Application Information

AGENCY LISTINGS

UL and CSA

LESSON Electric and Lincoln Motors Fire Pump and Explosion Proof motors are UL Listed. Other motor types are UL Recognized, including models with inherent overheating protection as noted (i.e. thermally protected models). Leeson and Lincoln motors are also CSA Certified for both explosion proof and non-explosion proof enclosures.

AC Motors

Non-Explosion Proof	UL File No.	CSA File No.
NEMA 48-449 Frame	E49747	LR2025
NEMA 500 and 5000 Frame	—	LR2025*
IEC 63-90 Frame	E49747	LR2025
IEC 100-280 Frame	E49747	LR2025#
Thermally Protected motors	E6312	LR2025
Insulation Systems	E37900	LR2025
* Does not include coverage for use with VFD		
# Domestic product only		
Explosion Proof	**UL File No.**	**CSA File No.**
NEMA 56-326 Frame	E12044	LR47504
NEMA 364-449 Frame	E12044	LR21839
Fire Pump Motors	**UL File No.**	**CSA File No.**
NEMA 143-510	EX5190	LR2025
Class I, Division 2/Zone 2	**UL File No.**	**CSA File No.**
NEMA 48-449, 5000 Frame	—	LR21839
European ATEX Zone 2	**Intertek Certificate No.**	
NEMA 143-449, IEC 112-280	ITS06ATEX45370	

PMDC Motors + Gear Motors

Non-Explosion Proof	UL File No.	CSA File No.
NEMA 56-145	E49747	LR2025
AC Inverters	E161242	#
SpeedMaster SCR Controls	E132235	LR41380
FHP Speed Drives	E132235	_

- UL Certified for Canada under UL File E 1.67242

ATEX Directive (ATmospheres EXplosibles)

Mandatory by law, the European Union (EU) Directive 94/9/EC requires that electric motors for use in explosive atmospheres carry the CE mark, notified body identifier, Ex symbol, equipment group and category, plus the date code. See "European Installations" for additional details, located on the next page.

NEMA (National Electrical Manufacturers Ass'n)

LEESON Electric and Lincoln Motors' are manufactured in accordance with all applicable areas of NEMA standards in MG1-2006. When applied in accordance with the "Guidelines for Application of Three Phase Motors on Variable Frequency Drives", **LEESON Electric and Lincoln Motors' are in full compliance with NEMA MG1-2006, Part 31, Section 4.4.2**, as pertaining to voltage spikes. 460 volt motors must withstand voltage spikes of up to 1426 volts; 575 volt motors must withstand spikes up to 1788 volts. See "Insulation Systems" for additional detail on this subject. **Website: www.nema.org**

Commitment to RoHS and WEEE European Directives

European Directive 2002/95/EC "Restriction of Use of Certain Hazardous Substances" (RoHS) and Directive 2002/96/EC "Directives on Waste Electrical and Electronic Equipment" (WEEE) were enacted to control the amount of certain hazardous substances contained in products shipped into the E.U. Restricted substances include lead, mercury, cadmium, hexavalent chromium, polybrominated biphenyls and polybrominated dipheynl ethers.

The scope of products covered, affecting motors, is:

- Large household appliances
- Small household appliances
- IT and telecommunications equipment
- Consumer equipment
- Electrical and electronic tools (except large scale stationary and industrial tools)
- Toys, leisure and sports equipment
- Automatic dispensers

The Directives do not currently apply to medical devices, monitoring and control instruments, spare parts for the repair or reuse of electrical and electronic equipment placed on the market before July 1, 2006, and most military and state security equipment.

Regal Beloit Corporation worked closely with suppliers to assure that product falling within the scope of these Directives meets the specified levels of these substances. The Directives took affect July 1st, 2006 however many products were converted in May and June. The products converted are motors in NEMA frame size 145 and below, both AC and DC motors with the following exceptions:

- Brake motors in 56-145 frame **will have to be ordered specifically as RoHS compliant.**
- **Some motors with specialty electro-mechanical components.**

ISO QUALITY CERTIFICATION

Affiliate of The Regal Beloit corporation. We are ISO 9001:2008 and our registrar is NSF-ISR. The certificate number for the corporation is C0026928-IS2.

leeson.com/Technical Information

Continued on next page.

Application Information

LEESON Electric and Lincoln Motors employ the use of Exxon POLYREX® EM grease, a specially formulated bearing grease designed for electric motors. POLYREX® EM provides superior lubricity, durability and resists corrosion, rust and washout. POLYREX® EM is a registered trademark of Mobil Corporation.

Maximum safe mechanical speed capability is a function of bearing size, type and grease selection, as well as rotor balance specifications. Consult the "Maximum Safe Mechanical Speed Limits" chart in the "Overspeed Capability" section.

Note that these values do not imply maximum constant horsepower RPM.

EFFICIENCY

The efficiency of a motor is the ratio of its useful power output to its total power input and is usually expressed in a percentage. LEESON Electric and Lincoln Motors offers standard, high efficient EPAct, and **NEMA Premium**® efficient ratings. Standard efficiency motors may only be used on applications that are exempt from legislated efficiencies. The high efficient motor line is in compliance with the Energy Policy Act of 1992 (EPAct) and/or Canadian efficiencies as set by NRCan. The Energy Independance and Security Act of 2007 (**EISA07**) will become law on December 19, 2010, requiring current EPAct-compliant motors to meet NEMA Premium® efficiencies, and most EPAct-exempt motors to meet EPAct levels. Premium efficient motors in this catalog meet NEMA Premium® unless otherwise noted.

The LEESON WattSAVERe® and Lincoln Ultimate-e™ line is a premium efficiency line, which exceeds mandated efficiencies of EPAct and /or NRCan. Unless otherwise noted, premium efficient motors in this catalog meet NEMA Premium® the newly promoted efficiency levels by NEMA and the Consortium for Energy Efficiency (CEE).

ELECTRICAL TYPE/STARTING METHOD

Motors in this catalog are capacitor start, split phase, permanent split capacitor, or three phase. Capacitor Start motors have high starting torque, high breakdown torque, and relatively low starting current. Split phase motors have medium starting torque and medium starting current. Permanent split capacitor motors have low starting torque and low starting current. Three phase motors have high starting, extra breakdown torque, and typically very low starting current. Single phase motors cannot be applied on variable frequency drives with three phase output.

ENCLOSURE AND METHOD OF COOLING

LEESON Electric and Lincoln Motors are available in various enclosures; Dripproof (DP), Dripproof Force Ventilated (DPFV), Totally Enclosed Fan Cooled (TEFC), Totally Enclosed Non-Ventilated (TENV), Totally Enclosed (TEAO) and Totally Enclosed Blower Cooled (TEBC). Application conditions will determine the type of motor enclosure required.

Dripproof motors have open enclosures and are suitable for indoor use and in relatively clean atmospheres. Dripproof motors have ventilating openings constructed so that drops of liquid or solid particles falling on the machine at an angle of not greater than 15 degrees from the vertical cannot enter the machine.

Totally enclosed motors are suitable for use in humid environments or dusty, contaminated atmospheres. Totally enclosed non-ventilated motors are NOT cooled by external means. Totally enclosed fan cooled motors are cooled by external means that are part of the motor but not in the internal workings of the motor. Totally enclosed air over motors are sufficiently cooled by external means, provided by the customer.

HAZARDOUS DUTY

Hazardous Duty motors are totally enclosed (fan cooled or non-ventilated) motors designed for applications in hazardous atmospheres containing explosive gases and/or combustible dusts.

North American installations

North American standards for electric motors generally fall into one of two divisions. Division 1 Explosion Proof motors are UL Listed in accordance with NFPA Class I (Flammable Gases) or Class II (Combustible Dusts) and Groups (gases or dusts), depending upon the atmosphere. Division 2 motors are CSA Certified and are marked similarly to Division 1 equipment. Inverter Duty motors through 449T frames are CSA Certified for use in Division 2 locations.

