Electric Motor & Machines Terminology

Accelerating Time: The time required for a motor to reach full speed from standstill (zero speed) position.

AC Contactor: An alternating current (ac) contactor is designed for the specific purpose of establishing or interrupting an AC power circuit.

Accelerating Torque: The torque developed from standstill (zero speed) to full speed at nameplate voltage. Sometimes the term "Net Accelerating Torque" is used to mean the excess motor torque capability over the torque for the attached load.

Adjustable Speed: The concept of varying the speed of applications.

Adjustable Speed Drive: A unit comprised of a motor, drive controller and operator's controls (either manual or automatic). Is also used to refer to the inverter which is a device used to convert standard sine wave power form into a simulated form for varying speed ranges on the driven equipment.

Adjustable Speed Motor: A motor that can be varied in speed over a range, but a motor that is essentially constant speed at any one set speed within that range.

Aerator Motors: A specific duty motor used pump air into a sludge type environment. The large air/liquid interface area provides excellent gas transfer and enables the sludge to be broken down and recycled into the environment.

Air Filter: Filter made from polyurethane (vertical), zinc or stainless steel (horizontal) medium to trap air-borne particles which may clog the operations of a weather protected II (WPII) motor.

Air Gap: The space between the rotating and stationary member in an electric motor.

Air Pressure Differential Switch: For use with air filters on weather protected II (WPII) enclosed motors. This switch will send alarm when a concentration of particles causes a pressure drop in the air flowing through the filter and into the motor. This feature allows the air filter to be used until its maximum capacity is reached.

ALLGUARD® Protection: Similar to CORRO-DUTY® treatment on motors, ALLGUARD protects the gearbox from corrosive atmospheres.

Alternating Current: The commonly available electric power supplied by an AC generator and distributed in one, two, and three phase form.

Altitude: The height of the motor in reference to sea level. Standard altitude is 3300 feet, or 1000 meters. Sometimes written as 3300 FASL (feet above sea level).

Ambient Temperature (Amb.): Ambient Temperature is the temperature of the medium, such as air, water or earth, into which the heat of the equipment is dissipated.

For self-ventilated equipment, the ambient temperature is the average temperature of the air in the immediate neighborhood of the equipment.

For air or gas cooled equipment with forced ventilation, or secondary water cooling, the ambient temperature is taken as that of the incoming air or cooling gas.

For self-ventilated enclosed (including oil immersed) equipment, considered as a complete unit, the ambient temperature is the average temperature of the air outside of the enclosure in the immediate neighborhood of the equipment.

Most motors are designed to operate in an ambient not over 40°C (104°F).

Note: A rating of 40°C Ambient is not the same as a rating of 40°C Rise; see Temperature Rise.

Ampere: The rate of flow of charge in a conductor of one coulomb per second.

Ampere Turn: The magnetomotive force produced by a current of one ampere in a coil of one turn.

Angular Contact Bearing: A specialized thrust bearing used on high-thrust vertical motors. The special angular design reduces friction and wear while supporting the rotating parts.

Angular Velocity: Angular displacement per unit time, measured in degrees/time or radians/time.

Anti-Friction Bearings: A bearing using balls or rollers as the supporting device between hardened races.

Antihunt: Antihunt is the means of reducing or suppressing the oscillation of a system.

Antiplug Protection: The effect of a control function, or a device that operates to prevent application of counter torque, by the motor until the motor speed has been reduced to an acceptable value.

Arctic Duty: Specific duty motors designed to withstand severely cold temperatures and environments. These motors will withstand ambient temperatures to -70° F.

Armature: The laminated iron core with wire wound around it in which electromotive force is produced by magnetic induction in a motor or generator: usually the rotor of a DC motor or the stator of an AC motor.

Armature Control: Abbreviated term for armature voltage control of a DC motor, which describes the usual method of changing the speed of a DC motor by controlling the magnitude of applied armature voltage.

Armature Current: Armature current is the DC current required by a DC motor to product torque and drive a load. The maximum safe, continuous current is stamped on the motor nameplate. This can only be exceeded for initial acceleration, and for short periods of time. Armature current is proportional to the amount of torque being produced, therefore it rises and falls as the torque demand rises and falls.

Armature Reaction: The current that flows in the armature winding of a D.C. motor tends to produce magnetic flux in addition to that produced by the field current. This effect, which reduces the torque capacity, is called armature reaction and can effect the commutation and the magnitude of the motor’s generated voltage.

Armature Voltage Feedback: Armature voltage can be used as the speed feedback signal to an electronic speed regulator. This voltage is almost directly proportional to motor speed, assuming a constant motor field and ignoring IR drop. Armature voltage feedback is used where the expense of a tachometer generator for speed feedback is not justified and a regulation accuracy of 2-5% is adequate.

Asynchronous Motor: Also called non-synchronous motor, is an AC motor which does not run at synchronous speed. The ordinary induction motor is an asynchronous motor - single or polyphase.

Automotive Duty: Specific duty motors designed to meet the needs of the auto industry which include all cast iron construction, special ambient and temperature rise, and special drains and breathers. (See reference manual for actual automotive duty motor specification.)

Auxiliary Contacts: Auxiliary contacts of a switching device are contacts in addition to the main circuit contacts and operate with the movement of the latter.

Axial Centering Force: The magnetic force on the rotor resulting from its axial displacement from magnetic center.

Axis: A principal direction along which movement of the tool or workpiece occurs. The term "axis" also refers to one of the reference lines of a coordinate system.

Bandwidth: Generally, this is the frequency range of a system input over which the system will respond satisfactorily to a command.

Base Speed: Base speed is the manufacturer's nameplate rating where the motor will develop rated HP at rated load and voltage. With DC drives, it is commonly the point where full armature voltage is applied with full rated field excitation. With AC systems, it is commonly the point where 60 Hz is applied to the induction motor.

Bases - Slide Rails: A two piece mounting system for motors which enable the motor to be mounted and leveled to the needed heights.

Bases - Sole Plates: A one piece mounting system for motors which enable the motor to be raised and lowered to the required height.

Bearing, (Ball): A "ball" shaped component that is used to reduce friction and wear while supporting rotating elements. For a motor, this type of bearing provides a relatively rigid support for the output shaft.

Used where higher load capacity is required or ball bearing is preference. Common means used to keep out dirt:

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

Seals – Similar to shields, except have rubber lips that press against inner race, more effectively excluding dirt, etc.

Bearing, (Roller): A special bearing system with cylindrical rollers capable of handling belted load applications that are too large for standard ball bearings.

Bearing, Sleeve (Slv.): A bearing that is made of a sleeve bushing, not a ball or roller bearing. In fractional hp motors, sleeve bearings are used on motors with low to moderate radial and axial loads.

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

Bearing Life: The expected endurance of motor bearings under specified load conditions. Bearing life is normally stated in terms of hours or years. Commonly referred to in motor specifications as B10 life or L10 life; both are used interchangeably.

Bipolar Transistor: Ordinary NPN or PNP transistor with emitter, base and collector are called bipolar since they operate through the collector are called bipolar since they operate through the flow of both holes and elections. Unipolar devices, such as FET transistors, operate through the flow of minority carries only, i.e. election flow.

Braking: Braking provides a means of stopping an AC or DC motor and can be accomplished in several ways:

1. **Dynamic Braking (DC Drives)** - Slows the motor by applying a resistive load across the armature leads after disconnection from the DC supply. This must be done while the motor field is energized. The motor then acts as a generator until the energy of the rotating armature is dissipated. This is not a holding brake.

