TechData Sheet

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Energy Efficient Motors

This TechData Sheet is intended to help activity personnel identify cost effective energy projects for energy efficient motors. With this guide an energy manager can identify when an energy efficient induction motor should be used.

MOTOR TYPES AND EFFICIENCIES

Motor Types

There is a wide variety of motor types. One way to categorize them is by their electrical source. DC, single phase AC, or three phase AC electrical supplies are the most common. Examples of each are:

DC	Shunt wound Series wound Compound wound
AC - 1 Phase	Repulsion Induction Repulsion-induction Series
AC - 3 Phase	Induction (Asynchronous) Synchronous

Another way to categorize motors is by their application or load. Loads can be classified into solids, liquids, and gasses (e.g., elevator systems, water pumps, and HVAC fan systems, respectively) and define such specifications as horsepower, speed, and torque design characteristics. Speed classifications are:

- Constant Speed
- Adjustable Speed
- Multi Speed
- Varying Speed
- Adjustable Varying Speed

The load connection configuration defines specifications such as vertical or horizontal shaft position, pulley or direct drive, and speed. The environment defines motor specifications through ambient conditions and human factors. Ambient conditions such as humidity and ventilation define the needed enclosure type and cooling methodology. Human factors such as accidents, failures, or errors define specifications such as splash proof protection. Common open or totally enclosed enclosures are:

Open	Totally Enclosed
Drip proof Splash proof Guarded Semi-guarded Drip proof guarded Externally ventilated Pipe ventilated Weather protected, types I and II Encapsulated windings Sealed windings	Non-ventilated Fan cooled Fan cooled guarded Explosion proof Dust ignition proof Pipe ventilated Water cooled Water air cooled Air-to-air cooled

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Motor Efficiencies

The standards for energy efficient motors apply only to induction motors. This data sheet addresses only induction motor applications which are the most common. Motor efficiency is defined, in its simplest terms, as delivered shaft power divided by electrical input power. Not all of the electrical input is converted to mechanical power. The associated losses determine the efficiency of a motor. Motor losses are attributable to load independent and or load dependent causes. Typical losses and their usual range as a percent of total loss are given below:

Category	Loss (%)	Contributing Factors
Core (Iron)	15-25	Type and design of core material
Friction/Windage	5-15	Bearings and fan
Stator I^2R	25-40	Stator conductor impedance
Rotor I^2R	15-25	Rotor conductor impedance
Stray Load	10-20	Manufacturing and design

Motor Loss Categories

The National Electrical Manufacturers Association (NEMA) established standards for motor efficiency. Following NEMA standard for induction motors, efficient motor designers and manufacturers have improved overall motor performance with respect to nominal efficiency and power factor. Nominal motor efficiencies are defined by the American National Standards Institute (ANSI) testing standards C50.20.

WHEN TO BUY ENERGY EFFICIENT MOTORS

Energy efficient motors should be considered in the following circumstances:

CASE I - When a new motor is being purchased

CASE II - When considering rewinding a failed motor

CASE III - When an existing motor is operating inefficiently

The potential electricity saved is dependent on the horsepower (hp), speed, and percent load of the new and existing motors as defined in Equation 1.

$$E_s = 0.746 \frac{kW}{HP} \cdot HP \cdot (\eta_{std}^{-1} - \eta_{high}^{-1}) \qquad (1)$$

where:

E_S = energy saved
HP = horse power
η_{std} = efficiency of standard motor
η_{high} = efficiency of standard motor

The potential dollars saved can be calculated by multiplying the energy saved in kW by the cost per kWh by hours of operation per year.

$$D_S = (E_S)\,(C_E)\,(H_{op}) \qquad (2)$$

where:

D_S = dollars saved
E_S = energy saved
C_E = cost of electricity in $/kWh
H_{op} = hours of motor operation per year

For CASE I the simple payback can be calculated by subtracting the cost of the existing standard motor from the cost of the efficient motor and dividing the difference by the dollars saved per year. For CASE II the simple payback can be calculated by subtracting the cost of rewinding the existing standard motor from the cost of the efficient motor including all associated costs and dividing the difference by the dollars saved per year, calculated from Equation (2). For CASE III the simple payback can be calculated by subtracting the cost of operating the existing standard motor inefficiently from the cost of the efficient motor including all associated costs and dividing the difference by the dollars saved per year. Equation (3) summarizes the payback calculation.

