

Section TECH-G

Motor Data

TECH-G-1 Motor Enclosures

The selection of a motor enclosure depends upon the ambient and surrounding conditions. The two general classifications of motor enclosures are open and totally enclosed. An open motor has ventilating openings which permit passage of external air over and around the motor windings. A totally enclosed motor is constructed to prevent the free exchange of air between the inside and outside of the frame, but not sufficiently enclosed to be termed air-tight.

These two categories are further broken down by enclosure design, type of insulation, and/or cooling method. The most common of these types are listed below.

Open Drip Proof - An open motor in which all ventilating openings are so constructed that drops of liquid or solid particles falling on the motor at any angle from 0 to 15 degrees from vertical cannot enter the machine. This is the most common type and is designed for use in nonhazardous, relatively clean, industrial areas.

Encapsulated - A dripproof motor with the stator windings completely surrounded by a protective coating. An encapsulated motor offers more resistance to moisture and/or corrosive environments than an ODP motor.

Totally Enclosed, Fan-Cooled - An enclosed motor equipped for external cooling by means of a fan integral with the motor, but external to the enclosed parts. TEFC motors are designed for use in extremely wet, dirty, or dusty areas.

Explosion-Proof, Dust-Ignition-Proof - An enclosed motor whose enclosure is designed to withstand an explosion of a specified dust, gas, or vapor which may occur within the motor and to prevent the ignition of this dust, gas, or vapor surrounding the motor. A motor manufacturer should be consulted regarding the various classes and groups of explosion-proof motors available and the application of each.

Motor insulation is classified according to the total allowable temperature. This is made up of a maximum ambient temperature plus a maximum temperature rise plus allowances for hot spots and service factors. Class B insulation is the standard and allows for a total temperature of 130°C. The maximum ambient is 40°C, and the temperature rise is 70°C, for ODP motors and 75°C for TEFC motors.

TECH-G-2 NEMA Frame Assignments

SINGLE-PHASE MOTORS

Horizontal and Vertical
open type

Design L, 60 cycles, class B insulation system, open type, 1.15 service factor.

hp	speed, rpm		
	3600	1800	1200
3/4	-	-	145T
1	-	143T	182T
1 1/2	143T	145T	184T
2	145T	182T	-
3	182T	184T	-
5	184T	213T	-
7 1/2	213T	215T	-

POLYPHASE SQUIRREL-CAGE MOTORS

Horizontal and Vertical

open type

fan cooled

Designs A and B - class B insulation system, open type 1.15 service factor, 60 cycles.

hp	speed, rpm		
	3600	1800	900
1/2	-	-	143T
3/4	-	-	143T
1	-	143T	145T
1 1/2	143T	145T	182T
2	145T	145T	184T
3	145T	182T	213T
5	182T	184T	215T
7 1/2	184T	213T	254T
10	213T	215T	256T
15	215T	254T	284T
20	254T	256T	286T
25	256T	284T	324T
30	284TS	286T	326T
40	286TS	324T	364T
50	324TS	326T	365T
60	326TS	364TS	404T
75	364TS	365TS	405T
100	365TS	404TS	444T
125	404TS	405TS	445T
150	405TS	444TS	-
200	444TS	454TS	-
250	445TS*	-	-

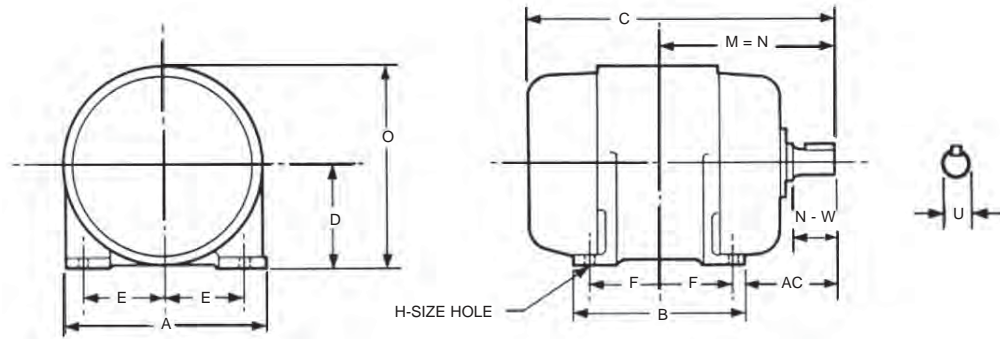
Designs A and B - class B insulation system totally-enclosed fan-cooled type, 1.00 service factor, 60-cycles.

hp	speed, rpm			
	3600	1800	1200	900
1/2	-	-	-	143T
3/4	-	-	143T	145T
1	-	143T	145T	182T
1 1/2	143T	145T	182T	184T
2	145T	145T	184T	213T
3	182T	182T	213T	215T
5	184T	184T	215T	254T
7 1/2	213T	213T	254T	256T
10	215T	215T	256T	284T
15	254T	254T	284T	286T
20	256T	256T	286T	324T
25	284TS	284T	324T	326T
30	286TS	286T	326T	364T
40	324TS	324T	364T	365T
50	326TS	326T	365T	404T
60	364TS	364TS	404T	405T
75	365TS	365TS	405T	444T
100	405TS	405TS	444T	445T
125	444TS	444TS	445T	-
150	445TS	445TS	-	-

*The 250 hp rating at the 3600 rpm speed has a 1.0 service factor

TECH-G-3 NEMA Frame Dimensions

IPP44 TOTALLY ENCLOSED & FLAMEPROOF (Similar to NEMA TEFC & Explosion Proof)



