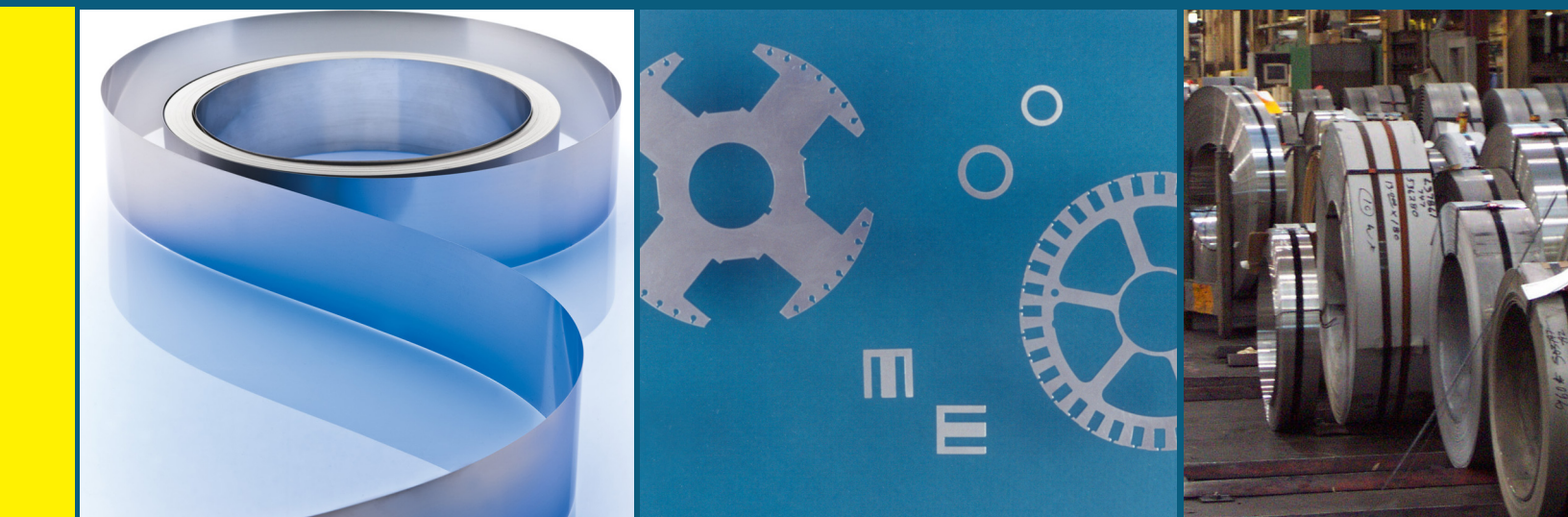


***WHEN PERFORMANCE IS EVERYTHING***



**Leadership in Soft Magnetic Alloys**

# Leadership in Soft Magnetic Alloys

CARPENTER TECHNOLOGY CORPORATION OFFERS A WIDE SELECTION OF SOFT MAGNETIC ALLOYS TO MEET YOUR MATERIALS SPECIFICATIONS.

Choose from high permeability alloys, shielding alloys, silicon core irons or high-flux-density cobalt-iron alloys that have been used in applications ranging from simple magnetic cores to the most complex electronic circuitry. All are produced to Carpenter’s exacting standards of consistency for uniform magnetic response using premium-melting vacuum technologies.

