

Chapter 2

Understanding Electrical Drawings

PART 4 Motor Nameplate and Terminology

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MOTOR NAMEPLATE

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The motor nameplate contains important information about the connection and use of the motor. An important part of making motors interchangeable is ensuring that nameplate information is common among manufacturers.

The diagram shows a motor nameplate with the following fields:

- Manufacturer (black header)
- AC Motor
- Thermally Protected Type
- Style Serial
- Frame Type
- HP Ph Housing
- RPM Service Factor
- Cycles S.F. Amps
- Volts
- Amps Code
- Deg. C Rise Hours

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NEC Required Nameplate Information

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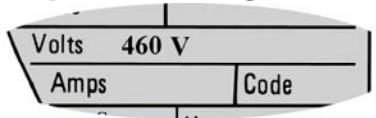


Motor Manufacture - This will include the name and logo of the manufacturer along with catalog numbers, parts numbers, and model numbers used to identify a motor. Each manufacturer uses a unique coding system.

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Voltage Rating - Indicates the voltage at which the motor is designed to operate. The voltage may be a single rating such as 115 V or, for dual-voltage motors, a dual rating such as 115 V/230 V. It is important to distinguish between nominal system and nameplate voltages.

Nominal voltage	Nameplate voltage
120 V	115 V
208 V	200 V
240 V	230 V
480 V	460 V
600 V	575 V
2,400 V	2,300 V
4,160 V	4,000 V
6,900 V	6,600 V



NEMA requires that the motor be able to carry their rated horsepower at nameplate voltage plus or minus 10%.

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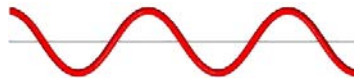
Current Rating - The nameplate current rating of a motor is abbreviated A or AMPS. The nameplate current rating is the full-load current at rated load, rated voltage, and rated frequency. Motors that are not fully loaded draw less than the rated nameplate current.

Volts 115 / 230	
Amps 7.4 / 3.7	
HP 1/2	

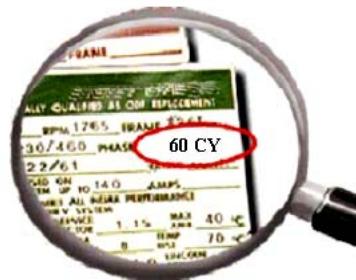
Motors that have dual voltage ratings also have dual current ratings. A dual voltage motor operated at the higher voltage rating will have the lower current rating.

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Line Frequency - The line frequency rating of a motor is abbreviated on the nameplate as CY or CYC (cycle), or Hz (hertz). A cycle is one complete wave of alternating voltage or current. Hertz is the unit of frequency and equals the number of cycles per second. In the U.S. 60 cycles (Hz) is the standard while in other countries 50 Hz (cycles) is more common.

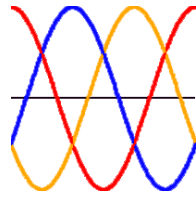


60 CYCLE



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Phase Rating - The phase rating of a motor is abbreviated on the nameplate as PH. The phase rating is listed as direct current (DC), single-phase alternating current (1 ϕ AC) or three-phase alternating current (3 ϕ AC).



3- PHASE



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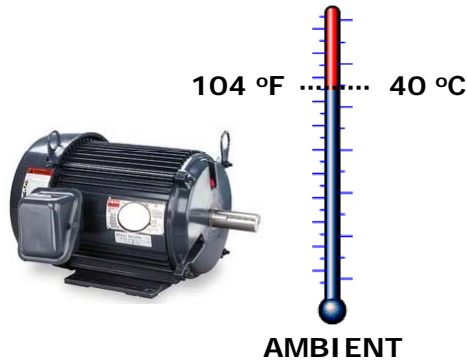
Motor Speed - The rated speed of a motor is indicated on the nameplate in revolutions per minute (RPM). This rated motor speed is not the exact operating speed, but the approximate speed at which a motor rotates when delivering rated horsepower to a load.