Motor Frame	H.P. (Open)			H.P. (Enclosed)				A Max.	B Max.	C (Approx.)		D	E	F	H	O (Approx.)		U	Keyway	V Min.	AC	Bolts		Wt. (Approx.)			
	900	1200	1800	3600	900	1200	1800			3600	Open					Encl.	Open					Encl.	Open	Encl.	Diag.	Lg.	Open
143T	1/2	3/4	1	1 1/2	1/2	3/4	1	1 1/2	7	6	12	12 1/2	3 1/2	2 3/4	2	11/32	6 7/8	7	7/8	3/16 x 3/32	2	4 1/2	1/4		40	45	
145T	3/4	1	1 1/2	2	3/4	1	1 1/2	2	7	6	12 1/2	13 1/2	3 3/4	2 3/4	2 1/4	11/32	6 7/8	7	7/8	3/16 x 3/32	2	4 1/2	1/4		45	50	
182T	1	1 1/2	3	5	1	1 1/2	3	3	9	6 1/2	13	14 1/2	4 1/2	3 3/4	2 1/4	13/32	9 1/8	9 1/4	1 1/8	1/4 x 1/8	5 1/2	5 1/2	5/16	1	65	79	
184T	1 1/2	2	5	7 1/2	1 1/2	2	5	5	9	7 1/2	14	15 1/2	4 1/2	3 3/4	2 3/4	13/32	9 1/8	9 1/4	1 1/8	1/4 x 1/8	2 1/2	5 1/2	5/16	1	80	95	
213T	2	3	7 1/2	10	2	3	7 1/2	7 1/2	10 1/2	7 1/2	16	18	5 1/4	4 1/4	2 3/4	13/32	10 3/8	10 7/8	1 3/8	5/16 x 5/32	3 1/8	6 7/8	5/16	1	120	140	
215T	3	5	10	15	3	5	10	10	10 1/2	9	17 1/2	19 1/2	5 1/4	4 1/4	3 3/4	13/32	10 3/8	10 7/8	1 3/8	5/16 x 5/32	3 1/8	6 7/8	5/16	1	140	160	
254T	5	7 1/2	15	20	5	7 1/2	15	15	12 1/2	10 3/4	20 1/2	22 1/2	6 1/4	5	4 1/8	17/32	12 5/8	12 3/4	1 5/8	3/8 x 3/16	3 3/4	8 1/4	3/8	1 1/4	200	235	
256T	7 1/2	10	20	25	7 1/2	10	20	20	12 1/2	12 1/2	22 1/2	24	6 1/4	5	5	17/32	12 5/8	12 3/4	1 5/8	3/8 x 3/16	3 3/4	8 1/4	3/8	1 1/4	235	270	
284T	10	15	25		10	15	25		14	12 1/2	23 1/2	25 1/2	7	5 1/2	4 3/4	17/32	14	14 3/8	1 7/8	1/2 x 1/4	4	9 3/8	3/8	1 1/2	295	370	
284TS				30				25	14	12 1/2	22	24 1/2	7	5 1/2	4 3/4	17/32	14	14 3/8	1 5/8	3/8 x 3/16	3	8	3/8	1 1/2	255	340	
286T	15	20	30		15	20	30		14	14	25	27	7	5 1/2	5 1/2	17/32	14	14 3/8	1 7/8	1/2 x 1/4	4 3/8	9 3/8	3/8	1 1/2	340	405	
286TS				40				30	14	14	23 1/2	26	7	5 1/2	5 1/2	17/32	14	14 3/8	1 5/8	3/8 x 3/16	3	8	3/8	1 1/2	295	395	
324T	20	25	40		20	25	40		16	14	26	28 1/2	8	6 1/4	5 1/4	21/32	16	16 5/8	2 1/8	1/2 x 1/4	5	10 1/2	1/2	1 3/4	440	520	
324TS				50				40	16	14	24 1/2	27	8	6 1/4	5 1/4	21/32	16	16 5/8	1 7/8	1/2 x 1/4	3 1/2	9	1/2	1 3/4	445	500	
326T	25	30	50		25	30	50		16	15 1/2	27 1/2	30	8	6 1/4	6	21/32	16	16 5/8	2 1/8	1/2 x 1/4	5	10 1/2	1/2	1 3/4	435	580	
326TS				60				50	16	15 1/2	26	28 1/2	8	6 1/4	6	21/32	16	16 5/8	1 7/8	1/2 x 1/4	3 1/2	9	1/2	1 3/4	480	560	
364T	30	40			30	40			18	15 1/4	29	33	9	7	5 5/8	21/32	18	18 1/2	2 3/8	5/8 x 5/16	5 5/8	11 3/4	1/2	1 3/4	605	755	
364TS			60	75			60	60	18	15 1/4	27	31	9	7	5 5/8	21/32	18	18 1/2	1 7/8	1/2 x 1/4	3 1/2	9 5/8	1/2	1 3/4	670	740	
365T	40	50			40	50			18	16 1/4	30	34	9	7	6 1/8	21/32	18	18 1/2	2 3/8	5/8 x 5/16	5 5/8	11 3/4	1/2	1 3/4	665	835	
365TS			75	100			75	75	18	16 1/4	28	32	9	7	6 1/8	21/32	18	18 1/2	1 7/8	1/2 x 1/4	3 1/2	9 5/8	1/2	1 3/4	730	820	
404T	50	60			50	60			20	16 1/4	32 1/2	37	10	8	6 1/8	13/16	20	20 5/8	2 7/8	3/4 x 3/8	7	13 7/8	5/8	2 1/4	830	1050	
404TS			100	125				20	16 1/4	29 1/2	34	10	8	6 1/8	13/16	20	20 5/8	2 1/8	1/2 x 1/4	4	10 7/8	5/8	2 1/4	870	1050		
405T	60	75			60	75			20	17 3/4	34	38 1/2	10	8	6 7/8	13/16	20	20 5/8	2 7/8	3/4 x 3/8	7	13 7/8	5/8	2 1/4	930	1160	
405TS			125	150			100	100	20	17 3/4	31	35 1/2	10	8	6 7/8	13/16	20	20 5/8	2 1/8	1/2 x 1/4	4	10 7/8	5/8	2 1/4	950	1150	
444T	75	100			75	100			22	18 1/2	38	42 1/2	11	9	7 1/4	13/16	22 3/8	23 1/8	3 3/8	7/8 x 7/16	8 1/4	16	5/8	2 1/4	1165	1440	