European installations

Motors for hazardous locations in Europe must meet a different set of standards and require different markings than those of North America. CENELEC sets the standards for equipment in hazardous locations for Europe. Motors for use in explosive atmospheres in Europe are often referred to as flameproof (Zone 1) or non-sparking (Zone 2) motors. These motors must comply with the ATEX Directive. The ATEX Directive covers all electrical equipment used in explosive atmospheres. To ensure compliance with the Directive, equipment must meet the essential ATEX requirements and carry the CE mark on the nameplate. Other information required on the nameplate includes the Ex symbol, group & category, Ex protection method, gas group, and temperature code, example (⟨Ex⟩ II 3 G Ex nA IIC T3).

The tables on the next page describe LEESON Electric and Lincoln Motors capabilities by Area Classification and by Temperature Code.

LEESON Electric and Lincoln Motors Hazardous Duty Motor Area Classification Chart

Class I Area Classification (Flammable Gases, Vapors or Mists)				Class II Area Classification (Combustible Dusts)			
North America		Europe - ATEX③ (Category G - Gases)		North America		Europe - ATEX③ (Category D - Dusts)	
Division 1 Explosion Proof	Division 2 TEFC & TENV	Zone1 Flameproof	Zone 2 Non-Sparking	Division 1 Explosion Proof	Division2	Zone 21 Flameproof	Zone 22 Non-Sparking
Group A①	Group A	N/A	N/A	-	-	-	-
Group B②	Group B	N/A	N/A	-	-	-	-
Group C	Group C	N/A	N/A	-	-	-	-
Group D	Group D	N/A	N/A	-	-	-	-
-	-	N/A	-	Group E①	-	N/A	N/A
-	-	N/A	-	Group F	Group F①	N/A	N/A
-	-	N/A	-	Group G	Group G①	N/A	N/A

- Group is not applicable to that Division or Zone, or is not defined.
① Group is not available from LEESON Electric and Lincoln Motors.
② Contact factory representative for availability.
③ Currently not available.

LEESON Electric and Lincoln Motors Hazardous Duty Motor Temperature Code Chart

	TEMPERATURE CODES		Division 1 Explosion Proof / Flameproof		Division 2 / Non-Sparking
			Class I Area Classification (Flammable Gases, Vapors or Mists)	Class II Area Classification* (Combustible Dusts)	Class I Area Classification (Flammable Gases, Vapors or Mists)
Temp.	UL/CSA	ATEX	Division 1/Zone 1	Division 1/Zone 21	Division 2/Zone 2
280°C	T2A	T2(280)	Explosion Proof - Class I, Group D (Group C as noted)		
260°C	T2B	T2(260)			Severe Duty & IEEE-841 @ 1.15 S.F., Class I, Groups A,B,C,D (Sine wave power)
215°C	T2D	T2(215)			
200°C	T3	T3			
165°C	T3B	T3(165)	Explosion Proof - Class I, Group D (Group C as noted), Sine wave or PWM power	Explosion Proof - Class II, Groups F & G, Sine wave or PWM power	
160°C	T3C	T3(160)			
135°C	T4	T4			

* Class II, Division 2 motors are not available from LEESON Electric and Lincoln Motors.

Division I & II ambient range is -25°C to +40°C

Variable Speed Operation

Guidelines for Application of General Purpose, Three Phase, Single Speed Motors on Variable Frequency Drives Meets NEMA MG1-2006 Part 30 and Part 31 Section 4.4.2 Unless stated otherwise, motor nameplates do NOT include listed speed range.

ENCLOSURE	EFFICIENCY	VARIABLE TORQUE	CONSTANT TORQUE							
		ALL FRAMES	56	143-215		254-286		324-365		404-449	
NEMA Motors		ALL POLES	ALL POLES	2-Pole	4&6 Pole	2-Pole	4&6 Pole	2-Pole	4&6 Pole	2-Pole	4&6 Pole
ODP	Standard (EPAct exempt)	10:1	2:1	10:1	10:1	2:1	2:1	2:1	2:1	2:1	2:1
	EPAct compliant	10:1	10:1	10:1	10:1	10:1	10:1	10:1	10:1	10:1	10:1
	NEMA Premium	10:1	10:1	10:1	10:1	10:1	10:1	10:1	10:1	10:1	10:1
TEFC	Standard (EPAct exempt)	10:1	2:1	10:1	10:1	10:1	10:1	10:1	10:1	10:1	10:1
	EPAct compliant	10:1	10:1	10:1	10:1	10:1	10:1	10:1	10:1	10:1	10:1
	NEMA Premium	10:1	10:1	10:1	10:1	10:1	10:1	10:1	10:1	10:1	10:1
TENV	EPAct compliant	10:1	10:1	1000:1	1000:1	1000:1	1000:1	1000:1	1000:1	1000:1	1000:1
	NEMA Premium	10:1	1000:1	1000:1	1000:1	1000:1	1000:1	1000:1	1000:1	1000:1	1000:1
Washdown TEFC	Standard (EPAct exempt)	10:1	10:1	10:1	10:1	N/A	N/A	N/A	N/A	N/A	N/A
	Premium & EPAct compliant	10:1	10:1	10:1	10:1	N/A	N/A	N/A	N/A	N/A	N/A
Washdown TENV	Standard (EPAct exempt)	10:1	10:1	10:1	10:1	N/A	N/A	N/A	N/A	N/A	N/A
	Premium & EPAct compliant	10:1	10:1	10:1	10:1	N/A	N/A	N/A	N/A	N/A	N/A
Explosion Proof	All efficiency levels	Explosion Proof motors must be properly nameplated with inverter duty information prior to use on VFD. Motors with automatic overload protectors cannot be used on VFDs.									

IEC Motors		ALL FRAMES	63-90	100-250	Speedmaster® Inverter Duty/Vector Duty Motors & Lincoln CTAC® Motors	ALL FRAMES
All Enclosures	All efficiency levels	10:1	20:1	Up to 20:1		2000:1

Lincoln Rolled Steel	ODP-280-360 Frame	2:1	Constant Torque
280 Frame and Higher	TEFC-280-360 Frame	2:1	Constant Torque
400 Frame and Higher -	Contact Sales Office		
Stock 90VDC and 180 VDC DC Motors		30:1	Rated Torque

Application Notes

Restricted use	DO NOT APPLY THE FOLLOWING MOTORS ON VARIABLE FREQUENCY DRIVES: Single Phase motors, Motors with inherent overload protection, Multi-Speed motors, Motors with 1.0 Service Factor on sine wave power. Fire Pump motors should not be used with variable frequency power supplies, due to the critical nature of these applications.
Hazardous Locations	Consult with LEESON Electric when applying motors and drives into Hazardous Locations, either Division/Zone 1 or Division/Zone 2 areas. UL and CSA policies prohibit the installation of bearing protection devices, such as shaft grounding brushes, rings or insulated bearings on motors in Hazardous Locations.

Maximum Cable Lengths from the Motor to Drive

PRODUCT DESCRIPTION	3 kHz CARRIER FREQUENCY (PHASE TO PHASE)*		
	230 VOLT	460 VOLT	575 VOLT
56-326 NEMA, 100-225 IEC Frames	600 ft.	125 ft.	40 ft.
364-5013 NEMA, 250-315 IEC Frames	1000 ft.	225 ft.	60 ft.
Motors with Corona Resistant Magnet Wire	1500 ft.	475 ft.	140 ft.
Motors with IRIS™ Insulation or Ultimate-e™ Spike Defense ™	Unlimited	Unlimited	650 ft.
Form-wound low voltage motors	Unlimited	Unlimited	650 ft.

* Higher carrier frequencies require shorter cable length to obtain normal (50Khrs) insulation life.

Standard Motor Insulation Systems

IRIS™ INSULATION SYSTEM	ULTIMATE SPIKE DEFENSE™
All LEESON 3-Phase Motors 1HP and above.	Lincoln Motors Premium Efficient
All Premium Efficient WattSAVERe® Motors	Lincoln Inverter Duty
	CTAC® Motors

Variable Speed Operation

VARIABLE SPEED INFORMATION

LEESON Electric and Lincoln Motors Vector-Duty and Inverter Duty motors, unless otherwise stated, are rated for continuous operation in a 40°C ambient and for altitudes up to 3300 feet (1000 meters) above sea level. Special application considerations, such as high or low ambient, intermittent ratings, high altitude, duty cycle rated, extended constant horsepower range, special base speed, voltage or frequency, or any other special requirements, should be reviewed by a factory representative.