$$P = \frac{C_{high} - C_{std}}{D_s} \quad (3)$$

where:

P = simple payback in years
C_{high} = efficient motor costs
C_{std} = standard motor costs
D_s = dollars saved per year

An efficient motor typically has a higher starting current than a standard motor and the potential effects on the motor power circuits should be analyzed. An efficient motor typically operates at a faster speed than a standard motor. Particular consideration should be given to the actual operating rpm specified. In some cases although the efficient motor is operating more efficiently the faster speed requires more energy to operate and could result in a net increase in energy expense, eliminating the cost effectiveness. For CASE I applications, speed sensitive loads should be considered carefully.

For CASE II applications, special high efficiency rewinding can yield a higher than manufactured efficiency for a standard motor, but will still be less than the NEMA 12-6C efficiency.

For CASE III applications, motor system consultants usually only consider motors with operating hours in excess of 2,000 hours per year. Applications such as emergency fire water pumps and back-up motors are only operated a few hours a year.

To further define CASE III, Tables 1 and 2 show the minimum operating hours required to yield simple paybacks between 2 and 10 years. Values are calculated at electrical rates between $0.03/kWh and $0.10/kWh. Table 1 is for Open Drip Proof (ODP) enclosure motors and Table 2 is for Totally Enclosed Fan Cooled (TEFC) and Explosion Proof enclosure motors. The tables are provided so that the user can quickly identify potential motor projects and eliminate from consideration most of the motors with a long or no payback. The assumptions include:

- The motors are at 75% of rated load since motor efficiency is usually the highest at 75% of rated output.
- The efficient motor is at nominal efficiency defined by NEMA 12-6C.
- The standard motor is at the average of the nominal efficiencies of currently manufactured motors that do not meet NEMA 12-6C.
- The user would choose an ODP, TEFC, or explosion proof enclosure.
- The demand charge and the incremental speed increase can be ignored.

To use the payback tables, locate the horsepower rating and speed rating in the appropriate columns. Identify the columns that are within your approximate energy charge in $/kWh. The columns labeled with 2, 3, 4, or 5 indicate the simple payback years. The minimum annual hours of operation are included within the matrix. In the tables, spaces marked with a dashed line (---) indicate that even constant operation, 8,760 hours per year, would not yield a payback in the number of years listed. For example replacing an existing standard motor with an efficient motor that is rated a 40 hp and 1,800 rpm operating in a facility with an approximate energy charge of $0.08/kWh would require at least 3,598 operating hours per year to yield a simple payback of 4 years.

Both tables show an increase in efficiency of approximately 5%. All tables in this article were generated using the Washington State Energy Office's Motor Master software. In general, incentives offered by motor distributors and/or electric utilities will yield a shorter payback. For example, a 10% discount on motor price can reduce the simple payback period by 0.2 to 0.3 years. Some typical rebates available from utilities around the country are:

Horsepower at 1,800 rpm	Rebate ($)
10	140
20	260
40	430
50	500
75	730
100	920
200	1,300

Table 1. Hours of operation at various electrical rates and paybacks for open drip proof enclosure motors.

