CARPENTER ELECTRIFICATION®

DATASHEET

# CHROME CORE® 13-FM

*U.S. Patent Number: 5,769,974*

## Type analysis

*Single figures are nominal except where noted.*

| | | | | | |
|---|---|---|---|---|---|
| **Iron** | Balance | **Chromium** | 12.50 to 13.50 % | **Silicon** | 1.20 to 1.80 % |
| **Manganese** | 0.50 to 1.25 % | **Molybdenum** | 0.20 to 0.50 % | **Sulfur** | 0.20 to 0.40 % |
| **Carbon (Maximum)** | 0.03 % | **Phosphorus (Maximum)** | 0.03 % | | |

## Forms manufactured

**Bar-Rounds**

## Description

Chrome Core 13-FM is a controlled chemistry, ferritic 13% chromium alloy that is a candidate for use in magnetic components where corrosion resistance superior to pure iron, low carbon steel, and silicon-iron alloys is desired without the substantial decrease in saturation induction associated with the 18% Cr ferritic stainless steels.

Applications could include electromechanical devices requiring some degree of corrosion resistance, either in service or for extended shelf life without the need for protective coatings. Chrome Core alloys have been considered for use in automotive components such as fuel injectors, fuel pump motor laminations, and ABS solenoids.

**Key Properties:**

- Superior corrosion resistance

**Markets:**

- Automotive
- Consumer
- Industrial

**Applications:**

- Fuel injectors
- Fuel pump motor laminations
- ABS solenoids



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# > CHROME CORE 13-FM

## Corrosion resistance

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

| | | | |
|---|---|---|---|
| **Nitric Acid** | Moderate | **Sulfuric Acid** | Restricted |
| **Phosphoric Acid** | Restricted | **Acetic Acid** | Restricted |
| **Sodium Hydroxide** | Moderate | **Salt Spray (NaCl)** | Restricted |
| **Humidity** | Good | | |

## Physical properties

| PROPERTY | At or From | English Units | Metric Units |
|---|---|---|---|
| **SPECIFIC GRAVITY** | — | 7.61 | 7.61 |
| **DENSITY** | — | 0.2750 lb/in$^3$ | 7612 kg/m$^3$ |
| **MEAN COEFFICIENT OF THERMAL EXPANSION** | 77 to 212°F (25 to 100°C) | 5.70 x 10$^{-6}$ length/length/°F | 10.20 x 10$^{-6}$ length/length/°C |
| | 77 to 392°F (25 to 200°C) | 6.00 x 10$^{-6}$ length/length/°F | 10.80 x 10$^{-6}$ length/length/°C |
| | 77 to 572°F (25 to 300°C) | 6.20 x 10$^{-6}$ length/length/°F | 11.20 x 10$^{-6}$ length/length/°C |
| | 77 to 752°F (25 to 400°C) | 6.40 x 10$^{-6}$ length/length/°F | 11.50 x 10$^{-6}$ length/length/°C |
| | 77 to 932°F (25 to 500°C) | 6.50 x 10$^{-6}$ length/length/°F | 11.70 x 10$^{-6}$ length/length/°C |
| | 77 to 1112°F (25 to 600°C) | 6.60 x 10$^{-6}$ length/length/°F | 11.80 x 10$^{-6}$ length/length/°C |
| **ELASTIC MODULUS** | — | 27.0 x 10$^3$ ksi | — |
| **ELECTRICAL RESISTIVITY** | 70°F (21°C) | 468.0 ohm-cir-mil/ft | 78 microohm·cm |

## Magnetic properties

| | |
|---|---|
| **SATURATION FLUX DENSITY (Bs)** | 17 kG |
| **COERCIVITY** | 1.8 Oe |
| **MAGNETIC PERMEABILITY** | 2900 |
| **RESIDUAL INDUCTION** | 11.4 kG |

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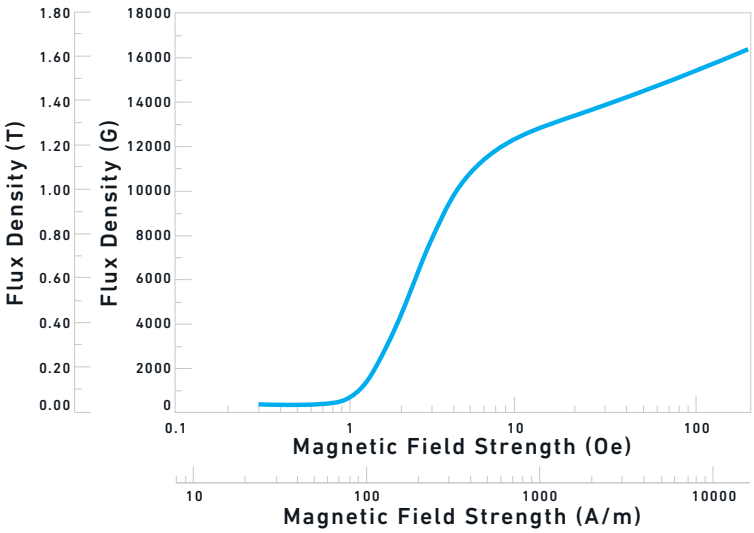
**TYPICAL DC NORMAL INDUCTION CURVE FOR BAR PRODUCT**




## Typical mechanical properties

| ANNEALED FOR OPTIMUM MAGNETIC PROPERTIES | | | | | | |
|---|---|---|---|---|---|---|
| **HEAT TREATMENT** | **0.2% YIELD STRENGTH** | | **ULTIMATE TENSILE STRENGTH** | | **ELONGATION IN 2 IN (50 MM)** | **REDUCTION IN AREA** |
| | **ksi** | **MPa** | **ksi** | **MPa** | **%** | **%** |
| Annealed | 40 | 276 | 65 | 449 | 40 | 60 |

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## Heat treatment

| | |
|---|---|
| **Annealing** | Anneal at a temperature of 820°C ± 14°C (1508°F ± 25°F) for 2 to 4 hours. Annealing temperatures above 850°C (1560°F) should be avoided because of potential degradation of the magnetic properties. |
| **Cooling** | The cooling rate after the anneal is not critical, although rapid cooling and quenching may induce stresses that impair the magnetic characteristics. Any inert annealing atmosphere such as vacuum, inert gases, or dry forming gas is satisfactory. Attempts to decarburize the alloy using a wet hydrogen atmosphere are not recommended. Similar heat treating practices can be used to soften the alloy for further forming. |

## Workability

| | |
|---|---|
| **Cold working** | Chrome Core 13-FM can be formed and cold drawn. Cold work will increase the hardness and degrade the magnetic properties. Because it is free machining, Chrome Core 13-FM will withstand less cold work than non-free machining ferritic alloys and is not recommended for parts produced by large amounts of cold deformation. |
| **Weldability** | Chrome Core 13-FM is not recommended for most arc welding or oxyacetylene welding processes due to the free machining nature of the alloy. Solid state welding, such as friction or inertia welding, as well as high-energy processes, such as laser and electron beam welding, may be satisfactory. Post weld heat treatment is desirable for toughness and magnetic performance. Use of austenitic stainless steel filler metal is not recommended due to the magnetic air gap created. |

**For additional information, please contact your nearest sales office:**
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