   Dynamic Braking (AC Drives) - Since AC motors do not have separate field excitation, dynamic braking is accomplished by continuing to excite the motor from the drive. This causes a regenerative current to the drive's DC intermediate bus circuit. The dynamic brake resistors are then placed across the DC bus to dissipate the power returned. The brake resistor is usually switched by a transistor or other power switch controlled by the drive.

2. **Regenerative Braking** - This is similar to dynamic braking, but it is accomplished electronically. The generated power is returned to the line through the power converter. It may also be just dissipated as losses in the converter (within its limitations).

3. **Motor Mounted or Separately Mounted Brake** - This is a positive action, mechanical, friction device. Normal configuration is such that when the power is removed, the brake is set. This can be used as a holding brake. (Note: A separately mounted brake is one which is located on some part of the mechanical drive train other than the motor..)

   Braking Torque: The torque required to bring a motor down from running speed to a standstill. The term is also used to describe the torque developed by a motor during dynamic braking conditions.

   Breakaway Torque: The torque required to start a machine from standstill.

   Breakdown Torque: The maximum torque which a motor will develop with rated voltage applied at rated frequency, without an abrupt drop in speed.

   Bridge Rectifier: A full wave rectifier that conducts current in only one direction of the input current. AC applied to the input results in approximate DC at the output.

Bridge Rectifier (Diode, SCR): A diode bridge rectifier is a non-controlled full wave rectifier that produces a constant, rectifier DC voltage. An SCR bridge rectifier is a full wave rectifier with an output that can be controlled by switching on the gate control element.

Brush: A brush is a conductor, usually composed of some element of carbon, serving to maintain an electrical connection between stationary and moving parts of a machine (commutator of a DC motor). The brush is mounted in a springloaded holder and positioned tangent to the commutator segments against which it "brushes." Pairs of brushes are equally spaced around the circumference of the commutator.

Buss Connections: An option on titan conduit boxes. Used to add up to three standoff insulators.

C-Face (Motor Mounting): This type of motor mounting is used to close couple pumps and similar applications where the mounting holes in the face are threaded to receive bolts from the pump. Normally, the C-Face is used where a pump or similar item is to be overhung on the motor. This type of mounting is a NEMA standard design and available with or without feet.

C-Flange: A type of mounting used to connect motors/gearmotors to driven equipment with dimensions defined by NEMA. This type of mounting is used to close couple pumps and similar applications where the mounting holes in the face are threaded to receive bolts from the driven equipment.

Capacitance: The value in microfarads of a capacitor or condenser.

Capacitor: A device which, when connected in an alternating current circuit, causes the current to lead the voltage in time phase. The peak of the current wave is reached ahead of the voltage wave. This is the result of the successive storage and discharge of electric energy.

Two kinds of capacitors are normally used in AC induction motors. A start capacitor is connected in series with the auxiliary circuit. It can only stay energized for a short period of time. Therefore it is only energized when the motor is started and it is removed from the circuit after the motor reaches operating speed. The run capacitor can stay energized continuously. Therefore, it stays in the circuit even after the motor reaches operation speed and used in PSC and the running circuit of capacitor-start capacitor-run motors.

Capacitor value and voltage rating are essential to the proper motor operation. Always use the correct capacitor as specified by the motor manufacturer to insure maximum performance and life and safe operation of the motor.

Cascade Drive System: Two or more drives connected to a master speed setting potentiometer. The master speed setting potentiometer sets the speed of the master drive. Each of the slave drives has a potentiometer of trimming the speed reference from the master speed setting potentiometer.

CEMF: Abbreviation for counter electromotive force, which is the product of a motor armature rotating in a magnetic field. This generating action takes place whenever a motor is rotating. Under stable motoring conditions the generated voltage (CEMF) is equal to the voltage supplied to the motor minus small losses. However, the polarity of the CEMF is opposite to that of the power being supplied to the armature.

Center Distance: The measured distance from the center of a pinion to the center of its mating gear.

Centrifugal Cutout Switch: A centrifugally operated automatic mechanism used in conjunction with single phase induction motors. Centrifugal cutout switch will open or disconnect the starting winding when the rotor has reached a predetermined speed, and re-connect it when the motor speed falls below it. Without such a device, the starting winding would be susceptible to rapid overheating and subsequent burnout.

Closed Loop: Closed loop refers to a regulator circuit in which the actual value of the controlled variable (e.g., speed) is sensed and a signal proportional to this value (feedback signal) is compared with a signal proportional to the desired value (reference signal). The difference between these signals (error signal) causes the actual value to change in the direction that will reduce the difference in signals to zero.

Code Letter: A code letter is a letter which appears on the nameplate of alternating-current motors to show their locked-rotor KVA per horsepower.

Cogging: A term used to describe non-uniform angular velocity. It refers to rotation occurring in jerks or increments rather than smooth motion. When an armature coil enters the magnetic field produced by the field coils, it tends to speed up and slow down when leaving it. This effect becomes apparent at low speeds. The fewer the number of coils, the more noticeable it can be.

Commutation (DC Motors): Reversing the current in an armature coil when the coil (ends) move from one side of the brush to the other side of the same brush. This completes the connection between the armature winding and the external circuit.

Commutation (Inverter): The process by which forward current is interrupted or transferred from one switching device to the other. In most circuits where power is supplied from an AC source, turn-on control is adequate and turn-off occurs naturally when the AC cycle causes the polarity across a given device to reverse.

Commutator: A cylindrical device mounted on the armature shaft and consisting of a number of wedge-shaped copper segments arranged around the shaft (insulated from it and each other). The motor brushes ride on the periphery of the commutator and electrically connect and switch the armature coils to the power source.

Comparator: A device that compares one signal to another, usually the process signal compared to the set point or command signal.

Computerized Numerical Control (CNC): A numerical control system where a computer is used to perform some or all of the basic numerical control functions on a machine tool.

Conduit Box: Metal box on motor where motor leads terminate.

Constant Horsepower: A multi-speed wound motor where all the windings are of the same horsepower.

Constant Horsepower Range: In VFD applications, a range of motor operation where the motor speed is controlled by field weakening. In this range, motor torque decreases as speed increases. Since horsepower is speed times torque (divided by a constant), the value of horsepower developed by the motor in this range is constant.

Constant Torque: A multi-speed motor wound so that the horsepower varies directly as the speed.

Constant Torque Range: In VFD applications, a speed range in which the motor is capable of delivering a constant torque, subject to cooling limitations of the motor.

Constant Voltage Range (AC Drives): The range of motor operation where the drive's output voltage is held constant as output frequency is varied. This speed range produces motor performance similar to a DC drive's constant horsepower range.

Constant Volts Per Hertz (V/HZ): This relationship exists in AC drives where the output voltage is varied directly proportional to frequency. This type of operation is required to allow the motor to produce constant rated torque as speed is varied.

Control Circuit: The control circuit of a control apparatus or system is the circuit which carries the electric signals directing the performance of the controller, but does not carry the main circuit power.

Control Device: A control device is an individual device used to control functions.

Control Transformer: A control transformer is a voltage transformer utilized to supply voltage suitable for the operation of control devices.

Counter Electromotive Force: (CEMF) The induced voltage in motor armature, caused by conductors moving through or "cutting" field magnetic flux. This induced voltage opposes the armature current and tends to reduce it.

Conductor: Any material which tends to make the flow of electric current relatively easy (copper, aluminum, etc.).

