Type 310S and Alloy 800.

Weldability

As with standard austenitic stainless steels, NAS601 may be welded using techniques such as TIG, MIG, and shield metal arc welding. For edge preparation, mechanical cutting is desirable. Wide U- and V-groove angles should be used. Care should be taken to ensure its welding portion is clean as NAS601 is sensitive to surface contamination.
AWS ERNiCrFe-11, AWS ERNiCrCoMo-1, AWS ENiCrFe-2, or AWS ENiCrCoMo-1 are commonly used.

Heat Treatment

NAS601 is non-hardenable by thermal treatment. Typical heat treatments are as follows:

- annealing: 950°C minimum, rapid cooling
- solution treatment: 1100°C~1200°C, rapid cooling

For applications requiring high strength at elevated temperatures, solution treatment is recommended.

Applications

Heat treatment fixtures, Muffle furnace, Radiant tube, Chemical plants, Automobile glow plug.

For more information, please contact:
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