FLUID POWER
Design Data Sheet

Revised Sheet 49 - Womack Design Data File

EFFECTS OF OVERSIZING OR UNDERSIZING AN ELECTRIC MOTOR FOR A JOB

Motor information given here pertains only to 3-phase squirrel cage induction motors, Design B, the type used most often to drive hydraulic pumps.

Our suggestions for limits on overloading electric motors were given in **Design Data Sheet 2**. Information in this issue considers other factors which may be pertinent to motor loading.

Optimum results are obtained if motor HP rating very closely matches load HP requirement, being neither too far oversized nor undersized. Some effects of mismatch are:

Oversized Motor. Using a 20 HP motor on a system which requires only 10 HP, for example, will give good results as far as running the system is concerned, but will consume more electric power than a 10 HP motor and will cause the power factor of the electric system in the plant to become poorer, especially during periods when the motor is idling. Idling current of a 20 HP motor is about half the full load current of a 10 HP motor, so a great deal of power is wasted during periods in the cycle when the motor is idling.

Undersized Motor. Using a 20 HP motor on a system which requires 25 HP for peaks is quite possible, but during overload periods the line current of such a motor may be about twice the line current of a 25 HP motor. Again, there may be a high waste of power during peak times in the cycle. But the smaller motor may save considerable power during periods it is idling or working at less than full rating.

In view of the above factors, on a hydraulic system where peak consumption occurs less than 10% of total running time, it may be good design to use an undersize motor provided it will not be overloaded by more than 25%.

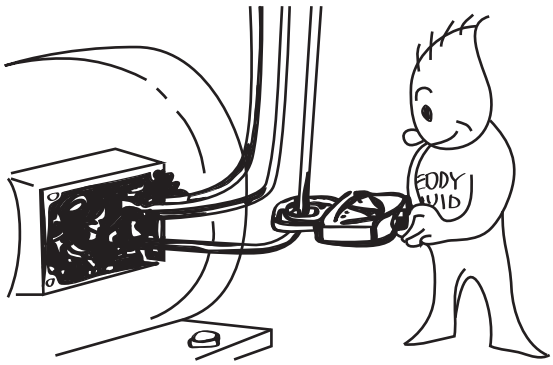
Power companies charge for power by the number of kilowatt-hours used. But in some plants, the rate at which each kilowatt-hour is charged is based on the maximum current flow occurring during the metering period. A poor power factor within the plant increases the line current (and the rate) without consumption of more power. Therefore, either oversizing or undersizing of electric motors can increase the cost of electric power to the plant.

Measuring HP Load on an Electric Motor

The line current can be measured to see whether a motor is working at less or at more than its full load rating. Measurements are made with a loop ammeter without disconnecting any wires. The ammeter loop is clipped around any one of the 3-phase feeder wires any place in the circuit, in the motor junction box or in the motor starter or fuse box. The current reading is compared to nameplate current rating. Since line current is not exactly proportional to HP, the chart in the opposite column may be used to estimate how nearly the motor is operating at its full load rating.

Values in the body of the chart are the amps which the motor will draw at various percentages of full loading. F.L. (full load) amps will vary slightly between brands. Amps are shown at 230 volts, and for 440 volt operation will be about half the values shown.

After measuring motor current, interpolate between values in the chart to estimate per cent of full loading.



Measure Motor Line Current With a Loop Ammeter.

Example: Suppose the measured current of a 40 HP, 1800 RPM motor was 55 amps. Interpolation between the 63.1 amps shown for 60% loading and the 47.4 amps shown for 40% loading will indicate that the motor is operating at about 50% of its full load capability. This same machine could be run with less current and with a better power factor with a 20 HP motor. And, if the 55 amps was peak current which occurred no more than 10% of total running time, a 15 HP motor would probably do the job.

Amperage/Loading Chart for Design B Induction Motors

Amperage values are shown in the body of the chart

HP	RPM	Frame	F.L. Amps	80% Load	60% Load	40% Load	20% Load	0% Load
20	1,200	286T	52.8	41.2	33.0	24.8	16.5	8.24
20	1,800	256T	51.2	40.0	32.0	24.0	16.0	7.99
20	3,600	254T	50.4	39.7	31.5	23.6	15.8	7.86
25	1,200	324T	65.6	51.2	41.0	30.8	20.5	10.2
25	1,800	284T	64.8	50.6	40.5	30.4	20.3	10.1
25	3,600	256T	60.8	47.5	38.0	28.5	19.0	9.48
30	1,200	326T	78.8	61.5	49.3	37.0	24.7	12.3
30	1,800	286T	75.6	59.0	47.3	35.5	23.7	11.8
30	3,600	284T	73.7	57.6	46.1	34.6	23.1	11.5
40	1,200	364T	102	79.7	63.8	47.8	31.9	15.9
40	1,800	324T	101	78.9	63.1	47.4	31.6	15.8
40	3,600	286T	96.4	75.3	60.3	45.2	30.2	15.0
50	1,200	365T	126	98.4	78.8	59.1	39.4	19.7
50	1,800	326T	124	96.8	77.5	58.2	38.8	19.3
60	1,200	404T	150	117	93.8	70.4	47.0	23.4
60	1,800	364T	149	116	93.1	69.9	46.0	23.2
75	1,200	405T	184	144	115	86.3	57.6	28.7
75	1,800	365T	183	143	114	85.8	57.3	28.5
100	1,200	444T	239	187	149	112	74.8	37.3
100	1,800	404T	236	184	148	111	73.9	36.8

