Allegheny Ludlum
An Allegheny Technologies Company

Technical Data BLUE SHEET

Allegheny Ludlum Corporation ◆ Pittsburgh, PA

Stainless Steel AL 625HP™ (UNS N06626)

GENERAL PROPERTIES

Allegheny Ludlum's AL 625HP alloy (UNS Designation N06626) is an austenitic nickel-base superalloy possessing exceptional fatigue resistance. Al 625HP alloy was developed especially for bellows applications. It also has excellent resistance to oxidation and corrosion over a broad range of conditions, including jet engine environments and in many other aerospace and chemical process applications. The alloy has outstanding strength and toughness at temperatures ranging from cryogenic temperatures to 2000°F (1093°C).

The AL 625HP alloy is a restricted composition, vacuum melted variant of the widely known alloy 625 (UNS N06625) material. It derives its strength from the solid solution strengthening effects of molybdenum and columbium on the nickel-chromium matrix. These elements also contribute to the alloy's outstanding corrosion resistance. Although the alloy was developed for high temperature strength, it also provides a high level of general corrosion resistance to a wide range of oxidizing and non-oxidizing environments. The levels of chromium and molybdenum provide excellent resistance to chloride ion pitting and the high level of nickel provides resistance to chloride stress corrosion cracking. The material possesses a high degree of formability and shows better weldability than many of the other highly alloyed nickel-base alloys. The alloy is resistant to intergranular corrosion even in the welded condition.

AL 625HP alloy is produced by a two-step melting process that includes a consumable electrode remelting procedure. At least one of these steps is performed in vacuum.

FORMS AND CONDITIONS AVAILABLE

The AL 625HP alloy is available in plate, sheet and strip. The alloy is supplied in the annealed condition.

SPECIFICATION

Al 625HP alloy is covered by the AMS 5879 specification. It also meets the requirements of the standard alloy 625 (UNS N06625) specification (AMS 5599) and can be dual certified.

COMPOSITION LIMITS

Element	Weight Percent
Carbon	0.03 max
Manganese	0.50 max
Phosphorus	0.015 max
Sulfur	0.015 max
Silicon	0.15 max
Chromium	20.0-23.0
Nickel	Balance (58.0 min)
Molybdenum	8.0-10.0
Columbium plus Tantalum	3.15-4.15
Titanium	0.40 max
Aluminum	0.40 max
Cobalt	1.0 max
Iron	5.0 max
Nitrogen	0.02 max

Data are typical and should not be construed as maximum or minimum values for specification or for final design. Data on any particular piece of material may vary from those shown herein.

CORROSION RESISTANCE

The high level of chromium and molybdenum in the AL 625HP alloy provides a high level of pitting and crevice corrosion resistance to chloride containing media, such as sea water, neutral salts and brines. the alloy is highly resistant to chloride stress-corrosion cracking. For additional information, please consult the Technical Data Blue Sheet for ALTEMP® 625 alloy.

The alloy is resistant to a variety of corrosive media from highly oxidizing to moderately reducing. Tests in simulated flue gas desulfurization environments show that AL 625HP alloy is highly resistant to the environment in contrast to lower alloy austenitic stainless steels such as Type 316.

OXIDATION RESISTANCE

AL 625HP alloy has excellent oxidation and scaling resistance at temperatures up to 2000°F (1093°C). It is superior to many other high temperature alloys under cyclic heating and cooling conditions.

PHYSICAL PROPERTIES – TYPICAL VALUES

Physical Constants

Density, lb/in^3 (g/cm^3)	0.305 (8.44)
Melting Range, °F (°C)	2350-2460 (1280-1350)
Specific Heat, Btu/lb • °F (J/kg • K)	0.098 (410)
Magnetic Permeability, 75°F, 200 Oersted	1.0006

Electrical Resistivity

Temperature		Electrical Resistivity
°F	°C	microhm-cm
70	21	128.9
100	38	129.6
200	93	131.9
400	204	133.9
600	316	134.9
800	427	135.9
1000	538	137.9
1200	649	137.9
1400	760	136.9
1600	871	135.9
1800	982	134.9
2000	1093	133.9

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Thermal Properties*

Temperature		Coefficient of Linear Thermal Expansion		Thermal Conductivity	
°F	°C	10^{-6} in/in • °F	10^{-6} cm/cm • °C	Btu • in/ft²•h•°F	W/m•K
-250	-157			50.4	7.3
-100	-129			51.6	7.4
-100	-73			57.6	8.3
0	-18			63.6	9.2
70	21			68.4	9.9
100	38			69.6	10.0
200	93	7.1	12.8	75.6	10.7
400	204	7.3	13.1	87.6	12.6
600	316	7.4	13.3	98.4	14.2
800	427	7.6	13.7	109.2	15.7
1000	538	7.8	14.0	121.2	17.5
1200	649	8.2	14.8	132.0	19.0
1400	760	8.5	15.3	144.0	20.8
1600	871	8.8	15.8	158.4	22.8
1700	927	9.0	16.2		
1800	982			175.2	25.3

*Measurements made from 70°F (21°C) to temperature shown; applicable to thermal expansion.

Elastic Properties

Temperature		Modulus of Rigidity (G)		Modulus of Elasticity (E)		Poisson's Ratio (μ)*
°F	°C	10^6 psi	GPa	10^6 psi	GPa	
70	21	11.4	79	29.8	205	0.306
200	93	11.2	77	29.2	200	0.307
400	204	10.8	75	28.4	195	0.310
600	316	10.5	72	27.5	190	0.313
800	427	10.1	70	26.6	185	0.316
1000	538	9.7	67	25.6	175	0.320
1200	649	9.2	63	24.4	170	0.324
1400	760	8.7	60	23.1	160	0.328
1600	871	8.2	57			

*Poisson's ratio (μ) computed from the relation: $\mu = (E-2G)/2G$

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MECHANICAL PROPERTIES

Typical room temperature tensile properties of AL 625HP alloy are:

Yield Strength (0.2% Offset)	Ultimate Tensile Strength	Elongation (% in 2")
70,000 psi	136,000 psi	46.0
485 MPa	940 MPa	

Minimum room temperature tensile properties (per AMS 5879) are:

Yield Strength (0.2% Offset)	Ultimate Tensile Strength	Elongation (% in 2")
60,000 psi	120,000 psi	40
415 MPa	825 MPa	

For applications such as deep drawing or hydroforming, the final annealing can be modified to produce material with lower strength and higher ductility than the requirements in the table above.

IMPACT RESISTANCT

The AL 625HP alloy maintains high impact resistance at low temperature.

FATIGUE RESISTANCE

The room temperature endurance limit for cold rolled and annealed AL 625HP sheet tested in complete reverse bending (constant deflection) was found to be about 35 percent of its tensile strength.

FORMABILITY

The AL 625HP alloy is capable of being formed like the standard austenitic stainless steels. The material is considerably stronger than conventional austenitic stainless steels and consequently requires higher loads to cause the material to deform. During cold working, the material work hardens more rapidly than austenitic stainless steels. The combination of high initial strength and work hardening rate may necessitate intermediate anneals if the cold deformation is extensive. The high ductility of AL 625HP alloy makes it well suited for the hydroforming o bellows type expansion joints.

WELDING

The AL 625HP alloy can be readily welded by conventional processes used for austenitic stainless steel, including fusion and resistance methods. The material should be in the mill annealed condition and thoroughly descaled and cleaned before welding. Preheating is not required and postweld treatment is not needed to maintain or restore corrosion resistance.

Material Safety Data Sheets have been prepared for this product and will be made available at or prior to the time of shipment.

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