Contactor: A two-state (On-Off) device for repeatedly establishing an interrupting an electric power circuit. Interruption is obtained by introducing a gap or a very large impedance.

Contactor Reversing: A method of reversing motor rotation by the use of two separate contactors, one of which produces rotation in one direction and the other produces rotation in the opposite direction. The contactors are electrically (and mechanically) interlocked so that both cannot be energized at the same time.

Continuous Duty: A motor that can continue to operate within the insulation temperature limits after it has reached normal operating temperature.

Continuous Rating: The maximum constant load that can be carried continuously without exceeding established temperature rise limitations under prescribed conditions of load and within the limitations of established standards.

Control Transformer: A control transformer is a voltage transformer utilized to supply voltage suitable for the operation of control devices.

Converter: The process of changing AC to DC and back to AC again. This is accomplished through the use of a diode rectifier or thyristor rectifier circuit. The term "converter" may also refer to the process such that is found in an adjustable frequency drive, consists of a rectifier, a DC intermediate circuit, an inverter and a control unit.

Copper Bar Rotor: Specialized rotor construction used on high inertia applications that require high slip or torques. Centrifugal cast end rings are fully brazed to each rotor bar. Rotor bars are swagged preventing inslot movement and tight bar constructions. Heavy finger plates tightly hold the rotor cove together controlling internal stress and maintaining dimension stability under all loads.

CORRO-DUTY ®: U.S. MOTORS® brand motor product created for withstanding corrosive environments.

Coupling: A means for which the driven load is connected to the driver (motor). Couplings are divided into 2 halves with one placed on the motor shaft and the other on the driven equipment. The 2 halves are then bolted together.

Coupling Angle: The mechanical degree relationship between the rotor and the rotating electrical field in a motor. While present in both synchronous and non-synchronous A.C. motors, it is usually of concern in synchronous applications. At no load, the rotor poles line up exactly with the field poles and the coupling angle is considered to be zero. When a load is applied, the lines of force coupling the rotor with the stator field are stretched, causing the rotor to fall behind the field. The mechanical angle by which the rotor lags behind the field is called the coupling angle. The coupling angle will continue to increase with load until it reaches the "pull-out" point. The maximum angle which is possible prior to pull-out is dependent on motor type and rotor design.

Critical Speed: All rotating masses have a so-called critical speed (RPM) where abnormal vibrations occur. Induction motors (rotors), generally run well above this speed, but occasionally in redesigning -- the critical speed may occur at or near the operating speed -- and intolerable situation.

Crusher Duty: Specific-duty motor design including special rotor, larger shaft (if needed), increased locked rotor and breakdown torques, end turn bracing and lock washers, and minimized stress riser.

Current Limit: An electronic method of limiting the maximum current available to the motor. This is adjustable so that the motor's maximum current can be controlled. It can also be preset as a protective device to protect both the motor and controller from extended overloads.

Current Limit Acceleration: A system of control in which acceleration is so governed that the motor current does not exceed an adjustable maximum value.

Current Limiting Fuse: A fuse that, when it is melted by a current within its specified current limiting range, abruptly introduces a high impedance to reduce the current magnitude and duration.

Current Relay: A current relay functions at a predetermined value of current. It may be an overcurrent relay, an undercurrent relay or a combination of both.

Current Transformers: Option available on titan motors to maintain the same magnitude of current flowing in and out of each phase of the motor winding. A breakdown in the insulation system alters this balance resulting in measurable "difference" when the current flowing in and out of each circuit is compared for symmetry. Any dissimilarity within an individual circuit is knows as "differential current" which can be detected with current transformers that provide differential protection.

D-Flange (Mounting): A type of motor mounting used when the motor is to be built as part of the machine. The mounting holds of the flange are not threaded. The bolts protrude through the flange from the motor side. Normally, D-flange motors are supplied without feet since the motor is mounted directly to the driven machine.

Damping: Damping is the reduction in amplitude of an oscillation in the system.

Dead Band: The range of values through which a system input can be changed without causing a corresponding change in system output.

Deceleration Time: The time required to stop a motor - whether - free running or with some braking means.

Definite Purpose Motor: A definite purpose motor is any motor design, listed and offered in standard ratings with standard operating characteristics and mechanical construction, for use under service conditions other than usual or for use on particular type of application (NEMA). An example would a vertical holloshaft motor.

Deviation: Difference between an instantaneous value of a controlled variable and the desired value of the controlled variable corresponding to the set point. Also called an error.

di/dt: The rate of change in current versus a rate of change in time. Line reactors and isolation transformers can be used to provide the impedance necessary to reduce the harmful effects that unlimited current sources can have on phase controlled rectifiers (SCR's).

Dimension Drawing: A dimension drawing or outline drawing (base plan or floor plan) is one which shows the physical space and mounting requirements of a piece of equipment. It may also indicate ventilation requirements and space provided for connections or the location to which connections are to be made.

Diode: A device that passes current in one direction, but blocks current in the reversed direction.

DC Contactor: A contactor specifically designed to establish or interrupt a direct current power circuit.

DC Motor - Compound Wound: Type of DC motor having both shunt and series field connections. This motor has good speed regulation and starting torque.

DC Motor - Permanent Magnet: Type of DC motor where the field poles and the armature poles are electromagnets. The only current used by the motor is that of the armature. Has high starting torque, good speed regulation and a definite maximum speed.

DC Motor - Series Wound: Type of DC motor which has its field winding connected in series with the armature. This motor has very high starting torque, but has a tendency to ‘run-away’ when lightly loaded or unloaded, and has poor speed regulation.

DC Motor - Shunt Wound: Type of DC motor which has its armature winding and field winding done in parallel circuits. This motor has very good speed regulation.

Distributed Pole: A motor has distributed poles when its stator or field windings are distributed in adjacent slots located within the arc of the pole.

Drain/Breather: A hole located in the lowest spot of the motor used to drain oil/grease when re-lubricating the motor.

Drift: Drift is the deviation from the initial set speed with no load change over a specific time period. Normally, the drive must be operated for a specified warm-up time at a specified ambient temperature before drift specifications apply. Drift is normally caused by random changes in operating characteristics of various controller components.

Drip Cover: A metal piece shaped like a pizza pan attached to the top of a motor mounted vertically shaft down to protect liquid from entering into the motor.

Drive Controller (Also variable speed drive): An electronic device that can control the speed, torque, horsepower and direction of an AC or DC motor.

Dual Voltage: A connection method with enough leads in the terminal box to permit simple reconnection to either of two voltages.

Duty Cycle: The relationship between the operating and rest time. A motor which can continue to operate within the temperature limits of its insulation system, after it has reached normal operating (equilibrium) temperature is considered to have a continuous duty (CONT.) rating. One which never reaches equilibrium temperature, but is permitted to cool down between operations is operating under intermittent duty (INT.) conditions.

dv/dt: The rate of change in voltage versus a rate of change in time. When a motor is operated under VFD power a high value of dv/dt will indicate voltage spikes and/or line disturbances.

Dwell: The time spent in one state before moving to the next. In motion control applications, for example, a dwell time may be programmed to allow for a tool change or part clamping operation.

Dynamic Braking: This is caused by current being applied to the windings after the power is shut off. This is accomplished by either excitation (D.C. motors) or by separate excitation, A.C. motors. It is seldomly used to hold a load, but it can be used as a retarding force to prevent over-running.

