See Electric Motor Terminology Section on 5th page for Detailed Information

Motors are used in a wide variety of applications. In some applications more than one motor design would work; in others, if an exact replacement cannot be found, a similar motor with slight differences in mechanical and electrical characteristics will provide reliable operation. The following selection guide is designed to help you choose the correct motor for your application.

STEP 1: GATHER MOTOR INFORMATION

You will need the following information to properly select a motor. If you are replacing a motor, much of the information can be found on the existing motor nameplate. See the sample nameplate on this page:

1-Phase (PH): Either single (1) or three (3). Match exactly.

2-Voltage (Volts): Match exactly.

3-Horsepower (HP): Very small motors are often rated in watts. Choose an equal or next higher HP.

4-Physical Size/Frame (FR): Match exactly.

5-Speed (RPM): Match within 5%.

6-Frequency (Hz): Match exactly.

7-Service Factor (SF): Choose a motor of equal or greater number.

8-Type: See table below.

9-Enclosure (Encl.): See table below.

10-Duty Cycle: If current motor is intermittent duty, you may upgrade to continuous. Air-over must be installed in the driven fan blade's airstream.

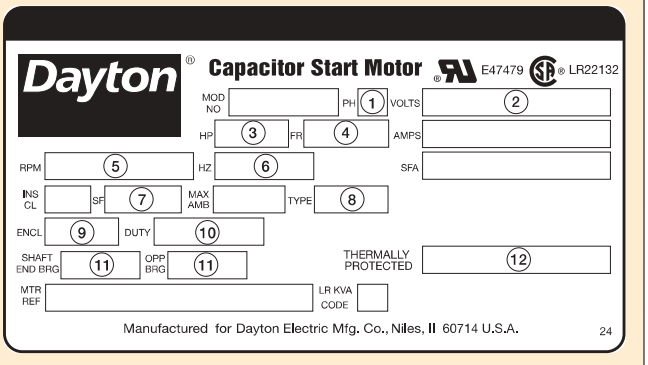
11-Bearing Type: Sleeve or Ball.

12-Thermal Protection: See Thermal Protection Information on page 5

STEP 2: DETERMINE THE RIGHT CATALOG SECTION

By your application: Many motors are listed by application. You will find these applications in the index on the front of the Motor Tab or under "Motors" in the Product Index in the catalog. Turn to the specific page or section to find your motor. If your application is not listed in the index, choose your motor by its characteristics.

By the characteristics: Motor type, horsepower, speed, frame, voltage, and enclosure. Grainger carries General Purpose motors designed for reliable use in a wide variety of applications, HVAC motors for various air moving, and Definite Purpose motors for specific applications.



General Purpose Motors are designed for mechanical loads (also effective for air moving), and for hard-to-start applications such as conveyors, belt-driven equipment, machine tools, and reciprocating pumps. These motors feature ball bearings to handle heavier radial and axial loads and heavier construction for industrial applications.

Definite Purpose Motors are specially designed for specific applications such as washdown, hazardous location, pump duty, etc. Motor features are driven by the specific application's environment.

HVAC Motors are designed mostly for air moving and other light- to medium-duty applications, such as fans and centrifugal pumps, small tools, and office equipment.

STEP 3: FIND THE RIGHT PAGE

Motors are arranged in each section as follows: first by type/application; then by enclosure or special features within that type. Example: When looking for a General Purpose 3-Phase TEFC motor, first turn to the General Purpose section, then find 3-Phase motor pages, then turn to TEFC pages.

STEP 4: SELECT SPECIFIC MOTOR

Match the information gathered in Step 1.

AC MOTOR TYPES

Phase	Type	Typical RPM	Starting Torque as Percent of Full-Load Torque	Comparative Efficiency	Typical Uses
1	Shaded Pole	1050, 1550, 3000	Very Low 50-100%	Low	Small direct-drive fans and blowers
1	Permanent Split Capacitor (PSC)	825, 1075, 1625	Low 75-150%	Moderate	Direct-drive fans and blowers
1	Split-Phase	1140, 1725, 3450	Low to Moderate 130-170%	Moderate	Belt-drive and direct-drive fans and blowers, small tools, centrifugal pumps, and appliances
1	Capacitor-Start	1140, 1725, 3450	Moderate to High 200-400%	Moderate to High	Pumps, compressors, tools, conveyors, farm equipment, and industrial ventilators
3	3-Phase	1140, 1725, 3450	Moderate to High 200-300%	High	Applications where 3-Phase power is available

ENCLOSURE TYPES

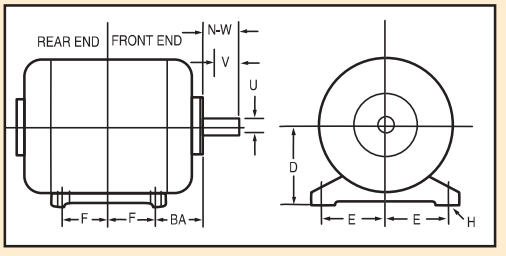
Enclosure Type	How Can I Tell?	Where Do I Use This Enclosure?
Open Dripproof (ODP)/Open	Ventilation holes in shell and/or endshield	Clean, dry, non-hazardous environments
Enclosed TEFC/TENV	No ventilation holes in shell or endshield	Dirty, moist, non-hazardous environments
Hazardous Location	Enclosed. Must have a UL Hazardous Location nameplate on motor	Designed for use in hazardous environments as defined by National Electrical Code (NEC) classifications. NEC Class and Group are designated on UL Hazardous Location nameplate mounted on motor. See page 31 for more details.

