CARPENTER TECHNOLOGY

DATASHEET

XM-27

Applicable specifications: ASTM A276, ASTM A240
Associated specifications: UNS S44627, AISI TYPE XM-27

Type analysis

Single figures are nominal except where noted.

Iron	Balance	**Chromium**	25.0–27.5 %	**Molybdenum**	0.75–1.50 %
Nickel	0.50 % max	**Manganese**	0.40 % max	**Silicon**	0.40 % max
Columbium/Niobium	0.05–0.20 %	**Copper**	0.20 % max	**Phosphorus**	0.020 % max
Sulfur	0.020 % max	**Nitrogen**	0.015 % max	**Carbon**	0.010 % max

Forms manufactured

Bar

Description

XM-27 is a high-purity soft magnetic super-ferritic stainless steel that combines excellent resistance to corrosion with consistent magnetic response, making it an ideal candidate for magnetic solenoid applications that may be exposed to corrosive environments. The high degree of cleanliness developed by Carpenter Technology's technologically advanced melt methods also make XM-27 ideally suited for semiconductor valve applications which are sensitive to contamination. XM-27 provides significantly better corrosion resistance than any other material in Carpenter Technology's family of solenoid-quality alloys. Its corrosion resistance is even greater than that of Type 316L stainless steel in some environments. The magnetic properties of XM-27 are similar to those of Type 430FR Solenoid Quality Stainless, but with considerably better corrosion resistance. XM-27's high resistivity suppresses eddy current losses and improves efficiency in applications involving AC or rapidly pulsed DC excitation.

Key Properties:

- Corrosion resistance
- Soft magnetic
- High purity
- High resistivity

Markets:

- Aerospace
- Energy
- Industrial

Applications:

- Solenoid valves
- Semiconductor valves

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Corrosion resistance

XM-27 provides the best corrosion resistance in Carpenter Technology's family of solenoid-quality alloys, even greater than Type 316L stainless steel in some environments.

IMPORTANT NOTE:
The following 4-level rating scale (Excellent, Good, Moderate, Restricted) is intended for comparative purposes only and is derived from experiences with wrought product. Additive manufactured material may perform differently; 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.

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

Physical properties

PROPERTY	At or From	English Units	Metric Units
SPECIFIC GRAVITY	—	7.7	—
DENSITY	—	0.278 lb/in^3	7695 kg/m^3
MEAN SPECIFIC HEAT	32°F, 210°F	0.110 Btu/lb/°F	460 J/kg·K
MEAN COEFFICIENT OF THERMAL EXPANSION	70 to 212°F (21 to 100°C)	5.5 x 10^{-6} length/length/°F	9.9 x 10^{-6} length/length/°C
ELASTIC MODULUS	—	29 x 10^3 ksi	200 GPa
ELECTRICAL RESISTIVITY	70°F (21°C)	379 ohm-cir-mil/ft	63 microohm·cm
CURIE TEMPERATURE	—	1185°F	640°C
MELTING RANGE	—	2600–2750°F	1427–1510°C

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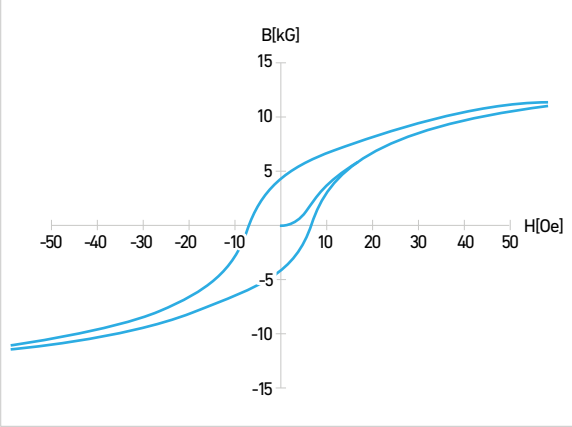
Magnetic properties

Typical mill annealed magnetic properties. Ring specimen per ASTM A773 and IEC 60404-4.