Dynamic Unbalance: A noise producing condition caused by non-symmetrical weight distribution of a rotating member. The lack of a uniform wire spacing in a wound armature or casting voids in a rotor or fan assembly can cause relatively high degrees of unbalance.

Eddy Current: Localized currents induced in an iron core by alternating magnetic flux. These currents translate into losses (heat) and their minimization is an important factor in lamination design.

Eddy Current Brake: A unit consisting of a rotating member keyed to a straight through, double extension shaft and a field coil assembly. The brake rotor rotates at the speed of the prime mover until the field coil is energized. Rotation of the rotor is slowed by controlling the current in the field coil.

Eddy Current Clutch: A device that permits connection between a motor and a load by electrical (magnetic) means - no physical contact is involved. This method is also used for speed control (by clutch "slippage").

Eddy Current Drive: A unit consisting of a driving member which is the drum assembly, the driven member which is the rotor assembly, and a magnetic member which is the field coil assembly. The driven member is driven by a constant speed AC motor. Control of the eddy current drive is obtained by controlling the current in the field coil.

Efficiency: The efficiency of a motor is the ratio of mechanical output to electrical input. It represents the effectiveness with which the motor converts electrical energy into mechanical energy at the output shaft. The higher the efficiency, the better the conversion process and the lower the operating costs.

Electrical Coupling: When two coils are so situated that some of the flux set up by either coil links some of the turns of the other, they are said to be electrically coupled.

Electrical Degree: A unit of measurement of time as applied to alternating current. One complete cycle = 360 electrical degrees. One cycle in a rotating electric machine is accomplished when the rotating field moves from one pole to the next pole of the same polarity. There are 360 electrical degrees in this time period. Therefore, in a two pole machine there are 360 degrees in one revolution, and the electrical and mechanical degrees are equal. In a machine with more than two poles, the number of electrical degrees per revolution is obtained by multiplying the number of pairs of poles by 360.

Electrical Time Constant: The ratio of electrical inductance to armature resistance.

Electromotive Force: (EMF) A synonym for voltage, usually restricted to generated voltage. In DC adjustable speed drives, voltage applied to the motor armature from a power supply is the EMF and the voltage generated by the motor is the counter-electromotive force, or CMEF.

Electronic DC Motor Controller: An electronic direct current motor controller is a phase-controlled rectifying system using semi-conductors for power conversion to supply the armature circuit or the armature and shunt field circuits of a direct current motor to provide adjustable speed, adjustable and compensated speed, or adjustable and regulated speed characteristics.

Enable: To allow an action or acceptance of data by applying an appropriate signal to the appropriate input.

Encapsulated Winding: A motor which has its winding structure completely coated with an insulating resin (such as epoxy). This construction type is designed for exposure to more severe atmospheric conditions than the normal varnished winding.

Enclosure: Enclosure refers to the housing in which the controller is mounted. Enclosures are available in designs for various environmental conditions.

Defines the motor construction according to environmental protection and method of cooling. Types include:

Open: A motor that has openings, which permit passage of external cooling air over and around the windings. Usually used indoors, in fairly clean locations.

Dripproof/Open Dripproof (DP/ODP): Horizontal motor term indicating a machine in which the ventilating openings are so constructed that successful operation is not interfered with when drops of liquid, or solid particles, strike, or enter, the enclosure at any angle from 0 to 15° downward from the vertical.

Dripproof Guard (DPG): An open dripproof machine in which all openings giving direct access to live metal or rotating parts (except smooth rotating surfaces) are limited in size by the structural parts, or by the screens, baffles, grilles, expanded metal, or other means to prevent accidental contact with hazardous parts. Openings giving direct access to such live or rotating parts shall not permit the passage of a cylindrical rod 0.75 inch in diameter.

Explosionproof (XP): Previous designation for Hazardous Location. A machine designed to withstand an explosion of a specified vapor, gas, or dust, inside the motor casing and prevent the ignition outside the motor by sparks, flashing, or explosion.

Pipe Ventilated: Similar to an open dripproof motor except that openings for admission of ventilating air are so arranged that inlet ducts or pipes can be connected to them. Air may be circulated by means integral with the machine or by means external to the machine (separately or forced ventilated).

Separately Ventilated (DC Motors): A motor which has a blower attached, or some other cooling equipment, to move air across the unit and keep it below the limiting temperature rise.

Splash Proof (DC Motor): An open machine in which the ventilating openings are so constructed that successful operation is not interfered with when drops of liquid or solid particles strike or enter the enclosure at any angle not greater than 100° downward from the vertical.

Totally Enclosed Air Over (TEAO): A machine which does not utilize a fan for cooling, but is used in situations where air is being blown over the motor frame for cooling, such as a fan application. When quoting this motor, air velocity in feet per minute must be specified.

Totally Enclosed Air-to-Air Machine (TEAAC): A totally enclosed machine which is cooled by circulating the internal air through a heat exchanger which, in turn, is cooled by circulating external air. It is provided with an air-to-air heat exchanger for cooling the internal air, a fan (or fans), integral with the rotor shaft or separate, for circulating the internal air and a separate fan for circulating the external air.

Totally Enclosed Fan Cooled (TEFC): A machine which has an enclosure which does not allow for free exchange of air, but still breathes air. A fan is attached to the shaft that pushes air over the frame during operation to help in the cooling process.

Totally Enclosed Non-Ventilated (TENV): A totally enclosed machine which does not have means for cooling built into the design. This design requires external cooling provision supplied by an outside source.

Totally Enclosed Water Cooled (TEWC): A totally enclosed machine which is cooled by circulating water and with the water or water conductors come in direct contact with the machine parts.

Totally Enclosed Water-to-Air Cooled (TEWAC): A totally enclosed machine which is cooled by circulating air which, in turn, is cooled by circulating water. These motors are provided with a water-cooled heat exchanger for cooling the internal and a fan(s), integral with the rotor shaft separate, for circulating the internal air. (Design not offered in U.S. MOTORS® brand product line.)

Washdown Duty: A machine designed specifically for the food processing industry and other applications that are routinely exposed to washdown, chemicals, humidity, and other severe environments.

Weather Protected I (WPI): A vertical or large horizontal machine which has ventilating passages constructed to minimize the entrance of rain, snow, airborne particles and prevent passage of a 0.75 inch diameter cylindrical rod.

Weather Protected II (WPII): A machine which has the protection of a weather protected I machine plus the normal path of the ventilating air which enters the electric parts of the machine so arranged so that there are at least 3 abrupt changes in direction, none of which is less than 90° . In addition, an area of low velocity not exceed 600 feet per minute shall be provided in the intake air path to minimize the possibility of moisture or dirt being carried into the electric parts of the machine.

Enclosure, Controller NEMA Type 1: A general purpose enclosure of either a ventilated or non-ventilated variety. It is used for most indoor applications and is intended to protect against dust, light, indirect splashing and accidental human contact with the electrical circuit.

Enclosure, Controller NEMA Type 4: A watertight enclosure, required whenever the unit is subjected to a great amount of water from any angle. It is normally used in areas that are repeatedly hosed down. This enclosure is not designed to be submerges.

Enclosure, Controller NEMA Type 7: An enclosure designed for a hazardous location , Class I (air), Group D, per the National Electrical Code. This hazardous environment is one in which flammable gases or vapor may be present in the air in quantities sufficient to produce explosive or ignitable mixtures. This hazardous location enclosure shall be of such substantial construction that it will withstand the internal pressures resulting from explosions without bursting, permanently distorting, or loosening its joints.