Other Abbreviations Used In Motor Listings

AC	Alternating Current
A, Amps	Amperes
Amb.	Ambient
Auto	Automatic
AWG	American Wire Gauge
C	Centigrade
Cap.	Capacitor
CCW	Counterclockwise
Cond.	Conductor
CSA	Canadian Standards Association
CW	Clockwise
CW/CCW	Reversible
CWSE	Clockwise Facing Shaft End
CWLE	Clockwise Facing Lead End
CCWSE	Counterclockwise Facing Shaft End
CCWLE	Counterclockwise Facing Lead End
DC	Direct Current
Dia.	Diameter
Encl.	Enclosure
FLA	Full-Load Amps
Ft.-Lb.	Foot-Pound
H, Ht.	Height
HP	Horsepower
Hz	Hertz
Imp.	Impedance
In.	Inch, Inches
In.-Lb.	Inch-Pound
Ins.	Insulation
L, Lgth.	Length, Long
Lbs.	Pounds
Man.	Manual
Max.	Maximum
Mfd	Microfarad
Min.	Minimum
Mtg.	Mounting
NEC	National Electrical Code
NEMA	National Electrical Manufacturer's Association
No.	Number
Nom.	Nominal
OC	On Center
ODP	Open Dripproof
OPAO	Open Air-Over
PE	Pump End
Prot.	Protection
PSC	Permanent Split Capacitor
Resil.	Resilient
Rev.	Reversible
RPM	Revolutions per Minute
SF	Service Factor
Shpg.	Shipping
Slv.	Sleeve
Spd.	Speed
Syn.	Synchronous
TEAO	Totally Enclosed Air-Over
TEFC	Totally Enclosed Fan-Cooled
TENV	Totally Enclosed Nonventilated
UL	Underwriters Laboratories, Inc.
V	Volts, Voltage
VFLE	View Facing Lead End
VFSE	View Facing Shaft End
W	Width, Watts

Motor Dimensional Chart

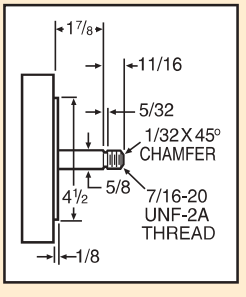
Standardized motor dimensions—established by the National Electrical Manufacturers Association (NEMA)—are tabulated below and apply to all base-mounted motors listed herein that carry a NEMA frame designation.



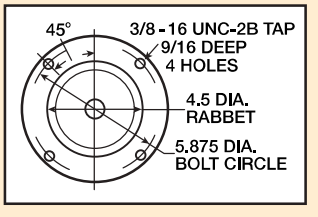
NEMA C- AND J-FACE MOUNTING DIMENSIONS

Mounting dimensions of the 56J-Face are exactly the same as the NEMA 56C.

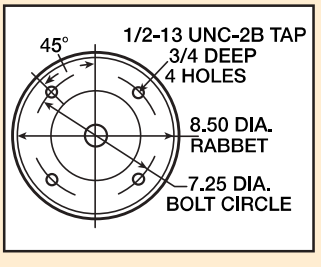
56J-Face has a threaded shaft of stainless steel while all others have a keyed steel shaft. See illustrations and table below for specifics.



56J SHAFT



56C, 56HC, 56J, 143TC AND 145TC- FACE DIMENSIONS



182TC THRU 256TC FACE DIMENSIONS

NEMA Face	Shaft Dia. (U)	Shaft Long (N-W)	Rabbet Dia.	Bolt Circle Dia.
42C	3/8	1⅛	3	3¾
48C	1/2	1½	3	3¾
56C	5/8	1⅞	4½	5⅞
56HC‡	5/8	1⅞	4½	5⅞
56J	5/8	2 1/16	4½	5⅞
143TC & 145TC	7/8	2¼	4½	5⅞
146ATC & 1412ATC	7/8	2¼	4½	5⅞
L182ACY & 186ACY	7/8	2¼	4½	5⅞
182TC & 184TC	1⅛	2¾	8½	7¼
186ATC & 189ATC	1⅛	2¼	8½	7¼
213TC & 215TC	1⅜	3⅜	8½	7¼
219ATC & 2110ATC	1⅜	2¾	8½	7¼
254TC & 256TC	1⅜	4	8½	7¼
284TC & 286TC	1⅞	4⅝	10½	9

