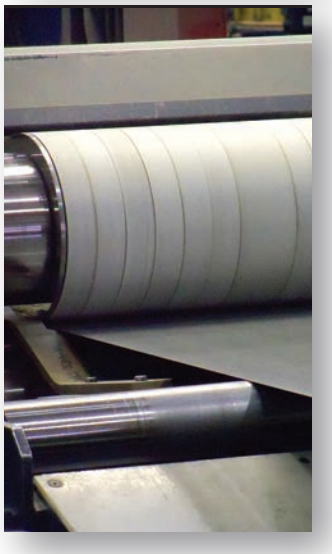
CLIFFS

DI-MAX® M-10X

NON-ORIENTED ELECTRICAL STEELS



- **Motors**
- **Generators**
- **Small Transformers**

DI-MAX® M-10X is a fully processed, high alloy content, non-oriented electrical steel designed for use in high efficiency 50 Hz and 60 Hz electric motors and power transformer applications. Nominal thickness of DI-MAX M-10X is 0.0140 in. (0.35 mm).

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DI-MAX® M-10X

Product Description

COMPOSITION (TYPICAL)		(WT %)
Silicon	(Si)	3.05
Aluminum	(Al)	0.80

GUARANTEED MAXIMUM AND TYPICAL MAGNETIC PROPERTIES

Maximum core loss is 1.25 W/lb. (15 kg, 60 Hz) [2.20 W/kg (1.5T, 50 Hz)]. Core loss guarantee is based 50/50 (parallel/transverse sheet rolling direction) as-sheared Epstein test (ASTM A343).

OTHER MAGNETIC PROPERTIES

Volume Resistivity	54 $\mu\Omega \cdot$cm
Saturation Induction	19.6 kG
Magnetic Induction at	5000 A/m 1.65 T

INSULATIVE COATING

		CARLITE® 3 ANTI-STICK™
Type	ASTM A976 C-5	ASTM A976 C-5-AS
Components	Inorganic/Organic Aluminum Phosphate, inorganic silicate fillers, acrylic resin	Inorganic Aluminum & Magnesium Phosphate, Chromic Anhydride
Coating Thickness	100 $\mu \cdot$in. typical	25 $\mu \cdot$in. typical
Space Factor	> 96.0%	> 97.0%
Franklin Current	0.02 A typical	0.3 – 0.9 A
Weldability	Good (minimal porosity)	Excellent (no porosity)

MECHANICAL AND PHYSICAL PROPERTIES

Density	7.60 gm/cm3
Yield Strength	58 ksi. (400 MPa)
Tensile Strength	72.5 ksi. (500 MPa)
Elongation, % in 2"	20% min.
Rockwell Hardness	B92
Nominal Pre-Coat Thickness	0.0134 in. (0.34 mm)
Tolerance	±0.00075 in. (±0.019 mm)
Strip Crown	0.00020 – 0.00025 in. (0.005 – 0.006 mm)

All values typical unless otherwise noted.