It is the responsibility of the startup personnel during commissioning of the VFD/motor system to properly tune the drive to the motor for the specific application. The correct voltage boost and volts/hertz settings are application dependent and unique to each motor design. Procedures for these adjustments should be in your VFD user manual. Many Vector Duty and Inverter Duty motors in this catalog are equipped with thermostats; warranty coverage may be denied if they are not properly utilized.

WARNING ***Power factor correction capacitors should never be installed between the drive and the motor.***

INVERTER DUTY OR INVERTER RATED

"Inverter Duty" (often called "Inverter Rated") motors are suitable for use with Variable Frequency Drives, as long as operation is within the application guidelines published in this catalog. In general, LEESON Electric and Lincoln Motors' three phase, general purpose, NEMA Design B motors are considered "Inverter Duty", and meet or exceed the requirements of NEMA MG1, Part 30. As required under Federal law, these motors comply with EISA2007 efficiencies when operating from utility power.

Inverter Duty (Rated) motors are most often used in 10:1 speed range, variable torque or constant torque applications. A vector control is usually required for operation beyond 10:1 CT.

Refer to "Guidelines for Application of General Purpose, Single Speed Three Phase Motors on Variable Frequency Drives" in this section of this catalog for the allowable speed range and cable length restrictions (from VFD to motor). Additional detail regarding a specific product's capabilities is available on its catalog page, or by consulting your application engineer.

VECTOR DUTY – "Vector Duty" describes a class of motors that are used in conjunction with Open- (without encoder) or Closed-Loop (with encoder) Vector controls, that provide enhanced performance under low speed operating conditions, or in cases where torque (rather than speed) must be controlled. "Vector Duty" motors can be applied to Volts/Hertz (scalar) drives, as well.

LEESON Electric's Speedmaster® motors and Lincoln Motors' CTAC Motors, have been specifically designed for optimal operation on vector or volts/hertz controls. These motors feature a wide constant torque (up to 2000:1) and/or constant horsepower (up to 4:1) speed range and are performance-matched to all current technology IGBT drives. Vector Duty motors meet or exceed the requirements of NEMA MG1, Part 31, and are equipped with an enhanced insulation system (IRIS or Ultimate Spike Defense) to provide many years of trouble-free service. Consult the catalog page for each product's capabilities and features. As these motors are specifically designed for operation through an inverter, they are exempt from EISA2007.

VARIABLE TORQUE LOADS – Applications include fans, blowers and centrifugal pumps. Torque varies as the square of the speed, and horsepower as the cube of the speed. Operation below base speed significantly lightens the load on the motor. While most variable torque applications do not require the motor to operate below half speed, the motor is fully capable of operation to zero speed. Operation above base speed significantly adds to the load on the motor; therefore, a factory representative must review applications requiring variable torque above base speed. Refer to the application chart found on page 14 for use of general purpose three phase motors on variable frequency drives. A bypass circuit is often employed in Variable Torque applications. If this device is intended to be used, selection of a NEMA Design B motor is recommended, to withstand the inrush current during across-the-line starting.

CONSTANT TORQUE LOADS – Applications include conveyors, elevators, hoists, extruders, positive displacement pumps, mixers and converting equipment. Torque remains constant throughout the range of operation, and extra care should be taken in the proper application of motors, especially at very low speeds. Most constant torque applications don't require operation below 10:1 (i.e. 6 Hz operation on a 60 Hz motor), but an increasing number of applications historically reserved for servo and/or stepper systems are being served with motors capable of operation beyond 20:1…even up to 2000:1 (zero speed, constant torque). Refer to the application chart found on page 14 for use of general purpose three phase motors on variable frequency drives.

Applications requiring greater than 20:1 C.T. are ideal for LEESON Speedmaster® Inverter Duty/Vector Duty and Lincoln Vector Duty CTAC® motors. These motors provide full rated torque within their listed speed range, without exceeding a Class F temperature rating while under inverter power (many operate at Class B). Ratings in this catalog have been developed, based on extensive testing on IGBT inverters, set at a minimum 3 KHz (or equivalent) carrier frequency.

Vector Duty and Inverter Duty motors from LEESON Electric and Lincoln Motors are designed for operation at 150% of rated load for one minute, up to the base speed of the motor (overload capability declines to 100% as the motor reaches maximum constant HP speed). These motors accommodate constant horsepower operation to 1-1/2 to 2 times base speed, subject to the motor's maximum safe mechanical speed limit. Refer to the Maximum Safe Mechanical Speed Chart, as well as the performance section for each motor's capability.

Motors rated for zero RPM continuous duty (1000:1 or 2000:1) must be powered by vector drives to produce rated torque without overheating. Optimum zero speed and low-speed full torque performance may require a closed loop vector drive (with encoder feedback).

Continued on next page.

Variable Speed Operation

CONSTANT HORSEPOWER LOADS – Applications include coil winders, band saws, grinders, and turret lathes. Operation requires the motor to deliver the same horsepower rating, regardless of shaft speed. Torque increases at low speed and decreases at higher speed. Most general purpose motors can deliver constant horsepower up to 1 1/2 times base speed (consult a factory representative to verify performance). However, many constant HP applications require operation to twice base speed, and some, such as coil winders, up to 4 times base speed.

MOTOR GROUNDING - Frames and accessories of all motors must be grounded in accordance with the National Electric Code (NEC) Article 430. Refer to NEC Article 250 for general information on grounding. Proper grounding of inverter-driven motors is essential to protect personnel and livestock from inverter-sourced common mode voltages, which may reach hazardous levels on the frame of ungrounded or poorly grounded motors.

LOW INPUT VOLTAGE – If, due to lower utility supply voltage, the input voltage from the VFD to the motor is lower than the motor's rated voltage, de-rating of the motor's base frequency, horsepower, full load RPM, and constant HP RPM is required. The revised values can be calculated by multiplying by the ratio of the voltage change. For example, to operate a 460 volt motor from an inverter fed by 50 or 60 HZ, 400 volt utility power, the multiplier is 400/460 or 0.87.

The VFD can be reprogrammed to match the new base point values, allowing the motor to provide rated torque at rated current from the new base speed down to its original minimum Constant torque speed. The motor's CHP range will begin at the new base frequency and will be shortened by the same ratio as described above.

OVERSPEED CAPABILITY – Maximum safe mechanical speed capability is a function of bearing size and type, lubrication, rotor balancing technique and specifications, air gap, enclosure, frame construction and connection to the driven load. In addition, consideration must be given to ambient noise levels, as operation above base speed will increase motor noise and vibration, and reduce bearing life. Under no circumstances should bearing hub temperature exceed 100° C. Belted loads should not exceed 60 Hz operating RPM by more than 25% (NEMA "TS" shafts are not suitable for belted loads). Due to external cooling fans, TEFC (and Explosion Proof Fan Cooled) motors are limited to 4000 RPM maximum speed.