NEMA Frame	All Dimensions in Inches D*	2E	2F	BA	H	N-W	U	V§ Min.	Key Wide	Key Thick	Key Long
42	2⅝	3½	1 11/16	2 1/16	9/32 slot	1⅛	3/8	—	—	3/64 flat	—
48	3	4¼	2¾	2½	11/32 slot	1½	1/2	—	—	3/64 flat	—
48H	3	4¼	4¾	2½	11/32 slot	1½	1/2	—	—	3/64 flat	—
56	3½	4⅞	3	2¾	11/32 slot	1 7/16†	5/8†	—	3/16†	3/16†	1 3/16‡
56H	3½	4⅞	3&5‡	2¾	11/32 slot	1 7/16†	5/8†	—	3/16†	3/16†	1 3/16†
56HZ	3½	**	**	**	**	2¼	7/8	2	3/16	3/16	1⅜
66	4⅛	5⅞	5	3⅜	13/32 slot	2¼	3/4	—	3/16	3/16	1⅞
143T	3½	5½	4	2¼	11/32 dia.	2¼	7/8	2	3/16	3/16	1⅜
145T	3½	5½	5	2¼		2¼	7/8	2	3/16	3/16	1⅜
146AT	3½	5½	5½	2¾		2¼	7/8	2	3/16	3/16	1⅜
148AT	3½	5½	7	2¾	11/32 dia.	2¼	7/8	2	3/16	3/16	1⅜
149AT	3½	5½	8	2¾		2¼	7/8	2	3/16	3/16	1⅜
1412AT	3½	5½	11	2¾		2¼	7/8	2	3/16	3/16	1⅜
182	4½	7½	4½	2¾		2¼	7/8	2	3/16	3/16	1⅜
184	4½	7½	5½	2¾	13/32 dia.	2¼	7/8	2	3/16	3/16	1⅜
182T	4½	7½	4½	2¾		2¾	1⅛	2½	1/4	1/4	1¾
184T	4½	7½	5½	2¾		2¾	1⅛	2½	1/4	1/4	1¾
182AT	4½	7½	4½	2¾		2¼	1⅛	2	1/4	1/4	1⅜
L182ACY	4½	7½	4½	2¾		2¼	7/8	2	3/16	3/16	1⅜
L182AT	4½	7½	4½	2¾		2¼	1⅛	2	1/4	1/4	1⅜
186ACY	4½	7½	7	2¾	13/32 dia.	2¼	7/8	2	3/16	3/16	1⅜
186AT	4½	7½	7	2¾		2¼	1⅛	2	1/4	1/4	1⅜
L186AT	4½	7½	7	2¾		2¼	1⅛	2	1/4	1/4	1⅜
189AT	4½	7½	10	2¾		2¼	1⅛	2	1/4	1/4	1⅜
203#	5	8	5½	3⅛	13/32 dia.	2¼	3/4	2	3/16	3/16	1⅜
204#	5	8	6½	3⅛		2¼	3/4	2	3/16	3/16	1⅜
213	5¼	8½	5½	3½		3	1⅛	2¾	1/4	1/4	2
215	5¼	8½	7	3½	13/32 dia.	3	1⅛	2¾	1/4	1/4	2
213T	5¼	8½	5½	3½		3⅜	1⅜	3⅛	5/16	5/16	2⅜
215T	5¼	8½	7	3½		3⅜	1⅜	3⅛	5/16	5/16	2⅜
219AT	5¼	8½	11	3½	13/32 dia.	2¾	1⅜	2½	5/16	5/16	1¾
2110AT	5¼	8½	12½	3½		2¾	1⅜	2½	5/16	5/16	1¾
224#	5½	9	6¾	3½	13/32 dia.	3	1	2¾	1/4	1/4	2
225#	5½	9	7½	3½		3	1	2¾	1/4	1/4	2
254#	6¼	10	8¼	4¼	21/32 dia.	3⅜	1⅛	3⅛	1/4	1/4	2⅜
254U	6¼	10	8¼	4¼		3¾	1⅜	3½	5/16	5/16	2¾
256U	6¼	10	10	4¼	17/32 dia.	3¾	1⅜	3½	5/16	5/16	2¾
254T	6¼	10	8¼	4¼		4	1⅝	3¾	3/8	3/8	2⅞
256T	6¼	10	10	4¼		4	1⅝	3¾	3/8	3/8	2⅞
284#	7	11	9½	4¾	21/32 dia.	3¾	1¼	3½	1/4	1/4	2¾
284U	7	11	9½	4¾		4⅞	1⅝	4⅝	3/8	3/8	3¾
286U	7	11	11	4¾	17/32 dia.	4⅞	1⅝	4⅝	3/8	3/8	3¾
284T	7	11	9½	4¾		4⅝	1⅞	4⅜	1/2	1/2	3¼
286T	7	11	11	4¾		4⅝	1⅞	4⅜	1/2	1/2	3¼
284TS	7	11	9½	4¾		3¼^	1 5/16^	3^	3/8	3/8	1⅞^
286TS	7	11	11	4¾		3¼^	1 5/16^	3^	3/8	3/8	1⅞^
324#	8	12½	10½	5¼	21/32 dia.	4⅞	1⅝	4⅝	3/8	3/8	3¾
326#	8	12½	12	5¼		4⅞	1⅝	4⅝	3/8	3/8	3¾
324U	8	12½	10½	5¼		5⅝	1⅞	5⅜	1/2	1/2	4¼
326U	8	12½	12	5¼		5¼	1⅞	5⅜	1/2	1/2	4¼
324T	8	12½	10½	5¼	21/32 dia.	5¼	2⅛	5	1/2	1/2	3⅞
326T	8	12½	12	5¼		5¼	2⅛	5	1/2	1/2	3⅞
324TS	8	12½	10½	5¼		3¾^	1 7/8^	3½^	1/2	1/2	2^
326TS	8	12½	12	5¼		3¾^	1 7/8^	3½^	1/2	1/2	2^
364#	9	14	11¼	5⅞		5⅝	1⅞	5⅜	1/2	1/2	4¼
364S#	9	14	11¼	5⅞	21/32 dia.	3¼	1⅝	3	3/8	3/8	1⅞
365#	9	14	12½	5⅞		5⅝	1⅞	5⅜	1/2	1/2	4¼
364U	9	14	11¼	5⅞		6⅜	2⅛	6⅛	1/2	1/2	5
365U	9	14	12½	5⅞	21/32 dia.	6⅜	2⅛	6⅛	1/2	1/2	5
364T	9	14	11 1/4	5 7/8		5 7/8	2 3/8	5 7/8	5/8	5/8	4 1/4
365T	9	14	12 1/4	5 7/8	21/32 dia.	5 7/8	2 3/8	5 7/8	5/8	5/8	4 1/4
364TS	9	14	11 1/4	5 7/8		3 3/4^	1 7/8^	3 1/2^	1/2	1/2	2^
365TS	9	14	12 1/4	5 7/8		3 3/4^	1 7/8^	3 1/2^	1/2	1/2	2^
404T	10	16	12 1/4	6 5/8		7 1/4	2 7/8	7	3/4	3/4	5 5/8
405T	10	16	13 3/4	6 5/8		7 1/4	2 7/8	7	3/4	3/4	5 5/8
404TS	10	16	12 1/4	6 5/8	13/16 dia.	4 1/4^	2 1/8^	4^	1/2	1/2	2 3/4^
405TS	10	16	13 3/4	6 5/8		4 1/4^	2 1/8^	4^	1/2	1/2	2 3/4^
404U	10	16	12 1/4	6 5/8		7 1/8	2 3/8	6 7/8	5/8	5/8	5 1/2
405U	10	16	13 3/4	6 5/8		7 1/8	2 3/8	6 7/8	5/8	5/8	5 1/2
444T	11	18	14 1/2	7 1/2		8 1/2	3 1/8	8 1/4	7/8	7/8	6 7/8
445T, 447T§§	11	18	16 1/2	7 1/2	13/16 dia.	8 1/2	3 1/8	8 1/4	7/8	7/8	6 7/8
444TS, 447TS§§	11	18	14 1/2	7 1/2		4 3/4^	2 3/8^	4 1/2^	5/8	5/8	3^
445TS	11	18	16 1/2	7 1/2		4 3/4^	2 3/8^	4 1/2^	5/8	5/8	3^
444U	11	18	14 1/2	7 1/2		8 7/8	2 7/8	8 3/8	3/4	3/4	7
445U	11	18	16 1/2	7 1/2	13/16 dia.	8 7/8	2 7/8	8 3/8	3/4	3/4	7
449T	11	18	25	7 1/2		8 1/2	3 1/8	8 1/4	7/8	7/8	6 7/8
449TS	11	18	25	7 1/2		4 3/4^	2 3/8^	4 1/2^	5/8	5/8	3^

(*) Dimension "D" will never be greater than the above values on rigid mount motors, but it may be less so that shims up to 1/32" thick (1/16" on 364U and 365U frames) may be required for certain machines.