Horse Power	RPM	At $0.03/kWh Payback in Years 2	3	4	5	6	7	8	9	10	At $0.04/kWh Payback in Years 2	3	4	5	6	7	8	9	10
20	900	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	1800	—	—	—	—	8192	7021	6144	5461	4915	—	—	—	7380	6150	5271	4613	4100	3690
	3600	—	—	—	—	7333	6286	5500	4889	4400	—	—	8250	6600	5500	4714	4125	3667	3300
40	900	—	—	—	8188	6823	5849	5118	4549	4094	—	—	—	—	—	—	—	8036	7232
	1800	—	—	—	7690	6408	5493	4806	4272	3845	—	—	7210	5768	4807	4120	3605	3204	2884
	3600	—	—	—	7980	6650	5700	4988	4433	3990	—	—	7480	5984	4987	4274	3740	3324	2992
50	900	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	8505
	1800	—	—	—	7960	6633	5686	4975	4422	3980	—	—	7470	5976	4980	4269	3735	3320	2988
	3600	—	—	—	7560	6300	5400	4725	4200	3780	—	—	7080	5664	4720	4046	3540	3147	2832
75	900	—	—	—	8200	6833	5857	5125	4556	4100	—	—	—	—	—	—	—	—	7716
	1800	—	—	—	8430	7025	6021	5269	4683	4215	—	—	7900	6320	5267	4514	3950	3511	3160
	3600	—	—	—	8200	6833	5857	5125	4556	4100	—	—	7690	6152	5127	4394	3845	3418	3076
100	900	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	7477
	1800	—	—	—	8040	6700	5743	5025	4467	4020	—	—	7530	6024	5020	4303	3765	3347	3012
	3600	—	—	—	—	7527	6451	5645	5018	4516	—	—	8470	6776	5647	4840	4235	3764	3388
200	900	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	8325	7400	6660
	1800	—	—	—	—	7935	6801	5951	5290	4761	—	—	—	7140	5950	5100	4463	3967	3570
	3600	—	—	—	—	—	7849	6868	6104	5494	—	—	—	8240	6867	5886	5150	4578	4120
300	1800	—	—	—	—	—	8539	7471	6641	5977	—	—	—	—	7472	6404	5604	4981	4483
	3600	—	—	—	—	7750	6643	5813	5167	4650	—	—	8718	6974	5812	4981	4359	3874	3487
400	900	—	—	—	—	—	8141	7124	6332	5699	—	—	—	8550	7125	6107	5344	4750	4275
	1800	—	—	—	—	—	—	8659	7697	6927	—	—	—	—	8657	7420	6493	5771	5194
	3600	—	—	—	—	8083	6929	6063	5389	4850	—	—	—	7270	6058	5193	4544	4039	3635

Horse Power	RPM	At $0.05/kWh Payback in Years 2	3	4	5	6	7	8	9	10	At $0.06/kWh Payback in Years 2	3	4	5	6	7	8	9	10
20	900	—	—	—	—	—	—	8291	7370	6633	—	—	—	—	—	7896	6909	6141	5527
	1800	—	—	7375	5900	4917	4214	3688	3278	2950	—	8197	6148	4918	4098	3513	3074	2732	2459
	3600	—	—	6600	5280	4400	3771	3300	2933	2640	—	7340	5505	4404	3670	3146	2753	2447	2202
40	900	—	—	—	—	—	8269	7235	6431	5788	—	—	—	—	8037	6889	6028	5358	4822
	1800	7690	5768	4614	3845	3296	2884	2563	2307	—	6413	4810	3848	3207	2749	2405	2138	1924	—
	3600	7970	5978	4782	3985	3416	2989	2857	2391	—	6650	4988	3990	3325	2850	2494	2217	1995	—
50	900	—	—	—	—	—	—	8506	7561	6805	—	—	—	—	—	8103	7090	6302	5672
	1800	7957	5968	4774	3978	3410	2984	2652	2387	—	6640	4980	3984	3320	2846	2490	2213	1992	—
	3600	7543	5658	4526	3772	3233	2829	2514	2263	—	6300	4725	3780	3150	2700	2363	2100	1890	—
75	900	—	—	—	—	—	—	7715	6858	6172	—	—	—	—	—	8573	7349	6430	5716	5144
	1800	8437	6328	5062	4218	3616	3164	2812	2531	—	7017	5263	4210	3508	3007	2631	2339	2105	—
	3600	8197	6148	4918	4098	3513	3074	2732	2459	—	6837	5128	4102	3418	2930	2564	2279	2051	—
100	900	—	—	—	—	—	8547	7479	6648	5983	—	—	—	—	—	8305	7119	6229	5537	4983
	1800	8040	6030	4824	4020	3446	3015	2680	2412	—	6703	5028	4022	3352	2873	2514	2234	2011	—
	3600	—	6770	5416	4513	3869	3385	3009	2708	—	7533	5650	4520	3767	3229	2825	2511	2260	—
200	900	—	—	—	—	—	7610	6659	5919	5327	—	—	—	—	—	7397	6340	5548	4931	4438
	1800	—	7140	5712	4760	4080	3570	3173	2856	—	7933	5950	4760	3967	3400	2975	2644	2380	—
	3600	—	8240	6592	5493	4709	4120	3662	3296	—	—	6860	5488	4573	3920	3430	3049	2744	—
300	1800	—	—	7168	5973	5120	4480	3982	3584	—	—	7460	5968	4973	4263	3730	3316	2984	—
	3600	—	6975	5580	4650	3986	3488	3100	2790	—	7747	5810	4648	3873	3320	2905	2582	2324	—
400	900	—	8550	6840	5700	4886	4275	3800	3420	—	—	7115	5692	4743	4066	3558	3162	2846	—
	1800	—	—	—	7518	6444	5639	5012	4511	—	—	8655	6924	5770	4946	4328	3847	3462	—
	3600	—	7268	5814	4845	4153	3634	3230	2907	—	8073	6055	4844	4037	3460	3028	2691	2422	—

