



Ferrium® S53 Mechanical Properties (typical)

YS (ksi)	UTS (ksi)	EI (%)	Ra (%)	Hardness (HRC)	CVN (ft-lb)	K _{Ic} (ksi√in)	K _{IscC} (ksi√in)
225	288	16-18	60-70	54	20	70	44

Other Key Properties

- Corrosion resistance has been measured in accelerated sea water tests and is less than 0.4 mils per year, comparable to 15-5PH.
- Limited fatigue testing at a number of R values and stress levels has shown equivalent performance to typical 300M values.
- S53 yields a Class A Weld. Welding studies have shown minimal impact on mechanical properties.

Materials by Design® Objective

Steels currently used in numerous aerospace applications, specifically landing gear, are not corrosion resistant and therefore require a protective cyanide-based cadmium plating process. Cadmium, a known carcinogen, represents significant environmental risks in both primary aerospace manufacture and at overhaul and repair facilities. The design objective of *Ferrium*® S53 was to create an ultrahigh-strength stainless steel that would eliminate the need for toxic metal plating.

Description

Ferrium S53 is a corrosion resistant ultrahigh-strength steel for structural aerospace applications. *Ferrium* S53 was designed to provide mechanical properties equal to, or better than, conventional ultrahigh-strength steels such as 300M and SAE 4340 with the added benefit of general corrosion resistance similar to 15-5 PH. This eliminates the need for cadmium coating processes, which are environmentally unfriendly and require subsequent hydrogen bake-out operations in order to avoid hydrogen embrittlement. *Ferrium* S53 has a greatly improved resistance to stress-corrosion cracking (SCC) over 300M and SAE 4340.

Ferrium S53 utilizes an efficient M₂C strengthening dispersion precipitated through tempering while avoiding other carbides. This maximizes strength, wear resistance, and toughness; resulting in a unique combination of mechanical properties for a stainless steel.

Ferrium S53 uses a stable passive oxide film for optimum corrosion resistance. It also has high hardenability, permitting less severe quench conditions for a given section size and resulting in less distortion during heat treatment.



Processing

Processing of *Ferrium* S53 is similar to other quench and tempered martensitic secondary-hardening steels. Vacuum heat treatment and vacuum tempering is recommended to avoid surface decarburization. After quenching to room temperature *Ferrium* S53 is subjected to cryogenic treatment to assure a complete martensitic transformation. *Ferrium* S53 is typically double-step tempered around 900°F (482°C) and has excellent thermal resistance approaching this temperature. This allows for higher grinding speeds without risk for grinding burns and more reliability in service.

Corrosion Resistance

The general corrosion resistance of *Ferrium* S53 is similar to typical precipitation-hardened stainless steels such as 17-4 PH and 15-5 PH. Linear polarization testing of *Ferrium* S53 measured an average corrosion rate of 0.40 mils per year versus a saturated Ag/AgCl reference electrode in 3.5% sodium chloride (NaCl) solution at ambient temperature. *Ferrium* S53 is rust resistant in 3.5% NaCl solution.

Density

The density of *Ferrium* S53 is 7.98 g/cc.

Product Forms

Ferrium S53 may be manufactured in typical ingot, bar, and billet forms. Sheet and plate also available upon request.

Other

Patent pending.