(‡) Designated 56H motors have two sets of 2F mounting holes—3" and 5".

(^) Standard short shaft for direct-drive applications.

(#) Discontinued NEMA frame.

(**) Base of Dayton 56HZ frame motors has holes and slots to match NEMA 56, 56H and 145T mounting dimensions.

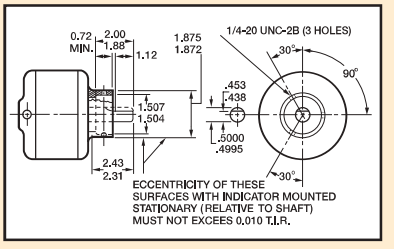
(†) Certain NEMA 56Z frame motors have 1/2" dia. x 1½" long shaft with 3/64" flat. These exceptions are noted in this catalog.

(§) Dimension "V" is shaft length available for coupling, pinion or pulley hub—this is a minimum value.

(§§) The 2F dimension is 20.

NEMA Guidelines

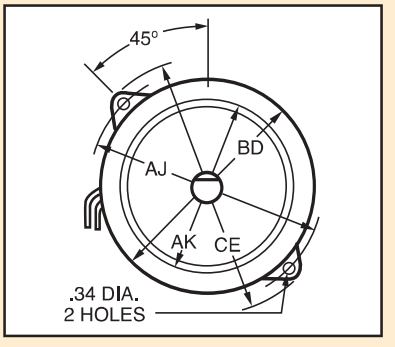
NEMA 48K AND 56K HUB DIMENSIONS FOR SUMP PUMP MOTORS



NEMA LETTER DESIGNATIONS FOLLOWING FRAME NUMBER

C	Face mount; see previous page.
H	Designated 56H motors have two sets of 2F mounting holes—3" and 5".
J	Face mount for jet pumps; see previous page for dimensions.
K	Has hub for sump pump mounting; see column at left for dimensions.
M, N	Flange mount for oil burner; see column at left for dimensions.
T, U	Integral HP motor dimension standards set by NEMA in 1964 and 1953.
Y	Nonstandard mounting; see manufacturer's drawing for mounting dimensions.
Z	Nonstandard shaft (N-W+U dimensions); see manufacturer's drawing for shaft dimensions.

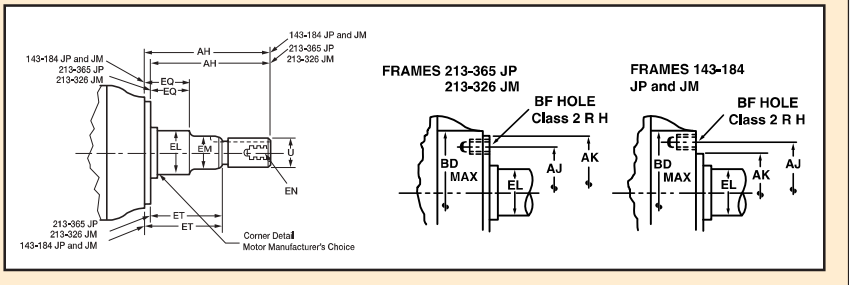
NEMA 48M, 48N AND 56N FLANGE MOUNT DIMENSIONS



OIL BURNER MOTORS

	48M	48N 56N
AJ	6¾"	7¼"
BD	6¼ max.	7 max.
AK	5½	6⅜
CE	7¾ max.	8¼ max.

CLOSE-COUPLED PUMP SHAFT DIMENSIONS



Frame Designations	U	EL	EM	EN	Dimensions (Inches) EQ	ET	AH	AJ	AK	BD	BF
143JM/145JM	7/8	1 9/32	1	3/8-16 x 3/4	5/8	2 1/8	4 1/4	5 7/8	4 1/2	6 5/8	3/8-16
143JP/145JP	7/8	1 9/32	1	3/8-16 x 3/4	1 9/16	5 15/16	7 5/16	5 7/8	4 1/2	6 5/8	3/8-16
182JM/184JM	7/8	1 1/4	1	3/8-16 x 3/4	5/8	2 1/8	4 1/4	5 7/8	4 1/2	6 5/8	3/8-16
182JP/184JP	7/8	1 1/4	1	3/8-16 x 3/4	1 9/16	5 15/16	7 5/16	5 7/8	4 1/2	6 5/8	3/8-16
213JM/215JM	7/8	1 1/4	1	3/8-16 x 3/4	5/8	2 1/8	4 1/4	7 1/4	8 1/2	9	1/2-13
213JP/215JP	1 1/4	1 3/4	1 3/8	1/2-13 x 1	2 3/8	5 1/8	8 1/8	7 1/4	8 1/2	9	1/2-13
254JM/256JM	1 1/4	1 3/4	1 3/8	1/2-13 x 1	5/8	3	5 1/4	7 1/4	8 1/2	9 1/4	1/2-13
254JP/256JP	1 1/4	1 3/4	1 3/8	1/2-13 x 1	2 3/8	5 1/8	8 1/8	7 1/4	8 1/2	9	1/2-13
284JM/286JM	1 1/4	1 3/4	1 3/8	1/2-13 x 1	5/8	3	5 1/4	11	12 1/2	13 7/8	5/8-11
284JP/286JP	1 1/4	1 3/4	1 3/8	1/2-13 x 1	2 3/8	5 1/8	8 1/8	11	12 1/2	13 7/8	5/8-11

Thermal Protection Information

Motors that start automatically (e.g. thermostat controlled) after tripping and are located out of operator sight must be protected against dangerous overheating due to failure-to-start or overloading. This protection may be a separate overcurrent device (e.g. motor starter) complying with Article 430 of the National Electrical Code (NEC), a thermally protected motor (internal motor protection), or an impedance protected motor.