444TS			150	200			125	125	22	18 1/2	34	38 1/2	11	9	7 1/4	13/16	22 3/8	23 1/8	2 3/8	5/8 x 5/16	4 1/2	12 1/4	5/8	2 1/4	1050	1440	
445T	100	125			100	125			22	20 1/2	40	44 1/2	11	9	8 1/4	13/16	22 3/8	23 1/8	3 3/8	7/8 x 7/16	8 1/4	16	5/8	2 1/4	1370	1650	
445TS			200	250			150	150	22	20 1/2	36	41 1/2	11	9	8 1/4	13/16	22 3/8	23 1/8	2 3/8	5/8 x 5/16	4 1/2	12 1/4	5/8	2 1/4	1250	1615	
447T									22	23 1/4	43 1/2	48	11	9	10	13/16	22 3/8	23 1/8	3 3/8	7/8 x 7/16	8 1/4	16	5/8	2 1/4	1800	2260	
447TS									22	23 1/4	40 1/2	46 1/2	11	9	10	13/16	22 3/8	23 1/8	2 3/8	5/8 x 5/16	4 1/2	12 1/4	5/8	2 1/4	1800	2260	
56									6 1/2	3 7/8	10 1/2		3 1/2	2 7/16	1 1/2	11/32	6 7/8		5/8	3/16 x 3/32	1 7/8	4 9/8	1/4	1			
182	1/2	3/4	1	1 1/2	1/2	3/4	1	1 1/2	9	6 1/2	12 1/2	14 1/2	4 1/2	3 3/4	2 1/4	13/32	9	9	7/8	3/16 x 3/32	2	5	5/16	1	60	70	
184	3/4	1	1 1/2	2	3/4	1	1 1/2	2	9	7 1/2	13 1/2	15 1/2	4 1/2	3 3/4	2 3/4	13/32	9	9	7/8	3/16 x 3/32	2	5	5/16	1	70	80	
213	1-1/2	2	3	5	1-1/2	2	3	5	10 1/2	7 1/2	15 1/2	17 1/2	5 1/4	4 1/4	2 3/4	13/32	10 1/2	10 5/8	1 1/8	1/2 x 1/8	2 3/4	6 1/2	5/16	1	105	125	
215	2	3	5	7 1/2	2	3	5	7 1/2	10 1/2	9	17	19	5 1/4	4 1/4	3 1/2	13/32	10 1/2	10 5/8	1 1/8	1/2 x 1/8	2 3/4	6 1/2	5/16	1	115	140	
254U	3	5	7 1/2	10	3	5	7 1/2	10	12 1/2	10 3/4	20 1/2	22	6 1/4	5	4 1/8	17/32	12 5/8	13 1/8	1 3/8	5/16 x 5/32	3 1/2	8	3/8	1 1/4	180	210	
256U	5	7 1/2	10	15	5	7 1/2	10	15	12 1/2	12 1/2	22 1/2	24	6 1/4	5	4 1/8	17/32	12 5/8	13 1/8	1 3/8	5/16 x 5/32	3 1/2	8	3/8	1 1/4	210	245	
284U	7 1/2	10	15	20	7 1/2	10	15		14	12 1/2	24	25	7	5 1/2	4 3/4	17/32	14	14 5/8	1 5/8	3/8 x 3/16	4 5/8	9 5/8	3/8	1 1/2	280	330	
286U	10		20	25	10		20	20	14	14	25 1/2	26 1/2	7	5 1/2	5 1/2	17/32	14	14 5/8	1 5/8	3/8 x 3/16	4 5/8	9 5/8	3/8	1 1/2	325	365	
324U		15	25			15	25	25	16	14	26 1/2	28	8	6 1/4	5 1/4	21/32	16	16 3/4	1 7/8	1/2 x 1/4	5 5/8	10 7/8	1/2	1 3/4	380	480	
324S				30					16	14	24 1/2	25 1/2	8	6 1/4	5 1/4	21/32	16	16 3/4	1 5/8	3/8 x 3/16	3	8 1/2	1/2	1 3/4	380	480	
326U	15	20	30		15	20	30		16	15 1/2	28	29 1/2	8	6 1/4	6	21/32	16	16 3/4	1 7/8	1/2 x 1/4	5 5/8	10 7/8	1/2	1 3/4	430	560	
326S				40				30	16	15 1/2	26	27	8	6 1/4	6	21/32	16	16 3/4	1 5/8	3/8 x 3/16	3	8 1/2	1/2	1 3/4	430	560	
364U	20	25	40		20	25	40		18	15 1/4	29 1/2	34	9	7	5 5/8	21/32	18 1/4	18 3/4	2 1/8	1/2 x 1/4	6 1/8	12 1/4	1/2	1 3/4	525	720	
364US				50				40	18	15 1/4	27	31	9	7	5 5/8	21/32	18 1/4	18 3/4	1 7/8	1/2 x 1/4	3 1/2	9 5/8	1/2	1 3/4	670	710	
365U	25	30			25	30			18	16 1/4	30 1/2	35	9	7	6 1/8	21/32	18 1/4	18 3/4	2 1/8	1/2 x 1/4	6 1/8	12 1/4	1/2	1 3/4	580	785	
365US			50	60			50	50	18	16 1/4	28	32	9	7	6 1/8	21/32	18 1/4	18 3/4	1 7/8	1/2 x 1/4	3 1/2	9 5/8	1/2	1 3/4	730	780	
404U	30	40			30	40			20	16 1/4	32 1/2	37 1/2	10	8	6 1/8	13/16	20 1/4	20 7/8	2 3/8	5/8 x 5/16	6 7/8	13 3/4	5/8	2 1/4	725	965	
404US			60	75					20	16 1/4	30	34 1/2	10	8	6 1/8	13/16	20 1/4	20 7/8	2 1/8	1/2 x 1/4	4	10 7/8	5/8	2 1/4	860	1075	
444U	40	50			40	50			20	17 3/4	34	39	10	8	6 7/8	13/16	20 1/4	20 7/8	2 3/8	5/8 x 5/16	6 7/8	13 3/4	5/8	2 1/4	810	1110	
405US			75	100			60	60	20	17 3/4	31 1/2	36	10	8	6 7/8	13/16	20 1/4	20 7/8	2 1/8	1/2 x 1/4	4	10 7/8	5/8	2v	970	1165	
444U	50	60			50	60			22	18 1/2	38	43 1/2	11	9	7 1/4	13/16	22 1/4	23 1/8	2 7/8	3/4 x 3/8	8 3/8	16 1/8	5/8	2 1/4	9		

