

NAS625 (UNS N06625)

NAS Corrosion-Resistant and Heat-Resistant Nickel Alloy

NAS625 (NCF625, UNS N06625) is a nickel-chromium-molybdenum alloy with an additional of niobium. Matrix stiffening provided by molybdenum and niobium results in high strength. The alloy resists a wide range of severe corrosion environments. It also offers resistance to high temperatures. Uses include parts in chemical and garbage incinerator plants. Nippon Yakin supplies this product in plate, sheet, and strip forms.

Grade/Standard

| NAS | JIS G4902 | ASTM B443 | EN |
|--------|-----------|------------|----|
| NAS625 | NCF625 | UNS N06625 | — |

Chemical Composition

| | C | Si | Mn | P | S | Ni | Cr | Mo | Al | Ti | Fe | Co | Nb+Ta |
|----------------------------|-------|-------|-------|--------|--------|--------|-------------|------------|-------|-------|-------|------|-----------|
| Specification (NCF625) | ≤0.10 | ≤0.50 | ≤0.50 | ≤0.015 | ≤0.015 | ≥58.00 | 20.00~23.00 | 8.00~10.00 | ≤0.40 | ≤0.40 | ≤5.00 | — | 3.15~4.15 |
| Specification (UNS N06625) | ≤0.10 | ≤0.50 | ≤0.50 | ≤0.015 | ≤0.015 | ≥58.0 | 20.0~23.0 | 8.0~10.0 | ≤0.40 | ≤0.40 | ≤5.0 | ≤1.0 | 3.15~4.15 |

Physical Properties

| | | | |
|--|------------------------|------------------------|------|
| Density | [g/cm ³] | 8.44 | |
| Specific heat | [J/kg · K] | 419 | |
| Electrical resistivity | [μΩ · cm] | 129 | |
| Thermal conductivity | [W/m · K] | 10.2 | |
| Average coefficient of thermal expansion | [10 ⁻⁶ /°C] | 20~200°C | 12.8 |
| | | 20~300°C | 13.1 |
| | | 20~400°C | 13.6 |
| Young's modulus | [MPa] | 20.7 × 10 ⁴ | |
| Magnetism | | None | |
| Melting range | [°C] | 1290~1350 | |

Mechanical Properties

Mechanical Properties at Room Temperature

Grade 1 (annealed)

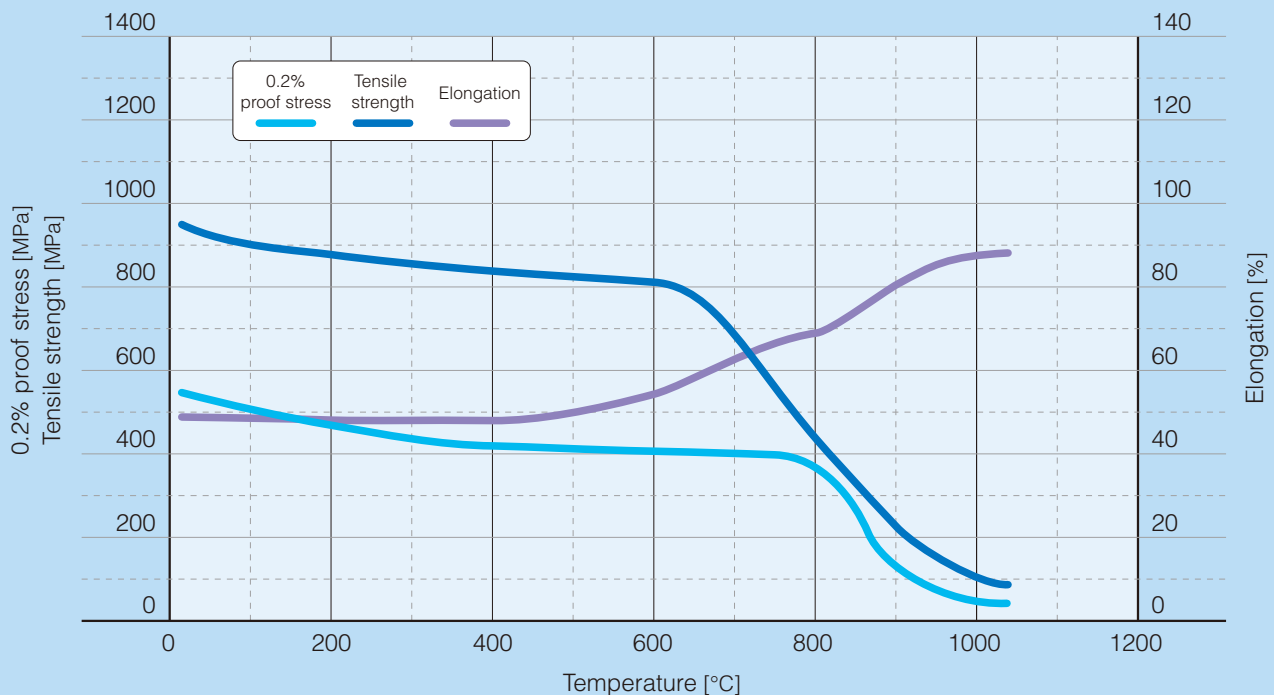
| | | 0.2% proof stress [MPa] | Tensile strength [MPa] | Elongation [%] | Hardness |
|--|---|-------------------------|------------------------|----------------|----------|
| Specification | >0.5mm ^t , ≤3.0mm ^t | ≥415 | ≥830 | ≥30 | — |
| NCF625 (annealing) | >3.0mm ^t , ≤70mm ^t | ≥380 | ≥760 | ≥30 | — |
| Specification UNS N06625 Grade 1 (annealed) | Cold-rolled sheet, strip | ≥414 | ≥827 | ≥30 | — |
| | Hot-rolled plate (≤70mm ^t) | ≥379 | ≥758 | ≥30 | — |
| | Cold-rolled sheet (≤9.5mm ^t) | ≥379 | ≥758 | ≥30 | — |
| Example | Hot-rolled plate 10mm ^t | 421 | 837 | 54 | HBW 212 |
| | Cold-rolled sheet 3.2mm ^t | 536 | 936 | 46 | HRBW 98 |

