Alloy 725

NiWire Industries
www.niwire.com

UNS N07725

Alloy 725 (UNS N07725) is a nickel based alloy which is highly resistant to many aqueous environments and is age hardenable for extremely high strength. Alloy 725 offers resistance to corrosion in extremely sour brine environments and in the presence of elemental sulfur at temperatures up to 242 °C. The maximum permitted hardness under NACE MR0175 requirements is 40 HRC. The stress corrosion cracking resistance of age-hardened Alloy 725 is superior to that of Alloy 718 in sour environments. A high-strength grade of Alloy 725, Alloy 725HS, has been assigned a NACE MR0175 maximum hardness level of 43 HRC and can be used for high-strength applications in sour service up to NACE test level VI at 175 °C.

Specification

NiWire's production follows:
ASTM B 805 (bar and wire)
NACE MR-01-75 (materials for use in sour gas wells)

Chemical Composition

Composition limit: 55.0 to 59.0 Ni; 19.0 to 22.5 Cr; 7.0 to 9.5 Mo; 2.75 to 4.0 Nb; 1.0 to 1.7 Ti; 0.35 max Al; 0.03 max C; 0.35 max Mn; 0.20 max Si; 0.015 max P; 0.010 max S; bal Fe

Applications

Typical uses: Age-hardenable Alloy 725 is used for hangers, landing nipples, side pocket mandrels, and polished bore receptacles in sour gas service. Also used for high-strength fasteners in marine applications. Its combined high strength and hardness make Alloy 725 a suitable choice for polymer extrusion dies.

Physical Properties

Density: 8.31 g/cm3 (0.300 lb/in.3)
Melting range: 1271 to 1343 °C (2320–2449 °F)
Magnetic permeability: <1.001 at a field strength of 15.9 kA/m

Thermal and electrical properties of Alloy 725:

Temperature		Coefficient of thermal expansion(a)		Electrical resistivity	
°C	°F	µm/m · K	µin./in. · °F	µΩ · m	Ω · circular-mil/ft
20	70	...	...	1.144	688.3
100	200	13.0	7.22	1.158	696.2
200	400	13.1	7.21	1.179	710.4
300	600	13.4	7.44	1.206	727.1
400	800	13.7	7.68	1.226	741.3
500	1000	14.1	7.79	1.251	758.6
600	1200	14.4	8.05	1.265	761.7
700	1400	...	...	1.273	776.1
800	1600	...	...	1.302	784.6

(a) Mean coefficient of linear expansion between 20 °C (70 °F) and the temperature shown

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Mechanical Properties

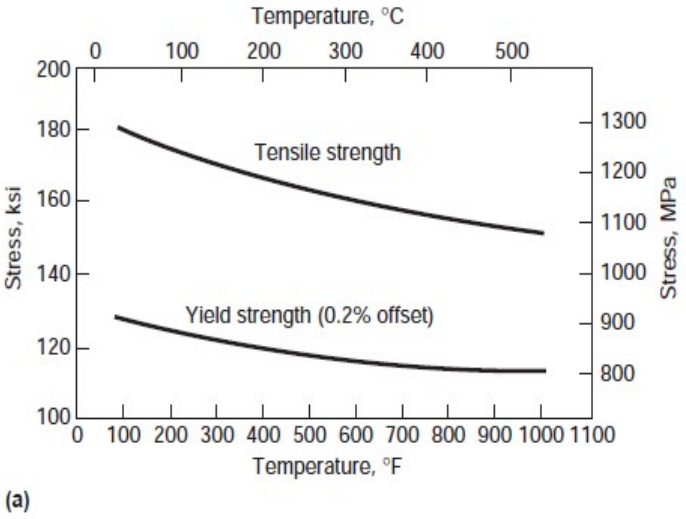
Elastic modulus: 204 GPa (29.6 × 106 psi) at 20 °C (70 °F)
Shear modulus: 78 GPa (11.3 × 106 psi) at 20 °C (70 °F)
Poisson's ratio: 0.31 at 20 °C (70 °F)

Typical room-temperature tensile, hardness, and impact properties of Alloy 725:

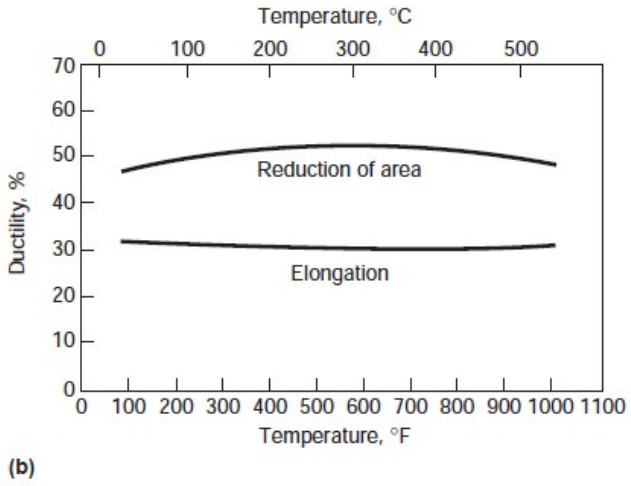
Form	Condition	Yield strength (0.2% offset)		Tensile strength		Elongation, %	Hardness, HRC	Charpy impact	
		MPa	ksi	MPa	ksi			J	ft · lbf
Round(a)	Annealed	427	62.0	855	124.0	57	5	...	...
	Age hardened	917	133.0	1241	180.0	30	36	92	68
Round(b)	Age hardened	903	131.0	1241	180.0	31	36	132	97
Tube	Annealed	334	48.4	783	113.6	60	5	...	...
	Age hardened	921	133.6	1268	183.9	27	39	...	...

(a) Transverse specimens from hot-finished rounds of 102 to 190 mm (4.0–7.5 in.) diameter.
(b) Longitudinal specimens from hot-finished rounds of 13 to 190 mm (0.5–7.5 in.) diameter

Elevated-temperature tensile properties of annealed and aged Alloy 725:



(a) Tensile and yield strength



(b) Elongation and reduction of area

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Chemical Properties

General corrosion behavior: Alloy 725 is especially resistant to media containing carbon dioxide, chlorides, and hydrogen sulfide, such as those encountered in deep sour gas wells. In such environments, it resists general corrosion, pitting, sulfide stress cracking (hydrogen embrittlement), and stress-corrosion cracking. Alloy 725 also displays resistance to corrosion in brines and seawater. The corrosion resistance of age-hardened nickel-base alloys in sour brine environments is as follows:
Alloy 725> Alloy 725HS > Alloy 925 > Alloy 718 > Alloy K-500 and Alloy X-750

Resistance to specific corroding agents: following table compares the resistance of Alloys 725, 625, and 718 in a simulated sour well environment.

Alloy	Condition	Yield strength 0.2% offset		Stress-corrosion cracking at:						
		MPa	ksi	177 °C	191 °C	204 °C	218 °C	232 °C	246 °C	260 °C
725	Age hardened	811	117.6	No	No	No	No	No	Yes(a)	No
	Age hardened	887	128.6	No	No	No	No	Yes	...	...
	Age hardened	916	132.9	No	No	No	No	No	No	No
	Age hardened	917	133.0	No	No	No	No	No	Yes(a)	No
625	Cold worked	993	144.0	No	Yes	...	...	...	...	...
	Cold worked	1103	160.0	No	Yes	...	...	...	...	...
718	Age hardened	898	130.3	Yes(b)	...	...	...	...	...	...

C-ring autoclave tests of 14 day duration at 100% of yield strength in 25% NaCl plus 0.5% acetic acid plus 1 g/L sulfur plus 827 kPa (120 psi) HsS. (a) One of two specimens cracked. (b) At 135 °C (275 °F)

Following table shows crevice corrosion test results for Alloy 625 and Alloy 725 using more severe crevice geometry. Alloy 725 exhibited excellent corrosion performance and showed no attack, while Alloy 625 samples crevice corroded during the test to a maximum depth of 0.66 mm. The titanium content in Alloy 725 appears to have a beneficial effect in improving crevice corrosion resistance in seawater.

Grade	Observed initiation days	Percent of sites attacked	Maximum Depth of attack (mm)
Alloy 725	None at 30 days	0	0.00
Alloy 625	2 to 5	25 to 75	0.02 to 0.66

Evaluated in quiescent seawater at 30_C for 30 days, using acrylic plastic crevice devices torqued to 25 in-lbs (0.288 m-kg).