Maximum Safe Mechanical Speed Limits (ODP, TENV, DPFV OR TEBC ENCLOSURES) 60 Hz base frequency

Frame Size	2-Pole	4, 6 or 8-Pole
56-184	7200	5400
213-256	5400	4200
284-286	5400	3600
324-326	4000	3600
364-365	4000	2800
404-449	3600	2800
5000 Fr	N/A	CALL
6800 Fr	N/A	CALL

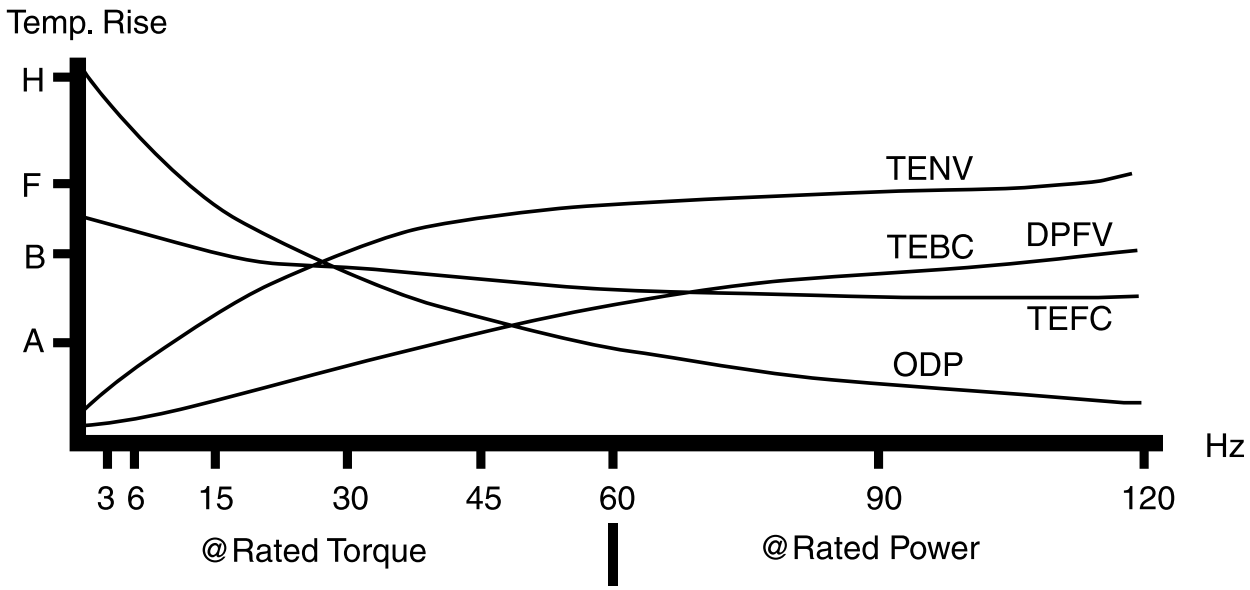
Variable Speed Operation

OTHER APPLICATION CONSIDERATIONS –

For proper selection, the following should be considered:

- Horsepower or torque requirements at various speeds.
- Desired speed range of the load and motor.
- Acceleration and deceleration rate requirements of the process being controlled.
- Starting requirements including the frequency of starting and a description of the load (reflected inertia at the motor, load torque during starting).
- Whether the application is a continuous process or duty cycle of starts, stops and speed changes.
- A general description of the type of application including the environment in which the VFD system components must operate (determines motor enclosure and/or explosion proof classification).
- Description of the available electrical power supply and wiring.
- Special performance requirements, if any.
- Whether the drive will be configured with a by-pass circuit. In case of its deployment, the motor will operate like its fixed speed counterpart and may require a NEMA B design which limits in-rush current, or selection of a larger motor starter or other protective circuitry.
- Load sharing
- Mounting and other mechanical considerations

Typical Temperature Rise Of Various Enclosures



LEESON MOTOR MODEL NUMBER NOMENCLATURE

All LEESON motors, both stock and custom, have a catalog number and a model number. The model number appears on the motor's nameplate and describes pertinent electrical and mechanical features of the motor. An example follows along with a listing of the various letters and positions used.

POSITION 1: U.L. PREFIX

A = Auto protector. U.L. recognized for locked rotor plus run, also recognized construction (U.L. 1004)*.
M = Manual protector. U.L. recognized for locked rotor plus run, also recognized construction (U.L. 1004)*.
L = Locked rotor protector (automatic). U.L. recognized for locked rotor only, also recognized construction (U.L. 1004)*.
C = Component recognition. (U.L. 1004) No protector.
U = Auto protector. U.L. recognized construction (UL1004). Motor/protector combination not UL recognized.
P = Manual protector. U.L. recognized construction (UL1004). Motor/protector combination not UL recognized.
T = Thermostat, not U.L. recognized.
N = No overload protection.

*This applies only to 48, S56, and 56 frame designs through 1 HP, Open & TENV.

POSITION 2: (OPTIONAL)

This position is not always used.
M = Sub-Fractional HP Motors.
Z = BISSC Approved.
Other = Customer Code

POSITION 3: FRAME

4 = 48 Frame
6 = 56 Frame
42 = 42 Frame
143 = 143T Framei
145 = 145T Frame
182 = 182T Frame
184 = 184T Frame
213 = 213T Frame
215 = 215T Frame
254 = 254T Frame
256 = 256T Frame
284 = 284T Frame
286 = 286T Frame
324 = 324T Frame
326 = 326T Frame
364 = 364T Frame
365 = 365T Frame
404 = 404T Frame
405 = 405 T Frame
444 = 444T Frame
447 = 447T Frame
449 = 449T Frame
23 = 23 Frame
30 = 30 Frame
34 = 34 Frame
36 = 36 Frame
38 = 38 Frame
39 = 39 Frame
40 = 40 Frame
43 = 43 Frame
44 = 44 Frame
53 = 53 Frame
65 = 65 Frame

POSITION 4: MOTOR TYPE

C = Cap. Start/Ind. Run
D = Direct Current
K = Cap. Start/Cap. Run
P = Permanent Split
S = Split Phase
T = Three Phase
B = Brushless DC
H = Hysteresis Sync.
R = Reluctance Sync.

Odd frequencies other than 50 Hz show synchronous speed code.

DC and special motors may have one, two, or three digits indicating motor speed rounded to the nearest hundred RPM.

EXAMPLE:

Position No.	1	2	3	4	5	6	7	8	9	10
Sample Model No.	A	B	4	C	17	D	B	1	A	(A-Z)

POSITION 5: RPM

RPM-Single Speed	RPM-Multi-Speed
34 = 3450 RPM 60 Hz 2 Pole	24 = 2 and 4 Poles
28 = 2850 RPM 50 Hz 2 Pole	26 = 2 and 6 Poles
17 = 1725 RPM 60 Hz 4 Pole	82 = 2 and 8 Poles
14 = 1425 RPM 50 Hz 4 Pole	212 = 2 and 12 Poles
11 = 1140 RPM 60 Hz 6 Pole	46 = 4 and 6 Poles
9 = 950 RPM 50 Hz 6 Pole	48 = 4 and 8 Poles
8 = 960 RPM 60 Hz 8 Pole	410 = 4 and 10 Poles
7 = 720 RPM 50 Hz 8 Pole	412 = 4 and 12 Poles
7 = 795 RPM 60 Hz 10 Pole	68 = 6 and 8 Poles
6 = 580 RPM 50 Hz 10 Pole	
6 = 580 RPM 60 Hz 12 Pole	

POSITION 6: ENCLOSURE

D = Drip-Proof
E = Explosion-Proof TENV
F = Fan Cooled
N = TENV
O = Open
S = Splashproof
W = Weatherproof, Severe Duty, Chemical Duty, WASHGUARD - TEFC
X = Explosion-Proof TEFC
V = Weatherproof, Severe Duty, Chemical Duty, WASHGUARD - TENV

POSITION 7: MOUNTING

B = Rigid base standard
C = "C" face - no base - NEMA
D = "D" flange - no base - NEMA
H = 48 frame - 56 frame mounting/shaft rigid
J = 48 frame - 56 frame mounting/shaft resilient
K = Rigid mount with "C" flange
L = Rigid mount with "D" flange
M = Motor parts - rotor and stator
R = Resilient base
S = Shell motor
T = Round body
Z = Special mounting

POSITION 8: SEQUENCE NUMBER

Number assigned as required when new designs with new characteristics are needed.

POSITION 9: MODIFICATION LETTER

Major modification letter. Used when revisions made in existing model ***will*** affect service parts.

POSITION 10: (OPTIONAL)

A date code consisting of either A-Z, and two digits 00-99.

Letter when shown on nameplate indicates model has U.L. primary single phasing recognition. (Applies to 3 phase motors only.)

