TP430

Material

TP430, UNS S43000, 1.4016, X6Cr17, 1Cr17

Overview

Type 430 is a chromium ferritic stainless steel with moderate corrosion and heat resistance. It is non-hardenable by heat treatment. TP430 is magnetic and exhibits good ductility. It can be readily formed into many desired shapes.

Characteristics

430 is a low carbon ferritic stainless steel, its corrosion resistance in mild corrosive environment or atmosphere is similar to some Ni-containing stainless steel, and has oxidation resistance at high temperature. 430 is ductile, low work hardening rate, and can be formed by rolling or drawing processes.

Application

Its typical applications include furnace combustion chambers, gas burners on heating units, downspouts etc. Industrial and commercial applications range from interior architectural applications to nitric acid plant equipment, oil refinery equipment, etc.

Chemical composition (wt% as per ASTM A268)

C	Si	Mn	P	S
≤0.12	≤1.0	≤1.0	≤0.040	≤0.030
Cr	Ni	Cu	Mo	
16.0~18.0	≤0.50	≤0.50	≤0.50	

Physical property

Density: 0.28 lbs/in^3 (7.75 g/cm^3)
Melting: 2600-2750°F (1427-1510°C)
Electric resistivity at 80°F (20°C): 23.68 (60) microhm-in (microhm-cm)
Specific heat at 32-21°F (0-100°C): 0.11 (0.46) Btu-lb/°F (kJ/kg•K)
Thermal Conductivity:
At 212 °F (100°C): 15.1(26.1) Btu/hr/ft^2/ft/°F (W/m•K)
At 932 °F (500°C): 15.2(26.3) Btu/hr/ft^2/ft/°F (W/m•K)
Modulus of elasticity: 29×10^3 (200×10^3) ksi (MPa) in tension
Magnetic Permeability: magnetic

Corrosion resistance

Type 430 resists corrosion from the atmosphere, fresh water and steam, foodstuffs, dairy products, nitric acid and many petroleum products and organic materials. Its resistance to chloride-stress-corrosion cracking at elevated temperatures is far superior to that of austenitic types 304 and 316.

The alloy has acceptable resistance to sulfide cracking at Rockwell C 22 maximum hardness per NACE MR0175.

For optimum corrosion resistance, surfaces must be free of scale, lubricants, foreign particles, and coatings applied for drawing and heading. After fabrication of parts, cleaning and/or passivation should be considered. When it is polished or rolled to a mirror-like finish, it has the best corrosion resistance.

If this material is cooled by air from temperatures higher than 1500°F (816°C), intergranular corrosion is likely to occur in some environments. This sensitivity to intergranular erosion may simultaneously reduce ductility. Corrosion resistance and ductility are usually restored by annealing.

Oxidation resistance

When not continuous operation in high temperature, its oxidation resistance can be up to 1600°F.
When continuous operation in high temperature, its oxidation resistance can be up to 1450-1500°F.
When the temperature changes suddenly, the formed oxide film will be tightly bonded, not easy to fall off.
The rate of oxidation is greatly affected by heating and cooling cycles and operation environment.

Microstructure

At temperatures below about 1650°F, TP430 is a ferrite with random spherical carbide diffusion. When heated above 1650°F, a small amount of austenite is formed in grain boundaries and grains. These austenites turn into martensite or ferrite or carbide, depending on the rate of cooling. Martensite may be found in the weld zone and the heat-affected zone of the parent metal, which is annealed and converted to ferrite and carbide.

Mechanical property

Tensile Strength: 60 KSI min (415 MPa min)
Yield Strength(0.2% Offset): 35 KSI min(240 MPa min)
Elongation: 20% min
Hardness: HRB90 (190HB) max.

Heat treatment

Annealing

TP430 shall be annealed in the temperature range 1450-1550°F (788-843°C), cooled with the furnace at a rate of 50°F per hour to 1100°F (593°C), then air cooled. If thin material, the annealing temperature does not exceed 1450°F (788°C), air cooling can be used instead of on-furnace cooling. The annealing scale should be removed after each treatment. This can be done by pickling in 50% hydrochloric acid heated to 140/150º F (60/65º C). Wash and passivate. Annealing TP430 does not produce a phase transition, but is used only to soften it sufficiently and to achieve maximum ductility. These materials produce an oxide film colour after annealing and must be removed for maximum corrosion resistance.

Hardening

Type 430 is not hardenable by heat treatment. However, its hardness can be moderately increased by cold work.

Workability

TP430 is readily drawn and formed. Its drawing characteristics are similar to those of low-carbon steel, although it is stronger in the annealed condition and will require stronger tooling and increased power. It is also adaptable to most hot-forming operations.

(1) Hot forming

Type 430 can be forged, upset and hot headed satisfactorily.

Forging

Heat uniformly to 1500/1600ºF (816/871ºC) and then increase as rapidly as possible to the forging temperature of 1900/2050ºF (1038/1121ºC). Do not soak at the forging temperature since this produces grain growth. Hot-working operations should not be continued when the temperature has dropped below 1500ºF (816ºC). Forgings should be air-cooled and then annealed.

(2) Cold working

Type 430 can be readily blanked, formed, tempered, stamped, and cold-headed

Deep drawing

This steel has excellent deep drawing properties and can be used in many products such as stainless steel sinks. Generally speaking, if the blank is 2.1 to 2.3 times the diameter of the final deep drawing part, it can be fully deep drawn without breaking, which is called the ultimate deep drawing ratio. Since ferritic steel is usually anisotropic, skirt lace formed during deep drawing should be pre-treated.

(3) Weldability

TP430 can be welded in the same way that stainless steel is normally welded in all industrial processes. To achieve the best welding results, stainless steel parts to be welded should be thoroughly removed from grease, oil or other surface contaminants. Satisfactory connection can be obtained by using 308-312 austenitic stainless steel welding wire or ferritic parent alloy as cladding metal. If the welded structure is subjected to periodic temperature changes, filling steel wire of the same composition as the base material should be used to avoid bending due to inconsistent thermal expansion.

Welding of these alloys may reduce the ductility of welding and heat affected zone due to the formation of martensite during cooling. The corrosion resistance of the welding heat affected zone in some environments will also decrease greatly, and the ductility and corrosion resistance can be restored by annealing.

(4) Cleaning

This steel shall be cleaned in accordance with acceptable stainless steel cleaning procedures.

Available Process

(1) Hot formed, annealed, descaled

(2) Cold worked and bright annealed

Common Tests

Chemical composition
Tension
Hardness
Flaring
Flange
Flattening
Micro structure
Hydrostatic
NDT
Intergranular Corrosion
Surface condition
Shape and dimension
Positive Material Identification