Enclosure, Controller NEMA Type 9: An enclosure designed for hazardous locations, Class II, Groups F and G, per the National Electrical Code. The atmosphere in which this controller must operate will contain carbon black, coal or coke dust, flour, starch, or grain dust.

Enclosure, Controller NEMA Type 12: Designed for industrial use. The enclosure is intended for use in applications where it is desirable to exclude such materials as cooling oil, seepage, dust, lint, fibers, and filings. This is normally a non-ventilated enclosure with an oil resistant, synthetic gasket between the case and the cover. The cover is hinged to swing horizontally and is held in place with suitable fasteners which require the use of a tool.

Encoder: An electromechanical transducer that produces a serial or parallel digital indication of mechanical angle or displacement. Essentially, an encoder provides high resolution feedback data related to shaft position and is used with other circuitry to indicate velocity and direction. The encoder produces discrete electrical pulses during each increment of shaft rotation.

End Bells: Also called end shields, cover plates, etc., used to support bearings or to cover the windings. On small motors the end bell is a complete cover, with a few openings for cooling. On large motors, when the bearings are not part of the end shield, a perforated cover may leave the rotor exposed, and only the stator windings are protected.

Endshield: That part of the motor housing which supports the bearing and acts as a protective guard to the electrical and rotating parts inside the motor. This part is frequently called the "end bracket" or "end bell".

Equilibrium Torque: The torque required by a load that will not cause a motor to become unstable. High 20% "buffer" between load and rated allowable load.

Excitation Current: A term usually applied to the current in the shunt field of a motor resulting from voltage applied across the field.

Fan: In totally enclosed, fan cooled motor enclosures (TEFC), the cooling device used to keep the temperature rise below a specified value.

Fan Cover Guard: In totally enclosed, fan cooled motor enclosures (TEFC), the fan cover guard covers the fan assembly to keep out solid objects while allowing air to enter the fan chamber for cooling purposes.

Farad: A unit of measurement for electrical capacitance. A capacitor has a capacitance of one farad when a potential difference of one volt will charge it with one coulomb of electricity.

Fault Current: A current which results from the loss of insulation between conductors or between a conductor and ground.

FDE (From Drive End): A way to view the motor. From drive end refers to looking at the motor from the shaft end.

Feedback: As it generally relates to motors (gear-motors) and controls, feedback refers to the voltage information received by a feedback circuit. Depending on a pre-determined potentiometer setting, a motor control can correct the voltage to deliver appropriate speed and/or torque.

Ferromagnetic: A material with high magnetic permeability (imposes little resistance to orientation in the presence of a magnetic field). Such materials as iron, steel, and nickel are ferromagnetic substances.

Field: A term commonly used to describe the stationary (stator) member of a D.C. motor. The field provides the magnetic field with which the mechanically rotating (armature) member interacts.

Field Control: Method of controlling DC motor speed by varying the field current in the shunt field windings.

Field Economy: A circuit design feature of a DC motor shunt field supply that reduces the supply voltage output after a predetermined period of time. On may field supplies, this means 50% reduction in output voltage 2 to 3 minutes after machine shutdown (idle). A field economy circuit serves to reduce standby power consumption and prolong the insulation life of the motor field windings.

Field Forcing: Temporarily over-exciting a motor shunt field to overcome the L/R time constant, increase the rate of flux change and rapidly reverse the direction of shunt motor field current.

Field Range: The range of motor speed from base speed to the maximum rated speed.

Field Reversing: One method for producing regeneration. It is accomplished by changing the direction of current through the motor field, which reverses the polarity of the motor CEMF to account for generator action.

Field Weakening: The introduction of resistance in series with the shunt wound field of a motor to reduce the voltage and current which weakens the strength of the magnetic filed and thereby increase the motor speed.

Filter: A device that passes a signal or a range of signals and eliminates all others.

Flux: The magnetic field which is established around an energized conductor or permanent magnet. The field is represented by flux lines creating a flux pattern between opposite poles. The density of the flux lines is a measure of the strength of the magnetic field.

FODE (From Opposite Drive End): A way to view the motor. From opposite drive end refers to looking at the motor from opposite the shaft end.

Follower Drive: A drive in which the referenced input and operation are direct functions of another drive, called the master drive.

Four-Quadrant Operation: The four combinations of forward and reverse rotation and forward and reverse torque of which a regenerative drive is capable:

1. Forward rotation/forward torque (motoring)
2. Forward rotation/reverse torque (regeneration)
3. Reverse rotation/reverse torque (motoring)
4. Reverse rotation/forward torque (regeneration)

Force: The tendency to change the motion or position of an object with a push or pull. Force is measured in ounces or pounds.

Form Factor: A figure of merit which indicates how much rectified current departs from pure (non-pulsating) D.C. A large departure from unity form factor (pure D.C.) increases the heating effect of the motor and reduces brush life. Mathematically form factor is the ratio of the root-mean-square (rms) value of the current to the average (av) current of Irms/Iav.

Form Wound Coils: Coils wound in form and shaped ready to insert into the slot of a motor.

Fractional Horsepower Motor: A motor with a continuous rating of less than one horsepower.

Frame: The main motor housing. Can be constructed of aluminum, steel, or cast iron.

Frame Size: Usually refers to the NEMA system of standardized motor mounting dimensions, which facilitates interchangeability. The physical size of a motor, usually consisting of NEMA defined "D" and "F" dimensions at a minimum. The "D" dimension is the distance in quarter inches from the center of the motor shaft to the bottom of the mounting feet. The "F" dimension relates to the distance between the centers of the mounting feet holes.

Frequency: The rate at which alternating current reverses its direction of flow. Measured in hertz (Hz); 1 Hz = 1 cycle per second.

Full-Load Amps (FLA): Line current (amperage) drawn by a motor when operating at rated HP and voltage. Shown on motor nameplate. Important for proper wire size selection, motor starter heater selection, and over current protection.

Full Load Current: The current drawn from the line when the motor is operating at full load torque and full load speed at rated frequency and voltage.

Full Load Speed: The speed that the output shaft of the drive motor attains with rated load connected and with the drive's controller adjusted to deliver rated output at rated speed. This will always be less than the synchronous speed and will vary depending on the rating and characteristics of the particular motor. For example, four pole 60 Hz fractional horsepower motors have a synchronous speed of 1800 RPM, a nominal full load speed (as shown on the nameplate) of 1725 RPM, and an actual full load speed ranging from 1715 to 1745 RPM.

Full Load Torque: The full-load torque of a motor is the torque necessary to produce its rated horsepower at full-load speed in pounds at a 1-foot radius, it is equal to the horsepower times 5252 divided by the full-load speed.

Full Pitch: The full pitch value is obtained by dividing the number of slots by the number of poles.

Full Wave Rectification: Full wave rectification passes the positive half and inverts the negative half cycle of the input sinusoid so that the output contains two half sine pulses for each input cycle.

Gain: The ratio of system output signal to system input signal.

Gate: The control element an SCR (silicon controlled rectifier) commonly referred to as a thyristor. When a small positive voltage is applied to the gate momentarily, the SCR will conduit current (when the anode is positive with respect to the cathode of the SCR). Current conduction will continue even after the gate signal is removed.

Gear Ratio: In gearboxes and gearmotors, the gear ratio is derived by dividing the input speed by the output speed.

Gear Types - Inline Reducer: A gearbox in which the input and output shafts are in a straight line.