Motors with automatic reset thermal protection MUST NOT be used where automatic or otherwise unexpected starting of the motor could be hazardous. Applications where automatic restarting could be hazardous include compressors, conveyors, power tools, farm equipment, and some fans and blowers. Where such a hazard exists, always use a manual reset, thermally-protected motor.

UL 507 Standard

Any motor used in a fan product, such as bathroom exhaust fans, wall-insert fans, ceiling-insert fans, attic-exhaust fans, whole-house fans, and duct fans, etc., which are built into or within the building structure and which are likely to operate unattended or in situations in which the operator may not detect a locked rotor (stalled motor) condition, must have either a manual reset thermal protector or a thermal cutoff (one-shot) device. Range hoods, circulating fans, pedestal fans, and ceiling-suspended fans are not included. Agricultural fans are included if they are built into the building structure and are likely to operate unattended or in situations in which the person operating the fan may not detect a locked rotor (stalled motor) condition; they must have either a manual reset thermal protector or a thermal cutoff (one-shot) device.

Premium Efficiency vs. Standard Efficiency

If you operate a 25 HP premium efficiency motor at full load for 24 hours a day (8760 hours per year) and your cost per kilowatt hour is 9 cents, you can save $532.00 annually. This comparison is based on a premium efficiency motor with a 94.1 efficiency rating vs. a high efficiency motor with a 91.0 efficiency rating.

Increased efficiency leads to lower operating temperatures, resulting in longer life.

Cool Operation: The life of an insulation system doubles for each 10°C reduction in operating temperature.

Longer Bearing Life: The lower the temperature, the longer the bearing grease will last.

Annual Savings = $0.746 \times HP \times L \times C \times N \left(\frac{100}{E1} - \frac{100}{E2}\right)$

- HP = Motor Horsepower
- L = Percent Load Divided by 100
- C = Energy Cost, Dollars per Kilowatt Hour
- N = Running Time, Hours per Year
- E1 = Efficiency (%) of Standard Efficiency Motor
- E2 = Efficiency (%) of Premium Efficiency Motor

IMPORTANT SAFETY INFORMATION: Refer to r UL 507 Standard pertaining to safety location information, proper thermal protection, dimensions, and other motor selection information.

IEC (International Electrotechnical Commission)

ENCLOSURES

- IEC uses numbers to denote a particular enclosure type
- The numbers follow the letters IP (Ingress Protection) in the motor description
- The first digit signifies, on a rating scale, how well-protected the motor is against entry of solid objects such as dust, wire, tools, or fingers
- The second digit signifies, on a rating scale, the motor's ability to protect against water entry

First Digit (solid object protection scale)

0 - None
1 - Protection against objects larger than 50 mm (approx. 2 in.) in diameter, like hands
2 - Protection against objects larger than 12 mm (approx. 1/2 in.) in diameter, like fingers
4 - Protection against objects larger than 1 mm (approx. 0.04 in.) in diameter, like small tools and wires
5 - Complete protection, including dust tightness
6 - Does not apply to motors

Second Digit (water entry protection scale)

0 - None
1 - Protected from water falling straight down
2 - Protected from water falling as much as 15° from vertical
3 - Protected from spraying water as much as 60° from vertical
4 - Protected from splashing water coming from any direction
5 - Protected from water sprayed from a nozzle in any direction
6 - Protected from heavy seas
7 - Protected against immersion for given time
8 - Protected against immersion indefinitely

Common Enclosure Ratings

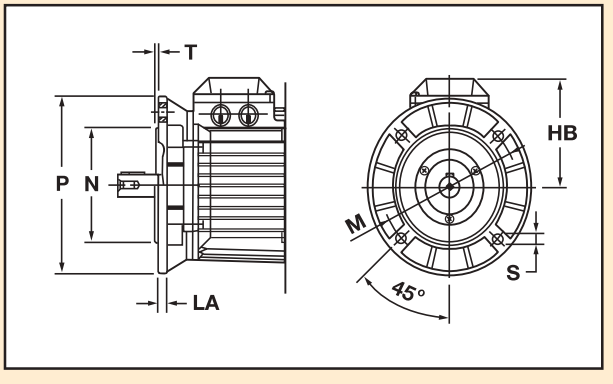
IP 22 - Open Dripproof Motors
IP 44 or 54 - Totally Enclosed (NEMA 12)
IP 45 - Weatherproof Motors
IP 55 - Washdown-Duty Motors

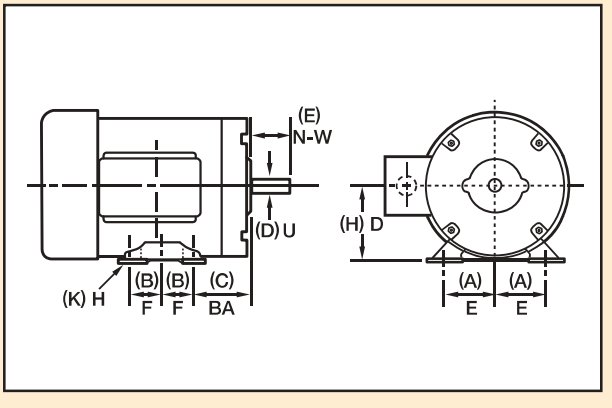
Common Motor Applications

IC 01 - NEMA Standard Open Motors
IC 40 (IC 410) - Totally Enclosed, Nonvented
IC 41 (IC 411) - Totally Enclosed, Fan-cooled
IC 48 (IC 418) - Totally Enclosed, Air Over

3-Phase Motors

A 50 Hz, 3-Phase motor will operate satisfactorily (at the nameplate KW) on a 60 Hz supply if the voltage is increased by the same ratio as the frequency. For example, a 400V, 50 Hz motor can satisfactorily operate on a 460V, 60 Hz input supply. The motor will perform acceptably at full nameplate KW, though shaft speed would be 1/6th higher than the nameplate speed. The available output KW of the motor will actually increase by the ratio of the frequencies (i.e. about 20%). 230V, 50 Hz, 3-Phase motors operated at 230V, 60 Hz may not operate satisfactorily without derating. A typical derate of KW might be by a factor of 0.80 to 0.85. This all relates to keeping motor heating in check on the 230V, 60 Hz load. Most manufacturers indicate in their literature whether a given motor is satisfactory for 60 Hz input and at what KW rating. Manufacturers will provide this information upon request.