Code letters indicate manufacturing location:
A = Grafton, WI
B = Black River Falls, WI
C = Saukville, WI
E = Neillsville, WI
G = Lincoln, MO
P = West Plains, MO

LINCOLN INDEX

NOTES & SYMBOLS/HOW TO ORDER

NOTES AND SYMBOLS

A	=	NEMA Design A
AG	=	Conforms to GM-7EH
AH	=	Conforms to GM-7EH and satisfies Chrysler NPEM-100 and Ford EM-1 specifications.
AQ	=	Conforms to GM-7EQ, Chrysler NPEM-100 and Ford EM-1 specifications.
AT	=	Auto rest overload protection
C	=	Meets or exceeds NEMA Design C starting (locked rotor) torque requirements for 1 - 200 HP, 1800 & 1200 RPM.
D	=	Item to be discontinued when present stock is depleted.
E3	=	Class H Insulation
F	=	Meets Ford EM1-1996 specifications
NN	=	No-Nafta
ML	=	Manual reset overload protection
S	=	Stock item
TT	=	Thermostat overload protection

Nameplated for the following operation:

H	=	208 V, 60 Hz @ 1.15 SF
J	=	208 V, 60 Hz @ 1.05 SF
K	=	208 V, 60 Hz @ 1.00 SF
M	=	380-415 V, 50 Hz @ 1.15 SF
N	=	380-415 V, 50 Hz @ 1.00 SF
P	=	208/415 V, 50 Hz @ 1.15 SF
Q	=	208/415 V, 50 Hz @ 1.00 SF
T	=	415 V, 50 Hz @ 1.15 SF
U	=	415 V, 50 Hz @ 1.00 SF
V	=	190-208/380-415, 50 Hz @ 1.15 SF
W	=	190-208/380-415, 50 Hz @ 1.00 SF
X	=	190/380, 50 Hz @ 1.15 SF
Y	=	190/380, 50 Hz @ 1.00 SF
Z	=	200/400, 50 Hz @ 1.15 SF
▼	=	190/380, 50 Hz at next lower HP @ 1.00 SF
◆	=	190/380, 50 Hz at next lower HP @ 1.15 SF
	=	190-208/380-415, 50 Hz at next lower HP @ 1.15 SF
	=	190-208/380-415, 50 Hz at next lower HP @ 1.00 SF

THREE WAYS TO ORDER QUALITY LINCOLN MOTORS

I. Product Number
LM16110

II. Model Number
SF2P50TSC61YB

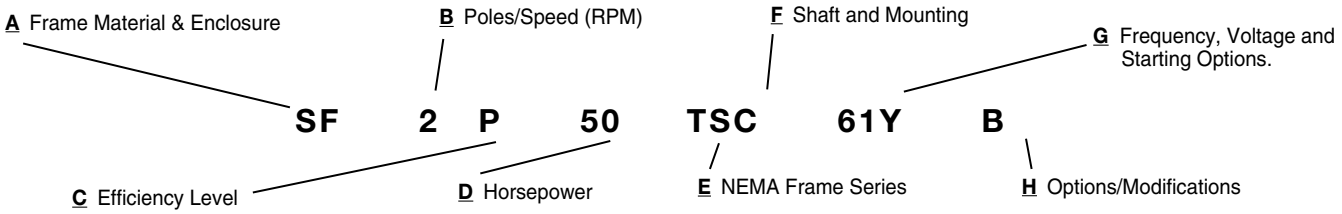
III. Generic Description
50HP 3600RPM 326TS Steel Frame Ultimate E1® (P) TEFC 230/460/3/60 with drive end C-Face and F-2 mount.

I. The **Product Number**, LM16110, is a unique letter and number combination that permanently identifies a motor and its options/modifications. It is assigned by the factory. Any change to a motor already assigned a Product Number dictates a different Product Number.

II. The **Model Number**, SF2P50TSC61YB, is a unique letter/number combination that permanently identifies a motor. Each character in conjunction with its position in the Model Number has significance (see Quick Reference). Options/modifications are addressed by additional letters/numbers inserted in the appropriate slot.

III. The **Generic Description** completely describes the motor by listing HP (50), speed (3600 RPM), frame size (326TS), construction material (steel), efficiency code (P), enclosure (TEFC), voltage (230/460), frequency (60) and options/modifications (C-Face, F-2 mount).

MODEL NUMBER - QUICK REFERENCE



A Frame Material (first letter): A = extruded aluminum; C = cast iron, M = steel with encapsulated windings; R (56-56H) and S (143T-449T) = steel.
Enclosure (second letter): A = TEAO; B = TEBC; C and F = TEFC; D = ODP; E = ODP w/encapsulated windings; EW = Wash-Thru™ motor, J and N = TENV; P = IEEE 841 Severe Duty; S = Severe Duty.

B Poles/Speed (rpm): this leads to motor synchronous speed
60 Hz: 2 = 3600, 4 = 1800, 6 = 1200, 8 = 900.
50 Hz: 2 = 3000, 4 = 1500, 6 = 1000, 8 = 750.

C Efficiency Level: B = exceeds NEMA MG-1 Table 12-10 values; P = meets NEMA MG-1 Table 12-10.

D Horsepower: Fractional thru largest available.
0.25 (1/4 HP) to 800 (800 HP).

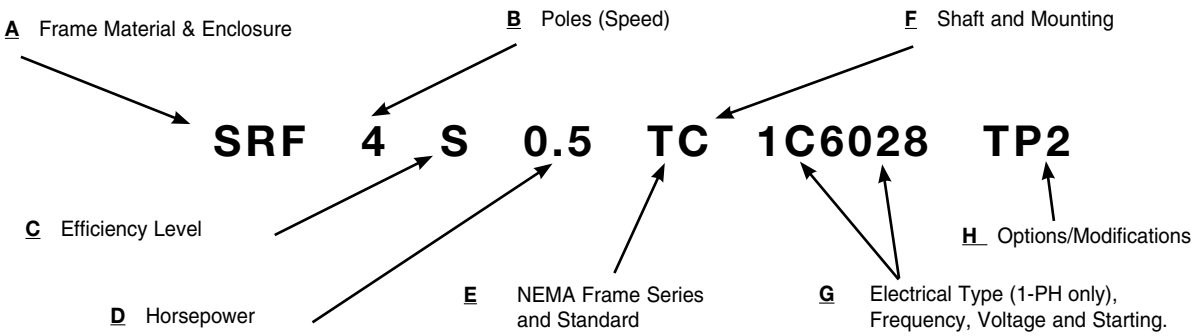
E NEMA Frame Series and Dimensions:
T or U = sets frame number and dimensions in accordance with NEMA design standards.

F Shaft and Mounting: C = C-Face; JM & JP = NEMA Pump bracket and shaft; N = No feet; R = Resilient mount; S = NEMA short shaft.

G Frequency (first digit): 6 = 60 Hz; 5 = 50 Hz.
Voltage (all digits): 61 = 230/460; 62 = 200/400; 64 = 460; 65 = 575; 6024 = 2300/4000; 51 = 220/380; 55 = 380.
Reduced voltage start capability:
P = Part winding start; Y = Y delta start.

H Options/Modifications: Listed in alphabetical sequence.
B = F-2 mount; Q10 = CTAC® w/feedback mount provision; Q15 = CTAC w/1024 ppr encoder; Q20 = CTAC w/o encoder mount; Q40 = Premium efficient CTAC w/o encoder mount; RB = Roller Bearing.