Tables

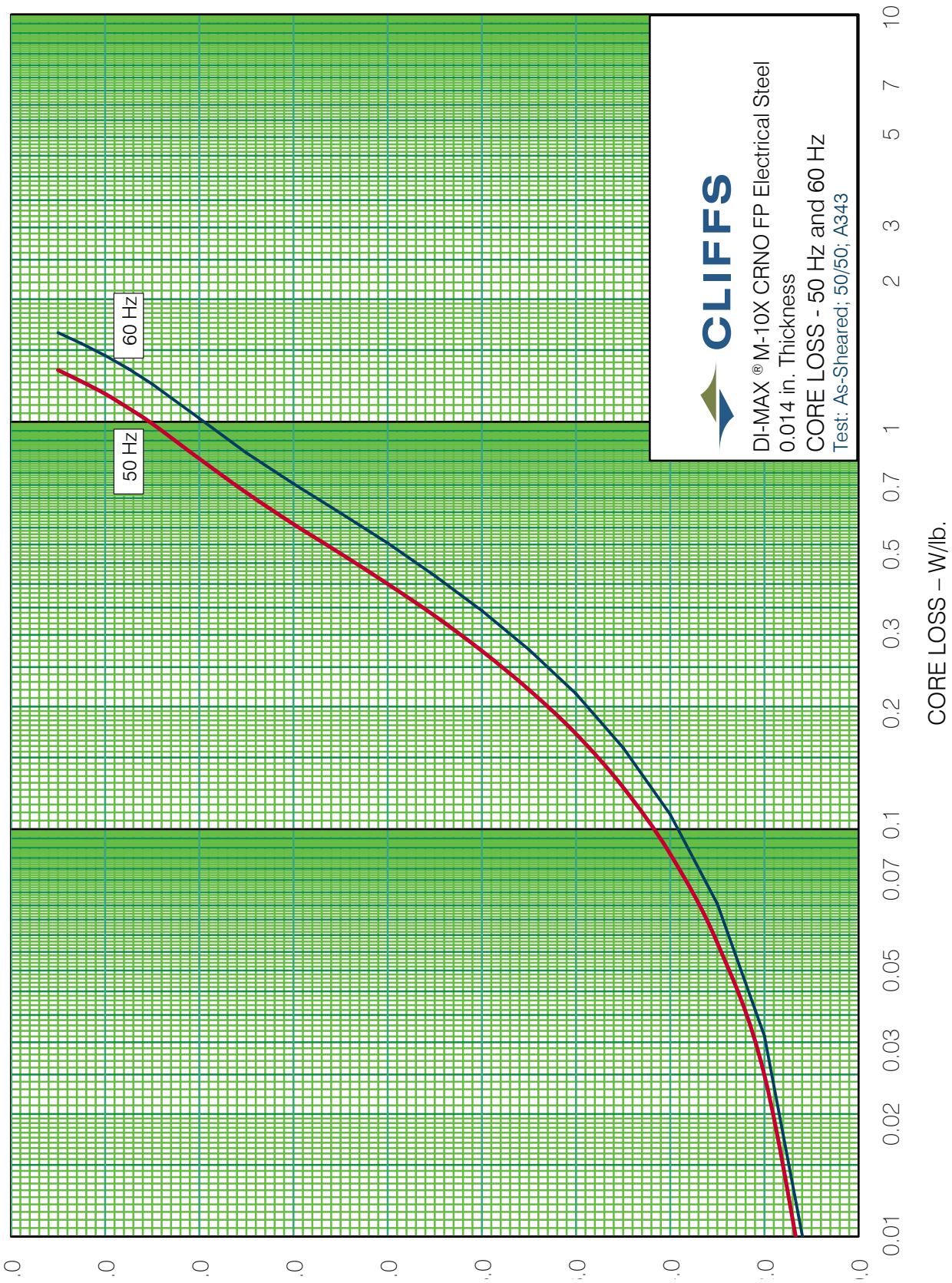
TABLE 1 – TYPICAL VALUES OF CORE LOSS AT SELECT FREQUENCIES FOR TYPICAL SPECIMENS OF CLEVELAND-CLIFFS 0.0140 IN. DI-MAX® M-10X FULLY PROCESSED ELECTRICAL STEEL

Flux Density (kG)	D-C Field Strength (Oe)	Core Loss W/lb. – ASTM A343 and A348 • 50/50 Samples • As Sheared								
		50	60	100	200	400	600	1000	2000	2500
1.0	0.241	0.00606	0.00764	0.0142	0.0360	0.0991	0.186	0.425	1.34	1.95
2.0	0.334	0.0249	0.0311	0.0581	0.146	0.393	0.724	1.604	4.87	6.95
3.0	0.417	0.0526	0.0656	0.124	0.310	0.838	1.535	3.37	10.0	14.3
4.0	0.467	0.0869	0.109	0.206	0.521	1.407	2.57	5.64	16.6	23.6
5.0	0.538	0.127	0.159	0.303	0.770	2.09	3.84	8.43	24.9	35.5
6.0	0.646	0.171	0.215	0.411	1.058	2.89	5.33	11.8	35.1	50.3
7.0	0.671	0.220	0.276	0.533	1.382	3.82	7.06	15.7	47.8	68.7
8.0	0.764	0.274	0.344	0.668	1.745	4.86	9.07	20.4	63.0	91.7
9.0	0.886	0.334	0.419	0.817	2.15	6.05	11.4	25.8	81.2	119
10.0	1.035	0.400	0.504	0.982	2.60	7.39	14.0	32.2	103	151
11.0	1.269	0.475	0.597	1.166	3.10	8.91	17.0	39.6	129	190
12.0	1.689	0.561	0.705	1.381	3.68	10.7	20.5	48.3	162	238
13.0	2.77	0.670	0.839	1.639	4.36	12.7	24.5	59.0	200	295
14.0	5.28	0.812	1.020	1.981	5.23	15.1	29.4	70.8	245	366
15.0	17.3	0.990	1.238	2.39	6.22	18.1	35.3	86.7	–	–
16.0	42.3	1.171	1.455	2.81	7.21	20.9	–	–	–	–
17.0	86.2	1.340	1.655	3.18	8.19	23.7	–	–	–	–