Table 1 (Cont). Hours of operation at various electrical rates and paybacks for open drip proof enclosure motors.

Horse Power	RPM	At $0.07/kWh Payback in Years 2	3	4	5	6	7	8	9	10	At $0.08/kWh Payback in Years 2	3	4	5	6	7	8	9	10
20	900	—	—	—	—	7897	6769	5923	5264	4738	—	—	—	8288	6907	5920	5180	4604	4144
	1800	—	7030	5273	4218	3515	3013	2636	2343	2109	—	6137	4603	3682	3068	2630	2301	2046	1841
	3600	—	6277	4708	3766	3138	2690	2354	2092	1883	8235	5490	4118	3294	2745	2353	2059	1830	1647
40	900	—	—	—	8268	6890	5906	5168	4593	4134	—	—	—	7228	6023	5163	4518	4016	3614
	1800	8235	5490	4118	3294	2745	2353	2059	1830	1647	7195	4797	3598	2878	2398	2056	1799	1599	1439
	3600	8540	5693	4270	3416	2847	2440	2135	1898	1708	7475	4983	3738	2990	2492	2136	1869	1661	1495
50	900	—	—	—	—	8102	6944	6076	5401	4861	—	—	—	8498	7082	6070	5311	4721	4249
	1800	8535	5690	4268	3414	2845	2439	2134	1897	1707	7485	4977	3733	2986	2488	2133	1866	1659	1493
	3600	8095	5397	4048	3238	2698	2313	2024	1799	1619	7100	4733	3550	2840	2367	2029	1775	1578	1420
75	900	—	—	—	—	7352	6301	5514	4901	4411	—	—	—	7708	6423	5506	4818	4282	3854
	1800	—	6027	4520	3616	3013	2583	2260	2009	1808	7895	5263	3948	3158	2632	2256	1974	1754	1579
	3600	—	5857	4393	3514	2928	2510	2196	1952	1757	7675	5117	3838	3070	2558	2193	1919	1706	1535
100	900	—	—	—	8540	7117	6100	5338	4744	4270	—	—	—	7480	6233	5343	4675	4156	3740
	1800	8620	5747	4310	3448	2873	2463	2155	1916	1724	7535	5023	3768	3014	2512	2153	1884	1674	1507
	3600	—	6453	4840	3872	3227	2766	2420	2151	1936	8480	5653	4240	3392	2827	2423	2120	1884	1696
200	900	—	—	—	7610	6342	5436	4756	4228	3805	—	—	8318	6654	5545	4753	4159	3697	3327
	1800	—	6797	5098	4078	3398	2913	2549	2266	2039	—	5957	4468	3574	2978	2553	2234	1986	1787
	3600	—	7853	5890	4712	3927	3366	2945	2618	2356	—	6887	5150	4120	3433	2943	2575	2289	2060
300	1800	—	8530	6398	5118	4265	3656	3199	2843	2559	—	7487	5600	4480	3733	3200	2800	2489	2240
	3600	—	6650	4988	3990	3325	2850	2494	2217	1995	—	5817	4363	3490	2908	2493	2181	1939	1745
400	900	—	8140	6105	4884	4070	3489	3053	2713	2442	—	7123	5343	4274	3562	3053	2671	2374	2137
	1800	—	—	7425	5940	4950	4243	3713	3300	2970	—	8647	6485	5188	4323	3706	3243	2882	2594
	3600	—	6923	5193	4154	3462	2967	2596	2308	2077	—	6057	4543	3634	3028	2596	2271	2019	1817