A TYPICAL SINGLE PHASE MOTOR MODEL NUMBER



A Frame Material:

A, AA = Extruded aluminum
AV = Alum 63 frame
AP = Alum 71 frame
AR = Alum 80 frame
C = Cast iron
M = Steel (encapsulated windings, 284T-445T frames)
S = Steel (143T-449T frames)

Signature Series Motors

SP = Steel (48 frames)
SR = Steel (56 frames)
SS = Steel (143T-215T frames)
CC = Cast iron (143T and larger)

Enclosure (follows Frame Material*):

A = TEAO	FW = TEFC, Washdown
B = TEBC	FX = TE, Explosion-proof
D = ODP	NW = TENV, Washdown
E = ODP-Encapsulated	RA = TEAO, Steel
EW = Wash-Thru™ Motor	NX = XP, TENV
F = TEFC	YF = TEFC, Metric
RN = Steel TENV 48 frame	PA = Steel 48 frame
N = TENV	PN = Steel TENV 48 frame
P = Severe Duty IEEE 841	RN = Steel TENV 48 frame
S = Severe Duty	

B Number of Magnetic Poles: this leads to motor synchronous speed (rpm).

Poles	Speed 60 Hz	Speed 50 Hz
2	3600 RPM	3000 RPM
4	1800	1500
6	1200	1000
8	900	750

Single speed motors:
4 = 1800 (60 Hz) or 1500 (50 Hz)

Two speed motors:
2/4/1 = 3600 and 1800 (60 Hz), one winding
4/8/2 = 1800 and 900 (60 Hz), two windings

C Efficiency Level:

B = Motors built after 12/19/10 meet NEMA Premium Table Table 12-12. Motors over 200 HP having a B, exceed Epact levels.
G = Below NEMA MG-1 Table 12-10, GM7EQ
P = Meets EPAct, NEMA MG-1 Table 12-10 and GM-7EH.
S, H = Below NEMA MG-1 Table 12-10

D Horsepower:

Single speed motor examples: 0.25, 0.5, 1.5, 75, 800

Horsepower range example: 5-7 = 5 to 7

Two speed motor example:
10/2.5 = 10 HP high speed, 2.5 HP low speed

E NEMA Frame Series and Dimensions:
T or U = sets frame number and dimensions in accordance with NEMA T or U design standards for the motor's HP, speed and enclosure.
E = Metric design IEC

F Shaft and Mounting:

AD	= Auger drive	R	= Resilient mount
C	= C-Face, B14	S	= NEMA short shaft
D	= D-Flange, B5	Y	= special mounting (ie. extended thru-bolts)
J	= Jet Pump		
JM	= JM Pump Mount	Z	= non-standard shaft dimensions (-1, -2, -3, etc. will appear at the end of the Model Number)
JP	= JP Pump Mount		
L	= Locked bearing		
N	= No feet		

Double shaft motors are identified by two symbols, the first for the "normal drive end" and the second for the "opposite normal drive end": SD4B30TTM61Y and SD4P75TSTS61Y

Each end of the double shaft can have its own mounting: MD4S125TSCTSC61 and CS6P15TTMC61Y

Mounting symbols are listed in alphabetical order when more than one is specified: SSD2S25TJMN61

MODEL NUMBERS DEFINED

G Electrical Type (Single Phase Only):

1A = permanent split capacitor
1B = capacitor start, capacitor run
1C = capacitor start, induction run
1N = split phase start, capacitor run
1S = split phase

Frequency:
6_ = 60 Hz and 5_ = 50 Hz

Voltage:

The specific number has no significance. Lincoln will assign the next number in sequence to a new, previously unmanufactured voltage when it is ordered.

Commonly used voltage codes:

60 Hz	50 Hz
61 = 230/460 V	51 = 220/380 V
62 = 200/400	52 = 240/415
63 = 208	53 = 230/400
64 = 460	54 = 200/400
65 = 575	55 = 380
66 = 230	56 = 400
67 = 440	57 = 415
68 = 380	58 = 440
69 = 480	59 = 220/440
6003 = 220/380	5001 = 190/380
6004 = 220/440	5007 = 346
6011 = 400V 60Hz	5012 = 550
6020 = 2300	5014 = 380-415
6021 = 4000	
6024 = 2300/4000	
6026 = 208-230/460	
6027 = 115/230	
6028 = 115/208-230	
6029 = 208-220/440	

Reduced Voltage Start Capability:

P = Part winding start (PWS)
Y = Wye-delta start (YDS)
PY = PWS and YDS

H Options/Modifications:

If a motor has more than one Option / Modification, the symbols will appear in alphabetical order.

AP1	CE Compliant Motor
AP5	Fire Pump certified
AP7	Farm Duty, High Torque
AP8	Farm Duty, Extra High Torque
AP9	Grain Stirring
AP10	PSC Variable Speed

H Options/Modifications (cont'd):

AP11	PSC Variable Speed, expanded speed range
AP13	UL Listed Class 1 Groups C & D and Class 2 Groups F & G, thermostats
AP14	UL Listed Class 1 Groups C & D and Class 2 Groups F & G, auto reset thermal protector
AP15	UL Listed Class 1 Group D and Class 2 Groups F & G, thermostats
AP21	China sourced
AP23	India sourced
AP25	China sourced
B	F-2 Mount
C_	Ceiling Mount - NEMA position follows "C"; 1-2
E3	Class H Insulation
E5	Class H Insulation & High Temperature Grease
F	Fungus Proofing (Tropicalization)
H4	Leads exit motor at 12 o'clock position
HS	Precision Dynamic Balance
HT1	Space Heater, 120V
HT2	Space Heater, 240 V
K	Omit Terminal Box
L_	Additional Lead Length - "L" followed by additional length in inches
MB3	Insulated bearings, both ends
MB6	Double sealed bearings, both ends
MK_	Brake installed on motor
Q10	CTAC® Inverter Duty Motor with provision for mounting feedback device
Q15	CTAC Inverter Duty Motor with factory installed Dynapar 625 1024 ppr encoder
Q15_	CTAC Inverter Duty Motor with factory installed encoder - letter following "Q15" represents brand and ppr rating of encoder, A through S.
Q20	CTAC Inverter Duty motor without provision for mounting feedback device
Q40	CTAC Inverter Duty Motor without provision for mounting feedback device
QS10	Crop dryer (single phase, auto reset)
QS11	Crop dryer (single phase, thermostats)
QS12	Crop dryer (three phase, thermostats)
RB	Roller bearing on drive end
T1	Thermostats, Class F, 3 in series
T5	Thermostats (2) Class F
TD1,2	RTD - Winding, 100 platinum
TD4	RTD - Winding, 10 copper
TD6	RTD - Winding, 120 nickel
TP1	Overload protection, manual reset
TP2	Overload protection, auto reset
TX1	Thermistors, 3 in series
W_	Wall Mount - W followed by NEMA position number, 1-8
X_	Paint color deviation

MOTOR SELECTION

Electric motors are the workhorses of industry. Many applications exist where more than one motor can be used and/or the exact replacement is not available. LEESON makes every effort to maximize interchangeability, mechanically and electrically, where compromise does not interfere with reliability and safety standards. If you are not certain of a replacement condition, contact any LEESON Authorized Distributor or the LEESON District Sales Office.

SELECTION

Identifying a motor for replacement purposes or specifying a motor for new applications can be done easily if the following information is known:

1. Nameplate Data
2. Motor Type
3. Electrical and Performance Characteristics
4. Mechanical Construction

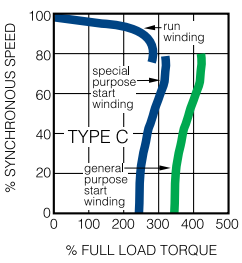
NAMEPLATE DATA

Nameplate data is the most important first step in determining motor replacement. Much of the information needed can generally be obtained from the nameplate of the motor to be replaced. Take time to record all the nameplate information because it can save time, avoid confusion and MISAPPLICATION.

MOTOR TYPE

Alternating current (AC) induction motors are divided into two electrical categories, based on power source—single phase and polyphase (three phase). Direct current (DC) motors are used in applications where precise speed control is required or when battery or generated direct current is the available power source.

TYPICAL SPEED TORQUE CURVES



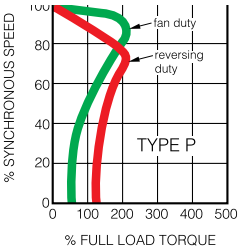
Capacitor Start/Induction Run

A single phase general purpose design, with an electrolytic capacitor in series with the start winding, offering maximum starting torque per ampere.