The number of poles in the motor and the frequency of the supply voltage determine the speed of an AC motor. The speed of a DC motor is determined by the amount of supply voltage and/or the amount of field current.

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Ambient Temperature - The ambient temperature rating of a motor is abbreviated AMD or DEG on the nameplate of a motor. Ambient temperature is the temperature of the air surrounding the motor. In general, maximum ambient temperature for motors is 40 Degrees C or 104 Degrees F.



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If the ambient temperature is over 104 degrees F, a higher horsepower motor or a special motor designed for operation at higher ambient temperatures must be used.

Temperature Rise - A motor's permissible temperature rise is abbreviated Deg.C/Rise on the nameplate of the motor. This indicates the amount the motor winding temperature will increase above the ambient temperature due to the heat from the current drawn by the motor at full load.



TEMP RISE
70 °C

Measuring Motor Temperature

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Insulation Class - Motor insulation prevents windings from shorting to each other or to the frame of the motor. Type of insulation used in a motor depends on the operating temperature the motor will experience. As the heat in a motor increases beyond the temperature rating of the insulation, the life of the insulation and of the motor is shortened.



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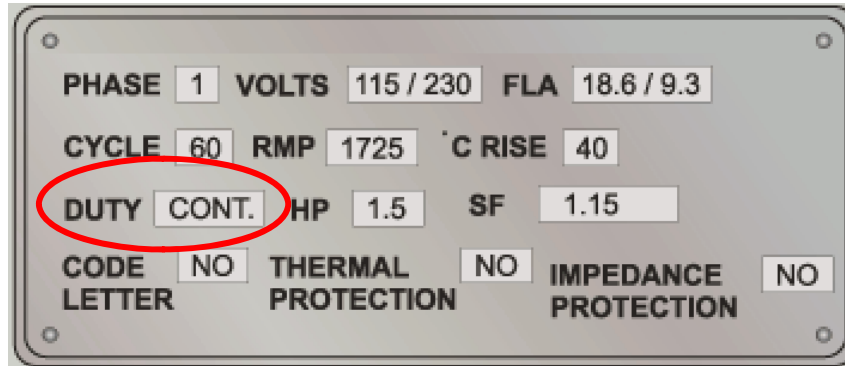
Standard NEMA insulation classes are given by alphabetic classifications according to their maximum temperature rating. Replacement motors must have the same insulation class or a higher temperature rating than the motor it is replacing.



NEMA Classification	Max Operating Temperatures
A	221 °F (105°C)
B	226 °F (130°C)
F	311 °F (155°C)
H	356 °F (180°C)

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Duty Cycle - The duty cycle is listed on the motor nameplate as **DUTY**, **DUTY CYCLE**, or **TIME RATING**. Motors are classified according to the length of time expected to operate under full load as being either: **Continuous Duty (CONT)** or **Intermittent Duty (INTER)**.



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Horsepower Rating - The horsepower rating of the motor is abbreviated on the nameplate, as **HP**. The HP rating is a measure of the full load output power the shaft the motor can produce without reducing its operating life.

A photograph of a motor nameplate with the following specifications:

MODEL	HP 10	KW 7.5	VOLTS	230			
RPM	3450	HZ	60	AMP	28.4	PH	3
S.F.	1.15	KVA CODE	H	S.F. MAX.	AMP	32.2	
MIN. FLOW	FT. / SEC. 0.5	30°C. MAX. AMB					
CONTINUOUS DUTY							

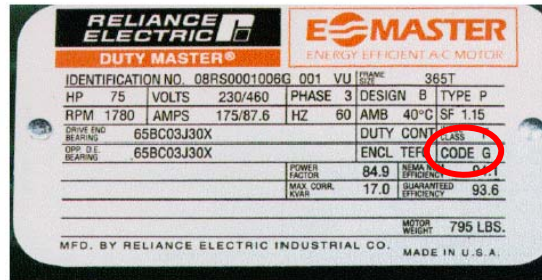
The 'HP 10' and 'KW 7.5' fields are circled in red.