DECIMAL EQUIVALENTS
of Fractional and Letter Size Drills, Common Fractions, and Metric Sizes

Size	Decimal Inches	Size	Decimal Inches	Size	Decimal Inches	Size	Decimal Inches	Size	Decimal Inches	Size	Decimal Inches
97	0.0059	1.15 mm	0.0453	3.1 mm	0.1220	5.6 mm	0.2205	8.2 mm	0.3228	13.5 mm	0.5315
96	0.0063	56	0.0465	1/8	0.1250	2	0.2210	P	0.3230	35/64	0.5469
95	0.0067	3/64	0.0469	3.2 mm	0.1260	5.7 mm	0.2244	8.25 mm	0.3248	14 mm	0.5512
94	0.0071	1.2 mm	0.0472	3.25 mm	0.1280	5.75 mm	0.2264	8.3 mm	0.3268	9/16	0.5625
93	0.0075	1.25 mm	0.0492	30	0.1285	1	0.2280	21/64	0.3281	14.5 mm	0.5709
92	0.0079	1.3 mm	0.0512	3.3 mm	0.1299	5.8 mm	0.2283	8.4 mm	0.3307	37/64	0.5781
0.2 mm	0.0079	55	0.0520	3.4 mm	0.1339	5.9 mm	0.2323	Q	0.3320	15 mm	0.5906
91	0.0083	1.35 mm	0.0531	29	0.1360	A	0.2340	8.5 mm	0.3346	19/32	0.5938
90	0.0087	54	0.0550	3.5 mm	0.1378	15/64	0.2344	8.6 mm	0.3386	39/64	0.6094
0.22 mm	0.0087	1.4 mm	0.0551	28	0.1405	6 mm	0.2362	R	0.3390	15.5 mm	0.6102
89	0.0091	1.45 mm	0.0571	9/64	0.1406	B	0.2380	8.7 mm	0.3425	5/8	0.6250
88	0.0095	1.5 mm	0.0591	3.6 mm	0.1417	6.1 mm	0.2402	11/32	0.3438	16 mm	0.6299
0.25 mm	0.0098	53	0.0595	27	0.1440	C	0.2420	8.75 mm	0.3445	41/64	0.6406
87	0.0100	1.55 mm	0.0610	3.7 mm	0.1457	6.2 mm	0.2441	8.8 mm	0.3465	16.5 mm	0.6496
86	0.0105	1/16	0.0625	26	0.1470	D	0.2460	S	0.3480	21/32	0.6562
85	0.0110	1.6 mm	0.0630	3.75 mm	0.1476	6.25 mm	0.2461	8.9 mm	0.3504	17 mm	0.6693
0.28 mm	0.0110	52	0.0635	25	0.1495	6.3 mm	0.2480	9 mm	0.3543	43/64	0.6719
84	0.0115	1.65 mm	0.0650	3.8 mm	0.1496	E	0.2500	T	0.3580	11/16	0.6875
0.3 mm	0.0118	1.7 mm	0.0669	24	0.1520	1/4	0.2500	9.1 mm	0.3583	17.5 mm	0.6890
83	0.0120	51	0.0670	3.9 mm	0.1535	6.4 mm	0.2520	23/64	0.3594	45/64	0.7031
82	0.0125	1.75 mm	0.0689	23	0.1540	6.5 mm	0.2559	9.2 mm	0.3622	18 mm	0.7087
0.32 mm	0.0126	50	0.0700	5/32	0.1562	F	0.2570	9.25 mm	0.3642	23/32	0.7188
81	0.0130	1.8 mm	0.0709	22	0.1570	6.6 mm	0.2598	9.3 mm	0.3661	18.5 mm	0.7283
80	0.0135	1.85 mm	0.0728	4 mm	0.1575	G	0.2610	U	0.3680	47/64	0.7344
0.35 mm	0.0138	49	0.0730	21	0.1590	6.7 mm	0.2638	9.4 mm	0.3701	19 mm	0.7480
79	0.0145	1.89 mm	0.0748	20	0.1610	17/64	0.2656	9.5 mm	0.3740	3/4	0.7500
1/64	0.0156	48	0.0760	4.1 mm	0.1614	6.75 mm	0.2657	3/8	0.3750	49/64	0.7656
0.4 mm	0.0158	1.95 mm	0.0768	4.2 mm	0.1654	H	0.2660	V	0.3770	19.5 mm	0.7677
78	0.0160	5/64	0.0781	19	0.1660	6.8 mm	0.2677	9.6 mm	0.3780	25/32	0.7812