Gear Types - Parallel Shaft: A gear box in which the input and output shafts run in parallel to each other.

Gear Types - Planetary: A specialized speed reducer in which the self-aligning gear train floats to evenly distribute all internal loads. This design is used for demanding high shock load applications.

Gear Types - Right Angle: A gear box in which the input and output shafts run at right angles to each other.

Gear Types - Worms: A type of gear box in which the gear teeth mesh with a threaded shaft called the worm when operating.

Gears - Bevel: Gears which are made in a beveled shape.

Gears - Helical: Gears which are made in a helical shape.

Gears - Herringbone: Gears which are made in a herringbone shape.

General Purpose Motors: Motors as defined by NEMA which have certain operating characteristics that make them applicable for operation of many type of driven equipment.

Generator Action of an Induction Motor: An induction (squirrel cage) motor acts as a generator in 2 different ways:

1. Generally the rotor acquires some residual magnetism (especially if DC current is applied to the stator for dynamic braking). In this case the rotor causes generator action in the stator for several seconds. That is, with the line switch quickly opened, a voltage remains across the motor terminals from 1/2 second to several seconds, diminishing with the decrease in motor speed.
2. An induction motor driven above its rated speed delivers leading power factor current back into the line -- it must derive its exciting current from the line. This is a very simple form of generation of power and for certain power systems is an almost ideal method of increasing line capacity.

GTO: Gate turn-off or gate turn-on power semiconductor device.

Guide Bearing: A bearing on vertical motors which acts as the guide in shaft alignment.

Half Wave Rectification: In the rectifying process, half wave rectification passes only one-half of each incoming sinusoid, and does not pass the opposite half cycle. The output contains a single half sine pulse for each input cycle. A single rectifier provides half wave rectification.

Hazardous Location Motor: 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. (Previously referred to as Explosionproof)

Hazardous Location Divisions: The first classification of hazardous location motors as developed by the National Electrical Code (NEC). Divisions divide the motor environment into areas where the danger of explosion is always present (division 1) and areas where only under certain conditions is the danger of explosion present (division 2).

Hazardous Location Groups: The third classification of hazardous location motors as developed by the National Electrical Code (NEC). Groups divide the motor classes even further by grouping together similar liquids, vapors, dusts, and flyings.

Hazardous Location Labels: In electric motors the hazardous location label describes whether the motor is good for liquids only, or for liquids, vapors, dusts, and flyings.

Head: A measurement of pressure, usually in feet of water. A 30 foot head is the pressure equivalent to the pressure found at the base of the column of water 30 feet high.

Heater Coil (Thermal Overload Relay): A heater coil is a part of a thermal overload relay that is intended to produce heat when conducting current. Heater coils are sometimes referred to as heaters, thermal units, current elements or heater elements.

Heat Loss: Losses due to resistance take the form of heat which has to be dissipated into the air or surrounding cooling medium. Heat loss is also referred to as I2R loss because the current squared, multiplied by the resistance will yield the heat loss value (in watts).

Heat Loss at Full Load: The total heat loss at full load of a motor usually given in Kilowatts. This value is needed to determine total power requirements when a number of motors are supplied by a power source, or more often when the motor or motors are in an enclosed area, to fine the cooling needed.

Heat Loss From Starting: A necessary figure to answer two questions: (1) If the motor is started often will the accumulated heat damage the winding, and (2) Does additional cooling have to be added to overcome this accumulated heat from starting.

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

High Potential Test: A test which consists of the application of a voltage higher than rated between the winding and the frame or between two or more windings for the purpose of determining the adequacy against breakdown of insulating materials and spacings under normal conditions. It is not a test of the conductor insulation in any one winding.

Horsepower: 33,000 foot pounds of work per minute or 550 foot pounds per second.

Hot Spot Allowance: An insulation system is only as good as its weakest link. Thus it is necessary to locate the hottest part of the machine as this limiting temperature determines the motor life. The difference in degrees of temperature between the readily accessible points and the true "hot-spot" is called the hot spot allowance.

Hunting: Undesirable fluctuations in motor speed that can occur after a step change in speed reference (either acceleration or deceleration) or load.

Hysteresis Loss: The resistance offered by materials to becoming magnetized results in energy being expended and corresponding loss. Hysteresis loss in a magnetic circuit is the energy expended to magnetize and demagnetize the core.

Index of Protection Code: A European definition describing motor enclosures. Common ones are IP55 - totally enclosed fan cooled, and IP23 - weather protected I. See charge in enclosure for the complete listing.

Inductance: The characteristic of coil or wire to cause the current to lag the voltage in time phase. The current reaches its peak after the voltage does.

Induction Motor: An alternating current motor in which the primary winding on one member (usually the stator) is connected to the power source. A secondary winding on the other member (usually the rotor) carries the induced current. There is no physical electrical connection to the secondary winding; its current is induced.

Inertia: A measure of a body's resistance to changes in velocity, whether the body is at rest or moving at a constant speed. The velocity can be either lineal or rotational. The moment of inertia (WK^2) is the product of the weight (W) of an object and the square of the radius of gyration (K^2). The radius of gyration is a measure of how the mass of the object is distributed about the axis of rotation. WK^2 is usually expressed in units of lb. $ft.^2$.

Inertial Load: A load (flywheel, fan, etc.) which tends to cause the motor shaft to continue to rotate after the power has been removed (stored kinetic energy). If this continued rotation cannot be tolerated, some mechanical or electrical braking means must normally be applied.

Inline Thrust Motor: A specialized vertical solid shaft motor which can handle thrust values up to 2000 pounds (depending on the horsepower and speed) and the thrust can be either up or down thrust.

Instability: The state or property of a system where there is an output but no corresponding input.

Insulation (Ins.): In motors, usually classified by maximum allowable operating temperatures as defined by U.L.:

Class A - 105°C (221°F)

Class B - 130°C (266°F)

Class F - 155°C (311°F)

Class H - 180°C (356°F)

Insulator: A material which tends to resist the flow of electric current (paper, glass, etc.).

Integral Horsepower Motor: In terms of HP, a motor built in a frame having a continuous rating of one horsepower or more. An integral horsepower motor is in the 1 to 500 horsepower range.

Interconnection Diagram: An interconnection diagram is a diagram which shows only the external connections between controllers and associated machinery and equipment.

Intermittent Duty: A motor that never reaches equilibrium temperature, but is permitted to cool down between operations. For example, a crane, hoist, or machine tool bar is often rated for 15 or 30 duty.

Interrupting Capacity: The interrupting capacity is the maximum value of current that a contact assembly is required to successfully interrupt at a specified voltage for a limited number of operations under specified conditions.

Inverter: A term commonly used for an AC adjustable frequency drive. An inverter is also a term used to describe a particular section of an AC drive. This section uses the DC voltage from a previous circuit stage (intermediate DC circuit) to produce an AC current or voltage having the desired frequency.

IR Compensation: A way to compensate for the voltage drop across resistance of the AC or DC motor circuit and the resultant reduction in speed. This compensation also provides a way to improve the speed regulation characteristics of the motor, especially at low speeds. Drives that use a tachometer generator for speed feedback do not require an IR compensation circuit because the tachometer will inherently compensate for the loss in speed.

Isolation Transformer: A transformer that electrically separates the drive from the AC power line. An isolation transformer provides the following functions:

1. In DC motor applications, it guards against inadvertent grounding of power plant lines through grounds in the DC motor armature circuit.
2. Enhances protection of semiconductors from line voltage transients.
3. Reduces disturbances from other solid state control equipment such as drives without isolation transformers, time clock systems and electronic counters.