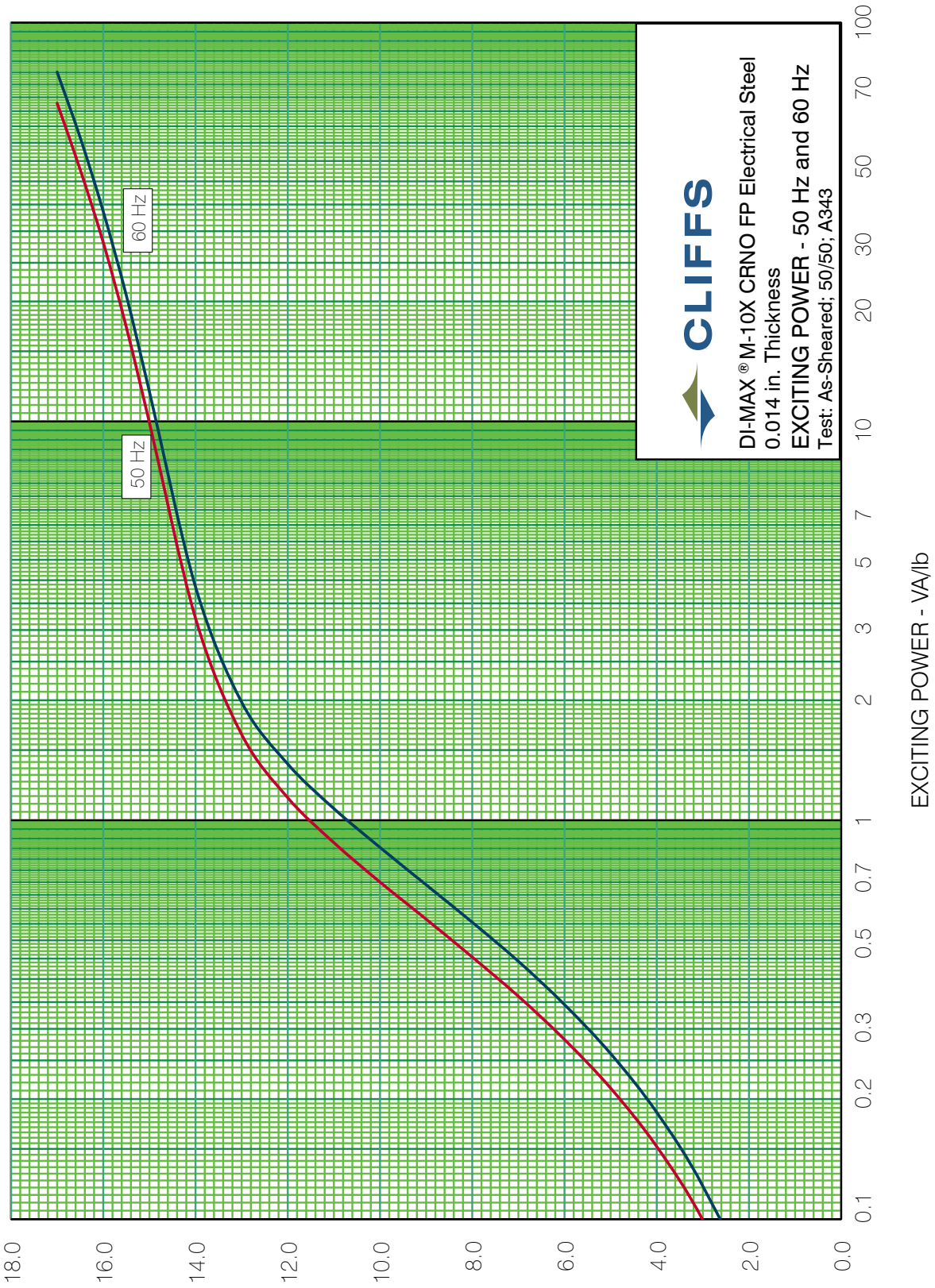
TABLE 2 – TYPICAL VALUES OF EXCITING POWER AT SELECT FREQUENCIES FOR TYPICAL SPECIMENS OF CLEVELAND-CLIFFS 0.0140 IN. DI-MAX® M-10X FULLY PROCESSED ELECTRICAL STEEL

Flux Density (kG)	EXCITING POWER VA/lb. – ASTM A343 and A348 • 50/50 Samples • As Sheared								
	50	60	100	200	400	600	1000	2000	2500
1.0	0.0192	0.0230	0.0394	0.0834	0.184	0.303	0.597	1.68	2.37
2.0	0.0548	0.0666	0.1151	0.252	0.585	0.992	2.01	5.70	8.01
3.0	0.0994	0.1209	0.212	0.475	1.134	1.945	4.01	11.4	16.0
4.0	0.152	0.185	0.328	0.745	1.807	3.13	6.50	18.7	26.4
5.0	0.213	0.260	0.461	1.058	2.60	4.55	9.55	27.9	39.6
6.0	0.282	0.345	0.615	1.422	3.53	6.22	13.2	39.3	56.2
7.0	0.362	0.443	0.789	1.833	4.61	8.17	17.6	53.4	76.8
8.0	0.454	0.555	0.992	2.31	5.84	10.4	22.7	70.5	103
9.0	0.565	0.689	1.228	2.86	7.26	13.1	28.8	91.3	134
10.0	0.700	0.855	1.516	3.51	8.92	16.2	36.1	117	173
11.0	0.879	1.070	1.886	4.32	10.9	19.9	44.7	147	219
12.0	1.139	1.384	2.42	5.44	13.5	24.5	55.2	185	277
13.0	1.642	1.978	3.41	7.43	17.8	31.6	69.7	232	348
14.0	3.21	3.85	6.53	13.6	30.8	51.7	105	319	470
15.0	9.94	11.9	19.9	40.3	94.9	154	271	–	–
16.0	28.1	33.6	56.3	113	281	–	–	–	–
17.0	62.8	75.2	126	253	645	–	–	–	–