Grade 2 (solution annealed)

| | | 0.2% proof stress [MPa] | Tensile strength [MPa] | Elongation [%] | Hardness |
|---------------|--|-------------------------|------------------------|----------------|----------|
| Specification | >0.5mm ^t , ≤70mm ^t | ≥275 | ≥690 | ≥30 | — |
| Specification | UNS N06625 Grade 2 (solution annealed) | ≥276 | ≥690 | ≥30 | — |
| Example | Hot-rolled plate 11mm ^t | 407 | 826 | 62 | HBW 201 |
| | Cold-rolled sheet 2.5mm ^t | 392 | 832 | 57 | Hv 197 |

High Temperatures Strength

Results of high-temperature tensile test (Grade 1)



Corrosion Resistance

Pitting Corrosion Resistance

| Alloy | ASTM G48 Method A | | ASTM G48 Method C |
|---------|-------------------|------|---|
| | 22°C | 50°C | Critical pitting corrosion temperature CPT (°C) |
| NAS185N | ○ | ○ | 70 |
| NAS825 | ○ | × | 30 |
| NAS625* | ○ | ○ | >103 |

*Grade 1

Test conditions ASTM G48 Method A (○: No pitting corrosion, ×: Pitting corrosion)

• Test solution: 6%FeCl₃

• Test temperature: 22°C, 50°C (Recommended temperature in this test)

• Test time: 72h

ASTM G48 Method C

• Test solution: 6%FeCl₃ + 1%HCl

• Test time: 72h

Crevice Corrosion Resistance

| Alloy | ASTM G48 Method D |
|---------|---|
| | Critical crevice corrosion temperature CCT (°C) |
| NAS185N | 40 |
| NAS825 | 10 |
| NAS625* | 40 |

*Grade 1

Test conditions ASTM G48 Method D

• Test solution: 6%FeCl₃ + 1%HCl

• Test time: 72h

Acid Resistance

| Alloy | Corrosion rate in sulfuric acid at 80°C (mm/y) | | | | | |
|---------|--|------|------|------|------|------|
| | 5% | 10% | 20% | 40% | 60% | 80% |
| NAS185N | 0.02 | 0.04 | 1.32 | 2.89 | 3.20 | 4.78 |
| NAS825 | 0.01 | 0.03 | 0.30 | 0.21 | 0.23 | 0.73 |
| NAS625* | <0.01 | 0.01 | 0.02 | 0.61 | 1.07 | 2.81 |

*Grade 1

Test time: 24h

(Reference)

| Alloy | JIS | UNS No. | Chemical composition |
|---------|---------|---------|---------------------------------|
| NAS185N | SUS312L | S31254 | 20Cr-18Ni-6Mo-0.8Cu-0.2N |
| NAS825 | NCF825 | N08825 | 40Ni-23Cr-3Mo-2Cu-0.7Ti |
| NAS625 | NCF625 | N06625 | 62Ni-22Cr-9Mo-3.7Nb-0.2Ti-0.2Al |

Workability

Because the high-temperature strength of NAS625 is extremely higher than that of Type304, care is required when hot working. The cold workability of NAS625 is basically the same as that of standard austenitic stainless steels such as Type 304, Type316, etc. However, the fact that this is a high strength material must be considered in cold 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. Susceptibility of NAS625 to solidification cracking is higher than that of Type304.

Heat Treatment

Annealing of NAS625 is normally performed at 871°C and higher followed by being quenched in water or rapidly cooled by other means.

Solution annealing of NAS625 is normally performed at 1093°C and higher followed by being quenched in water or rapidly cooled by other means.

Pickling

A mixture of nitric acid and fluoric acid is used in pickling. However, because descaling is somewhat difficult in comparison with Type304, alkali immersion before acid pickling, and if possible, shot blasting are extremely effective.

Applications

Chemical plants, nuclear power, seawater applications, jet engine parts, aircraft material, heat treatment furnace material, evaporators

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