0.781 IN. RD, MILL ANNEALED



B(G)	H(Oe)	PERMEABILITY
3709	10	372.0
6678	20	334.0
8414	30	280.0
9638	40	241.0
10527	50	210.0
11902	75	159.0
12636	100	126.0
13402	150	89.3
13810	200	69.0

MAXIMUM PERMEABILITY	377
MAXIMUM INDUCTION (Bm)	13.8 kG
MAXIMUM MAGNETIC FIELD STRENGTH (Hm)	203 Oe
COERCIVE FIELD STRENGTH (Hc)	6.72 Oe
RESIDUAL INDUCTION (Br)	4.19 kG

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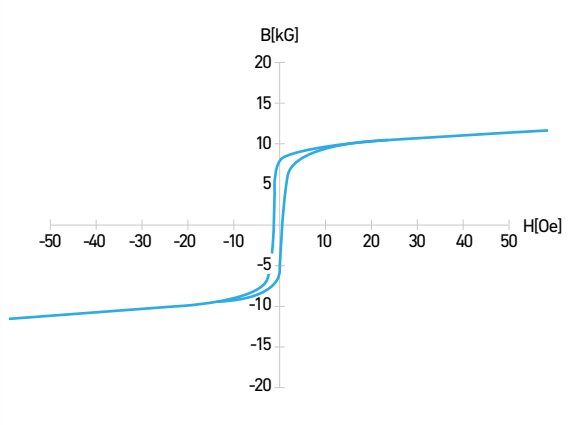
0.781 IN. RD, RE-ANNEALED AT 2150°F USING DRY HYDROGEN ATMOSPHERE, 4 HRS, COOL AT 181°F/HR



B(G)	H(Oe)	PERMEABILITY
9249	10	922.0
10063	20	502.0
10584	30	352.0
11002	40	274.0
11367	50	227.0
12131	75	161.0
12731	100	127.0
13545	150	90.1
13998	200	69.8

MAXIMUM PERMEABILITY	3167
MAXIMUM INDUCTION (Bm)	14.0 kG
MAXIMUM MAGNETIC FIELD STRENGTH (Hm)	203 Oe
COERCIVE FIELD STRENGTH (Hc)	0.989 Oe
RESIDUAL INDUCTION (Br)	7.20 kG

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TYPICAL DC MAGNETIC PROPERTIES

0.500–2.50 IN. RD BAR, MILL ANNEALED 1508°F, 1 HR, RAPID COOL AND MAGNETICALLY ANNEALED 2150°F, 4 HRS, COOL AT 1810°F/HR

CONDITION	0.2% YIELD STRENGTH		10 Oe 800 A/m		20 Oe 1600 A/m		50 Oe 4000 A/m		100 Oe 8000 A/m	
	ksi	MPa	kG	T	kG	T	kG	T	KG	T
Magnetic annealed	44	303	9.3	0.93	10.1	1.01	11.4	1.14	12.7	1.27
Mill annealed	44	303	3.7	0.37	6.7	0.67	10.5	1.05	12.6	1.26

COMPARISON OF PHYSICAL/MAGNETIC PROPERTIES

ALLOY	SATURATION FLUX DENSITY Bs (Tesla)	MAXIMUM PERMEABILITY	RESISTIVITY μΩ-MM	COERCIVITY Hc (A/m)
Chrome Core® 8 & 8FM	1.8	3100	492	200
Chrome Core® 12 & 12-FM	1.7	3100	570	200
Chrome Core® 13 & 13-FM	1.7	2900	779	140
Chrome Core® 13-XP	1.7	3300	814	127
430F Solenoid Quality	1.6	2000	600	200
430FR Solenoid Quality	1.5	2500	760	200
Chrome Core® 18-FM	1.5	1500	755	199
XM-27 (annealed)	1.3	3167	630	79