TECH-G-4 Synchronous and Approximate Full Load Speed of Standard A.C. Induction Motors

NUMBER of POLES	60 CYCLE RPM		50 CYCLE RPM	
	SYNC.	F.L.	SYNC.	F.L.
2	3600	3500	3000	2900
4	1800	1770	1500	1450
6	1200	1170	1000	960
8	900	870	750	720
10	720	690	600	575
12	600	575	500	480
14	515	490	429	410
16	450	430	375	360
18	400	380	333	319
20	360	340	300	285
22	327	310	273	260
24	300	285	240	230
26	277	265	231	222
28	257	245	214	205
30	240	230	200	192

TECH-G-5 Full Load Amperes at Motor Terminals* Average Values for All Speeds and Frequencies

MOTOR HP	SINGLE-PHASE A-C		THREE PHASE A-C INDUCTION TYPE SQUIRREL CAGE & WOUND ROTOR			DIRECT CURRENT	
	115 VOLTS	230 VOLTS**	230 VOLTS**	460 VOLTS	575 VOLTS	120 VOLTS	240 VOLTS
1/2	9.8	4.9	2.0	1.0	.8	5.2	2.6
3/4	13.8	6.9	2.8	1.4	1.1	7.4	3.7
1	16	8	3.6	1.8	1.4	9.4	4.7
1 1/2	20	10	5.2	2.6	2.1	13.2	6.6
2	24	12	6.8	3.4	2.7	17	8.5
3	34	17	9.6	4.8	3.9	25	12.2
5	56	28	15.2	7.6	6.1	40	20
7 1/2	80	40	22	11	9	58	29
10	100	50	28	14	11	76	29
15			42	21	17	112	55
20			54	27	22	148	72
25			68	34	27	184	89
30			80	40	32	220	106
40			104	52	41	292	140
50			130	65	52	360	173
60			154	77	62	430	206
75			192	96	77	536	255
100			240	120	96		350
125			296	148	118		440
150			350	175	140		530
200			456	228	182		710
250			558	279	223		

* These values for full-load current are for running at speeds usual for belted motors and motors with normal torque characteristics. Motors built for especially low speeds or high torques may require more running current, in which case the nameplate current rating should be used.

** For full-load currents of 208 and 200 volt motors, increase the corresponding 230 volt motor full-load current by 10 and 15 percent respectively.

TECH-G-6 Motor Terms

AMPERE: a unit of intensity of electric current being produced in a conductor by the applied voltage.

