CARPENTER ELECTRIFICATION®

DATASHEET

SILICON CORE IRON C

Type analysis

Single figures are nominal except where noted.

Iron	Balance	**Silicon**	4.00 %
Manganese	0.15 %	**Carbon**	0.03 %

Forms manufactured

Bar-Rounds	**Billet**

Description

Silicon Core Iron C is melted in electric arc furnaces to exacting chemical specifications, and carefully controlled in rolling and annealing practices to produce a fine-grained uniform quality magnetic core iron.

This material possesses low residual magnetism in DC circuits and the effect of magnetic aging is negligible.

Key Properties:

- Maximum resistivity
- Maximum initial permeability
- Minimum hysteresis loss in AC and DC circuits

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	—	7.60	7.60
DENSITY	—	0.2740 lb/in^3	7584 kg/m^3
MEAN COEFFICIENT OF THERMAL EXPANSION CONDITION: ANNEALED AT 1385°F (750°C)	77 to 212°F (25 to 44.5°C)	6.55 x 10^{-6} length/length/°F	11.79 x 10^{-6} length/length/°C
	77 to 392°F (25 to 200°C)	6.86 x 10^{-6} length/length/°F	12.35 x 10^{-6} length/length/°C
	77 to 572°F (25 to 300°C)	7.31 x 10^{-6} length/length/°F	13.16 x 10^{-6} length/length/°C
	77 to 752°F (25 to 300°C)	7.31 x 10^{-6} length/length/°F	13.16 x 10^{-6} length/length/°C
	77 to 752°F (25 to 400°C)	7.50 x 10^{-6} length/length/°F	13.5 x 10^{-6} length/length/°C
	77 to 932°F (25 to 500°C)	7.72 x 10^{-6} length/length/°F	13.9 x 10^{-6} length/length/°C
	77 to 1112°F (25 to 600°C)	7.89 x 10^{-6} length/length/°F	14.2 x 10^{-6} length/length/°C
	77 to 1292°F (25 to 700°C)	8.00 x 10^{-6} length/length/°F	14.4 x 10^{-6} length/length/°C
ELECTRICAL RESISTIVITY	70°F (21°C)	350.0 ohm-cir-mil/ft	58 microohm·cm
CURIE TEMPERATURE	—	1450°F	788°C

Magnetic properties

SATURATION FLUX DENSITY (Bs)	20000 G	20 kG
COERCIVITY	0.600 Oe	
MAXIMUM PERMEABILITY	4000	
RESIDUAL INDUCTION	4000 G	4 kG
TREATMENT FOR FINAL CLOSED PACK ANNEAL	1550°F	843°C

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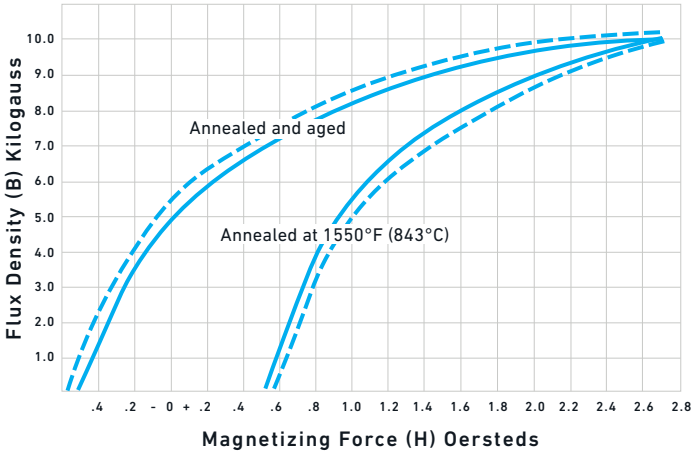
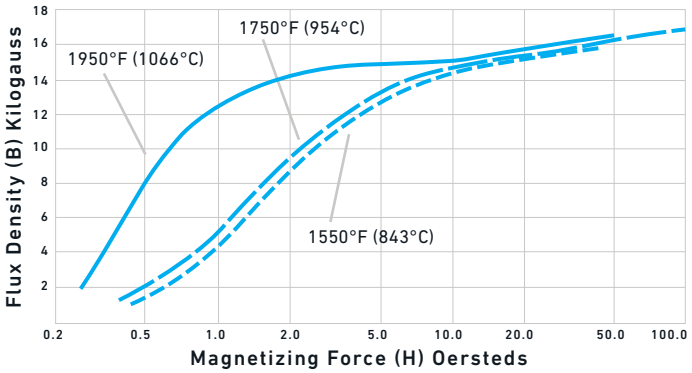
Direct current (DC) hysteresis

ANNEALED AT 1550°F (843°C)/2 HR/AGED AT 301°F (150°C)/100 HR



Normal direct current (D)C magnetization curves

ANNEALED AT VARIOUS TEMPERATURES



Typical mechanical properties

3/8 IN (9.53 MM) DIAMETER BAR						
HEAT TREATMENT	**0.2% YIELD STRENGTH**		**ULTIMATE TENSILE STRENGTH**		**ELONGATION IN 4D**	**HARDNESS**
	ksi	**MPa**	**ksi**	**MPa**	**%**	**ROCKWELL B**
Mill unannealed	80	552	95	655	Not reported	100
Annealed for magnetic properties[1]	75	517	95	655	30	95

1 1550°F (843°C), 4 hrs

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Heat treatment

Uniform piece part magnetic characteristics	To achieve uniform piece part magnetic characteristics, the finished machined parts should be given a heat treatment.
Heat treatment	Heat treating temperature should be 1385°F (750°C) or higher. As the temperature increases to 1950°F (1066° C), the maximum permeability increases and HC decreases for a given heat treatment condition (time and atmosphere).
Time at temperature	Time at temperature should be 1 to 8 hours depending upon magnetic piece part performance desired. A nonoxidizing, noncarburizing atmosphere must be employed. Atmospheres such as nitrogen-hydrogen, vacuum, dry or wet hydrogen should be employed. A wet hydrogen atmosphere can be used up to 1750°F (955°C) to achieve very soft magnetic properties. Above 1750°F (955°C), a dry hydrogen atmosphere must be employed.

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	75	.015	M-2	300	375	.020	C-6
.025	105	.007	M-3	385	475	.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*	
65	.001	.0015	.002	.0015	.001	.001	.0007	M-42
225	.0035	.0045	.006	.003	.0025	.0025	.0015	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*	
50	.001	.002	.004	.007	.011	.013	.015	.017	M-42

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TAPPING	
SPEED, FPM	**TOOL MATERIAL**
10-15	M-1, M-7, M-10

DIE THREADING				
SPEED, FPM				**TOOL MATERIAL**
7 OR LESS	**8 TO 15**	**16 TO 24**	**25 AND UP, TPI**	
8–20	10–25	15–30	20–35	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	50	.002	.003	.005	.006	M-42	300	.003	.004	.006	.007	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 developed for best production results with optimum tool life. Speeds or feeds should be increased or decreased in small steps.

Other information

Applicable specifications	ASTM A867 Alloy 3

For additional information, please contact your nearest sales office:
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