Horse Power	RPM	At $0.09/kWh Payback in Years 2	3	4	5	6	7	8	9	10	At $0.10/kWh Payback in Years 2	3	4	5	6	7	8	9	10
20	900	—	—	—	7368	6140	5263	4605	4093	3684	—	—	8288	6630	5525	4736	4144	3683	3315
	1800	8180	5453	4090	3272	2727	2337	2045	1818	1636	7380	4920	3690	2952	2460	2109	1845	1640	1476
	3600	7335	4890	3668	2934	2445	2096	1834	1630	1467	6600	4400	3300	2640	2200	1886	1650	1467	1320
40	900	—	—	8038	6430	5358	4593	4019	3572	3215	—	—	7240	5792	4827	4137	3620	3218	2896
	1800	6400	4267	3200	2560	2133	1829	1600	1422	1280	5770	3847	2885	2308	1923	1649	1443	1282	1154
	3600	6635	4423	3318	2654	2212	1896	1659	1474	1327	5980	3987	2990	2392	1993	1709	1495	1329	1196
50	900	—	—	—	7560	6300	5400	4725	4200	3780	—	—	8500	6800	5667	4857	4250	3778	3400
	1800	6635	4423	3318	2654	2212	1896	1659	1474	1327	5960	3973	2980	2384	1987	1703	1490	1324	1192
	3600	6300	4200	3150	2520	2100	1800	1575	1400	1260	5660	3773	2830	2264	1887	1617	1415	1258	1132
75	900	—	—	8580	6864	5720	4903	4290	3813	3432	—	—	7710	6168	5140	4406	3855	3427	3084
	1800	7020	4680	3510	2808	2340	2006	1755	1560	1404	6320	4213	3160	2528	2107	1806	1580	1404	1264
	3600	6835	4557	3418	2734	2278	1953	1709	1519	1367	6150	4100	3075	2460	2050	1757	1538	1367	1230
100	900	—	—	8300	6640	5533	4743	4150	3689	3320	—	—	7480	5984	4987	4274	3740	3324	2992
	1800	6695	4463	3348	2678	2232	1913	1674	1488	1339	6030	4020	3015	2412	2010	1723	1508	1340	1206
	3600	7535	5023	3768	3014	2512	2153	1884	1674	1507	6780	4520	3390	2712	2260	1937	1695	1507	1356
200	900	—	—	7400	5920	4933	4229	3700	3289	2960	—	—	6660	5328	4440	3806	3330	2960	2664
	1800	7940	5293	3970	3176	2647	2269	1985	1764	1588	7140	4760	3570	2856	2380	2040	1785	1587	1428
	3600	—	6103	4578	3662	3052	2616	2289	2034	1831	8240	5493	4120	3296	2747	2354	2060	1831	1648
300	1800	—	6633	4975	3980	3317	2843	2488	2211	1990	—	5977	4483	3586	2988	2561	2241	1992	1793
	3600	7745	5163	3873	3098	2582	2213	1936	1721	1549	6975	4650	3488	2790	2325	1993	1744	1550	1395
400	900	—	6330	4748	3798	3165	2713	2374	2110	1899	8550	5700	4275	3420	2850	2443	2138	1900	1710
	1800	—	7700	5775	4620	3850	3300	2888	2567	2310	—	6927	5195	4156	3463	2969	2598	2309	2078
	3600	8070	5380	4035	3228	2690	2306	2018	1793	1614	7275	4850	3638	2910	2425	2079	1819	1617	1455

Table 2. Hours of operation at various electrical rates and paybacks for totally enclosed, fan cooled, and explosion proof enclosure motors.