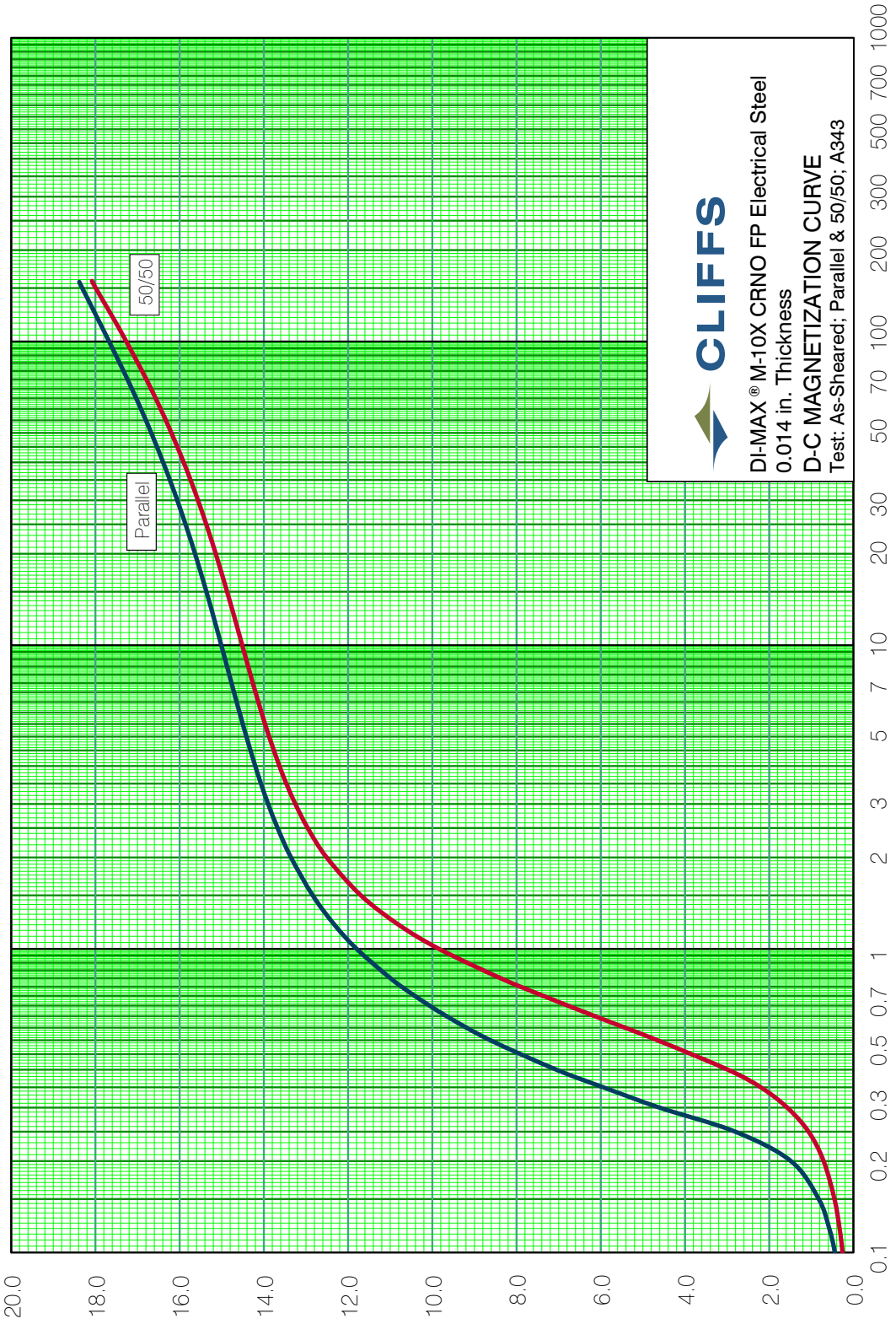
Core Loss Curve – Di-Max M-10X



Exciting Power Curve – Di-Max M-10X



D-C Magnetization Curve – Di-Max M-10X



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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.

CLIFFS

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