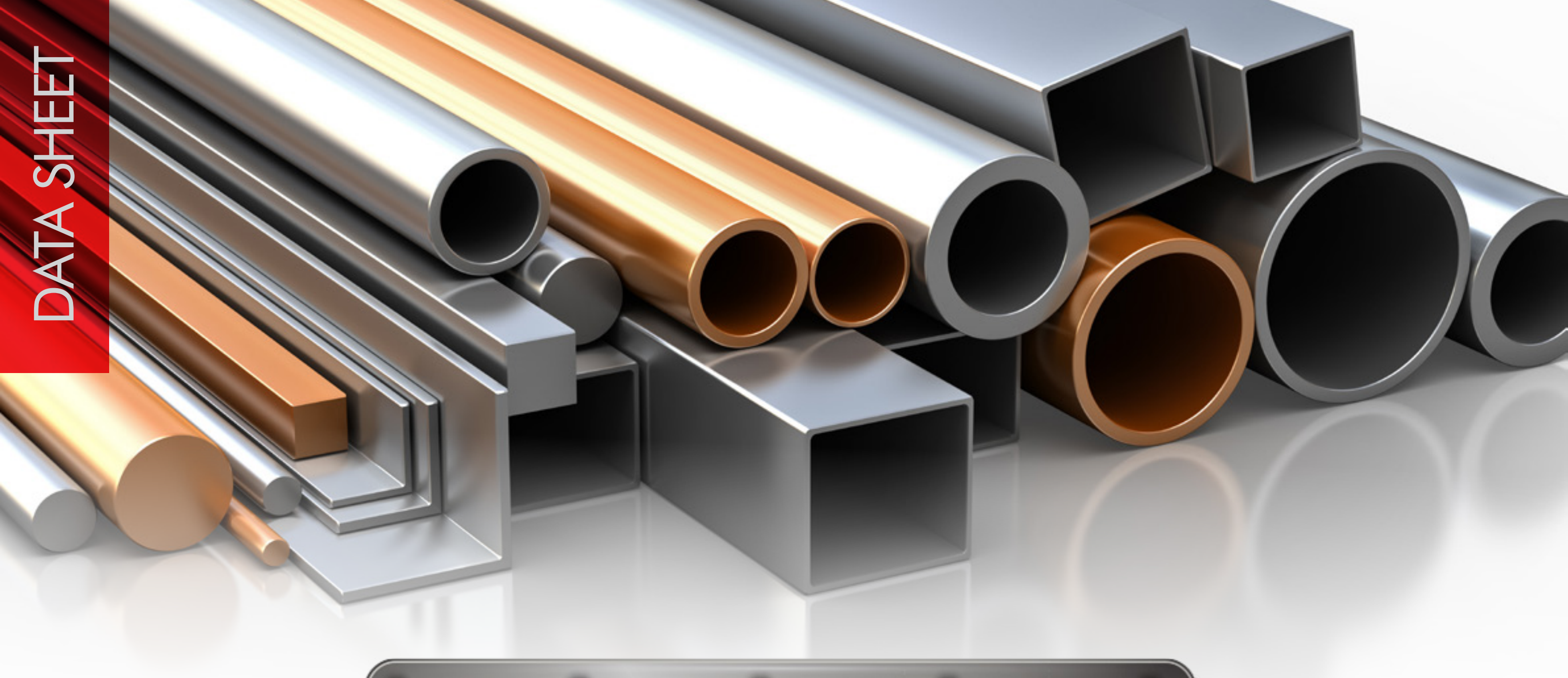
DATA SHEET



INCONEL® 601

UNS No - N06601

Other common names: Alloy 601

Inconel 601 is a nickel-chromium alloy utilized for applications that oblige resistance to corrosion and heat. These nickel alloys emerge because of its resistance to high temperature oxidation, remaining exceptionally resistant to oxidation through 2200° F. Alloy 601 adds to a firmly disciple oxide scale which resist spalling even under states of extreme thermal cycling. These nickel alloys holds its ductility after long service exposure and has great high temperature strength. It has good resistance to aqueous corrosion, high mechanical strength, and is promptly shaped, machined and welded. Inconel 601's properties make it a material of expansive utility in fields like thermal processing, chemical processing, pollution control, aerospace and power generation. Thus, alloy 601 is not recommended for use in firmly reducing, sulfur bearing environments.

Applications

- Chemical Processing
- Aerospace
- Heat treating industry
- Power generation
- Heat treating muffles and retorts
- Radiant tubes
- Catalyst support grids in nitric acid production
- Steam super heater tube supports

Characteristics

- Outstanding oxidation resistance to 2200° F
- Resists spalling even under severe thermal cycling conditions
- Highly resistant to carburization
- Good creep rupture strength
- Metallurgical stability

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Machining

Standard machining methods utilized for iron based alloys might be utilized. This alloy works harden during machining and has higher strength and “gumminess” not typical of steels. Heavy duty machining equipment as well as tooling should be utilized to minimize chatter or work-hardening of the alloy in front of the cutting. Most any business coolant might be utilized as a part of the machining operations. Water-base coolants are favored for high speed operations, for example, turning, grinding or milling. Heavy lubricants work best for tapping, drilling, broaching or boring. Turning: Carbide tools are recommended for turning with a nonstop cut. High speed steel tooling should be utilized for interfering with slices and for smooth completing to close resilience. Tools should have a positive rake angle. Cutting speeds and feeds are in the accompanying reaches: For High-Speed Steel Tools For Carbide Tooling Depth Surface Feed Depth Surface Feed of cut pace in inches of cut rate in inches feet/min. per rev. inches, feet/min. per rev. 0.250” 25-35 0.030 0.250” 150-200 0.020 0.050” 50-60 0.010 0.050” 325-375 0.008 Drilling: Steady feed rates must be utilized to maintain a strategic distance from work hard because of harping of the drill on the metal. Rigid setups are crucial with as short a stub drill as practical. Heavy duty, high speed steel drills with heavy web is recommended. Feeds fluctuate from 0.0007 inches for each rev. for holes of less than 1/16” measurement, 0.003 inches for each rev. for 1/4” dia., to 0.010 inches for each rev. for holes of 7/8”diameter. Processing: To acquire great exactness and a smooth completion, it is fundamental to have unbending machines and fixtures and sharp cutting devices. High speed steel cutters, for example, M-2 or M-10 work best with cutting speeds of 30 to 40 feet per minute and feed of 0.004”- 0.006” per cutting tooth. Grinding: The alloy should be wet ground and aluminium oxide wheels or belts are favored.