Horse Power	RPM	At $0.03/kWh Payback in Years 2	3	4	5	6	7	8	9	10	At $0.04/kWh Payback in Years 2	3	4	5	6	7	8	9	10
10	1800	—	—	—	—	—	—	7960	7076	6368	—	—	—	—	7957	6820	5968	5304	4774
	3600	—	—	—	—	—	7571	6625	5889	5300	—	—	—	7936	6613	5669	4960	4409	3968
20	1800	—	—	—	—	—	8721	7631	6783	6105	—	—	—	—	7637	6546	5728	5091	4582
	3600	—	—	—	—	7972	6833	5979	5314	4783	—	—	—	7166	5972	5119	4479	3981	3583
40	1800	—	—	—	—	—	8571	7500	6667	6000	—	—	—	—	7503	6431	5628	5002	4502
	3600	—	—	—	—	7403	6346	5553	4936	4442	—	—	8323	6658	5548	4756	4161	3699	3329
50	1800	—	—	—	—	—	8660	7578	6736	6062	—	—	—	—	7578	6496	5684	5052	4547
	3600	—	—	—	8672	7227	6194	5420	4818	4338	—	—	8148	6518	5432	4656	4074	3621	3259
75	900	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	1800	—	—	—	—	—	—	—	7894	7105	—	—	—	—	—	7609	6658	5918	5326
	3600	—	—	—	—	—	—	7840	6989	6272	—	—	—	—	7840	6720	5880	5227	4704
100	1800	—	—	—	—	—	—	8333	7407	6666	—	—	—	—	8322	7133	6241	5548	4993
	3600	—	—	—	—	—	—	—	8439	7595	—	—	—	—	—	8147	7129	6337	5703
200	900	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	1800	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	7903	7113
	3600	—	—	—	—	—	—	—	8692	7823	—	—	—	—	—	—	—	8196	7376
300	900	—	—	—	—	—	—	—	—	—	—	—	—	—	—	8386	7338	6522	5870
	1800	—	—	—	—	—	—	8683	7718	6946	—	—	—	—	—	—	—	—	—
	3600	—	—	—	—	—	—	8103	7202	6482	—	—	—	—	8687	7448	6515	5791	5212
400	900	—	—	—	—	—	—	—	—	—	—	—	—	—	8103	6946	6078	5402	4862
	1800	—	—	—	—	—	—	8410	7476	6728	—	—	—	—	—	—	—	8594	7735
	3600	—	—	—	—	—	—	—	8410	7589	—	—	—	—	8410	7209	6308	5607	5046
															—	8109	7095	6307	5676

Horse Power	RPM	At $0.05/kWh Payback in Years 2	3	4	5	6	7	8	9	10	At $0.06/kWh Payback in Years 2	3	4	5	6	7	8	9	10
10	1800	—	—	—	7638	6365	5456	4774	4243	3819	—	—	7973	6378	5315	4556	3986	3543	3189
	3600	—	—	7950	6360	5300	4543	3975	3533	3180	—	—	6615	5292	4410	3780	3308	2940	2646
20	1800	—	—	—	7324	6103	5231	4578	4069	3662	—	—	7623	6098	5082	4356	3811	3388	3049
	3600	—	—	7160	5728	4773	4091	3580	3182	2864	—	7970	5978	4782	3985	3416	2989	2657	2391
40	1800	—	8870	6503	5202	4335	3716	3251	2890	2601	—	—	7490	5992	4993	4280	3745	3329	2996
	3600	—	8143	6108	4886	4072	3490	3054	2714	2443	—	7417	5563	4450	3708	3179	2781	2472	2225
50	1800	—	—	—	7272	6060	5194	4545	4040	3638	—	—	7578	6062	5052	4330	3789	3368	3031
	3600	—	—	6658	5326	4438	3804	3329	2959	2663	—	7243	5433	4346	3622	3104	2716	2414	2173
75	900	—	—	—	—	—	—	—	—	5261	—	—	—	—	—	—	—	8608	7651	6886
	1800	—	—	—	8532	7110	6094	5333	4740	4266	—	—	—	7114	5928	5081	4446	3952	3557
	3600	—	—	—	7516	6263	5369	4698	4176	3758	—	—	7840	6272	5227	4480	3920	3484	3136
100	1800	—	—	—	7988	6657	5706	4993	4438	3994	—	—	8323	6658	5548	4756	4161	3699	3329
	3600	—	—	—	—	7592	6507	5694	5061	4555	—	—	—	7604	6337	5431	4753	4224	3802
200	900	—	—	—	—	—	8121	7106	6317	5685	—	—	—	—	8232	7056	6174	5488	4939
	1800	—	—	—	—	—	8421	7369	6550	5895	—	—	—	—	8190	7020	6143	5460	4914
	3600	—	—	—	—	7827	6709	5870	5218	4696	—	—	—	7832	6527	5594	4895	4351	3916
300	900	—	—	—	—	—	—	—	8361	7525	—	—	—	—	—	—	—	7840	6969	6272
	1800	—	—	—	8338	6948	5956	5211	4632	4169	—	—	8695	6956	5797	4969	4348	3864	3478
	3600	—	—	—	7778	6482	5556	4861	4321	3889	—	—	8103	6482	5402	4630	4051	3601	3241
400	900	—	—	—	—	—	8264	7231	6428	5785	—	—	—	—	8585	7359	6439	5723	5151
	1800	—	—	—	8078	6732	5770	5049	4488	4039	—	—	8410	6728	5607	4806	4205	3738	3364
	3600	—	—	—	—	7562	6481	5671	5041	4537	—	—	—	7568	6307	5406	4730	4204	3784

