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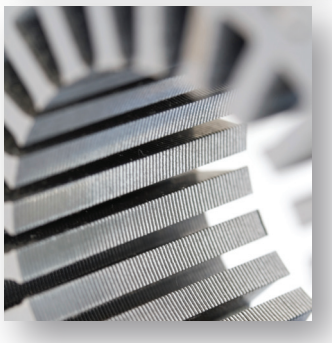
MOTOR-MAX®

NON-ORIENTED ELECTRICAL STEEL FOR HIGH FREQUENCY MOTORS AND GENERATORS

TECHNICAL BULLETIN



This brochure contains additional detailed property information associated with Cleveland-Cliffs' **MOTOR-MAX®** High Frequency Non-Oriented Electrical Steel (HF NOES) grades. General product information and property data can be found in our main **MOTOR-MAX®** HF NOES brochure. The information contained is organized by High Frequency (HF) grade name and is noted at the top of the page. Information includes: Core Loss and Exciting Power tables**. All of our products are melted and manufactured in the United States.**

For questions or additional information on available electrical steel grades, visit www.clevelandcliffs.com or contact your Cleveland-Cliffs representative.

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MOTOR-MAX® 25HF1550 (HF-10)

Core Loss And Exciting Power Tables As-Sheared

Flux Density (T)	CORE LOSS (W/kg) @ Frequency (Hz) - ASTM A343; ASTM A348; 50/50										
	50	60	100	200	400	700	1000	1500	2500	5000	10000
0.1	0.0123	0.0151	0.0271	0.0648	0.17	0.396	0.699	1.36	3.23	10.4	32.7
0.2	0.0556	0.0683	0.123	0.289	0.736	1.66	2.86	5.43	12.4	37.5	113.0
0.4	0.205	0.252	0.46	1.09	2.78	6.23	10.6	19.8	43.8	128.0	395.0
0.7	0.528	0.651	1.20	2.91	7.55	17.1	29.4	55.3	125.0	380.0	–
1.0	0.972	1.20	2.22	5.43	14.4	33.4	58.3	112.0	265.0	842.0	–
1.2	1.38	1.71	3.16	7.7	20.4	48.3	85.2	168.0	–	–	–
1.3	1.66	2.05	3.78	9.18	24.3	56.9	101.0	200.0	–	–	–
1.4	2.02	2.49	4.58	11.1	29.0	–	–	–	–	–	–
1.5	2.45	3.03	5.53	13.3	35.0	–	–	–	–	–	–
1.6	2.87	3.54	6.47	15.5	40.1	–	–	–	–	–	–
1.7	3.25	4.00	7.23	17.1	–	–	–	–	–	–	–
EXCITING POWER (VA/kg) @ Frequency (Hz) - ASTM A343; ASTM A348; 50/50											
0.1	0.0498	0.06	0.101	0.207	0.433	0.809	1.24	2.06	4.09	12.5	36.8
0.2	0.143	0.173	0.294	0.617	1.34	2.62	4.14	7.12	14.7	43.2	126.0
0.4	0.389	0.471	0.811	1.75	3.97	8.07	13.1	23.0	48.4	143.0	432.0
0.7	0.905	1.10	1.90	4.16	9.72	20.4	33.8	61.0	134.0	425.0	–
1.0	1.76	2.13	3.67	7.98	18.6	39.7	66.7	124.0	285.0	965.0	–
1.2	2.94	3.55	6.06	12.9	29.1	61.0	102.0	190.0	–	–	–
1.3	4.31	5.20	8.79	18.3	39.9	81.5	133.0	242.0	–	–	–
1.4	8.32	10.0	16.7	34.1	71.2	–	–	–	–	–	–
1.5	24.2	29.4	49.0	98.6	203.0	–	–	–	–	–	–
1.6	68.2	82.5	137.0	276.0	574.0	–	–	–	–	–	–
1.7	150.0	181.0	301.0	604.0	–	–	–	–	–	–	–

MOTOR-MAX® 25HF1300 (HF-10X)

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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MOTOR-MAX® 30HF1600 (HF-12)