Some small fractional-horsepower motors are rated in watts (1 HP = 746 W). Motors rated by the IEC are rated in kilowatts (kW).

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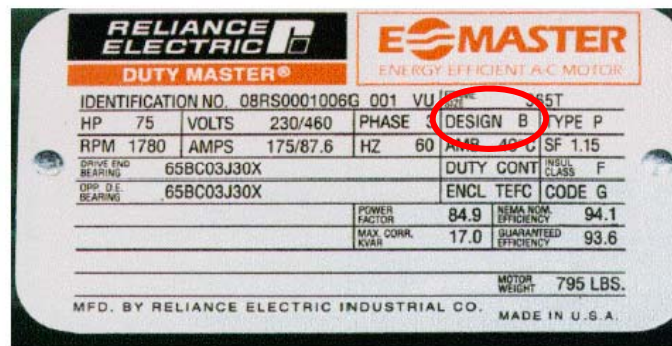
Code Letter - Designates the locked rotor rating of the motor in kilovolt-amperes per nameplate horsepower. Code letters from A to V are listed in Article 430 of the NEC. As an example, an "G" rating allows for 5.6 to 6.29 kVA per horsepower.

Code	kVA/hp	Code	kVA/hp
A	0-3.14	L	9.0-9.99
B	3.15-3.54	M	10.0-11.19
C	3.55-3.99	N	11.2-12.49
D	4.0-4.49	P	12.5-13.99
E	4.5-4.99	R	14.0-15.99
F	5.0-5.59	S	16.0-17.99
G	5.6-6.29	T	18.0-19.99
H	6.3-7.09	U	20.0-22.39
J	7.1-7.99	V	22.4 & Up
K	8.0-8.99		



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Design Letter - The design letter is an indication of the shape of the motor's torque speed curve. The most common design letters are A, B, C, D, and E. Design B is the standard industrial duty motor, which has reasonable starting torque with moderate starting current.

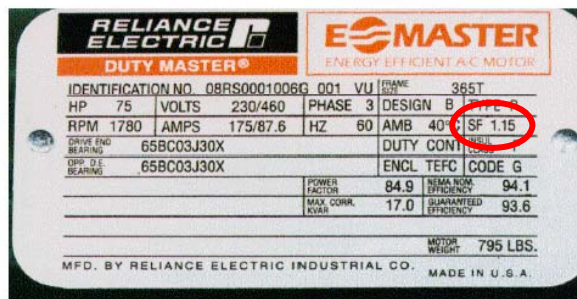


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Optional Nameplate Information

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Service Factor - Service factor (abbreviated SF on the nameplate) is a multiplier that is applied to the motor's normal horsepower rating to indicate an increase in power output (or overload capacity) that the motor is capable of providing under certain conditions. For example, a 10 HP motor with a service factor of 1.25 safely develops 125% of rated power or 12.5 HP.



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Motor Enclosure - The two general classifications of motor enclosures are *open* and *totally enclosed*. An open motor has ventilating openings, which permit passage of external air over and around the motor windings. A totally enclosed motor is constructed to prevent the free exchange of air between the inside and outside of the frame, but not sufficiently enclosed to be termed airtight.



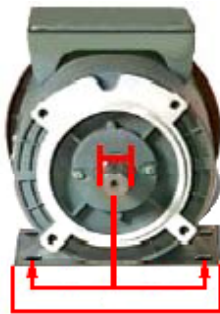
OPEN



TOTALLY ENCLOSED

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Frame Size - Refers to a set of physical dimensions of motors as established by NEMA and IEC. Frame sizes include physical size, construction, dimensions, and certain other physical characteristics of a motor.