Table 2 (Cont). Hours of operation at various electrical rates and paybacks for totally enclosed, fan cooled, and explosion proof enclosure motors.

Horse Power	RPM	At $0.07/kWh Payback in Years									At $0.08/kWh Payback in Years								
		2	3	4	5	6	7	8	9	10	2	3	4	5	6	7	8	9	10
10	1800	—	—	6833	5466	4555	3904	3416	3037	2733	—	7970	5978	4782	3985	3416	2989	2657	2391
	3600	—	7563	5673	4538	3782	3241	2836	2521	2269	—	6630	4973	3978	3315	2841	2486	2210	1989
20	1800	—	8730	6548	5238	4365	3741	3274	2910	2619	—	7620	5715	4572	3810	3266	2858	2540	2286
	3600	—	6833	5125	4100	3417	2929	2563	2278	2050	—	5987	4490	3592	2993	2566	2245	1996	1796
40	1800	—	8553	6415	5132	4277	3666	3208	2851	2566	—	7503	5628	4502	3752	3216	2814	2501	2251
	3600	—	6337	4753	3802	3168	2716	2376	2112	1901	8325	5550	4163	3330	2775	2379	2081	1850	1665
50	1800	—	8670	6503	5202	4335	3716	3251	2890	2601	—	7593	5695	4556	3797	3254	2848	2531	2278
	3600	—	6190	4643	3714	3095	2653	2321	2063	1857	8150	5433	4075	3260	2717	2329	2038	1811	1630
75	900	—	—	—	—	—	8436	7381	6561	5905	—	—	—	—	8600	7371	6450	5733	5160
	1800	—	—	7623	6098	5082	4356	3811	3388	3049	—	—	6658	5326	4438	3804	3329	2959	2663
	3600	—	—	6723	5378	4482	3841	3361	2988	2689	—	7827	5870	4696	3913	3354	2935	2609	2348
100	1800	—	—	7140	5712	4760	4080	3570	3173	2856	—	8320	6240	4992	4160	3566	3120	2773	2496
	3600	—	—	8148	6518	5432	4656	4074	3621	3259	—	—	7118	5694	4745	4067	3559	3163	2847
200	900	—	—	—	8128	6773	5806	5080	4516	4064	—	—	—	7114	5928	5081	4446	3952	3557
	1800	—	—	—	8428	7022	6019	5266	4681	4213	—	—		7376	6147	5269	4610	4098	3688
	3600	—	—	8388	6710	5592	4793	4194	3728	3355	—	—	7335	5868	4890	4191	3668	3260	2934
300	900	—	—	—	—	—	7684	6724	5977	5379	—	—	—	—	7840	6720	5880	5227	4704
	1800	—	—	7448	5958	4965	4256	3724	3310	2979	—	8700	6525	5220	4350	3729	3263	2900	2610
	3600	—	—	6943	5554	4628	3967	3471	3086	2777	—	8087	6065	4852	4043	3466	3033	2696	2426
400	900	—	—	—	8830	7358	6307	5519	4906	4415	—	—	—	7728	6438	5519	4829	4292	3863
	1800	—	—	7205	5764	4803	4117	3603	3202	2882	—	8410	6308	5048	4205	3604	3154	2803	2523
	3600	—	—	8103	6482	5402	4630	4051	3601	3241	—	—	7095	5676	4730	4054	3548	3153	2838