IEC FLANGE MOUNT MOTOR DIMENSIONS (mm)

Frame	Large Flange (B5) D-Flange HB	LA	M	N	P	S	T	Small Flange (B14) C-Face HB	LA	M	N	P	S	T
63 (*)	108	7	115	95	140	10	3.0	68	7	75	60	90	M5	2.5
63	108	7	130	110	160	10	3.5	—	—	—	—	—	—	—
71	120	7	130	110	160	10	3.5	120	9	85	70	105	M6	2.5
80	126	12	165	130	200	12	3.5	126	9	100	80	120	M6	3.0
90S	139	12	165	130	200	12	3.5	139	9	115	95	140	M8	3.0
90L	139	12	165	130	200	12	3.5	139	9	115	95	140	M8	3.0
100L	170	11	215	180	250	15	4.0	170	14	130	110	160	M8	3.5
112	188	12	215	180	250	15	4.0	188	14	130	110	160	M8	3.5
132	213	12	265	230	300	15	4.0	215	14	165	130	200	M10	3.5

(*) M2AA63 can be supplied with shaft extension D=11, E=23, F=4 and GA=125mm, and DB=M4, if flange M=115mm.

IEC and NEMA DIMENSIONS AND FRAME COMPARISONS (mm)

(IEC) NEMA	(H) D	(A) E	(B) F	(K) H	(D) U	(C) BA	(E) N-W
(56) †	56	45	35.5	5.8	9	36	20
(63)	63	50	40	7	11	40	23
42	66.7	44.5	21.4	7.1	9.5	52.4	28.6
(71)	71	56	45	7	14	45	30
48	76.2	54	34.9	8.7	12.7	63.5	38.1
(80)	80	62.5	50	10	19	50	40
56	88.9	61.9	38.1	8.7	15.9	69.9	47.6
(90S)	90	70	50	10	24	56	50
143T	88.9	69.8	50.8	8.7	22.2	57.2	57.2
(90L)	90	70	62.5	10	24	56	50
145T	88.9	69.8	63.5	8.7	22.2	57.2	57.2
(100L) †	100	80	70	12	28	63	60
(112S)	112	95	57	12	28	70	60
182T	114.3	95.2	57.2	10.7	28	70	69.9
(112M)	112	95	70	12	28	70	60
184T	114.3	95.2	68.2	10.7	28	70	69.9
(132S)	132	108	70	12	38	89	80
213T	133.4	108	69.8	10.7	34.9	89	85.7
(132M)	132	108	89	12	38	89	80
215T	133.4	108	88.8	10.7	34.9	89	85.7
(160M)*	160	127	105	15	42	108	110
254T	158.8	127	104.8	13.5	41.3	108	101.6
(160L)*	160	127	127	15	42	108	110
256T	158.8	127	127	13.5	41.3	108	101.6
(180M)*	180	139.5	120.5	15	48	121	110
284T	177.8	139.8	120.2	13.5	47.6	121	117.5
(180L)*	180	139.5	139.5	15	48	121	110
286T	177.8	139.8	139.8	13.5	47.6	121	117.5
(200M)*	180	159	133.5	19	55	133	110
324T	203.3	158.8	133.4	16.7	54	133	133.4
(200L)*	200	159	152.5	19	55	133	110
326T	203.2	158.8	152.4	16.7	54	133	133.4

(*) Shaft dimensions of these motors may vary among manufacturers. (†) No NEMA equal.

Motor Terminology

Amb. (Ambient)—The temperature of the space around the motor.

Brgs. (Bearings)—Basic Types:

Slv (Sleeve)—Preferred where low noise level is important, as on fan and blower motors. Unless otherwise stated, sleeve bearing motors listed herein can be mounted in any position, including shaft-up or shaft-down (all-position mounting).

Ball—Used where higher load capacity is required or periodic lubrication is impractical. The two methods used to keep out dirt are: shields and seals.

Shielded Ball—Metal rings with close running clearance on one side (single-shielded) or both sides (double-shielded) of bearing.

Sealed Ball—Similar to shields, except have rubber lips that press against inner race, more effectively excluding dirt, etc.

Unit—Motors are constructed with a long, single sleeve bearing. For fan duty only. All-position mounting unless otherwise stated.

Efficiency— A measure of how well the electrical energy input to a motor is converted into mechanical energy at the output shaft.

Encl. (Enclosure)—The motor's housing Types:

Hazardous Location—A totally enclosed motor designed to withstand an internal explosion of specified gases or vapors, and not allow the internal flame or explosion to escape.

ODP (Open Dripproof)—Ventilation openings in endshields and shell placed so drops of liquid falling within an angle of 15° from vertical will not affect performance. Usually used indoors, in fairly clean locations.

OPAO (Open Air-Over)—Motors intended for fan and blower service. Must be located in the driven fan blade's air stream to provide motor cooling.

TEAO (Totally Enclosed Air-Over)—Air flow from driven or external device provides cooling air flow over the motor, but not airtight or waterproof.

TEFC (Totally Enclosed Fan-Cooled)—Includes an external fan in a protective shroud, to blow cooling air over the motor, but not airtight or waterproof.

TENV (Totally Enclosed Nonventilated)—Not equipped with an external cooling fan, but not airtight or waterproof. Depends on convection air for cooling.

Washdown—Designed for use in wet areas, or applications that require frequent cleaning.

FLA (Full-Load Amps)—Line current (amperage shown on motor nameplate) drawn by a motor when operating at rated HP and voltage.

Frame—Refers to the NEMA or IEC systems of standardized motor mounting dimensions, which facilitates interchangeability.

Hz (Hertz)—Frequency, in cycles per second, of AC power; usually 60 Hz in USA, 50 Hz overseas.

HP (Horsepower)—The amount of work a motor can do. One HP equals 746 watts.

Ins. (Insulation)—In motors, usually classified by maximum allowable operating temperatures: Class A-105°C (221°F), Class B-130°C (266°F), Class F-155°C (311°F), Class H-180°C (356°F).