0.45 mm	0.0177	47	0.0785	4.25 mm	0.1673	6.9 mm	0.2717	9.7 mm	0.3819	20 mm	0.7874
77	0.0180	2 mm	0.0787	4.3 mm	0.1693	I	0.2720	9.75 mm	0.3839	51/64	0.7969
0.5 mm	0.0197	2.05 mm	0.0807	18	01695	7 mm	0.2756	9.8 mm	0.3858	20.5 mm	0.8071
76	0.0200	46	0.0810	11/64	0.1719	J	0.2770	W	0.3860	13/16	0.8125
75	0.0210	45	0.0820	17	0.1730	7.1 mm	0.2795	9.9 mm	0.3898	21 mm	0.8268
0.55 mm	0.0217	2.1 mm	0.0827	4.4 mm	0.1732	K	0.2810	25/64	0.3906	53/64	0.8281
74	0.0225	2.15 mm	0.0846	16	0.1770	9/32	0.2812	10 mm	0.3937	27/32	0.8438
0.6 mm	0.0236	44	0.0860	4.5 mm	0.1772	7.2 mm	0.2835	X	0.3970	21.5 mm	0.8465
73	0.0240	2.2 mm	0.0866	15	0.1800	7.25 mm	0.2854	Y	0.4040	55/64	0.8594
72	0.0250	2.25 mm	0.0886	4.6 mm	0.1811	7.3 mm	0.2874	13/32	0.4062	22 mm	0.8661
0.65 mm	0.0256	43	0.0890	14	0.1820	L	0.2900	Z	0.4130	7/8	0.8750
71	0.0260	2.3 mm	0.0906	13	0.1850	7.4 mm	0.2913	10.5 mm	0.4134	22.5 mm	0.8858
0.7 mm	0.0276	2.35 mm	0.0925	4.7 mm	0.1850	M	0.2950	27/64	0.4219	57/64	0.8906
70	0.0280	42	0.0935	4.75 mm	0.1870	7.5 mm	0.2953	11 mm	0.4331	23 mm	0.9055
69	0.0292	3/32	0.0938	3/16	0.1875	19/64	0.2969	7/16	0.4375	29/32	0.9062
0.75 mm	0.0295	2.4 mm	0.0945	4.8 mm	0.1890	7.6 mm	0.2992	11.5 mm	0.4528	59/64	0.9219
68	0.0310	41	0.0960	12	0.1890	N	0.3020	29/64	0.4531	23.5 mm	0.9252
1/32	0.0312	2.45 mm	0.0965	11	0.1910	7.7 mm	0.3031	15/32	0.4688	15/16	0.9375
0.8 mm	0.0315	40	0.0980	4.9 mm	0.1929	7.75	0.3051	12 mm	0.4724	24 mm	0.9449
67	0.0320	2.5 mm	0.0984	10	0.1935	7.8 mm	0.3071	31/64	0.4844	61/64	0.9531
66	0.0330	39	0.0995	9	0.1960	7.9 mm	0.3110	12.5 mm	0.4921	24.5 mm	0.9646
0.85 mm	0.0335	38	0.1015	5 mm	0.1968	5/16	0.3125	1/2	0.5000	31/32	0.9688
65	0.0350	2.6 mm	0.1024	8	0.1990	8 mm	0.3150	13 mm	05118	25 mm	0.9843
0.9 mm	0.0354	37	0.1040	5.1 mm	0.2008	O	0.3160	33/64	0.5156	63/64	0.9844
64	0.0360	2.7 mm	0.1063	7	0.2010	8.1 mm	0.3189	17/32	0.5312	1	1.000
63	0.0370	36	0.1065	13/64	0.2031						
0.95 mm	0.0374	2.75 mm	0.1083	6	0.2040						
62	0.0380	7/64	0.1094	5.2 mm	0.2047						
61	0.0390	35	0.1100	5	0.2055						
1 mm	0.0394	2.8 mm	0.1102	5.25 mm	0.2067						
60	0.0400	34	0.1110	5.3 mm	0.2087						
59	0.0410	33	0.1130	4	0.2090						
1.05 mm	0.0413	2.9 mm	0.1142	5.4 mm	0.2126						
58	0.0420	32	0.1160	3	0.2130						
57	0.0430	3 mm	0.1181	5.5 mm	0.2165						
1.1 mm	0.0433	31	0.1200	7/32	0.2188						

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