A centrifugal switch removes the auxiliary winding and capacitor when the motor approaches full load speed. The design is a heavy-duty unit which has approximately 300% (of full load) starting torque. Common applications include compressors, pumps, conveyors and other "hard-to-start" applications.

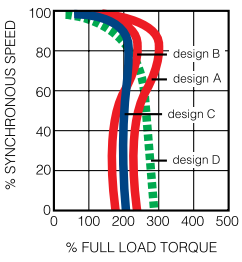
Capacitor Start/Capacitor Run

This design has two capacitors of different values. A centrifugal switch is used to remove the electrolytic capacitor when the motor approaches full load speed. A second run capacitor remains in series with the auxiliary winding during full load operation. This type of design has lower full-load amps as a result of the run capacitor and is consequently used on most higher horsepower single phase motors.



Permanent Split Capacitor (PSC)

This design has an auxiliary winding with a "run" capacitor, but unlike the capacitor start/induction run motor, the capacitor and auxiliary winding remain in the circuit under running conditions. (There is no centrifugal switch on this type motor.) A permanent split capacitor design has low starting torque and low starting current. They are generally used on direct-drive fans and blowers. They can also be designed for higher starting torque and intermittent applications, where rapid reversing is desired.

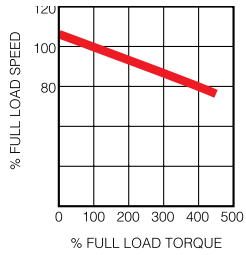


Three Phase or Polyphase

General purpose three phase motors have different electrical design classifications as defined by NEMA. NEMA Design A and B motors are of normal starting torque with normal starting current. NEMA Design C motors have higher starting torque with normal starting current. All three types have slip of less than 5%. ("Slip" being a term which expresses, as a percentage, the difference between synchronous motor speed and full load motor speed, for example, 1800 rpm synchronous versus a full load speed of 1740 rpm.

NEMA's Design B and C standards are minimum performance standards. In practice, some manufacturers (including LEESON) build small integral HP Design B motors with locked rotor and breakdown torque levels equalling NEMA Design C standards.

NEMA T frame motors 1 through 200 HP *covered* by EPACT (identified with a "G" catalog prefix) are labeled Design B, exceed NEMA Design B performance levels, and have efficiencies equal to EPACT mandated levels. EPACT *exempt* three phase, base-mounted motors are labeled Design C and have performance characteristics meeting NEMA's Design C standards, with standard motor efficiencies. Motors 250 HP and larger are exempt from EPACT legislation.



Permanent Magnet DC

This design has linear speed/torque characteristics over the entire speed range. SCR rated motor features include high starting torque for heavy load applications and dynamic braking, variable speed and reversing capabilities. Designs are also available for use on generated low voltage DC power or remote applications requiring battery power.

ELECTRICAL AND PERFORMANCE CHARACTERISTICS

One of the best ways to guarantee economical performance and long motor life is to make sure your motors operate at nameplate voltage. Applying too high a voltage may reduce the motor's efficiency and increase operating temperatures. The net result is shorter motor life.

Under-voltage can also shorten motor life. Operating on too low a voltage reduces the motor's effective horsepower. The motor will attempt to drive the load it was intended to drive, become overloaded, draw more current than normal, and overheat. Again, the result will be premature failure.

ENCLOSURES AND ENVIRONMENT

DRIP-PROOF: Venting in end frame and/or main frame located to prevent drops of liquid from falling into motor within a 15˚ angle from vertical. Designed for use in areas that are reasonably dry, clean, and well ventilated (usually indoors). If installed outdoors, it is recommended that the motor be protected with a cover that does not restrict the flow of air to the motor.

TOTALLY ENCLOSED AIR OVER (TEAO): Dust-tight fan and blower duty motors designed for shaft mounted fans or belt driven fans. The motor must be mounted within the airflow of the fan.

TOTALLY ENCLOSED NON-VENTILATED (TENV): No vent openings, tightly enclosed to prevent the free exchange of air, but not airtight. Has no external cooling fan and relies on convection for cooling. Suitable for use where exposed to dirt or dampness, but not for hazardous (explosive) locations.

TOTALLY ENCLOSED FAN COOLED (TEFC): Same as the TENV except has external fan as an integral part of the motor, to provide cooling by blowing air around the outside frame of the motor.

TOTALLY ENCLOSED, HOSTILE AND SEVERE ENVIRONMENT MOTORS: Designed for use in extremely moist or chemical environments, but not for hazardous locations.

TOTALLY ENCLOSED BLOWER COOLED MOTORS (TEBC): Used to extend the safe speed range of inverter-fed motors. Similar to TEFC except a small, constant-speed fan provides uniform airflow regardless of the drive motor's operating speed.

EXPLOSION-PROOF MOTORS: These motors meet Underwriters Laboratories and Canadian Standards Association standards for use in hazardous (explosive) locations, as indicated by the UL label affixed to the motor. Locations are considered hazardous because the atmosphere does or may contain gas, vapor, or dust in explosive quantities.

NEMA SERVICE FACTORS

HP	ENCLOSURE	RPM 3600	RPM 1800	RPM 1200
1/4-1/3	Open	1.35	1.35	1.35
1/2-3/4	Open	1.25	1.25	1.25
1 & Larger	Open	1.15	1.15	1.15
All	Totally Enclosed	1.00	1.00	1.00

Most LEESON Totally Enclosed Motors have 1.15 Service Factor. Refer to the Service Factor information on each page to identify specific totally enclosed motors with NEMA 1.00 Service Factor or LEESON 1.15 Service Factor. All drip-proof motors have NEMA Service Factors of 1.15 or higher. All three phase totally enclosed motors have NEMA Service Factors of 1.15 except when noted ( ).

SCR PM DC MOTORS ON PWM POWER SUPPLIES

Pulse width modulated DC controls have a voltage output similar to pure direct current which has a form factor of 1.00. SCR thyristor drives, such as the SPEEDMASTER® controls listed on page 117, have a form factor of 1.4.

LEESON stock SCR rated motors can also be used with PWM controls. In fact, the motor's HP rating can be increased because of less heating in the motor. In addition, the motor will operate quieter and the brush life will be extended.

Rated HP 1.40 FF	Rated RPM	Rated Volts	Catalog Number	Rated HP 1.05 FF
1/4	1750	90	**098002**	0.40
	1750	180	**098003**	0.50
1/3	1750	90	**098004**	0.50
	1750	90	**108424**	0.56
	1750	180	**098005**	0.50
1/2	2500	90	**098006**	0.75
	2500	180	**098007**	0.70
	1750	90	**098000**	0.70
	1750	90	**108014**	0.75
	1750	90	**108226**	0.75
	1750	180	**098008**	0.56
	1750	180	**108015**	0.70
	1750	180	**108227**	0.70
3/4	2500	90	**098009**	1.00
	2500	90	**108016**	1.00
	2500	180	**098010**	1.00
	2500	180	**108017**	0.86
	1750	90	**098032**	1.00
	1750	90	**108018**	1.00
	1750	90	**108228**	1.25
	1750	180	**098069**	1.00
	1750	180	**108019**	1.00
	1750	180	**108229**	1.25
1	2500	90	**108020**	1.50
	2500	180	**108021**	1.50
	1750	90	**108022**	1.25
	1750	90	**108230**	1.25
	1750	180	**108023**	1.25
	1750	180	**108231**	1.25
1½	2500	180	**108265**	2.00
	1750	180	**108092**	1.75
	1750	180	**108262**	1.75
	1750	180	**108232**	1.75
	1750	180	**128000**	--
2	2500	180	**108266**	3.00
	1750	180	**128001**	--
	1750	180	**128010**	--
3	2500	180	**128008**	--
	1750	180	**108502**	--

METRIC (IEC) DESIGNATIONS

The International Electrotechnical Commission (IEC) is a European-based organization that publishes and promotes worldwide mechanical and electrical standards for motors, among other things. In simple terms, it can be said that IEC is the international counterpart to the National Electrical Manufacturers Association (NEMA), which publishes the motor standards used in the United States.