FREQUENCY: the number of complete cycles per second of alternating current, e.g., 60 Hertz.

HORSEPOWER: the rate at which work is done. It is the result of the work done (stated in foot-pounds) divided by the time involved.

INERTIA: the property of physical matter to remain at rest unless acted on by some external force. Inertia usually concerns the driven load.

MOTOR EFFICIENCY: a measure of how effectively the motor turns electrical energy into mechanical energy. Motor efficiency is never 100% and is normally in the neighborhood of 85%.

POWER FACTOR: the ratio of the true power to the volt-amperes in an alternating current circuit or apparatus.

SERVICE FACTOR: a safety factor in some motors which allows the motor, when necessary, to deliver greater than rated horsepower.

SYNCHRONOUS SPEED & SLIP: the speed of an a-c motor at which the motor would operate if the rotor turned at the exact speed of the rotating magnetic field. However, in a-c induction motors, the rotor actually turns slightly slower. This difference is defined as slip and is expressed in percent of synchronous speed. Most induction motors have a slip of 1-3%.

TORQUE: that force which tends to produce torsion or rotation. In motors, it is considered to be the amount of force produced to turn the load, it is measured in lb.-ft.

VOLTAGE: a unit of electro-motive force. It is a force which, when applied to a conductor, will produce a current in the conductor.

APPROXIMATE RULES OF THUMB		MECHANICAL FORMULAS
At 1800 rpm, a motor develops 3 lb.- ft per hp.	At 230 volts, a single- phase motor draws 2.5 amp per hp.	Torque in lb-ft = $\frac{HP \times 5250}{RPM}$
At 1200 rpm, a motor develops 4.5 lb-ft per hp.	At 230 volts, a single- phase motor draws 5 amp per hp.	Hp = $\frac{Torque \times RPM}{5250}$
At 575 volts, a 3-phase motor draws 1 amp per hp.	At 115 volts, a single- phase motor draws 10 amp per hp.	RPM = $\frac{120 \times Frequency}{No. of poles}$
At 460 volts, a 3-phase motor draws 1.25 amp per hp.		

Average Efficiencies and Power Factors of Electric Motors							
kW	Efficiency %			Power Factor			Full Load Amps on 3ph 415V
	Full Load	³ / ₄ Load	¹ / ₂ Load	Full Load	³ / ₄ Load	¹ / ₂ Load	
0.75	74	73	69	0.72	0.65	0.53	2.0
1.5	79	78.5	76	0.83	0.78	0.69	3.2
3	82.5	82	80.5	0.85	0.80	0.73	6.0
5.5	84.5	84.5	83.5	0.87	0.82	0.75	10.5
7.5	85.5	85.5	84.5	0.87	0.83	0.76	14
11	87	87	85.5	0.88	0.84	0.77	20
18.5	88.5	88.5	87	0.89	0.85	0.79	33
30	90	89.5	88	0.89	0.86	0.80	52
45	91	90.5	89	0.89	0.86	0.80	77
75	92	91.5	90	0.90	0.87	0.81	126

Required Value	Direct Current	Single Phases	Two-Phase 4-Wire	Three Phase
HP Output	$\frac{I \times E \times Eff}{746}$	$\frac{I \times E \times Eff \times PF}{746}$	$\frac{I \times E \times 2 \times Eff \times Pf}{746}$	$\frac{I \times E \times 1.73 \times Eff \times PF}{746}$

TECH-G-7 Electrical Conversion Formulae

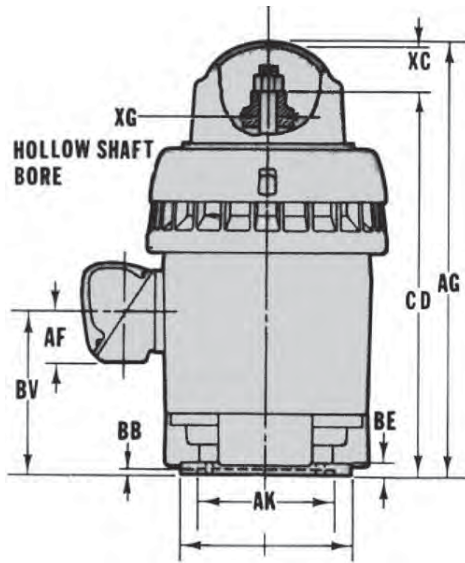
TO FIND	DIRECT CURRENT	ALTERNATING CURRENT	
		Single Phase	Three Phase
Amperes when horsepower (input) is known	$\frac{HP \times 746}{E \times Eff}$	$\frac{HP \times 746}{E \times Eff \times P.F.}$	$\frac{HP \times 746}{1.73 \times E \times Eff \times P.F.}$
Amperes when kilowatts is known	$\frac{kW \times 1000}{E}$	$\frac{kW \times 1000}{E \times P.F.}$	$\frac{kW \times 1000}{1.73 \times E \times P.F.}$
Amperes when kva is known		$\frac{kva \times 1000}{E}$	$\frac{kva \times 1000}{1.73 \times E}$
Kilowatts	$\frac{I \times E}{1000}$	$\frac{I \times E \times P.F.}{1000}$	$\frac{1.73 \times I \times E \times P.F.}{1000}$
Kva		$\frac{I \times E}{1000}$	$\frac{1.73 \times I \times E}{1000}$
P.F.		$\frac{KW}{Kva}$	$\frac{KW}{Kva}$
Horespower (output)	$\frac{I \times E \times Eff}{746}$	$\frac{I \times E \times Eff \times P.F.}{746}$	$\frac{1.73 \times I \times E \times Eff \times P.F.}{746}$

I = Amperes
E = Volts
HP= Horsepower

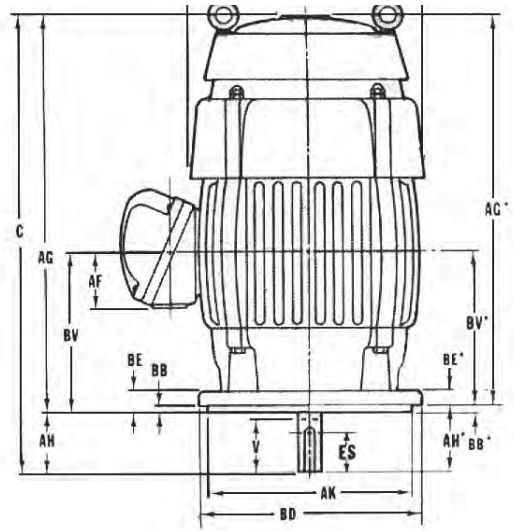
Eff= Efficiency (decimal)
P.F = Power Factor

