

# SILICON CORE IRON B-FM

## Type analysis

Single figures are nominal except where noted.

<b>Iron</b>	Balance	<b>Silicon</b>	2.50 %	<b>Manganese</b>	0.40 %
<b>Phosphorus</b>	0.120 %	<b>Carbon</b>	0.03 %		

## Forms manufactured

<b>Bar-Rounds</b>	<b>Bar</b>
<b>Billet</b>	Many forms and conditions (Note: cold drawn bar available in diameters 1/2 in [12.7 mm] or less)
<b>Strip</b>	

## Description

Silicon Core Iron B-FM is melted in electric arc furnaces to exacting chemical specifications and carefully controlled through all manufacturing processes to produce a fine-grain, uniform quality magnetic core iron.

This alloy exhibits improved machining characteristics over Silicon Core Iron B. Improvements in machinability of up to 40% have been realized on automatic screw machines.

In addition, Silicon Core Iron B-FM displays lower residual magnetism, higher electrical resistivity, and is more magnetically soft when heat treated under identical conditions than Silicon Core Iron B.

The magnetic characteristics and cold working/cold forming properties of Silicon Core Iron B-FM are in the same range as Silicon Core Iron B.

### Key Properties:

- Lower residual magnetism
- Higher electrical resistivity
- Improved machinability
- Superior magnetic core component

### Markets:

- Aerospace
- Automotive
- Consumer
- Industrial

### Applications:

- Solenoid switches
- Relays
- Armatures
- Cores
- Pole pieces

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### Physical properties

PROPERTY	At or From	English Units	Metric Units
SPECIFIC GRAVITY	—	7.69	7.69
DENSITY	—	0.2760 lb/in <sup>3</sup>	7634 kg/m <sup>3</sup>
MEAN COEFFICIENT OF THERMAL EXPANSION	77 to 750°F (25 to 399°C)	7.35 x 10 <sup>-6</sup> length/length/°F	13.23 x 10 <sup>-6</sup> length/length/°C
ELECTRICAL RESISTIVITY	70°F (21°C)	240.7 ohm-cir-mil/ft	40 microohm-cm
CURIE TEMPERATURE	—	1470°F	799°C

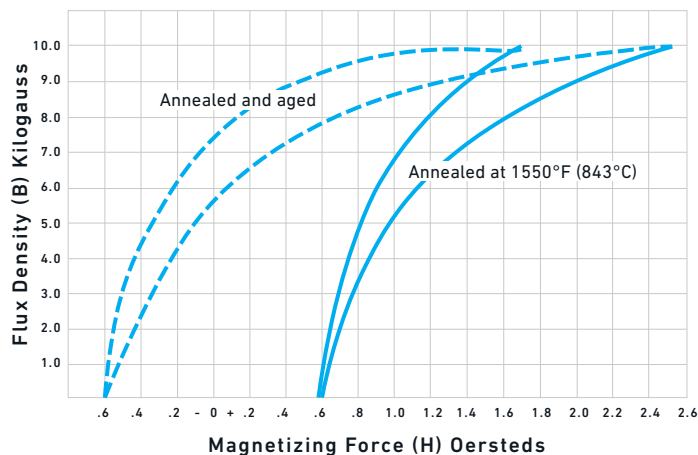
### Magnetic properties

Magnetic properties are determined in accordance with ASTM A341. Diameters less than 1 in. (25.4 mm) are determined on a 10 in. (25.4 cm) long specimen on a Fahy permeameter. Diameters 1 in. (25.4 mm) and larger are evaluated on solid ring specimens machined from a disc.

Specimens are annealed at 1550°F (843°C) 2 hours in a wet hydrogen atmosphere and furnace cooled at a rate of 100°F (55.6°C) per hour to 1000°F (538°C) and any cooling rate thereafter.

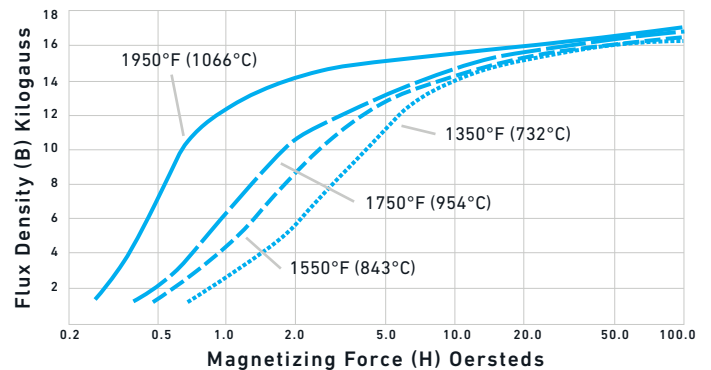
### DC hysteresis

ANNEALED AT 1550°F (843°C)/2 HR/AGED AT 302°F (150°C)/100 HR



### Normal DC magnetization curves

ANNEALED AT VARIOUS TEMPERATURES



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<b>SATURATION FLUX DENSITY (Bs)</b>	20600 G	20.6 kG
<b>COERCIVITY</b>	0.700 Oe	
<b>MAXIMUM PERMEABILITY</b>	5000	
<b>RESIDUAL INDUCTION</b>	5500 G	5.5 kG
<b>TREATMENT FOR FINAL CLOSED PACK ANNEAL</b>	1550°F	843°C