Forming

This alloy has good ductility and might be promptly formed by every standard technique. Since the alloy is more powerful than consistent steel it need more power to perform forming. Heavy-duty lubricants should be utilized during cold forming. It is crucial to altogether clean the part of all traces of lubricant to shaping as embrittlement of the alloy might occur at high temperatures if lubricant is left on.

Welding

The usually utilized welding strategies work well with this alloy. The coordinating alloy filler metal should be utilized. In the event that coordinating alloy is not available, then the closest alloy richer in the essential chemistry (Ni, Co, Cr and Mo) should be utilized. All welds dots should be marginally curved. It is not important to utilize preheating. Surfaces to be welded must be perfect and free from oil, paint or crayon marking. The cleaned area should stretch out no less than 2” past either side of a welded joint. Gas-Tungsten Arc Welding: DC straight polarity (electrode negative) is recommended. Keep as short an arc length as could be expected under the circumstances and use consideration to keep the hot end of filler metal dependably inside of the protected environment. Shielded Metal-Arc Welding: Electrodes should be kept in dry storage and if dampness has been grabbing the electrodes should be prepared at 600 F for one hour to safeguard dryness. Current settings shift from 60 amps for material (0.062” thick) up to 140 amps for material of 1/2” and thicker. It is best to weave the electrode marginally as this alloy weld metal does not tend to spread.

Cleaning of slag is finished with a wire brush (hand or powered). Complete evacuation of all slag is essential before progressive weld passes furthermore after final welding. Gas Metal-Arc Welding: Reverse-polarity DC should be utilized and best results are acquired with the welding weapon at 90 degrees to the joint. For Short-Circuiting-Transfer GMAW a typical voltage is 20-23 with a current of 110-130 amps and a wire feed of 250-275 inches per minute. For Spray-Transfer GMAW voltage of 26 to 33 and current in the scope of 175-300 amps with wire feed rate of 200-350 inches per minute, relying on filler wire diameter. Submerged-Arc Welding: Matching filler metal, the same concerning GMAW, should be utilized. DC current with either turn around or straight polarity might be utilized. Convex weld globules are favored.

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Heat Treatment
The alloy is not hardened or strengthened by heat treatment.

Forging
Forging might be done in the temperature scope of 2250 F to 1900 F.

Hot Working
Hot work within the scope of 2250 F to 1600 F. Avoid working within the scope of 1400 F to 1000 F as the alloy is apt to thermal crack in that region.

Cold Working
Cold forming might be done utilizing standard tooling albeit plain carbon tool steels are not recommended for shaping as they tend to produce galling. Soft die materials (bronze, zinc alloy, and so forth.) minimize galling and deliver great completions, yet the die life is to some degree short. For long production runs the alloy tool steels (D-2, D-3) and high speed steels (T-1, M-2, M-10) give great results particularly if hard chromium plated to decrease galling. Tooling should be, for example, to take into consideration liberal clearances and radii. Heavy duty lubricants should be utilized to minimize galling in all forming operations. Twisting of sheet or plate through 180 degrees is for the most part constrained to a twist sweep of 1 T for material up to 1/8" thick and 2 T for material thicker than 1/8".

Annealing
Annealing taking after cold working might be important. The annealing temperature is 2100 F and the alloy should be quickly cooled through the scope of 1400 to 1000 F to maintain a strategic distance from thermal cracking.

Hardening
The alloy hardens by cold working only.

Chemical Properties

C	Al	Si	S	Cr	Mn	Fe	Ni	Cu
0.1 max	1.0-1.7	0.5 max	0.015 max	21.0-25.0	1.0 max	Remainder	58.0-63.0	1.0 max

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Mechanical Properties

Tensile Strength (ksi)	0.2% Yield Strength (ksi)	Elongation% in 2 inches
80	30	30

Physical Properties

Properties	Units	Temperature in °C
Density	8.11 g/cm³	Room
Specific Heat	0.107 Kcal/kg.C	20°
Melting Range	1360 - 1411 °C	-
Modulus of Elasticity	206.5 KN/mm²	20°
Electrical Resistivity	118 μΩ.cm	20°
Coefficient of Expansion	13.75 μm/m °C	20 - 100°
Thermal Conductivity	11.2 W/m -°K	20°

ASTM Specifications

Pipe / Tube (SMLS)	Pipe Welded	Sheet / Plate	Bar	Forging	Fitting	Wire
B 167	B 517	B 168	B 166	B 564	B 366	B 166

Availability

MANUFACTURING
Refractory Anchors
Fasteners
Custom Machining
Custom Fabrication
Piping / Spools
Stamped Parts
B/W Fittings
S/W Fittings
Flanges
Compression Fittings

RAW MATERIALS
Pipes
Tubes
Bars
wires
Sheets
Plates
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