Jogging: A means of accomplishing momentary motor movement by repetitive closure of a circuit using a push-button or contact elements.

Kinetic Energy: The energy of motion possessed by a body.

Leads: The wires exiting out of the motor terminal box used to connect the motor and/or accessories to the power supply.

Line Voltage: Voltage supplied by the power company or voltage supplied as input to the device.

Linear Acceleration/Deceleration (LAD): A Circuit that controls the rate at which the motor is allowed to accelerate to a set speed or decelerate to zero speed. On most drives, this circuit is adjustable and can be set to accommodate a particular application.

Linearity: The measure of the maximum deviation between the actual speed and the set speed, expressed as a percentage of set speed.

Locked-Rotor Current: The steady-state current taken from the line with the rotor locked and with rated voltage (and rated frequency in the case of alternating-current motors) applied to the motor.

Locked-Rotor Torque: (Static Torque) The locked-rotor torque of a motor is the minimum torque which it will develop at rest for all angular positions of the rotor, with rated voltage applied at rated frequency.

Long Shaft Motor: NEMA standard MG-1 defines shaft length as the dimension AH, or the distance from the face, flange or base of the machine to the end of the shaft. In a standard type "T" frame the NEMA standard shaft extension (long shaft) is supplied. It is normally used where overhung loads from pulleys, shieves and sprockets are encountered.

Magnetic Polarity: It is a fundamental principle of winding that adjacent poles must be wound to give opposite magnetic polarity. This does not mean that the coils actually have to be wound in this direction before being placed into the stator. It does mean that the winding must be connected so that, if the current proceeds through one pole in a clockwise direction, it must proceed through the next pole in a counterclockwise direction. This principle is used to determine the correctness of connection diagrams.

Marine Duty Motor: A specialized motor designed for use onboard ships. Motors are designed per IEEE 45 motor specification.

Master Drive: A drive that sets the reference for one or more follower drives.

Mechanical Degree: The popular physical understanding of degrees (360 degrees = 1 revolution).

Megohm Meter: A device used to measure an insulation system's resistance. This is usually measured in megohms and tested by passing a high voltage at low current through the motor windings and measuring the resistance of the various insulation systems.

Modular Construction: The major circuit elements are mounted in replaceable modules which can readily be removed and replaced. Equipment can be serviced without delay.

Module: A unit of circuit elements usually packaged so it can be readily replaced.

Motor Constant: The ratio of motor torque to motors input current (motor torque per amp).

Mounting (Mtg.): – Basic types:

1. Bolted – Motor is attached to frame with removable bolts.
2. Rigid – Motor solidly fastened to equipment through metal base that is welded, bolted, or cast into the metal shell or clamped to the end shield hubs.
3. Cradle/Resilient (Res.) – Motor shell isolated from base by vibration absorbing material, such as rubber rings on the end shields, to reduce transmission of vibration to the driven equipment.
4. 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 pumps, oil burners and gear reducers.
5. Stud – Motor has bolts extending from front or rear, by which it is mounted. Often used on small, direct-drive fans and blowers.
6. Yoke – Tabs or ears are welded to motor shell, to allow bolting motor to a fan column or bracket.

Multi Motor Operation: A system in which one controller operates two or more motor simultaneously, maintaining a constant ratio between the speeds of the motors.

Multi Speed Motor: An induction motor that can obtain tow, three, or four discrete (fixed) speeds by the selection of various stator winding configurations.

Mush Wound Coils: Also called random wound coils -- Where the turns are wound without definite placement, or, at random. Most small motors up to 25 HP are mush wound although motors up to 150 HP have been successfully wound without formed coils. The limit is not the horsepower, but did the manufacturer allow enough slot space for the wasteful, random wound coil.

National Electrical Code (NEC): The recommendation of the National Fire Protection Association and is revised every 3 years. The NEC determines the divisions, classes, groups, and temperature codes of hazardous location motors.

National Electrical Manufacturers Association (NEMA): A non-profit organization organized and supported by manufacturers of electrical equipment and supplies. Some of the standards NEMA specifies are horsepower ratings, speeds, frame sizes and dimensions, and torques and enclosures.

NEC: The National Electrical Code is the recommendation of the National Fire Protection Association and is revised every three years. City or state regulations may differ from these code regulations and take precedence over NEC rules.

Negative Feedback: A condition where feedback is subtractive to the input reference signal. Negative feedback forms the basis for automatic control systems.

Negative Torque: A torque developed in opposition to the normal torque of the motor. This may occur at starting (common to 2 pole motors) or at some speed below nameplate RPM. This causes "cusps" or "saddles" in the graphed torque curves.

NEMA Design A Motors: Classification of motors by NEMA used on machines such as fans, blowers, pumps and compressors, requiring relatively low starting torque followed by increasing torque with increasing speed up to the full-load speed and torque. Design A motors are differentiated from design B motors by a higher locked-rotor current.

NEMA Design B Motors: Classification of motors by NEMA used on machines such as fans, blowers, pumps and compressors, requiring relatively low starting torque followed by increasing torque with increasing speed up to the full-load speed and torque. This is the most popular motor design.

NEMA Design C Motors: Classification of motors by NEMA used on machines such as reciprocating air compressors and conveyors, requiring relatively high starting torque that is normally greater than the torque required at full-load speed.

NEMA Design D Motors: Classification of motors by NEMA used on machines that impose pulsating loads or require frequent starting of the motor, such as punch press, oil well pumping, and hoist applications. Design D motors are not offered by as part of the U.S. MOTORS® brand product line.

NFPA: National Fire Protection Association. The group that prepares and published the National Electric Code, Hazardous Chemicals, and numerous other such publications.

No Load: The state of a machine rotating at normal speed under rated conditions, but when no output is required from it.

Non-Reverse Ratchet: A feature on vertical motors for use in deep well applications where water lubricated pump bearings are installed. These ratchets stop the shaft from spinning once the power is discontinued and the pump water column is receding. U.S. MOTORS® brand products use a ball-type non-reverse ratchet which has extended life over pin types as used by other vertical motor manufacturers.

Off Delay: Off delay signifies that the timing period of a time delay relay is initiated upon de-energizing of its coil.

Offset: The steady state deviation of a controlled variable from a fixed setpoint.

Oil Mist Lubrication: A centralized lubricating system in which the energy of compressed gas, usually air taken from the plant supply, is used to atomize oil. Oil is then conveyed by the air in a low pressure distribution system to multiple point of lubricant application.

On Delay: On delay signifies that the timing period of a time delay relay is initiated upon energization of its coil.

Open Circuit: An open circuit in a motor is a defect which causes an interruption in the path through which the electric current normally flows.

Open Loop: A control system that lacks feedback.

Operating Overload: Operating overload is the overcurrent to which an electric apparatus is subjected in the course of the normal operating conditions that it may encounter. For example, those currents in excess of running current which occur for a short time as a motor is started or jogged are considered normal operating overloads for a control apparatus.

Op Amp: An operational amplifier is usually a high gain DC amplifier that is designed to be used with external circuit elements to perform a specified computing operation.

Open Machine (Motors): A machine having ventilating openings which permit passage of external cooling air over and around the windings of the machine.