Carpenter soft magnetic alloys have been used in the following applications:

- Motor laminations
- Magnetic amplifiers
- Magnetic bearings
- Magnetic shielding
- Forged electromagnetic components
- GFCI
- Relays
- Speedometers
- Transformers
- Vacuum equipment
- Watt-hour meters

## World-Class Manufacturing and Quality Systems

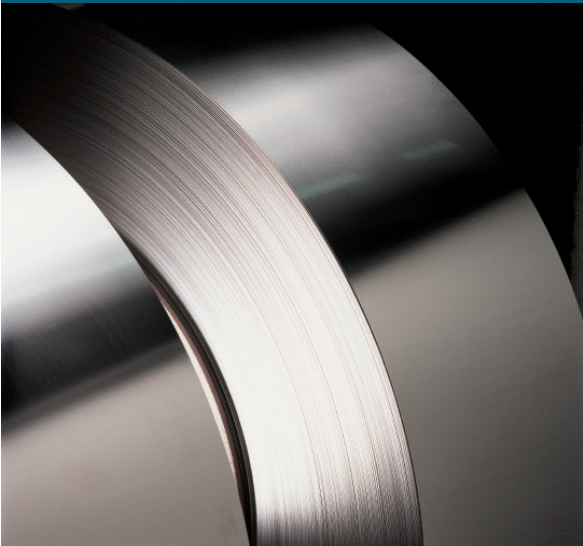
Carpenter is a fully integrated manufacturer, using advanced equipment and technologies including vacuum induction melting, vacuum arc remelting, double-vacuum melting (VIM-VAR), in-line hot rolling, and modern cold finishing equipment. This combination of capabilities, coupled with a highly skilled work force, supports your requirements for consistent, quality material lot after lot.

## Selecting Carpenter Soft Magnetic Alloys

The matrix below compares various classes or “families” of soft magnetic alloys in terms of their relative performance characteristics and costs. It can serve as an initial guide for you in selecting which family of alloys to explore for an application.

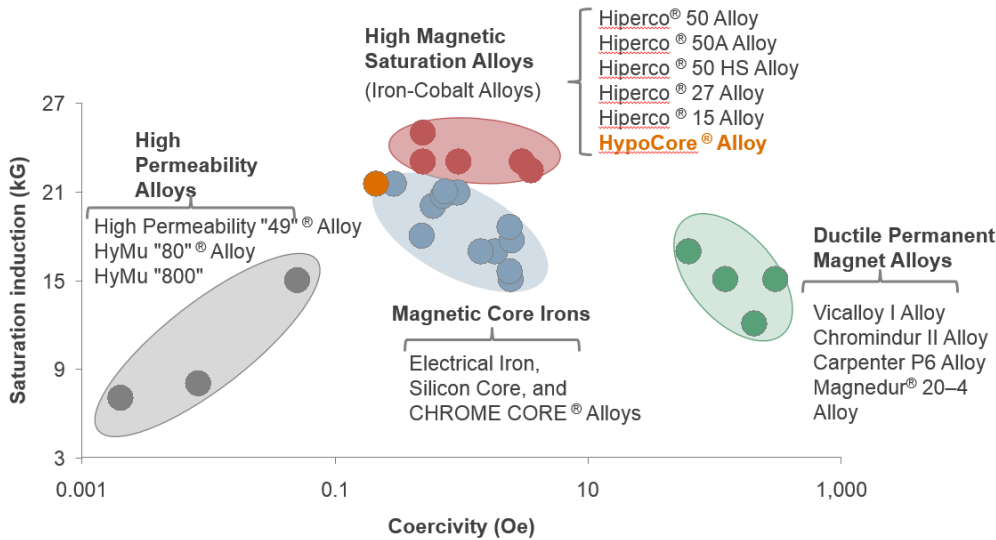
|         | SENSITIVITY<br>(permeability) | STRENGTH<br>(flux density) | COST               |
|---------|-------------------------------|----------------------------|--------------------|
| HIGHEST | Nickel-Iron                   | Iron-Cobalt                | Iron-Cobalt        |
|         | Silicon Iron                  | Iron                       | Nickel-Iron        |
|         | Iron                          | Silicon Iron               | Ferritic Stainless |
| LOWEST  | Iron-Cobalt                   | Ferritic Stainless         | Silicon Iron       |
|         | Ferritic Stainless            | Nickel-Iron                | Iron               |

THE RESULT OF DECADES OF MATERIALS EXPERTISE IS CARPENTER’S ABILITY TO CONSISTENTLY HELP OUR CUSTOMERS COMPETE IN A CHANGING WORLD.