Kva = Kilovolt- amperes
kW = Kilowatts

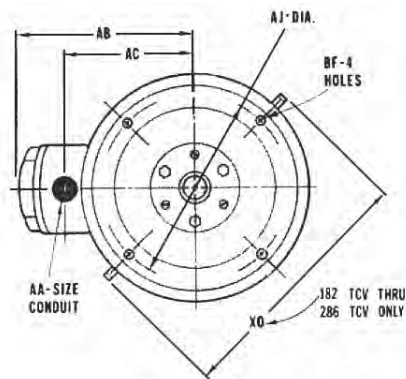
TECH-G-8 Vertical Motors



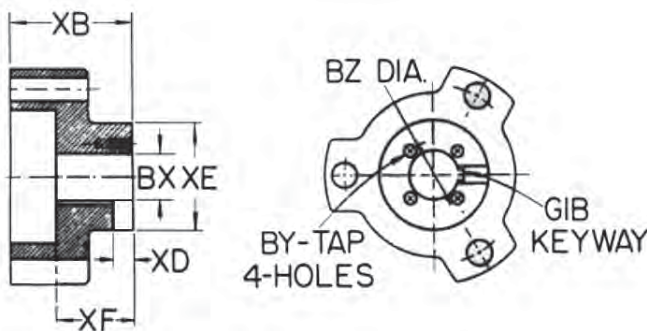
VHS VERTICAL HOLLOWSHAFT
 Pump shaft thru motor and coupled below motor with impeller adjustment made at top of motor.



VHS VERTICAL SOLID SHAFT
 Pump shaft coupled to shaft extension below motor. Impeller adjustment at coupling



NOTE: The following dimensions may vary upon vendor selection and design: XC, CD, AG, AF, BV, C.

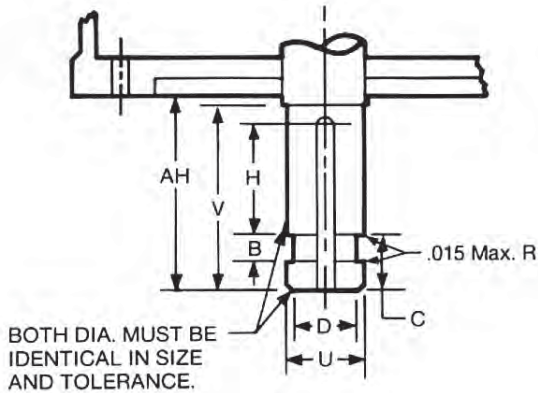


VERTICAL HOLLOWSHAFT
 NEMA dimensions for common top drive coupling sizes.

DIMENSIONS				
Top Shaft Dia.	BX Bore	BZ Dia. BC	SQ Key Size	BY Tap Size
3/4	0.751	1 3/8	3/16	10-32
1	1.001	3/8	1/4	10-32
1 3/16	1.188	1 3/4	1/4	1/4 - 20
1 1/2	1.501	2 1/8	3/8	1/4 - 20
1 15/16	1.938	2 1/2	1/2	1/4 - 20
2 3/16	2.188	3 1/4	1/2	3/8 - 16

NEMA SOLID SHAFT

NEMA DIMENSIONS FOR COMMON SOLID SHAFT EXTENSION SIZES.



DIMENSIONS								
Motor Shaft Dia. U	AH	V	H	B	C	D	Nominal Keyway	Pump Shaft Diameters
7/8	2 ³ / ₄	2 ³ / ₄	5/8	3/8	3/4	11/16	3/16 x 3/22	7/8
1 ¹ / ₈	2 ³ / ₄	2 ³ / ₄	1	3/8	3/4	15/16	1/4 x 1/8	7/8, 1
1 ⁵ / ₈	4 ¹ / ₂	4 ¹ / ₄	2 ⁵ / ₈	3/8	3/4	1 ¹ / ₄	3/8 x 3/16	7/8, 1, 1 ³ / ₁₆ , 1 ¹ / ₂
2 ¹ / ₈	4 ¹ / ₂	4 ¹ / ₄	2 ⁵ / ₈	3/8	3/4	1 ³ / ₄	1/2 x 1/4	1, 1 ³ / ₁₆ , 1 ¹ / ₂ , 1 ¹⁵ / ₁₆
2 ⁵ / ₈	5	5	3 ¹ / ₂	3/8	3/4	2 ¹ / ₄	5/8 x 5/16	2 ³ / ₁₆
2 ⁷ / ₈	7	6 ¹ / ₂	5	1/2	1	2 ³ / ₈	3/4 x 3/8	2 ³ / ₁₆ , 2 ¹¹ / ₁₆
3 ¹ / ₈	7	7	4 ³ / ₄	3/4	1 ¹ / ₂	2 ⁵ / ₈	3/4 x 3/8	2 ³ / ₁₆ , 1 ¹ / ₁₆ , 2 ¹⁵ / ₁₆

HEADSHAFT COUPLINGS

WITH VERTICAL HOLLOWSHAFT MOTOR:

Impeller adjustment made on adjusting nut above motor (under motor canopy and bolted to top drive coupling).

1. Sleeve type (lineshaft) coupling.
2. Rigid flanged coupling (Type AR).
3. No coupling-straight shaft (not recommended due to difficult installation/disassembly of head and motor).

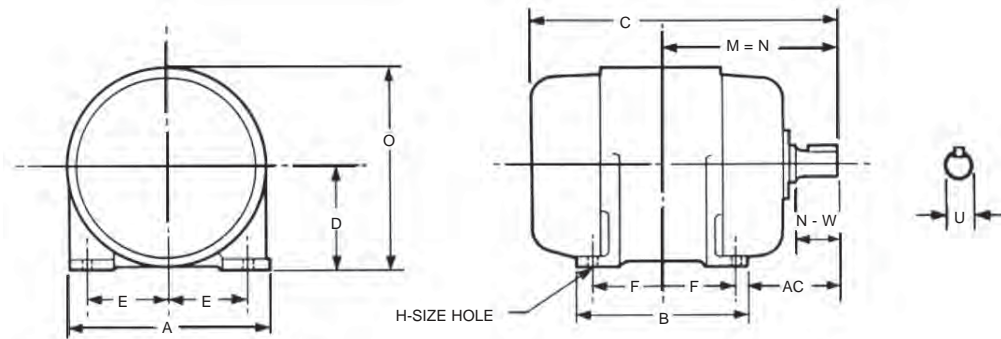
WITH VERTICAL SOLID SHAFT MOTOR:

Impeller adjustment made on adjusting plate of coupling without removal of motor canopy. (VSS motors also provide a lesser tolerance of shaft run-out which coincides with mechanical seal recommendations).

1. Adjustable coupling (Type A).
2. Adjustable spacer coupling (Type AS-recommended for applications with mechanical seals. The mechanical seal can be removed without disengaging motor).

