

DI-MAX[®] HF-10X

**COLD-ROLLED FULLY-PROCESSED
NON-ORIENTED ELECTRICAL STEEL**



**High Frequency
Motors**

Vehicle Electrification

Aircraft Generators

**Automotive Traction
Motors**



DI-MAX[®] HF-10X is a fully-processed non-oriented electrical steel designed for use in high speed motors, traction motors, aircraft generators and other rotating equipment operating at frequencies above 60 Hz. DI-MAX HF-10X is supplied in a nominal thickness of 0.25 mm.



DI-MAX® HF-10X

Specifications

MAGNETIC CORE LOSS

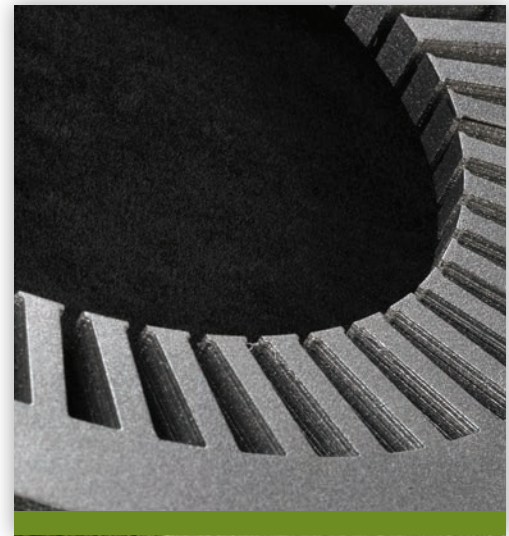
Maximum As-Sheared: 13.0 W/kg
 Release grading is based on as-sheared Epstein specimens and core loss at 1.0T and 400 Hz in accordance with ASTM A343 standard test method.

MAGNETIC CORE LOSS TYPICAL PROPERTIES

Typical As-Sheared: 12.3 W/kg
 Typical after SRA*: 11.3 W/kg
 *Stress Relief Anneal: 830 °C, 1 hour, 95% N2/5% H2
 Typical Magnetic Induction at 2500 A/m (B25): 1.56 T
 Typical Magnetic Induction at 5000 A/m (B50): 1.66 T
 Saturation Induction: 1.97 T
 Volume Resistivity: 60 μΩ•cm

OTHER TYPICAL PROPERTIES

Density 7.60 gm/cm³
 Yield Strength 440 MPa
 Tensile Strength 570 MPa
 % Elongation in 2 in. (50 mm) 20%
 Vickers Hardness 193
 Thickness Aim 0.25 mm
 Thickness Variation ±0.02 mm
 Strip Crown 0.005 – 0.006 mm



INSULATIVE COATING

	C-5 Phosphate Chromium Free	Carlite® 3 Anti-Stick™	C-5-R Chromium Free
Type	ASTM A976 C-5	ASTM A976 C-5-AS	ASTM A976 C-5
Components	Inorganic with some organic material	Inorganic	Inorganic with some organic materials
Thickness	2.3 – 2.8 μm	0.25 – 0.76 μm	0.8 – 1.3 μm
Space Factor	96.6% @ 1.0 MPa	97.0% @ 1.0 MPa	97.2% @ 1.0 MPa
Franklin Current	0.02 A	0.3 – 0.9 A	0.2 – 0.5 A
Weldability	Good (minimal porosity)	Excellent (no porosity)	Good (minimal porosity)