Motor Types—Classified by operating characteristics and/or type of power required:

Shaded Pole – 1-Phase
Permanent Split Capacitor (PSC)–1-Phase
Split-Phase – 1-Phase
Capacitor Start – 1-Phase
3-Phase

DC (Direct Current)—Speed control enables adjustable-speed applications

AC/DC (AC series or universal)—Operate on AC (60 or 50 Hz) or DC power. High speed, usually 5000 RPM or more. Speed drops rapidly as load increases. Useful for drills, saws, etc., where high RPM and small size are desired and speed characteristic and limited life (primarily of brushes) is acceptable.

Mtg. (Mounting)—Basic types:

Bolted—Frame is attached to motor with removable bolts.

C-Face or Flange—Shaft end has a flat mounting surface, machined to standard dimensions, with holes to allow easy, secure mounting to driven equipment. Commonly used on jet pumps, oil burners and gear reducers.

Cradle/Resilient—Motor shell is isolated from base by vibration-absorbing material, such as rubber rings on the endshields, to reduce transmission of vibration to the driven equipment.

Rigid—Motor solidly fastened to equipment through metal base that is welded to, or cast into, motor shell.

Stud—Motor has bolts extending from front or rear, by which it is mounted. Often used on small, direct drive fans and blowers.

Yoke—Tabs or ears are welded to motor shell to allow bolting of motor to a fan column/pedestal or bracket.

Nameplate RPM—The nominal speed at which an induction motor operates under rated load (HP) conditions.

Power—The energy used to do work. Also the rate at which work is done. Measured in watts, horsepower, etc.

Power Supply/Voltage (V)—Single-phase power is the most readily available power supply. Single-phase motors of correct voltage can operate from a 3-phase system when properly connected to any one of the three phases. Contact a local licensed electrician for proper connection. However, 3-phase motors cannot be connected to single phase power.

Rotation—Direction in which shaft rotates: CWSE = clockwise facing shaft end; CWLE = clockwise facing lead end; CCWSE = counterclockwise facing shaft end; CCWLE = counterclockwise facing lead end; REV or CW/CCW = reversible, rotation can be changed.

SF (Service Factor)—A measure of the reserve margin built into a motor. Motors rated over 1.0 SF have more than normal margin, and are used where unusual conditions such as occasional high or low voltage, momentary overloads, etc. are likely to occur.

Severe Duty—A totally enclosed motor with extra protection (shaft slinger, gasketed terminal box) to resist entry of contaminants. Used in extra dirty, damp or other non-hazardous contaminated environments.

Temperature Rise—The amount by which a motor, operating under rated conditions, is hotter than its surroundings. On most motors, manufacturers have replaced the Rise rating on the motor nameplate with a listing of the Ambient temperature rating, insulation class and service factor.

Thermal Protection—A temperature sensing device built into the motor that shuts off the motor if the temperature becomes excessive due to failure-to-start or overloading. Basic types:

Auto (Automatic-Reset)—After motor cools, thermal protector automatically connects motor to power.

WARNING: Should not be used where unexpected restarting would be hazardous.

Imp (Impedance Protected)—Motor is designed so that it will not burn out in less than 15 days under locked rotor (stalled) conditions, in accordance with UL standard No. 519.

Man (Manual-Reset)—An external button must be pushed to reconnect power to motor. Preferred where unexpected restarting would be hazardous, as on saws, conveyors, compressors, etc.

T-Stat (Thermostat)—A temperature-sensing device installed inside the motor with separate leads brought out for connection into motor starter coil (control) circuit. Under failure-to-start or overload conditions thermostat contacts will open. Thermostat contacts will reclose automatically when motor cools.

Torque—Twist, or turning ability, as applied to a shaft. Measured in foot-pounds (ft.-lbs.), inch-pounds (in.-lbs.), ounce-feet (oz.-ft.) or ounce-inches (oz.-in.).

Breakdown—The maximum torque a motor will produce while running, without an abrupt drop in speed and power.

Locked Rotor or Starting—The maximum torque produced at initial start.

Voltage—The pressure in an electric system. The force pushing the electric current through the circuit, like pressure in a water system.

3-Phase Motor NEMA Premium™ Information Guide

National Electrical Manufacturers Association (NEMA), in conjunction with the US electric motor industry, has established NEMA Premium Efficiency standards as the highest nominal efficiencies to date, and is endorsed by the Consortium for Energy Efficiency (CEE). CEE members include electric utilities, administrators of state and regional efficiency programs, and environmental and research groups. CEE's motor specifications are used as a basis for public motor efficiency programs, which may include rebates or financing.

3-PHASE MOTORS AND NEW ENERGY LEGISLATION (EISA)

The Energy Independence and Security Act (EISA) of 2007 was signed into law in December of 2007. While the policy covers several areas of promoting energy efficiency, its primary focus is to conserve domestic resources, limit dependence on foreign oil, and reduce toxic emissions. The production of energy is one of the largest contributors to the decline of natural resources as well as pollution of the environment. Motors consume approximately 60% of the electricity used in the United States; therefore, motors were targeted to raise the bar in minimum efficiency levels to help drive this initiative. While the law was signed in 2007, the real action will take place on December 19th of 2010. Motor manufacturers will only be able to manufacture motors covered by the legislation meeting the newer, higher efficiency levels after that date.

ENERGY LEGISLATION COVERAGE

The EPAct 2007 legislation separates the motors covered by the policy into 2 groups: Subtype 1 and Subtype 2. These are defined as follows.

SUBTYPE 1

- General Purpose 3-Phase Motors
- 1 to 200 HP
- NEMA frame 143T and larger
- C-Face Motors with Base Mount

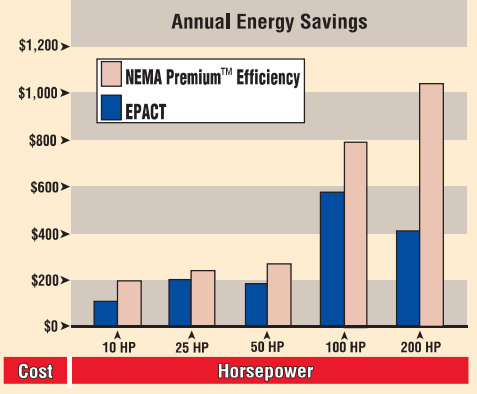
Motors previously covered under EPAct 1992 will now be required to meet NEMA Premium Efficient levels (NEMA MG1 Table 12-12).