Horse Power	RPM	At $0.09/kWh Payback in Years									At $0.10/kWh Payback in Years								
		2	3	4	5	6	7	8	9	10	2	3	4	5	6	7	8	9	10
10	1800	—	7067	5300	4240	3533	3029	2650	2356	2120	—	6373	4780	3824	3187	2731	2390	2124	1912
	3600	—	5900	4425	3540	2950	2529	2213	1967	1770	7930	5287	3965	3172	2643	2266	1983	1762	1586
20	1800	—	6777	5083	4066	3388	2904	2541	2259	2033	—	6103	4578	3662	3052	2616	2289	2034	1831
	3600	7975	5317	3988	3190	2658	2279	1994	1772	1595	7180	4787	3590	2872	2393	2051	1795	1596	1436
40	1800	—	6657	4993	3994	3328	2853	2496	2219	1997	—	5987	4490	3592	2993	2566	2245	1996	1796
	3600	7405	4937	3703	2962	2468	2116	1851	1648	1481	6655	4437	3328	2662	2218	1901	1664	1479	1331
50	1800	—	6747	5060	4048	3373	2891	2530	2249	2024	—	6073	4555	3644	3037	2603	2278	2024	1822
	3600	7230	4820	3615	2892	2410	2066	1808	1807	1446	6525	4350	3263	2610	2175	1864	1631	1450	1305
75	900	—	—	—	—	7650	6557	5738	5100	4590	—	—	—	8268	6890	5906	5168	4593	4134
	1800	—	7883	5913	4730	3942	3379	2956	2628	2365	—	7097	5323	4258	3548	3041	2661	2366	2129
	3600	—	6980	5235	4188	3490	2991	2618	2327	2094	—	6280	4710	3768	3140	2691	2355	2093	1884
100	1800	—	7417	5563	4450	3708	3179	2781	2472	2225	—	6680	4995	3996	3330	2854	2498	2220	1998
	3600	—	—	—	—	7368	6316	5528	4912	4421	—	7593	5695	4556	3797	3254	2848	2531	2278
200	900	—	—	7908	6326	5272	4519	3954	3514	3163	—	—	7118	5694	4745	4067	3559	3163	2847
	1800	—	—	8190	6552	5460	4680	4095	3640	3276	—	—	7380	5904	4920	4217	3690	3280	2952
	3600	—	8700	6525	5220	4350	3729	3263	2900	2610	—	7827	5870	4696	3913	3354	2935	2609	2348
300	900	—	—	—	8358	6963	5969	5223	4642	4178	—	—	—	7534	6278	5381	4709	4186	3767
	1800	—	7710	5783	4626	3855	3304	2891	2570	2313	—	6950	5213	4170	3475	2979	2606	2317	2085
	3600	—	7213	5410	4328	3607	3091	2705	2404	2164	—	6483	4863	3890	3242	2779	2431	2161	1945
400	900	—	—	8585	6868	5723	4906	4293	3816	3434	—	—	7733	6186	5155	4419	3866	3437	3093
	1800	—	7477	5608	4486	3738	3204	2804	2492	2243	—	6717	5038	4030	3358	2879	2519	2239	2015
	3600	—	8410	6308	5046	4205	3604	3154	2803	2523	—	7563	5673	4538	3782	3241	2836	2521	2269

DEPARTMENT OF THE NAVY

COMMANDING OFFICER
NFESC
560 CENTER DRIVE
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OFFICIAL BUSINESS

If you feel you have a feasible project after reviewing the data in Tables 1 and 2, please contact your EFD or NFESC. These agencies will assist you in validating your project and preparing the ECIP/ECAP documentation.

If you have any questions about efficient motors, please contact:

Gene Crank, Code ESC22, NFESC
(805) 982-5589 or DSN 551-5589