HAYNES® 214® alloy

Principal Features

Excellent Oxidation Resistance

HAYNES® 214® alloy (UNS N07214) is a nickel - chromium-aluminum-iron alloy, designed to provide the optimum in high-temperature oxidation resistance for a wrought austenitic material, while at the same time allowing for conventional forming and joining. Intended principally for use at temperatures of 1750°F (955°C) and above, 214 alloy exhibits resistance to oxidation that far exceeds virtually all conventional heat-resistant wrought alloys at these temperatures. This is attributable to the formation of a tightly adherent Al_2O_3-type protective oxide scale, which forms in preference to chromium oxide scales at these high temperatures. At temperatures below 1750°F (955°C), 214 alloy develops an oxide scale which is a mixture of chromium and aluminum oxides. This mixed scale is somewhat less protective, but still affords 214 alloy oxidation resistance equal to the best nickel-base alloys. The higher temperature Al_2O_3 - type scale which 214 alloy forms also provides the alloy with excellent resistance to carburization, nitriding and corrosion in chlorine-bearing oxidizing environments.

Fabrication

HAYNES® 214® alloy, like many high aluminum content nickel-base alloys that are intended to be age-hardened by intermediate temperature heat treatment, will exhibit age-hardening as a result of the formation of a second phase, gamma prime (Ni_3Al), if exposed at temperatures in the range of 1100 - 1700°F (595 - 925°C). As a consequence of this, 214® alloy is susceptible to strain-age cracking when highly stressed, highly-restrained, welded components are slowly heated through the intermediate temperature regime. The keys to avoiding this problem are to minimize weldment restraint through appropriate component design, and/or heat rapidly through the 1100 - 1700°F (595 - 925°C) temperature range during post-fabrication heat treatment (or first-use heat-up).

With the exception of the above consideration, HAYNES® 214® alloy does exhibit good forming and welding characteristics. It may be forged or otherwise hot-worked, providing it is held at 2100°F (1150°C) for a time sufficient to bring the entire piece to temperature. Its room temperature tensile ductility is also high enough to allow the alloy to be formed by cold working. All cold or hot-worked parts should be annealed and rapidly cooled in order to restore the best balance of properties.

The alloy can be welded by a variety of techniques, including gas tungsten arc (TIG), gas metal arc (MIG) or shielded metal arc (coated electrode) welding.

Heat-Treatment

HAYNES® 214® alloy is furnished in the solution heat-treated condition, unless otherwise specified. The alloy is normally solution heat-treated at 2000°F (1095°C) and rapidly cooled or quenched for optimum properties. Heat treating at temperatures below the solution heat-treating temperature will result in grain boundary carbide precipitation and, below 1750°F (955°C), precipitation of gamma prime phase. Such lower temperature age-hardening heat treatments are not suggested.

Applications

HAYNES® 214® alloy combines properties which make it very suitable for service in relatively low-stress, high temperature oxidizing environments, where the utmost in resistance to oxidation or scale exfoliation is needed. Its resistance to such environments persists to temperatures as high as 2400°F (1315°C), although strength limitations may apply. Applications can include “Clean Firing” uses such as

mesh belts, trays and fixtures for firing of pottery and fine china, and the heat treatment of electronic devices and technical grade ceramics. In the gas turbine industry, 214® alloy is used for foil construction honeycomb seals, combustor splash plates, and other static oxidation - limited parts. The automotive industry has applications for 214® alloy in catalytic converter internals, and it is used as a burner cup material in auxiliary heaters for military vehicles. In the industrial heating market, 214® alloy is used for highly specialized applications such as refractory anchors, furnace flame hoods, and rotary calciners for processing chloride compounds. It is also used for parts in high temperature chlorine-contaminated environments, such as hospital waste incinerator internals.