Meeting stringent performance requirements

High strength corrosion resistant steel for aerospace

The article below was kindly provided by Dr. Gregory Vartanov, Advanced Materials Development (AMD) Corp, Canada. It demonstrates the advantages of using HSCR steel in aircraft landing gear and structures.

Aircraft landing gear and structures have stringent performance requirements. They are subjected to severe loads, corrosion, and adverse environmental conditions, and have complex shapes which vary in thickness. 300M steel is widely used for high stress aircraft landing gear and structures. This steel is not corrosion resistant and requires protective coatings.

Plating of 300M steel involves using cadmium for corrosion resistance on external surfaces and chrome for wear resistance on internal surfaces. New restrictions have listed cadmium and chrome coatings as substances of concern due to the environmental and health risks associated with the manufacturing of cadmium and chrome coatings.

Recently, a new alternative non-toxic zinc-nickel coating is being developed. However, the zinc-nickel coating does not solve the corrosion problem if it cracks. Ultimately, the use of stainless steel provides a more robust solution, reducing maintenance time and cost of repairs caused by corrosion.

New cobalt-free, quenched and tempered high

Table 1

Steels	YS (ksi/MPA)	UTS (ksi/MPa)	El (%)	RA (%)	CVN (ft-lb/J)	K_{1C} ksi√in/MPa√m
HSCR	220/1520 min	285/1965 min	9 min	36 min	16/22 min	55/60 min
300M	230/1585 min	280/1930 min	9 min	3 min	16/22 min	50/55 min

strength corrosion resistant steel ("HSCR steel") provides the same strength, ductility, and toughness as the 300M steel, while it possesses corrosion resistance in salt spray tests.

Table 1 shows a comparison of room temperature mechanical properties of HSCR steel and 300M steel after solution annealing, oil quenching, and tempering.

Table 2

Steels	YS (ksi/MPA)	UTS (ksi/MPa)	El (%)	CVN (ft-lb/J)
HSCR	180/1245 min	240/1795 min	5 min	8/10.5 min
17-4 PH	110/755 min	140/965 min	5 min	8/10.5 min

HSCR steel showed no rust after the salt spray test in 5% NaCl solution at 95°F for more than 200 hours. Aerospace applications of the wrought HSCR steel include landing gear components, rotatable shafts, actuators, flap tracks, slat tracks, fasteners, and others.

Modification of the HSCR steel is applicable for casting, including investment casting, sand casting and other commonly used casting techniques. The cast HSCR steel possesses higher strength than the cast 17-4 PH stainless steel at the same ductility and toughness. Corrosion resistance of the cast HSCR steel is lower than cast 17-4 PH stainless steel and it is comparable with the corrosion resistance of cast 420 martensitic stainless steel.

Table 2 shows a comparison of mechanical properties of the cast HSCR steel and 17-4 PH stainless steel after annealing and hardening.

Aerospace applications of the investment cast HSCR steel include hydraulic fluid system components, motion control and actuation systems, cargo system, bearing cages, flight critical and safety components.