Typical mechanical properties

0.325–2.50 IN. RD BAR, ANNEALED

FORM	ORIENTATION	0.2% YIELD STRENGTH		ULTIMATE TENSILE STRENGTH		ELONGATION IN 4D OR 2 IN	REDUCTION OF AREA	HARDNESS
		ksi	MPa	ksi	MPa	%	%	HRB
Room temp., mill annealed and magnetic annealed	Long	50	—	75	—	38	84	84

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Heat treatment

Annealing to soften	1346–1553°F (730–845°C), 1 hour, rapid cool.
Cooling	Rapid cool to avoid 885°F (475°C) embrittlement. Minimize exposure times at 800–1100°F (426–593°C).
Hydrogen annealing for magnetic properties	2150°F (1177°C), 4 hours, cool at 181°F (83°C)/hr in dry hydrogen.
Other heat treating atmospheres	Vacuum heat treating may also be used.

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Workability

Blanking and forming	XM-27 is readily blanked or formed.
Cold working	XM-27 has a work hardening rate similar to other ferritic stainless steels.
Forging	XM-27 should be heated uniformly to 1065°C for forging. Soak times must be carefully controlled to avoid excessive grain growth. Rapidly cool or post anneal after forging to avoid embrittlement.
Hot working	1065–1175°C for hot working. Rapidly cool or post hot work annealing is recommended.
Machinability	XM-27 is readily machined.
Weldability	XM-27 is readily welded, but care must be taken to avoid 475°C embrittlement. A post weld heat treat is recommended.

Typical feeds and speeds

The feeds and speeds in the following charts are conservative recommendations for initial setup. Higher feeds and speeds may be attainable depending on machining environment.

TURNING — SINGLE-POINT AND BOX TOOLS

DEPTH OF CUT, IN	HIGH-SPEED TOOLS			CARBIDE TOOLS			
				SPEED, FPM			
	SPEED, FPM	FEED, IPR	TOOL MATERIAL	UNCOATED OR BRAZED	COATED OR THROW AWAY	FEED, IPR	TOOL MATERIAL
0.040	150	0.007	M-2, M-3	575	850	0.007	CC-7
0.150	120	0.015	M-2, M-3	450	650	0.015	CC-6

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TURNING — CUT-OFF AND FORM TOOLS

SPEED, FPM	FEED, IPR							TOOL MATERIAL	
	CUT-OFF TOOL WIDTH, IN			FORM TOOL WIDTH, IN				HIGH-SPEED TOOLS	CARBIDE TOOLS
	1/16	*1/8*	*1/4*	*1/2*	*1*	*1-1/2*	*2*		
90	0.001	0.0015	0.002	0.002	0.0015	0.0012	0.001	M-2, M-3	C-6
300	0.001	0.0015	0.002	0.002	0.0015	0.0012	0.001	M-2, M-3	C-6

ROUGH REAMING

HIGH-SPEED TOOLS		FEED, IPR, REAMER DIAMETER, IN					
SPEED, FPM	TOOL MATERIAL	*1/8*	*1/4*	*1/2*	*1*	*1-1/2*	*2*
75	M-2, M-7	0.003	0.004	0.005	0.008	0.010	0.012
90	C-2	.004	0.008	0.012	0.016	0.020	0.024

DRILLING — HIGH-SPEED TOOLS

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*	
65	0.001	0.002	0.004	0.007	0.010	0.012	0.015	0.018	M-1, M-7, M-10

TAPPING — HIGH-SPEED TOOLS

SPEED, FPM				TOOL MATERIAL
7 OR LESS, TPI	8 TO 15, TPI	16 TO 24, TPI	25 AND UP, TPI	
15	25	35	40	M-1, 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*	
.020	145	0.001	0.002	0.004	0.005	M-2, M-3, M-7	455	0.0005	0.001	0.003	0.005	C-5
.060	110	0.002	0.003	0.005	0.006	M-2, M-3, M-7	350	0.001	0.002	0.004	0.006	C-5

BROACHING — HIGH-SPEED TOOLS

SPEED, FPM	CHIP LOAD, IPT	TOOL MATERIAL
20	.003	M-2, M-7

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