TECH-G-9 I.E.C. Motor Frames

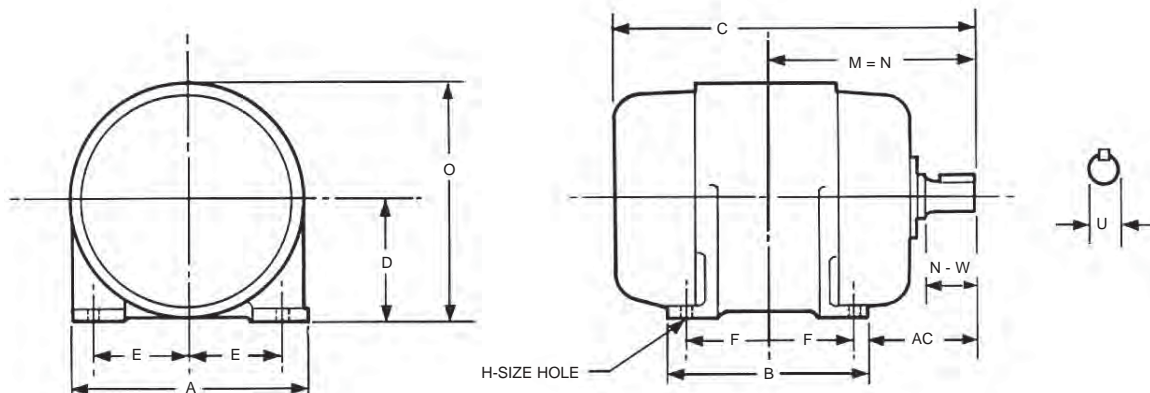
IPP44 TOTALLY ENCLOSED & FLAMEPROOF
(Similar to NEMA TEFC & Explosion Proof)



DIMENSIONS																
I.E.C. Frames	Poles	Units	A Max.	B Max.	C Approx.	D	E	F	H	M & N	O Approx.	U Nominal Tolerance		N & W	AC	Weight Approx.
D80-19	All	mm	157	130	245	80	63	50	10	140	185	19	j6	40	90	10 kg
E80-19		Inches	6 ¹ / ₈	5 ¹ / ₈	10	3.15	2 ¹ / ₂	2	³ / ₈	5 ¹ / ₂	7 ¹ / ₄	7890		1 ¹ / ₂	3 ¹ / ₂	20 Lbs
D90S24	"	mm	180	130	300	90	70	50	10	156	210	24	j6	50	106	20 kg.
E900S24		Inches	7	5 ¹ / ₈	10	3.54	2 ³ / ₄	2	³ / ₈	6 ³ / ₁₆	8 ¹ / ₄	9459		2	4 ³ / ₁₆	45 kg.
D90L24	"	mm	180	155	320	90	70	63	10	169	210	24	j6	50	106	22 kg.
E90L24		Inches	7	6 ¹ / ₈	12 ¹ / ₂	3.54	2 ³ / ₄	2 ¹ / ₂	³ / ₈	6 ¹¹ / ₁₆	8 ¹ / ₄	.9499		2	4 ³ / ₁₆	50 Lbs.
D100L28	"	mm	205	180	380	100	80	70	12	193	230	28	j6	60	123	30 kg.
E100L28		Inches	8	7	15	3.94	3 ¹ / ₈	2 ³ / ₄	¹⁵ / ₃₂	7 ⁵ / ₈	9	1.1024		2 ³ / ₈	4 ⁷ / ₈	65 Lbs.
D112M28	"	mm	240	185	380	112	95	70	12	200	250	28	j6	60	130	44 kg.
E112M28		Inches	9 ¹ / ₂	7 ¹ / ₄	15	4.41	3 ³ / ₄	2 ³ / ₄	¹⁵ / ₃₂	7 ⁷ / ₈	10	1.1024		2 ³ / ₈	5 ¹ / ₈	100 Lbs
D132S38	"	mm	266	185	440	132	108	70	12	239	290	38	k6	80	169	65 kg.
E132S38		Inches	10 ¹ / ₂	7 ¹ / ₄	17 ¹ / ₂	5.20	4 ¹ / ₄	2 ³ / ₄	¹⁵ / ₃₂	9 ³ / ₈	11 ¹ / ₂	1.4961		3 ¹ / ₈	6 ⁵ / ₈	145 Lbs
D132M38	"	mm	266	225	480	132	108	89	12	258	290	38	k6	80	169	90 kg.
E132M38		inches	10 ¹ / ₂	8 ³ / ₄	19	5.20	4 ¹ / ₄	3 ¹ / ₂	¹⁵ / ₃₂	10 ¹ / ₈	11 ¹ / ₂	1.4961		3 ¹ / ₈	6 ⁵ / ₈	100 Lbs.
D160M42	"	mm	318	267	580	160	127	105	15	323	360	42	k6	110	218	120 kg.
E160M42		Inches	12 ¹ / ₂	10 ¹ / ₂	23	6.30	5	4 ¹ / ₈	¹⁹ / ₃₂	12 ³ / ₄	14	1.6539		4 ³ / ₈	8 ⁵ / ₈	265 Lbs.
D160L42	"	mm	318	311	620	160	127	127	15	345	360	42	k6	110	218	150 kg.
E160L42		Inches	12 ¹ / ₂	12 ¹ / ₄	24 ¹ / ₂	6.30	5	5	¹⁹ / ₃₂	13 ⁵ / ₈	14	1.6539		4 ³ / ₈	8 ⁵ / ₈	330 Lbs
D180M48	"	mm	356	300	650	180	140	121	15	352	400	48	k6	110	231	175 kg.
E180M48		Inches	14	11 ³ / ₄	25 ¹ / ₂	7.09	5 ¹ / ₂	4 ³ / ₄	¹⁹ / ₃₂	13 ¹ / ₈	15 ³ / ₄	1.8898		4 ³ / ₈	9 ¹ / ₈	385 Lbs.
D180L48	"	mm	356	340	685	180	140	140	15	371	400	48	k6	110	231	190 kg.
E180L48		Inches	14	13 ³ / ₈	27	7.09	5 ¹ / ₂	5 ¹ / ₂	¹⁹ / ₃₂	14 ⁵ / ₈	15 ³ / ₄	1.8898		4 ³ / ₈	9 ¹ / ₈	420 Lbs.
D200L55	"	mm	400	368	760	200	159	153	19	396	440	55	m6	110	243	255 kg.
E200L55		Inches	15 ³ / ₄	14 ¹ / ₂	30	7.87	6 ¹ / ₄	6	³ / ₄	15 ¹ / ₂	17 ¹ / ₂	2.1654		4 ³ / ₈	9 ¹ / ₂	560 Lbs.
D225S55	2	mm	457	370	810	225	178	143	19	402	490	55	m6	110	259	290 kg.
E225S55		Inches	18	14 ¹ / ₂	32	8.86	7	5 ⁵ / ₈	³ / ₄	15 ⁷ / ₈	19 ¹ / ₄	2.1654		4 ³ / ₈	10 ¹ / ₄	640 Lbs
D225M60	4 to 8	mm	457	395	835	225	178	156	19	445	490	60	m6	140	289	350 kg
E225M60		Inches	18	15 ¹ / ₂	33	8.86	7	6 ¹ / ₈	³ / ₄	17 ¹ / ₂	19 ¹ / ₄	2.3622		5 ¹ / ₂	11 ³ / ₈	770 Lbs.
D250M60	2	mm	508	426	925	250	203	175	24	483	550	60	m6	140	308	440 kg.
E250M60		Inches	20	16 ³ / ₄	36 ¹ / ₂	9.84	8	6 ⁷ / ₈	¹⁵ / ₁₆	19	21 ⁵ / ₈	2.3622		5 ¹ / ₂	12 ¹ / ₈	970 Lbs.
D250M65	4 to 8	mm	508	426	925	250	203	175	24	483	550	65	m6	140	308	440 kg.
E250M65		Inches	20	16 ³ / ₄	36 ¹ / ₂	9.84	8	6 ⁷ / ₈	¹⁵ / ₁₆	19	21 ⁵ / ₈	2.5591		5 ¹ / ₂	12 ¹ / ₈	970 Lbs.
D280S65	2	mm	570	470	1000	280	229	184	24	514	630	65	m6	140	330	615 kg.
E280S65		Inches	22 ¹ / ₂	18 ¹ / ₂	39 ¹ / ₂	11.02	9	7 ¹ / ₄	¹⁵ / ₁₆	20 ¹ / ₄	24 ³ / ₄	2.5591		5 ¹ / ₂	13	1355 Lbs.
D280S75	4 to 8	mm	570	470	1000	280	229	184	24	514	630	75	m6	140	330	615 kg.
E280S75		Inches	22 ¹ / ₂	18 ¹ / ₂	39 ¹ / ₂	11.02	9	7 ¹ / ₄	¹⁵ / ₁₆	20 ¹ / ₄	24 ³ / ₄	2.9528		5 ¹ / ₂	13	1355 Lbs.
D280M65	2	mm	570	520	1060	280	229	210	24	540	630	65	m6	140	330	675 kg.
E280M65		Inches	22 ¹ / ₂	20 ¹ / ₂	42	11.02	9	8 ¹ / ₄	¹⁵ / ₁₆	21 ¹ / ₄	24 ³ / ₄	2.5591		5 ¹ / ₂	13	1500 Lbs.
D280M75	4 to 8	mm	570	520	1060	280	229	210	24	540	630	75	m6	140	330	675 kg.
E280M75		Inches	22 ¹ / ₂	20 ¹ / ₂	42	11.02	9	8 ¹ / ₄	¹⁵ / ₁₆	21 ¹ / ₄	24 ³ / ₄	2.9528		5 ¹ / ₂	113	1500 Lbs.
D315S65	2	mm	635	520	1140	315	254	203	28	559	725	65	m6	140	356	800 kg.
E315S65		Inches	25	20 ¹ / ₂	45	12.41	10	8	¹ / ₃₂	22	28 ¹ / ₂	2.5591		5 ¹ / ₂	14	1760 Lbs.
D315S80	4 to 8	mm	635	520	1140	315	254	203	28	589	725	80	m6	170	386	800 kg.
E315S80		Inches	25	20 ¹ / ₂	45	12.41	10	8	¹ / ₃₂	23 ¹ / ₄	28 ¹ / ₂	3.1945		6 ¹ / ₁₆	15 ¹ / ₄	1760 Lbs
D315S80	2	mm	635	570	1190	315	254	229	28	585	725	65	m6	140	356	900 kg.
E315M65		Inches	25	22 ¹ / ₂	47	12.41	10	9	¹ / ₃₂	23	28 ¹ / ₂	2.5591		5 ¹ / ₂	14	1985 Lbs.
D315M80	4 to 8	mm	635	570	1190	315	254	229	28	615	725	80	m6	170	386	900 kg.
E315M80		Inches	25	22 ¹ / ₂	47	12.41	10	9	¹ / ₃₂	24 ¹ / ₄	28 ¹ / ₂	3.1495		6 ¹ / ₁₆	15 ¹ / ₄	1985 Lbs.