SUBTYPE 2

- General Purpose and Definite Purpose 3-Phase Motors
- 1 to 200 HP
- NEMA frame 143T and larger
- U Frame Motor Designs
- NEMA Design C Torque
- Close-Coupled Pump
- Metric IEC
- Fire Pump
- Footless Design, C-Face without Base
- Vertical Solid Shaft Normal Thrust
- 8 Pole General Purpose Design up to 600V
- NEMA Design B General Purpose 201 to 500 HP

3-Phase motors not covered under EPAct 1996 and meeting the following requirements, will now be required to meet old EPAct 1996 minimum efficiency standards (NEMA MG1 Table 12-11).

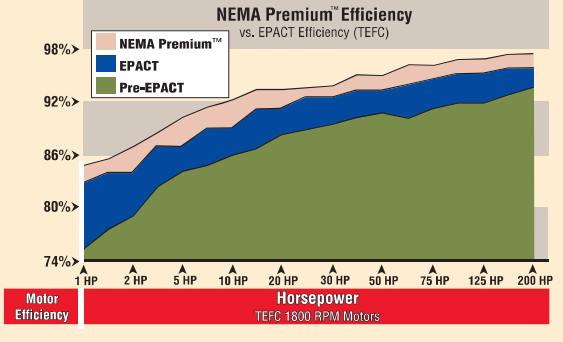
Note: NEMA Premium is a registered trademark of the National Electrical Manufacturers Association and may only be used on products covered by a memorandum of understanding between the manufacturer and NEMA.



ANNUAL ENERGY SAVINGS

NEMA Premium™ Efficiency motors will save you significant energy costs, resulting in a faster payback on your purchase.

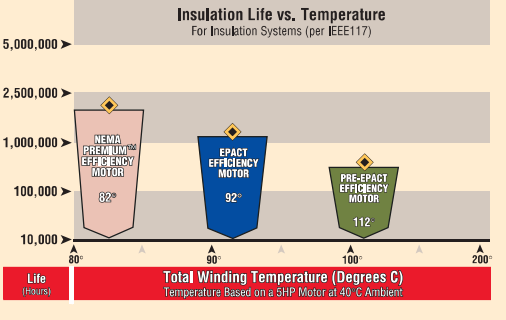
Comparisons are based on industry average efficiency standards. Based on a Dayton TEFC motor, 1800 rpm, 0.07/KWH @ 4400 hours.



EFFICIENCY COMPARISONS

Grainger carries a complete line of 1 to 200 HP NEMA Premium™ Efficiency motors.

Motor HP	NEMA EPACT Nominal Full-Load Efficiency						NEMA Premium Nominal Full-Load Efficiency					
	Open Motors			Enclosed Motors			Open Motors			Enclosed Motors		
	1200 rpm	1800	3600	1200 rpm	1800	3600	1200 rpm	1800	3600	1200 rpm	1800	3600
1	80	82.5	—	80	82.5	75.5	82.5	85.5	77.0	82.5	85.5	77.0
1½	84	84	82.5	85.5	84	82.5	86.5	86.5	84.0	87.5	86.5	84.0
2	85.5	84	84	86.5	84	84	87.5	86.5	85.5	88.5	86.5	85.5
3	86.5	86.5	84	87.5	87.5	85.5	88.5	89.5	85.5	89.5	89.5	86.5
5	87.5	87.5	85.5	87.5	87.5	87.5	89.5	89.5	86.5	89.5	89.5	88.5
7½	88.5	88.5	87.5	89.5	89.5	88.5	90.2	91.0	88.5	91.0	91.7	89.5
10	90.2	89.5	88.5	89.5	89.5	89.5	91.7	91.7	89.5	91.0	91.7	90.2
15	90.2	91	89.5	90.2	91	90.2	91.7	93.0	90.2	91.7	92.4	91.0
20	91	91	90.2	90.2	91	90.2	92.4	93.0	91.0	91.7	93.0	91.0
25	91.7	91.7	91	91.7	92.4	91	93.0	93.6	91.7	93.0	93.6	91.7
30	92.4	92.4	91	91.7	92.4	91	93.6	94.1	91.7	93.0	93.6	91.7
40	93	93	91.7	93	93	91.7	94.1	94.1	92.4	94.1	94.1	92.4
50	93	93	92.4	93	93	92.4	94.1	94.5	93.0	94.1	94.5	93.0
60	93.6	93.6	93	93.6	93.6	93	94.5	95.0	93.6	94.5	95.0	93.6
75	93.6	94.1	93	93.6	94.1	93	94.5	95.0	93.6	94.5	95.4	93.6
100	94.1	94.1	93	94.1	94.5	93.6	95.0	95.4	93.6	95.0	95.4	94.1
125	94.1	94.5	93.6	94.1	94.5	94.5	95.0	95.4	94.1	95.0	95.4	95.0
150	94.5	95	93.6	95	95	94.5	95.4	95.8	94.1	95.8	95.8	95.0
200	94.5	95	94.5	95	95	95	95.4	95.8	95.0	95.8	96.2	95.4
250	—	—	—	—	—	—	95.4	95.8	95.0	95.8	96.2	95.8
300	—	—	—	—	—	—	95.4	95.8	95.4	95.8	96.2	95.8
350	—	—	—	—	—	—	95.4	95.8	95.4	95.8	96.2	95.8
400	—	—	—	—	—	—	95.8	95.8	95.8	95.8	96.2	95.8
450	—	—	—	—	—	—	96.2	96.2	95.8	95.8	96.2	95.8
500	—	—	—	—	—	—	96.2	96.2	95.8	95.8	96.2	95.8



INSULATION LIFE VS. TEMPERATURE

NEMA Premium™ Efficiency motors run cooler and operate at a lower temperature rise which increases insulation life, grease life, and ultimately the life of the motor.

You'll enjoy lower maintenance and air conditioning costs with less downtime.