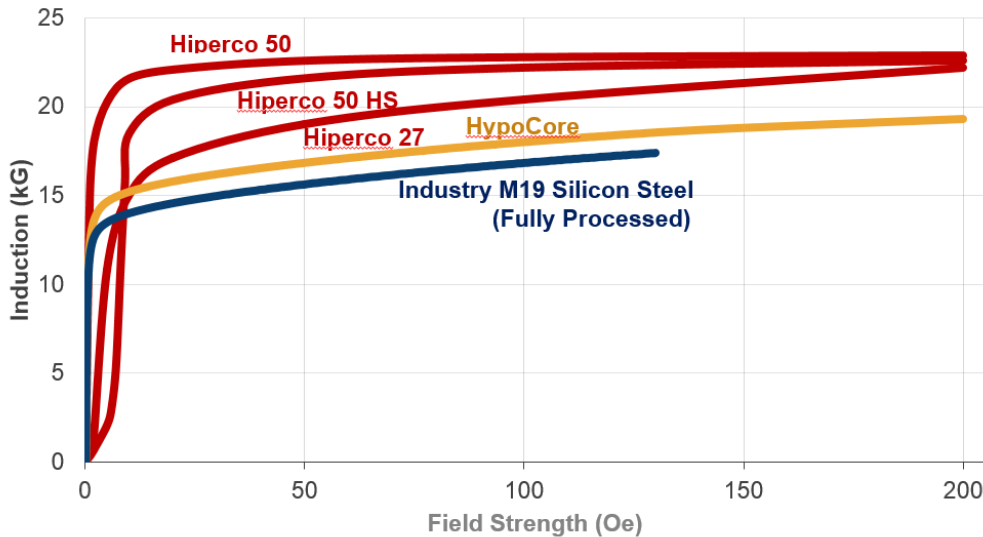


- Forms manufactured:
- Strip
  - Plate
  - Bar
  - Wire
  - Other forms available upon application

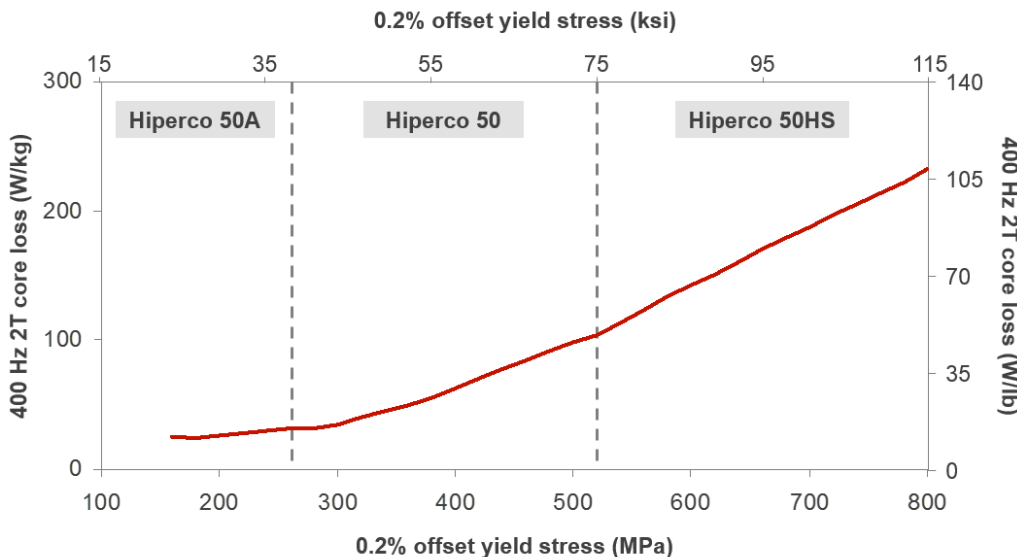
## Carpenter Soft Magnetic Alloy Map



## D.C Normal Induction on High Saturation Soft Magnetic Alloys



## Core Loss vs. Yield Strength for CarTech High Saturation Soft Magnetic Alloys



Carpenter Technology Corp. is a world recognized developer and manufacturer of cast wrought and powder metallurgy specialty alloys including stainless steels, high-strength alloys, superalloys, and tool and die steels as well as titanium alloys.