I.E.C. Motor Frames (cont'd)

IP23 ENCLOSED VENTILATED
(Similar to NEMA Open Drip Proof)



DIMENSIONS

I.E.C. Frames	Poles	Units	A Max.	B Max.	C Approx.	D	E	F	H	M & N	O Approx.	U		N & W	AC	Weight Approx.
												Nominal	Tolerance			
C160M48	All	mm	318	267	700	160	127	105	15	323	330	48	k6	110	218	120 kg
		inches	12 ¹ / ₂	10 ¹ / ₂	27 ¹ / ₂	6.30	5	4 ¹ / ₈	19 ¹ / ₃₂	12 ³ / ₄	13	1.8898		4 ³ / ₈	8 ⁵ / ₈	265 Lbs.
C160L48	All	mm	318	311	750	160	127	127	15	345	330	48	k6	110	218	150 kg
		inches	12 ¹ / ₂	12 ¹ / ₄	29 ¹ / ₂	6.30	5	5	19 ¹ / ₃₂	13 ⁵ / ₈	13	1.8898		4 ³ / ₈	8 ⁵ / ₈	330 Lbs.
C180M55	All	mm	356	300	770	180	140	121	15	352	370	55	m6	110	231	200 kg
		inches	14	11 ³ / ₄	30 ¹ / ₄	7.09	5 ¹ / ₂	4 ³ / ₄	19 ¹ / ₃₂	13 ⁷ / ₈	14 ¹ / ₂	2.1654		4 ³ / ₈	9 ¹ / ₈	440 Lbs.
C180L55	All	mm	356	340	810	180	140	140	15	371	370	55	m6	110	231	210 kg
		inches	14	13 ³ / ₈	31 ⁷ / ₈	7.09	5 ¹ / ₂	5 ¹ / ₂	19 ¹ / ₃₂	14 ⁵ / ₈	14 ¹ / ₂	2.1654		4 ³ / ₈	9 ¹ / ₈	465 Lbs.
C200M60	All	mm	400	326	870	200	159	133	19	406	410	60	m6	140	273	270 kg
		inches	15 ³ / ₄	12 ⁷ / ₈	34 ¹ / ₄	7.87	6 ¹ / ₄	5 ¹ / ₄	3 ³ / ₄	16	16	2.3622		5 ¹ / ₂	10 ³ / ₄	595 Lbs.
C200L60	All	mm	400	368	900	200	159	152	19	425	410	60	m6	140	273	285 kg
		inches	15 ³ / ₄	14 ¹ / ₂	35 ¹ / ₂	7.87	6 ¹ / ₄	6	3 ³ / ₄	16 ³ / ₄	16	2.3622		5 ¹ / ₂	10 ³ / ₄	630 Lbs.
C225M60	2	mm	457	395	970	225	178	156	19	445	490	60	m6	140	289	350 kg
		inches	18	15 ¹ / ₂	38	8.86	7	6 ¹ / ₈	3 ³ / ₄	17 ¹ / ₂	19 ¹ / ₄	2.3622		5 ¹ / ₂	11 ³ / ₈	770 Lbs.
C225M65	4 to 8	mm	457	395	970	225	178	156	19	445	490	65	m6	140	289	350 kg
		inches	18	15 ¹ / ₂	38	8.86	7	6 ¹ / ₈	3 ³ / ₄	17 ¹ / ₂	19 ¹ / ₄	2.5591		5 ¹ / ₂	11 ³ / ₈	770 Lbs.
C250S65	2	mm	508	388	1100	250	203	154	24	464	550	65	m6	140	308	450 kg
		inches	20	15 ¹ / ₄	43 ¹ / ₄	9.84	8	6 ¹ / ₈	15 ¹ / ₁₆	18 ¹ / ₄	21 ⁵ / ₈	2.5591		5 ¹ / ₂	12 ¹ / ₈	990 Lbs.
C250S75	4 to 8	mm	508	388	1100	250	203	154	24	464	550	75	m6	140	308	450 kg
		inches	20	15 ¹ / ₄	43 ¹ / ₄	9.84	8	6 ¹ / ₈	15 ¹ / ₁₆	18 ¹ / ₄	21 ⁵ / ₈	2.9528		5 ¹ / ₂	12 ¹ / ₈	990 Lbs.
C250M65	2	mm	508	426	1140	250	203	175	24	483	550	65	m6	140	308	500 kg
		inches	20	16 ³ / ₄	44 ⁷ / ₈	9.84	8	6 ⁷ / ₈	15 ¹ / ₁₆	19	21 ⁵ / ₈	2.5591		5 ¹ / ₂	12 ¹ / ₈	1100 Lbs.
C250M75	4 to 8	mm	508	426	1140	250	203	175	24	483	550	75	m6	140	308	500 kg
		inches	20	16 ³ / ₄	44 ⁷ / ₈	9.84	8	6 ⁷ / ₈	15 ¹ / ₁₆	19	21 ⁵ / ₈	2.9528		5 ¹ / ₂	12 ¹ / ₈	1100 Lbs.
C280S65	2	mm	570	470	1265	280	229	184	24	514	630	65	m6	140	330	650 kg
		inches	22 ¹ / ₂	18 ¹ / ₂	49 ³ / ₄	11.02	9	7 ¹ / ₄	15 ¹ / ₁₆	20 ¹ / ₄	24 ³ / ₄	2.5591		5 ¹ / ₂	13	1435 Lbs.
C280S80	4 to 8	mm	570	470	1265	280	229	184	24	544	630	80	m6	170	360	650 kg
		inches	22 ¹ / ₂	18 ¹ / ₂	49 ³ / ₄	11.02	9	7 ¹ / ₄	15 ¹ / ₁₆	21 ⁷ / ₁₆	24 ³ / ₄	3.1496		6 ¹¹ / ₁₆	14 ³ / ₁₆	1435 Lbs.
C280M65	2	mm	570	520	1315	280	229	210	24	540	630	65	m6	140	330	700 kg
		inches	22 ¹ / ₂	20 ¹ / ₂	51 ³ / ₄	11.02	9	8 ¹ / ₄	15 ¹ / ₁₆	21 ¹ / ₄	24 ³ / ₄	2.5591		5 ¹ / ₂	13	1545 Lbs.
C280M80	4 to 8	mm	570	520	1315	280	229	210	24	570	630	80	m6	170	360	700 kg
		inches	22 ¹ / ₂	20 ¹ / ₂	51 ³ / ₄	11.02	9	8 ¹ / ₄	15 ¹ / ₁₆	22 ⁷ / ₁₆	24 ³ / ₄	3.1496		6 ¹¹ / ₁₆	14 ³ / ₁₆	1545 Lbs.
C315S70	2	mm	635	520	1475	315	254	203	28	559	725	70	m6	140	356	850 kg
		inches	25	20 ¹ / ₂	58	12.40	10	8	1 ³ / ₃₂	22	28 ¹ / ₂	2.7559		5 ¹ / ₂	14	1875 Lbs.
C315S90	4 to 8	mm	635	520	1475	315	254	203	28	589	725	90	m6	170	386	850 kg
		inches	25	20 ¹ / ₂	58	12.40	10	8	1 ³ / ₃₂	23 ¹ / ₄	28 ¹ / ₂	3.5433		6 ¹¹ / ₁₆	15 ¹ / ₄	1875 Lbs.
C315M7C	2	mm	635	570	1525	315	254	229	28	585	725	70	m6	140	356	950 kg
		inches	25	22 ¹ / ₂	60	12.40	10	9	1 ³ / ₃₂	23	28 ¹ / ₂	2.7559		5 ¹ / ₂	14	2100 Lbs.
C315M90	4 to 8	mm	635	570	1525	315	254	229	28	615	725	90	m6	170	386	950 kg
		inches	25	22 ¹ / ₂	60	12.40	10	9	1 ³ / ₃₂	24 ¹ / ₄	28 ¹ / ₂	3.5433		6 ¹¹ / ₁₆	15 ¹ / ₄	2100 Lbs.

TECH-G-10 TEFC IP55 Metric IEC Motors (Conversion NEMA to Metric)

HP	kW	RPM	FRAME	NEMA Equivalent Frame
1	.75	3000	80	56
1	.75	1500	80	56
1	.75	1000	90S	143T
1.5	1.1	3000	80	56
1.5	1.1	1500	90S	143T
1.5	1.1	1000	90L	145T
2	1.5	3000	90S	143T
2	1.5	1500	90L	145T
2	1.5	1000	100L	182T
3	2.2	3000	90L	145T
3	2.2	1500	100L	182T
3	2.2	1000	112M	184T
4	3.0	3000	100L	182T
4	3.0	1500	100L	182T
4	3.0	1000	132S	213T
5.5	4.0	3000	112M	184T
5.5	4.0	1500	112M	184T
5.5	4.0	1000	132M	215T
7.5	5.5	3000	132S	213T
7.5	5.5	1500	132S	213T
7.5	5.5	1000	132M	215T
10	7.5	3000	132S	213T
10	7.5	1500	132M	215T
10	7.5	1000	160M	254T
15	11	3000	160M	254T
15	11	1500	160M	254T
15	11	1000	160L	256T
20	15	3000	160M	254T
20	15	1500	160L	256T
20	15	1000	180L	284T
25	18.5	3000	160L	256T
25	18.5	1500	180M	284T
25	18.5	1000	200L	326T
30	22	3000	180M	284T
30	22	1500	180L	286T
30	22	1000	200L	326T
40	30	3000	200L	326T
40	30	1500	200L	326T
40	30	1000	225M	365T
50	37	3000	200L	326T
50	37	1500	225S	364T
50	37	1000	250S	404T
60	45	3000	225M	354T
60	45	1500	225M	365T
60	45	1000	250M	405T
75	55	3000	250S	404T
75	55	1500	250S	404T
75	55	1000	280S	444T
100	75	3000	250M	405T
100	75	1500	250M	405T
100	75	1000	280M	445T
125	90	3000	280S	444T
125	90	1500	280S	444T
125	90	1000	315S	504Z
150	110	3000	280M	445T
150	110	1500	280M	445T
150	110	1000	315M	505Z