Dimensionally, NEMA standards are expressed in English units and IEC standards are expressed in metric units. NEMA and IEC standards both use letter codes to indicate specific mechanical dimensions, plus number codes for general frame size.

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Efficiency - Is a measure of the effectiveness with which the motor converts electrical energy into mechanical energy. Most motors operate near their maximum efficiency at rated load.



Energy-efficient motors are 2 to 8% more efficient than standard motors. Motors qualify as "energy-efficient" if they meet or exceed the efficiency levels listed in the NEMA's MG1 publication.

Energy-efficient motors owe their higher performance to key design improvements and more accurate manufacturing tolerances.

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Power Factor - The PF rating of a motor represents the motor's power factor at rated load and voltage. Motors are inductive loads and have power factors usually between 0.5 and 0.95. A motor with a low power factor will draw more current for the same horsepower than a motor with a high power factor.

MODEL		SPLIT PHASE		TOTALLY ENCLOSED		
FRAME		TYPE	INS. CLASS	IDENTIFICATION NO.		
145		KC	J			
HP	RPM	VOLTS		AMPS	CYC	S F
1 1/2	1725	115/230		15 / 7.5	60	1.25
DESIGN CODE: B				PHASE 1	EFF 62 %	PF 75 %
				DUTY: CONTINUOUS		
AMB 40 C						

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Thermal Protection - Thermal protection indicates that the motor has its own built in thermal protection device.

Automatic reset
inside motor



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The primary types of thermal overload protectors include *automatic* and *manual* reset devices that sense either current or temperature. With automatic reset devices, after the motor cools, this electrical circuit-interrupting device automatically restores power to the motor.

With manual reset devices, the electrical circuit-interrupting device has an external button located on the motor enclosure that must be manually pressed to restore power to the motor.



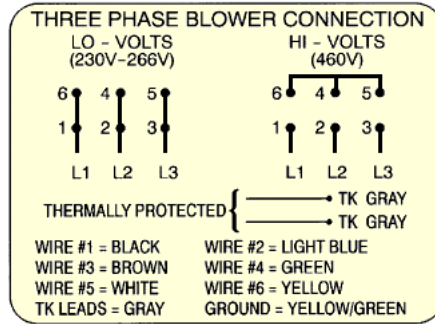
External
manual
reset
button



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Manual reset protection should be provided where automatic restart of the motor after it cools down could cause personal injury should the motor start unexpectedly.

Connection Diagrams - Connection diagrams are found on the nameplate of some motors. The diagram will indicate the specific connections for dual voltage rated motors. Some motors can operate in either direction depending on how the connections to the motor are made and this information may also be given on the nameplate.

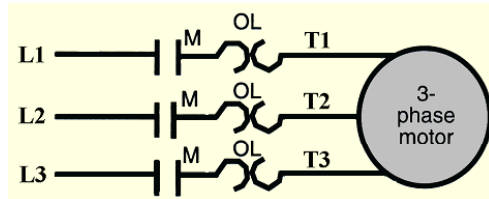


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Guide To Motor Terminology

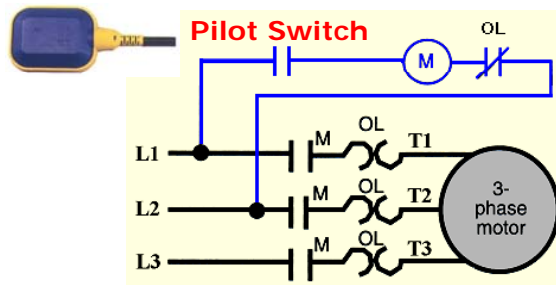
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Across-The-Line - A method of motor starting. Connects the motor directly to the supply line on starting or running. (Also called full voltage starting)



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Automatic Starter - A self-acting starter. Completely controlled by the master or pilot switches or some other sensing device.