Core Loss And Exciting Power Tables As-Sheared

B (T)	H (A/m)	CORE LOSS (W/kg) @ Frequency (Hz)											
		50	60	100	200	300	400	800	1000	2000	2500	5000	10000
0.2	27.0	0.0508	0.0626	0.116	0.282	0.491	0.741	2.10	2.97	8.91	12.7	38.3	117
0.3	32.2	0.108	0.134	0.248	0.606	1.050	1.580	4.43	6.22	18.4	26.0	76.7	239
0.4	36.8	0.179	0.222	0.414	1.020	1.780	2.67	7.51	10.5	30.6	43.4	129	–
0.5	41.4	0.261	0.324	0.607	1.510	2.64	3.98	11.2	15.7	45.8	65.0	196	–
0.6	46.5	0.352	0.438	0.826	2.06	3.63	5.51	15.5	21.8	64.1	91.7	–	–
0.7	52.3	0.453	0.565	1.070	2.69	4.77	7.23	20.5	28.9	–	–	–	–
0.8	59.2	0.565	0.705	1.340	3.40	6.03	9.18	26.3	37.2	–	–	–	–
0.9	68.1	0.690	0.860	1.640	4.17	7.44	11.4	32.9	46.7	–	–	–	–
1.0	79.9	0.828	1.030	1.970	5.03	9.00	13.8	40.4	57.6	–	–	–	–
1.1	97.9	0.986	1.230	2.35	6.00	10.8	16.5	49.0	70.5	–	–	–	–
1.2	131	1.170	1.470	2.79	7.12	12.8	19.7	–	–	–	–	–	–
1.3	213	1.420	1.770	3.35	8.52	15.3	23.5	–	–	–	–	–	–
1.4	518	1.750	2.17	4.03	10.2	18.2	27.9	–	–	–	–	–	–
1.5	1580	2.14	2.66	5.01	12.6	22.4	34.4	–	–	–	–	–	–
1.6	3710	2.57	3.20	6.02	15.0	26.7	41.1	–	–	–	–	–	–
1.7	7040	3.12	3.90	–	–	–	–	–	–	–	–	–	–

B (T)	EXCITING POWER (VA/kg) @ Frequency (Hz)											
	50	60	100	200	300	400	800	1000	2000	2500	5000	10000
0.2	0.114	0.139	0.239	0.516	0.829	1.180	2.88	3.91	10.7	14.9	42.8	140
0.3	0.207	0.251	0.438	0.964	1.570	2.25	5.68	7.75	21.3	29.8	85.1	273
0.4	0.315	0.383	0.672	1.500	2.47	3.57	9.15	12.5	34.7	48.7	141	–
0.5	0.440	0.535	0.943	2.12	3.52	5.12	13.3	18.3	51.2	72.2	213	–
0.6	0.583	0.710	1.250	2.84	4.73	6.90	18.1	25.0	71.2	101	–	–
0.7	0.749	0.912	1.610	3.66	6.12	8.96	23.8	33.0	–	–	–	–
0.8	0.944	1.150	2.03	4.61	7.72	11.3	30.3	42.2	–	–	–	–
0.9	1.180	1.43	2.52	5.71	9.56	14.0	37.9	53.1	–	–	–	–
1.0	1.470	1.78	3.13	7.05	11.7	17.2	46.8	65.8	–	–	–	–
1.1	1.850	2.25	3.92	8.74	14.5	21.2	57.4	80.8	–	–	–	–
1.2	2.44	2.96	5.12	11.2	18.3	26.6	–	–	–	–	–	–
1.3	3.68	4.45	7.61	16.2	25.8	36.6	–	–	–	–	–	–
1.4	8.13	9.85	15.4	31.7	48.8	67.2	–	–	–	–	–	–
1.5	26.6	32.3	54.7	111	169	229	–	–	–	–	–	–
1.6	73.2	88.7	150	303	460	622	–	–	–	–	–	–
1.7	157	191	–	–	–	–	–	–	–	–	–	–

7.60 gm/cm3 test density
ASTM A343, ASTM A348; 50/50
B = Magnetic induction
H = Applied field

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MOTOR-MAX® HF NOES

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, direct reduced iron, and ferrous scrap 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 supplier of steel to the automotive industry in North America. The Company is headquartered in Cleveland, Ohio with mining, steel and downstream manufacturing operations located across the United States and in Canada. For more information, visit www.clevelandcliffs.com.

CLIFFS

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