Core Loss And Exciting Power Tables As-Sheared

B (T)	H (A/m)	Typical CORE LOSS (W/kg) @ Frequency (Hz)								
		50	60	100	200	400	800	1000	2500	5000
0.1	16.2	0.0115	0.0141	0.0259	0.0623	0.163	0.464	0.663	2.95	9.28
0.2	21.6	0.0485	0.0598	0.109	0.261	0.670	1.86	2.62	11.1	33.1
0.3	25.9	0.103	0.127	0.233	0.560	1.44	3.95	5.55	22.9	67.8
0.4	30.8	0.171	0.211	0.390	0.943	2.43	6.68	9.40	38.4	114
0.5	36.9	0.249	0.308	0.573	1.39	3.61	10.0	14.1	57.4	172
0.6	43.9	0.337	0.418	0.778	1.91	4.99	13.9	19.5	80.8	242
0.7	52.2	0.435	0.539	1.01	2.48	6.55	18.3	25.8	108	330
0.8	61.9	0.543	0.674	1.26	3.12	8.27	23.3	32.9	140	436
0.9	74.3	0.664	0.824	1.54	3.84	10.2	29.0	41.1	178	566
1.0	89.8	0.799	0.992	1.86	4.63	12.3	35.5	50.6	223	733
1.1	113	0.954	1.18	2.22	5.51	14.8	42.9	61.2	275	919
1.2	151	1.14	1.41	2.64	6.55	17.6	51.5	73.7	337	1131
1.3	234	1.36	1.69	3.16	7.81	20.9	61.5	88.2	408	
1.4	520	1.66	2.06	3.83	9.44	25.1	72.3	104		
1.5	1520	1.98	2.46	4.57	11.2	29.6				
1.6	3620	2.24	2.80	5.20	12.7	33.6				
1.7	6990	2.52	3.15	5.89	14.5	38.2				
1.8	12200	2.74	3.44	6.43	15.8					
1.9	24200									

B (T)	Typical EXCITING POWER (VA/kg) @ Frequency (Hz)								
	50	60	100	200	400	800	1000	2500	5000
0.1	0.0407	0.0490	0.0829	0.172	0.368	0.836	1.11	3.91	11.1
0.2	0.117	0.1410	0.242	0.516	1.15	2.74	3.69	13.5	38.2
0.3	0.212	0.257	0.444	0.962	2.20	5.39	7.31	27.1	76.3
0.4	0.324	0.393	0.683	1.500	3.47	8.65	11.8	44.2	127
0.5	0.454	0.551	0.960	2.12	4.95	12.5	17.1	65.2	190
0.6	0.604	0.733	1.28	2.83	6.66	17.0	23.3	90.4	270
0.7	0.778	0.946	1.65	3.64	8.61	22.1	30.5	122	375
0.8	0.985	1.20	2.08	4.59	10.9	28.1	38.7	158	497
0.9	1.24	1.50	2.60	5.71	13.5	34.9	48.3	201	646
1.0	1.55	1.88	3.25	7.09	16.6	43.0	59.6	253	827
1.1	1.99	2.41	4.13	8.90	20.5	52.9	73.2	314	1042
1.2	2.66	3.22	5.48	11.6	26.2	66.2	91	388	1291
1.3	3.99	4.83	8.15	16.9	36.8	89.9	121	494	
1.4	8.16	9.87	16.6	33.8	70.9	168	216		
1.5	24.5	29.8	50.1	101	210				
1.6	67.1	81.3	136	275	572				
1.7	146	177	297	601	1263				
1.8	280	338	567	1149					

7.60 gm/cm3 test density
 ASTM A343, A348, 50/50 AC values
 ASTM A596, A341, 50/50 DC values
 B = Magnetic induction
 H = Applied field



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About Cleveland-Cliffs Inc.

Cleveland-Cliffs is the largest flat-rolled steel producer in North America. Founded in 1847 as a mine operator, Cliffs also is the largest manufacturer of iron ore pellets in North America. The Company is vertically integrated from mined raw materials and direct reduced iron to primary steelmaking and downstream finishing, stamping, tooling, and tubing. The Company serves a diverse range of markets due to its comprehensive offering of flat-rolled steel products and is the largest steel supplier to the automotive industry in North America. Headquartered in Cleveland, Ohio, Cleveland-Cliffs employs approximately 25,000 people across its mining, steel and downstream manufacturing operations in the United States and Canada.



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