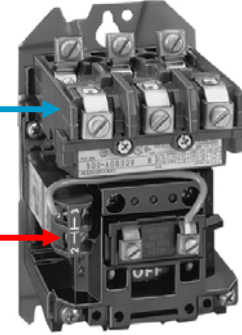


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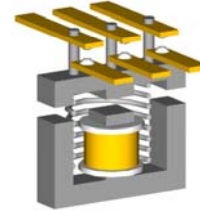
Auxiliary Contact - Contact of a switching device in addition to the main circuit contacts. Operated by the main contacts.

Main contacts

Auxiliary contact



Contactor - A type of relay used for power switching.



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Jog - Momentary operation. Small movement of a driven machine.



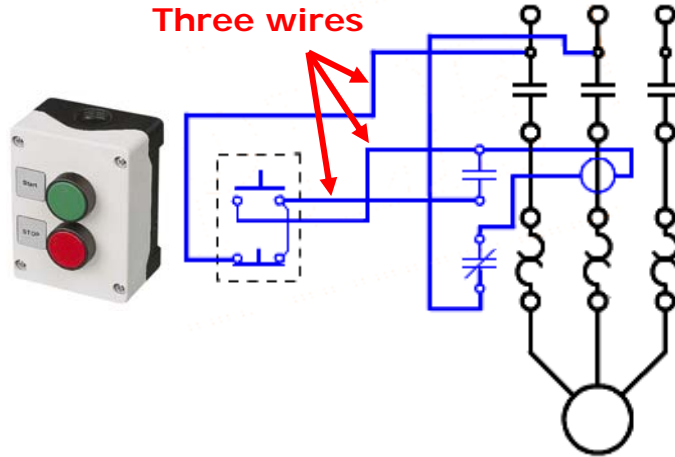
In the Jog mode, the motor will run as long as the Jog pushbutton is held pressed down.

Locked-Rotor Current - Measured current with the rotor locked and with rated voltage and frequency applied to the motor.



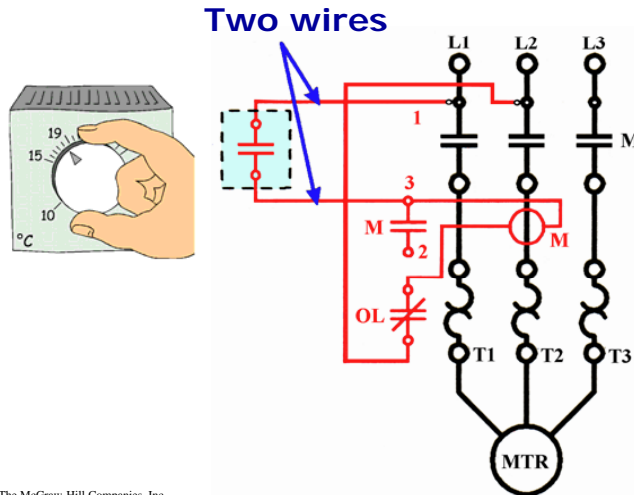
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Low Voltage Protection (LVP) - Magnetic control only; nonautomatic restarting. A three-wire control. A power failure disconnects service; when power is restored, manual restarting is required.



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Low Voltage Release (LVR) - Magnetic control only; automatic restarting. A two-wire control. A power failure disconnects service; when power is restored, the controller automatically restarts.



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Magnetic Contactor - A contactor that is operated electromechanically.



Multispeed Starter - An electric controller with two or more speeds and full or reduced voltage starting.

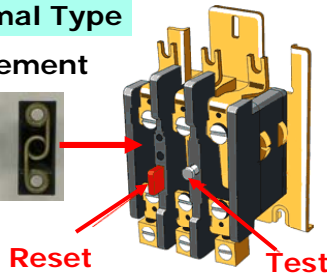


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Overload Relay - Running overcurrent protection. Operates on excessive current. It does not necessarily provide protection against a short circuit. It causes and maintains interruption of the device from a power supply.

