

Stainless steels -- also known as corrosion-resistant steels -- have alloying additions specifically to provide a continuous, adherent, self-healing oxide film and so reduce the attack of corrosive media. In addition to corrosion resistance, they also exhibit a number of other properties making them useful engineering materials (oxidation resistance, creep resistance, toughness at low temperature, magnetic or thermal characteristics). This section concentrates on those materials, normally aircraft grades, which can be considered for use in space and introduces precautions for their applications.

Stainless steels are normally grouped by their metallurgical -austenitic: derived from the basic 18 Cr/8 Ni compositions (300-series), or higher strength versions in which some of the Ni-content was replaced by nitrogen and manganese (200-series). There are a large number of variants that were developed to provide resistance to specific environments or to enhance particular mechanical properties, including creep resistance. Strength is increased by cold-working and properties are retained at low temperatures.

-ferritic: 400-series materials contain between 11 % Cr--30 % Cr and a maximum of 0,1 %C. Other elements are used to improve processability (welding) or environmental resistance (pitting and crevice corrosion; high-temperature scaling). Low interstitial grades control carbon and nitrogen to below 0,03 %.

Often used in the annealed or cold-worked condition, increased strength can be obtained by heat-treatment.

-martensitic: also fall within the 400-series, normally have chromium contents between 11 % and 18 %. Some can be heat-treated to give high tensile strengths (>1400 MPa).

-duplex: mixed ferritic/austenitic microstructures. High Cr and Mo contents provide pitting corrosion resistance and reasonable resistance to SCC in chloride environments, (i.e. better than some austenitic grades). Nitrogen additions provide high strengths (cold-working) and better as-welded corrosion resistance than non nitrogen-containing grades.

-precipitation hardened: based on martensitic or duplex grades with additions of copper and aluminium for precipitation hardening. They can be heat-treated to give high strengths combined with high corrosion resistance.