IEC standards are expressed in metric units.

IEC ENCLOSURE PROTECTION INDEXES

Like NEMA, IEC has designations indicating the protection provided by a motor's enclosure. However, where NEMA designations are word descriptive, such as Open Drip-Proof or Totally Enclosed Fan Cooled. IEC uses a two-digit Index of Protection (IP) designation. The first digit indicates how well-protected the motor is against the entry of solid objects, the second digit refers to water entry.

By way of general comparison, an IP22 motor relates to Open Drip-Proof, IP54 to totally enclosed.

Protection Against Solid Objects		Protection Against Liquids	
Number	Definition	Number	Definition
0	No protection	0	No protection
1	Protected against solid objects of over 50 mm (e.g. accidental hand contact)	1	Protected against water vertically dripping (condensation)
2	Protected against solid objects of over 12 mm (e.g. finger)	2	Protected against water dripping up to 15° from the vertical
3	Protected against solid objects of over 2.5 mm (e.g. tools, wire)	3	Protected against rain falling at up to 60° from the vertical
4	Protected against solid objects of over 1 mm (e.g. thin wire)	4	Protected against water splashes from all directions
5	Protected against dust	5	Protected against jets of water from all directions
6	Totally protected against dust.	6	Protected against jets of water comparable to heavy seas
		7	Protected against the effects of immersion to depths of between 0.15 and 1m
		8	Protected against the effects of prolonged immersion at depth

IEC DESIGN TYPES

The electrical performance characteristics of IEC Design N motors in general mirror those of NEMA Design B—the most common type of motor for industrial applications. By the same token, the characteristics of IEC Design H are nearly identical to those of NEMA Design C. There is no specific IEC equivalent to NEMA Design D.

MOTOR EFFICIENCY TEST METHODS

Performance data of single phase motors is determined by using I.E.E.E. Std. 114 (Method B), three phase motors by I.E.E.E. Std. 112 (Method B). Motor efficiency is calculated using CSA C390. These testing methods meet the requirements of EPACT of 1992 and most utility companies.

For complete performance data on all LEESON motors, please review the Find-A-Product section on *www.leeson.com*.

Motors Designed For Use In The Automotive Industry

Automotive Duty 56 frame and U Frame motors (pages 233-240) are designed to meet automotive industry specifications from General Motors (GM-7EQ, GM-7EH), Ford (EM1) and Chrysler (NPEM-100). Actual qualifications for individual ratings are indicated in the footnotes on the price pages.

Automotive Duty T Frame motors (pages 233-240) are designed to meet or exceed Ford EM1-1996 specification(see footnotes on the price pages).

UL Recognized Component Listing

Low voltage (< 600 V) motors in frames 48-449T and 182U-445U listed in this catalog (excludes REW, SREW, SEW, SSEW, MD and SE models) carry UL Recognized Component Listing (contact Lincoln for file number).

Web: www.ul.com

NAFTA

A NAFTA (North American Free Trade Agreement) Certificate of Origin can be supplied on request.

Canadian Standards Association (CSA)

Low voltage (< 600 V) motors in frames 48-449T and 182U-445U listed in this catalog have Canadian Standards Association approval (contact Lincoln for file number).

Web: www.csa-international.org

CE (Conformité Européene)

Lincoln offers a variety of CE-compliant motors. Copies of Lincoln's Declaration of Conformity for the Low Voltage Directive and Manufacturer's Declaration for the Machinery Directive are available on request.

Motors for Hazardous Locations

NEMA defines an explosion-proof motor as follows: "a totally-enclosed machine designed and constructed to withstand an explosion of a specified gas or vapor which may occur within it and to prevent ignition of specified gas or vapor surrounding the machine by sparks, flashes or explosions of the specified gas or vapor which may occur within the machine casing".

Typical applications include petroleum and chemical plants or pipelines, gasoline pumps and natural gas compressors.

A **dust-ignition-proof** motor is "a totally enclosed machine whose enclosure is designed and constructed in a manner which will exclude ignitable amounts of dust or amounts which might affect performance or rating, and which will not permit arcs, sparks, or heat otherwise generated or liberated inside of the enclosure to cause ignition of exterior accumulations or atmospheric suspensions of a specific dust on or in the vicinity of the enclosure. Successful operation of this type of machine requires avoidance of overheating from such causes as excessive overloads, stalling, or accumulation of excessive quantities of dust on the machine".

Typical applications include grain elevators, coal handling equipment, feed and cereal mills, sugar refineries and chemical plants. Both types of motors are submitted to Underwriters Laboratories (UL) for approval.

The following is a brief description of the hazardous locations of both gaseous and dusty atmospheres as classified by the National Fire Protection Association's (NFPA) National Electrical Code (NEC) and printed from the 1996 Handbook. Consult the National Electrical Code for more information on explosion proof regulations.

Class 1 Group Classifications:

Class C - Atmospheres containing ethyl ether, ethylene, or gases or vapors of equivalent hazard.

Class D - Atmospheres such as acetone, ammonia, benzene, butane, cyclopropane, ethanol, gasoline, hexane, methanol, methane, natural gas, naphtha, propane,or gases or vapors of equivalent hazard.

Class 2 Group Classifications:

Group F - atmospheres containing carbonaceous dusts, including carbon black, charcoal, coal or coke dusts that have more than 8% total entrapped volatiles, or dusts that have been sensitized by other materials so that they present an explosion hazard.

Group G - atmospheres containing combustible dusts not included in Group E or F, including flour, grain, wood, plastic, and chemicals.

Lincoln Explosion-Proof motors are UL listed in the following NEC locations (indicated by ✔ mark):

Because these motors are suitable for Division 1 locations, they are also suitable for Division 2 locations of the same Class and Group.

BAKING INDUSTRY SANITATION STANDARDS COMMITTEE

WASHGUARD II, stainless steel washdown duty motors, NEMA frames 56, 143T, 145T, 182T and 184T are certified to Standard No. 29 for Electric Motors and Accessory Equipment, authorization number 769. The WBMQ Series of gear reducers are BISSC certified to Standard No. 29 for Electric Motors and Accessory Equipment, authorization number 941.

SAUDI ARABIAN STANDARDS ORGANIZATION

SCCP Ref. No.: R-100157

The CE Mark

CE is an acronym for the French phrase *"Conformite Europeene"* and is similar to the UL or CSA marks of North America. However, unlike UL or CSA which require independent laboratory testing, the CE mark can be applied by the motor manufacturer through "self certifying" that its products are designed to the appropriate standards. The European Union has issued 24 directives related to the **CE** mark. Three Directives apply to electric motors.

Low Voltage Directive (2006/95/EC) This directive applies to electrical equipment operating in the voltage range of 50-1000 volts AC or 75-1500 volts DC. Virtually all LEESON motors (except low voltage DC) are included in this directive.

Based on our testing to the applicable electrical and mechanical standards EN60034 and IEC 34, LEESON certifies conformity to this directive. All three phase 50 Hz stock motors comply with the nameplate designations, lead markings and connection diagrams required. A "Declaration of Conformity" accompanies these motors and a CE label is applied.

Machinery Directive (89/3392/EEC) This directive applies to machinery that may contain certain motors. This is an issue with equipment manufacturers and requires the use of a motor meeting the Low Voltage Directive and requires a "Declaration of Incorporation" document which means that only the motor complies with the requirements of the Low Voltage Directive. A CE label is applied to the motor but it remains the responsibility of the equipment manufacturer to obtain certification for the finished product.

Electromagnetic Compatibility (EMC) Directive (2004/108/EC) This directive addresses the final product and is again a concern for the equipment manufacturer. Since this Directive addresses electromagnetic interference (EMI) concerns, it does not affect three phase AC motors because they do not produce EMI. DC motors, however, do produce EMI. How much of the "noise" is emitted outside the machine depends on a host of factors. LEESON's Engineering Department can assist OEM's in applying DC motors in machinery destined for Europe and requiring certification to the EMC Directive.

CE CONFORMITE EUROPEENE