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Figures are nominal.

| Alloy Category                  | Alloys                                               | Carbon | Cobalt | Manganese | Nickel | Silicon   | Iron    | Other                                                            | B <sub>sat</sub><br>(kG) | H <sub>c</sub><br>(Oe) | $\rho$<br>( $\mu 20\Omega\text{cm}$ ) |
|---------------------------------|------------------------------------------------------|--------|--------|-----------|--------|-----------|---------|------------------------------------------------------------------|--------------------------|------------------------|---------------------------------------|
| High Magnetic Saturation Alloys | CarTech® Hipercor® 50 Alloy                          | 0.01   | 48.75  | 0.05      |        | 0.05      | Balance | V 1.90                                                           | 24                       | 0.55                   | 40                                    |
|                                 | CarTech Hipercor 50A Alloy                           |        | 48.75  | 0.05      |        | 0.05      | Balance | V 2.00                                                           | 24                       | 0.5                    | 40                                    |
|                                 | CarTech Hipercor 50HS Alloy                          | 0.01   | 48.75  | 0.05      |        | 0.05      | Balance | V 1.90<br>Cb 0.3                                                 | 24                       | 6.2                    | 42                                    |
|                                 | CarTech Hipercor 27 Alloy                            | 0.01   | 27.00  | 0.25      | 0.60   | 0.25      | Balance | Cr .60                                                           | 22.9                     | 2.75                   | 19                                    |
|                                 | CarTech Hipercor 15 Alloy                            | 0.01   | 15.00  | 2.70      | 0.10   | 0.30      | Balance | Cr .60                                                           | 22.5                     | 3.25                   | 41                                    |
|                                 | CarTech HypoCore™ Alloy                              | .005   | 5.00   | 1.00      |        | 2.30      | Balance | Cr .30                                                           | 21                       | 0.28                   | 52                                    |
| High Permeability Alloys        | CarTech High Permeability "49"® Alloy/<br>Hy Ra 49   | 0.02   |        | 0.50      | 48.00  | 0.35      | Balance |                                                                  | 16                       | 0.04                   | 48                                    |
|                                 | CarTech HyMu "80"® Alloy                             | 0.02   |        | 0.50      | 80.00  | 0.35      | Balance | Mo 4.2                                                           | 7.5                      | 0.014                  | 58                                    |
|                                 | CarTech HyMu "800"                                   | 0.01   |        | 0.50      | 80.00  | 0.15      | Balance | Mo 5.0                                                           | 7.5                      | 0.002                  | 62                                    |
| Magnetic Core Iron              | CarTech Silicon Core Iron "A"                        | 0.03   |        | 0.15      |        | 1.00      | Balance |                                                                  | 21                       | 0.9                    | 25                                    |
|                                 | CarTech Silicon Core Iron "A-FM"                     | 0.04   |        | 0.15      |        | 1.00      | Balance | P 0.18                                                           | 21                       | 0.9                    | 25                                    |
|                                 | CarTech Silicon Core Iron "B"                        | 0.03   |        | 0.15      |        | 2.50      | Balance |                                                                  | 20.6                     | 0.7                    | 40                                    |
|                                 | CarTech Silicon Core Iron "B-FM"                     | 0.03   |        | 0.40      |        | 2.50      | Balance | P 0.12                                                           | 20.6                     | 0.7                    | 40                                    |