### Typical mechanical properties

5/8 IN (15.87 MM) DIAMETER BAR						
HEAT TREATMENT	0.2% YIELD STRENGTH		ULTIMATE TENSILE STRENGTH		ELONGATION IN 4D	HARDNESS
	ksi	MPa	ksi	MPa	%	ROCKWELL B
Mill anneal	70	483	85	586	Not reported	90
Annealed <sup>1</sup>	65	448	80	552	40	88

<sup>1</sup> Annealed for magnetic properties — 1550°F (843°C), 4 hrs

### Heat treatment

<b>Magnetic property requirements</b>	Items as supplied from the mill are not in the most magnetic soft condition, nor are they supplied to magnetic property requirements. As supplied magnetic property requirements must be approved by the mill.
<b>Heat treatment</b>	Finish fabricated parts must be heat treated to achieve soft magnetic characteristics. Suggested heat treating atmosphere is a wet hydrogen atmosphere in the temperature range of 1550/1600°F (843/871°C), 2 to 4 hours at temperature and cooled at a rate of 100/200°F (38/93°C) per hour to 1000°F (538°C) and any rate thereafter.
<b>Other heat treating atmospheres</b>	Other heat treating atmospheres can be employed, such as nitrogen-hydrogen combinations, vacuum, exothermication, and inert atmosphere retort. Resulting magnetic characteristics will not be as good as the wet hydrogen atmosphere, which provides the best degree of decarburization.
<b>Other heat treatment temperatures</b>	Other heat treatment temperatures in the range of 1350°F (732°C) to 1900°F (1038°C) can be employed to achieve certain advantages such as brazing and fine grain size as required by end application. A sacrifice in certain magnetic characteristics will be realized. A dry atmosphere must be employed at 1750°F (954 °C) and above.

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### Workability

#### Cold working

Cold working and cold forming properties are of the same order as the non-free-machining Silicon Core Iron B (2.5% silicon core iron). Only thin machine sections (less than 1/16 in. [1.60 mm]) thick can be formed.

### Typical feeds and speeds

#### TURNING — SINGLE-POINT AND BOX TOOLS

DEPTH OF CUT, IN	HIGH-SPEED TOOLS			CARBIDE TOOLS			
	SPEED, FPM	FEED, IPR	TOOL MATERIAL	SPEED, FPM		FEED, IPR	TOOL MATERIAL
				BRAZED	THROW AWAY		
.150	120	.015	M-2	400	485	.020	C-6
.025	160	.007	M-3	475	625	.007	C-7

#### TURNING — CUT-OFF AND FORM TOOLS

SPEED, FPM	FEED, IPR							TOOL MATERIAL
	CUT-OFF TOOL WIDTH, IN			FORM TOOL WIDTH, IN				
	1/16	1/8	1/4	1/2	1	1-1/2	2	
110	.002	.0025	.003	.0025	.0025	.0015	.0015	M-2
340	.004	.006	.008	.006	.005	.004	.003	C-6

#### DRILLING

SPEED, FPM	FEED, IPR								TOOL MATERIAL
	NOMINAL HOLE DIAMETER, IN								
	1/16	1/8	1/4	1/2	3/4	1	1-1/2	2	
80-85	.001	.003	.005	.010	.013	.016	.020	.025	M-42

#### TAPPING

SPEED, FPM	TOOL MATERIAL
25-30	M-1, M-7, M-10

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**DIE THREADING**
**SPEED, FPM**

7 OR LESS	8 TO 15	16 TO 24	25 AND UP, TPI
10-20	15-25	20-35	25-40

**TOOL MATERIAL**

M-1, M-2, M-7, M-10

**MILLING — END PERIPHERAL**

DEPTH OF CUT, IN.	HIGH-SPEED TOOLS					CARBIDE TOOLS						
	SPEED, FPM	FEED, IN PER TOOTH				TOOL MATERIAL	SPEED, FPM	FEED, IN PER TOOTH				TOOL MATERIAL
		CUTTER DIAMETER, IN						CUTTER DIAMETER, IN				
		1/4	1/2	3/4	1-2		1/4	1/2	3/4	1-2		
.050	80	.002	.003	.005	.007	M-42	350	.0025	.005	.007	.009	C-6

**Additional machinability notes**

Figures used for all metal removal operations covered are average. On certain work, the nature of the part may require adjustment of speeds and feeds. Each job has to be adjusted for best production results with optimum tool life. Speeds and feeds should be increased or decreased in small steps.

**Other information**
**Applicable specifications**

ASTM A867 Alloy 2F

**For additional information, please  
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