CHROME CORE 18-FM® SOLENOID QUALITY STAINLESS

Type analysis

Single figures are nominal except where noted.

Iron	Balance	**Chromium**	17.50 %	**Molybdenum**	1.75 %
Silicon	0.90 %	**Manganese**	0.40 %	**Sulfur**	0.30 %
Columbium/Niobium	0.25 %	**Nickel**	0.20 %	**Carbon**	0.02 %
Phosphorus	0.02 %				

Forms manufactured

Bar-Rounds

Description

Chrome Core 18-FM Solenoid Quality stainless is a soft magnetic ferritic material designed for operation in more corrosive environments than tolerated by 18% Cr-Fe Type 430 stainless. This new material has corrosion resistance superior to that of CarTech 430FR Solenoid Quality stainless with generally similar magnetic properties.

Chrome Core 18-FM Solenoid Quality stainless is stabilized with columbium to provide improved corrosion resistance with optimum machinability. The alloy balance also provides resistivity similar to that of CarTech 430FR Solenoid Quality stainless. High resistivity is beneficial in applications involving C excitation due to the suppression of eddy current losses.

Key Properties:

- Superior corrosion resistance
- Optimum machinability
- High resistivity

Markets:

- Aerospace
- Automotive
- Consumer
- Industrial

Applications:

- Solenoid parts

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Chrome Core 18-FM Solenoid Quality stainless is available in the magnetically soft condition, requiring only machining for production of solenoid parts. This alloy may be used as machined if tooling and coolants are not laden with free iron from machining carbon steel. Users who perform their own heat treatment may purchase material which has not been treated at Carpenter.

Corrosion resistance

Chrome Core 18-FM Solenoid Quality stainless provides the highest level of corrosion resistance of the Carpenter solenoid quality materials. It has resistance superior to that of Type 430FR Solenoid Quality stainless and is a candidate for service in corrosive aqueous environments and mild chemicals.

The improvement over Type 430FR Solenoid Quality stainless was demonstrated by critical crevice corrosion tests in 5% FeCl3 + 1% NaN03. Crevice specimens were exposed for 24 hours at successively higher temperatures until crevice attack was noted. Type 430FR Solenoid Quality stainless was attacked at 41°F (5°C), while Chrome Core 18-FM Solenoid Quality stainless typically withstood attack up to 77°F (25°C). This test was designed to demonstrate material differences and was more severe than many service environments.

Optimum corrosion resistance has been obtained without passivation, provided surfaces are free of scale and foreign particles. If contamination with carbon steel particles occurs during machining, they may be removed by passivating in 10% to 20% citric acid at up to 100°F (38°C) followed by appropriate rinsing and neutralization procedures. Contact Carpenter for details.

IMPORTANT NOTE:
The following 4-level rating scale is intended for comparative purposes only. Corrosion testing is recommended; factors which affect corrosion resistance include temperature, concentration, pH, impurities, aeration, velocity, crevices, deposits, metallurgical condition, stress, surface finish and dissimilar metal contact.

Nitric Acid	Moderate	**Acetic Acid**	Moderate
Sodium Hydroxide	Moderate	**Salt Spray (NaCl)**	Excellent
Sea Water	Restricted	**Humidity**	Excellent

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Physical properties

PROPERTY	At or From	English Units	Metric Units
SPECIFIC GRAVITY	—	7.70	7.70
DENSITY	—	0.2780 lb/in^3	7695 kg/m^3
MEAN SPECIFIC HEAT	32 to 212°F	0.1100 Btu/lb/°F	460.55 J/kg·K
MEAN COEFFICIENT OF THERMAL EXPANSION	73 to 400°F (23 to 204°C)	5.80 x 10^{-6} length/length/°F	10.4 x 10^{-6} length/length/°C
	73 to 800°F (23 to 427°C)	6.40 x 10^{-6} length/length/°F	11.5 x 10^{-6} length/length/°C
	73 to 1800°F (23 to 982°C)	7.30 x 10^{-6} length/length/°F	13.1 x 10^{-6} length/length/°C
ELECTRICAL RESISTIVITY	70°F (21°C)	453.0 ohm-cir-mil/ft	75.3 microohm·cm
CURIE TEMPERATURE	—	1220°F	660°C

Magnetic properties of stress relieved material

SATURATION FLUX DENSITY (Bs)	15000 G	1.5 Tesla
RESISTIVITY	453 Ω-cir mil/ft	75.5 μΩ-cm
COERCIVITY	2.5 Oe	199 A/m
MAGNETIC PERMEABILITY	1500	

Typical mechanical properties

ROOM TEMPERATURE							
HEAT TREATMENT	0.2% YIELD STRENGTH		ULTIMATE TENSILE STRENGTH		ELONGATION IN 4D (50 MM)	REDUCTION OF AREA	HARDNESS
	ksi	MPa	ksi	MPa	%	%	HRB
Annealed	50	345	75	517	35	61	86
Stress relieved	50	345	75	517	35	64	86

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Heat treatment

Annealing	This material is normally supplied in the stress relieved condition to provide optimum magnetic properties. Annealing may be performed at 1650/1830°F (900/1000°C). Contact Carpenter for additional information on the effects of annealing and processing.
Hardening	The alloy cannot be thermally hardened. The hardness can be increased moderately by cold work, but coercivity will also be increased.

Workability

Forging	The alloy should be heated uniformly to 1950°F (1065°C) for hot working. Soaking at the forging temperature will produce grain growth.
Cold working	Chrome Core 18-FM Solenoid Quality stainless will withstand moderate cold work, but is not recommended for severe cold upsetting operations. This material is designed for magnetic components that are machined to shape.
Machinability	Chrome Core 18-FM Solenoid Quality stainless has demonstrated excellent machinability in triplicate automatic screw machine tests. This material produced an average of 426 parts before tool wear allowed 0.003 in. part growth, while alloy 1802 averaged only 260 parts with the same increase in part size. Type 430FR Solenoid Quality stainless was slightly superior to the alloy 1802, with an average of 300 parts machined with the same test criterion. Type 430 FR Solenoid Quality Stainless bar machined well, with between 610 and 630 parts produced before 0.003 in. tool wear occured. With Alloy 1802, heavy tool wear or tool failure occured after production of only 270 to 350 parts. Chrom Core 18-FM Solenoid Quality stainless was the best material, allowing production of 610 parts in all three trials before discontinuing the test with only 0.0012 in. to 0.0017 in. tool wear.
Weldability	This material has been welded in thin sections, but care is required because of the high sulfur content. When welding is necessary, low heat input should be used.

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NUMBER PARTS TO CAUSE 0.003 IN TOOL WEAR AT 245.5 SFPM			
TEST NO.	**TYPE 430 FR SOLENOID QUALITY STAINLESS**	**ALLOY 1802 (18%CR-2%MO-TI)**	**CHROME CORE 18-FM SOLENOID QUALITY STAINLESS**
1	610	270; Heavy wear	610; 0.0012 IN wear
2	630	310; Tool failed	610; 0.0017 IN wear
3	630	350; Tool failed	610; 0.0017 IN wear

For additional information, please contact your nearest sales office:
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