|                                 | CarTech Silicon Core Iron "C"                        | 0.03   |        | 0.15      |        | 4.00      | Balance |                                                                  | 20                       | 0.6                    | 58                                    |
|                                 | CarTech Electrical Iron                              | 0.02   |        | 0.12      | 0.08   | 0.12      | Balance | Cr 0.20<br>P 0.01<br>V 0.05                                      | 18                       | 0.5                    | 12                                    |
|                                 | CarTech CONSUMET® Electrical Iron                    | 0.20   |        | 0.15      |        | 0.15      | Balance | V 0.04-0.10                                                      | 21.5                     | 0.9                    | 10                                    |
|                                 | CarTech CHROME CORE® 8 Alloy                         | 0.03   |        | 0.20-0.70 |        | 0.30-0.70 | Balance | P 0.30<br>S 0.03<br>Cr 7.50-8.50<br>Mo 0.20-0.50                 | 18.6                     | 2.5                    | 49                                    |
|                                 | CarTech CHROME CORE 8 FM Alloy                       | 0.03   |        | 0.20-0.70 |        | 0.30-0.70 | Balance | P 0.30<br>S 0.20-0.40<br>Cr 7.50-8.50<br>Mo 0.20-0.50            | 18.6                     | 2.5                    | 49                                    |
|                                 | CarTech CHROME CORE 12 FM Alloy                      | 0.03   |        | 0.20-0.70 |        | 0.30-0.70 | Balance | P 0.03<br>S 0.20-0.40<br>Cr 11.50-12.50<br>Mo 0.20-0.50          | 17.7                     | 2.5                    | 57                                    |
|                                 | CarTech CHROME CORE 13 FM Alloy                      | 0.03   |        | 0.50-1.25 |        | 1.20-1.80 | Balance | P 0.03<br>S 0.20-0.40<br>Cr 12.50-13.50<br>Mo 0.20-0.50          | 17                       | 1.8                    | 78                                    |
|                                 | CarTech CHROME CORE 13 XP Alloy                      | 0.03   |        | 0.50      |        | 1.20-1.80 | Balance | P 0.03<br>S 0.20-0.40<br>Cr 12.5-13.5<br>Mo 0.5-1.0<br>V 0.5-1.0 | 17                       | 1.8                    | 78                                    |
|                                 | CarTech CHROME CORE 18 FM Stainless Solenoid Quality | 0.02   |        | 0.40      | 0.20   | 0.90      | Balance | P 0.02<br>Nb 0.25<br>S 0.30<br>Cr 17.50<br>Mo 1.75               | 15                       | 2.5                    | 75                                    |
|                                 | CarTech 430F Stainless Solenoid Quality              | 0.07   |        | 0.80      | 0.60   | 0.30-0.70 | Balance | P 0.03<br>S 0.25-0.40<br>Cr 17.25-18.25<br>Mo 0.50               | 15.6                     | 2.5                    | 60                                    |
|                                 | CarTech 430FR Stainless Solenoid Quality             | 0.07   |        | 0.80      | 0.60   | 1.00-1.50 | Balance | P 0.03<br>S 0.25-0.40<br>Cr 17.25-18.25<br>Mo 0.05               | 15.2                     | 2.5                    | 60                                    |
| Ductile Permanent Magnet Alloys | CarTech P6 Alloy                                     |        | 45     |           | 6.00   |           | Balance | V 4.8                                                            | 17                       | 63                     | 33                                    |
|                                 | CarTech Chromindur II Alloy                          | 0.15   | 10.50  | 0.10      |        | 0.10      | Balance | Cr 28.0                                                          | 15                       | 320                    | 75                                    |
|                                 | CarTech MAGNEDUR® 20-4 Alloy                         | 0.01   |        | 0.30      | 20     | 0.20      | Balance | Mo 4.0                                                           | 14.2                     | 45                     | 52                                    |
|                                 | CarTech Vicalloy I Alloy                             | 0.03   | 52     | 0.40      |        | 0.20      | Balance | V 10.0                                                           | 13                       | 210                    | 64                                    |

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