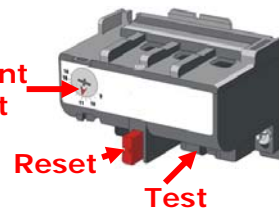
Thermal Type

Heater element



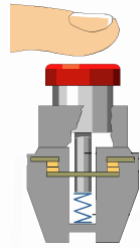
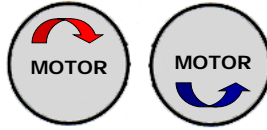
Electronic Type

Current adjust



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Plugging - Braking by reverse rotation. The motor develops retarding force.



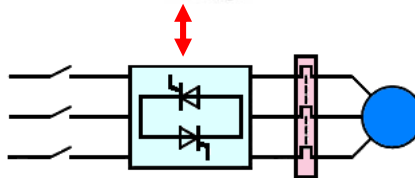
Pushbutton - A master switch that is a manually operable plunger or button for actuating a device, assembled into pushbutton stations.



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Reduced Voltage Starter - Applies a reduced supply voltage to the motor during starting.

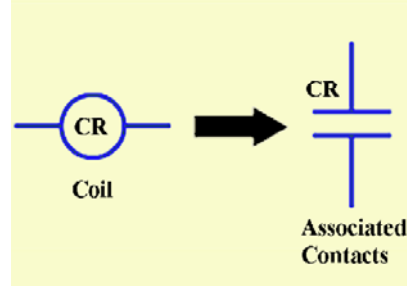
Reduced voltage soft starter



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Relay - Used in control circuits and operated by a change in one electrical circuit to control a device in the same circuit or another circuit. Ampere rated.

Electromechanical type



Solid state type



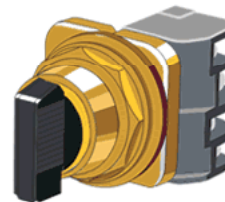
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Remote Control - Controls the function initiation or change of electrical device from some remote point.



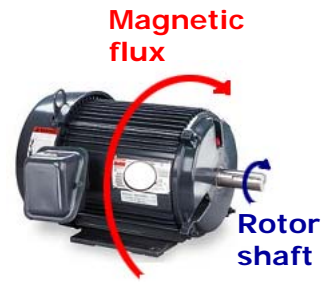
Remote control sensor

Selector Switch - A manually operated switch that has the same construction as pushbuttons, except that rotating a handle actuates the contacts.

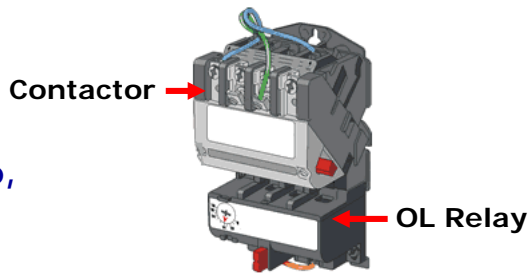


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Slip - The difference in speed between the rotation of the magnetic flux in the stator and the rotation of the rotor shaft. The slip increases (and the motor speed decreases) as the load on the motor increases.



Starter - An electric controller used to start, stop, and protect a connected motor.

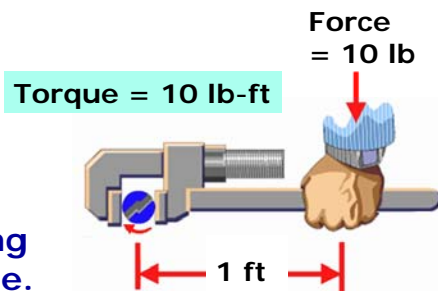


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Timer - A pilot device, also considered a timing relay that provides an adjustable time period to perform its function. It can be motor driven, solenoid actuated, or electronic operated.



Torque - The turning twisting force. There are two types of torque that are considered when looking at motors: starting torque and running torque.



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