1. **Drip-proof Machine -** is an open type machine in which the ventilating openings are so constructed that successful operations is not interfered with when drops of liquid or solid particles strike or enter the enclosure at any angle from 0 to 15 degrees downward from vertical.
2. **Splash-proof -** is an open machine in which the ventilating openings are so constructed that successful operation is not interfered with when drops of liquid or solid particles strike or enter the enclosure at any angle not greater than 100 degrees downward from the vertical.
3. **Semiguarded** - is an open machine in which part of the ventilating openings in the machine, normally in the top half, are guarded as in the case of a "guarded machine," while the other parts are left open.
4. **Guarded Machine (NEMA Standard)** - is an open machine in which all openings giving direct access to live metal or rotating parts (except smooth rotating surfaces) are limited in size by the structural parts or by the screens, baffles, grilles, expanded metal or other means to prevent accidental contact with hazardous parts. Openings giving direct access to such live or rotating parts shall not permit the passage of a cylindrical rod 0.75 inch in diameter.
5. **Drip-proof Guarded Machine -** is a drip-proof machine whose ventilating openings are guarded in accordance with the definition of a guarded machine.
6. **Open Externally Ventilated Machine -** is one which is ventilated by means of a separate motor driven blower mounted on the machine enclosure. This machine is sometimes known as a blower-ventilated or a force-ventilated machine.

7. **Open Pipe Ventilated Machine -** is basically an open machine except that openings for admission of ventilating air so arranged that inlet ducts or pipes can be connected to them. Air may be circulated by means integral with the machine or by means external to the machine (separately or forced ventilated).
8. **Weather Protected Machine -** is an open enclosure divided into two types:

1. Type 1 enclosures have ventilating passages constructed to minimize the entrance of rain, snow, airborne particles and prevent passage of a 0.75 in. diameter cylindrical rod.
2. Type 2 enclosures provide additional protection through the design of their intake and exhaust ventilating passages. The passages are so arranged that wind and airborne particles blown into the machine can be discharged without entering directly into the electrical parts of the machine. Additional baffling is provided to minimize the possibility of moisture or dirt being carried inside the machine.

Operating Service Deviation: A means of specifying the speed regulating performance of a drive's a controller, generally in percent of base speed. Operating Deviation defines speed change due to load change and typically assumes:

1. A change from one steady state load value to another (not transient).
2. A 95% maximum load change.

Service Deviation defines speed change due to changes in ambient conditions greater than these typical variations:

Condition	**Change**
AC Line Voltage	+10%, -5%
AC Line Frequency	+3%, -3%
Ambient Temperature	15°C.

Output Torque, Gear: A calculation of the input torque multiplied by the gear ratio and the gear efficiency.

Overcurrent Relay: An overcurrent relay operates when the current through the relay, during its operating period, is equal to or greater than its setting.

Overhung Load: A load which tends to impose a radial force (perpendicular to the shaft axis) on a motor or gear-motor output shaft.

Overshoot: The amount that a controlled variable exceeds a desired value after a change of input.

Overspeed: Any speed above the rated (nameplate) speed. Can be caused by a load overhauling (crane and elevator motors), or intentional as on induction generators.

Part Winding Starting: Originally and still defined by NEMA as a motor that has one half its windings energized first, then the other half is paralleled with the first half for full on. Now used as the name for tow thirds start and double delta starting.

Partial Motor: A motor sold with rotor and stator only -- NO end bells -- and no containing frame. Also called a "shell type" motor.

Permeability: Is the measurement of the ease with which a material can be magnetized and how much better than air it is as a path for magnetic fields (permeability of 1).

Phase: Phase is a term, which indicates the space relationships of windings, and changing values of the recurring cycles of A.C. voltages and currents. Due to the positioning (or the phase relationship) of the windings, the various voltages and currents will not be similar in all aspects at any given instant. Each winding will lead or lag another, in position. Each voltage will lead or lag another voltage, in time. Each current will lead or lag another current, in time.

Phase, Single: Available in these types:

1. Shaded Pole – Low starting torque. Usually used in direct-drive fans and blowers.
2. Permanent Split Capacitor (PSC) – Performance and applications similar to shaded pole but more efficient, with lower line current and higher horsepower capabilities.
3. Split-Phase Start, Induction Run (or simply Split-Phase) – Moderate starting torque, high breakdown torque. Used on easystarting equipment such as belt-driven fans and blowers, grinders, centrifugal pumps, gear motors, etc.
4. Split-Phase Start, Capacitor Run – Same performance as induction run, except higher efficiency.
5. Capacitor Start, Induction Run (or Capacitor Start) – High starting and breakdown torque, medium starting current. Used on hard-starting applications: compressors, positive displacement pumps, farm equipment, etc.
6. Capacitor Start, Capacitor Run – Similar to capacitor start, induction run, except have higher efficiency. Generally used in higher HP single-phase ratings.

Phase, Three: Operate on three-phase power only. High starting and breakdown torque, high efficiency, medium starting current, simple, rugged design, long life. For industrial uses.

Phase Control: The process of varying the point within the cycle at which forward conduction is permitted to begin.

Pickup Voltage or Current: The pickup voltage or current of a magnetically operated device is the voltage or current at which the device operates.

Piggyback Mounting: A mounting configuration where the motor is mounted to the top of the gearbox and then the motor shaft is connected to the gearbox input shaft by belts.

Plain Bearing: A term used for a non-ball or roller bearing, i.e., a sleeve bearing.

Plate Bearing: A specialized vertical motor bearing which has practically unlimited life factor if the thrust capacity is properly selected, lubricated, cooled and not overloaded. Vibration, cavitation and heat can severely affect the life of this type bearing. Construction of this bearing calls for a solid plate runner and segmental pivoted shoes with the runner riding on a film of oil between it and the bearing shoes. Operation at higher loads than designed for, or higher temperatures, may break down the film of oil and destroy the bearing.

Plugging: Plugging refers to a type of motor braking provided by reversing either voltage polarity or phase sequence so that the motor develops a counter-torque which exerts a retarding force to brake the motor.

Plug Reversal: Reconnecting a motor's windings to reverse its direction of rotation while running. Although it is an effective dynamic braking means in many applications, plugging is more severe than other methods and should be used with caution.

Polarities: Terms, (Positive, Negative: North and South) which indicate the direction of current and flux flow in electrical and magnetic circuits at any given instant.

Polarization Index: A term used to indicate the insulation value to ground of a winding. Actually the index determines the moisture content of a winding.

Pole: A definite group of coils connected in series that will show a uniform polarity with DC current applied. This can also be only one coil. This also applies to AC current rotating equipment.

Position Transducer: An electronic device (e.g., encoder or resolver) that measures actual position and converts this measurement into a feedback signal convenient for transmission. This signal may then be used as an input to programmable controller which controls the parameters of the positioning system.

Positive Feedback: Positive Feedback is a condition where the feedback is additive to the input signal.

Potentiometer: A three terminal rheostat, or a resistor with one or more adjustable sliding contacts, that function as an adjustable voltage divider.

Power: Work done per unit of time. Measured in horsepower or watts (1 HP = 33,000 ft. lb./min. = 746 watts).

Power Factor: A measurement of the time phase difference between the voltage and current in an A.C. circuit. It is represented by the cosine of the angle of this phase difference. For an angle of 0 degrees, the power factor is 100% and the volt/amperes of the circuit are equal to the watts.

Power Factor Correction Capacitor: A device used to raise the power factor on motors to avoid penalties from utilities for low power factors. This is because induction electrical equipment takes more power from the electrical supply system than is necessary to produce the work required. A properly sized capacitor will offset most of the lagging current of a motor and raise its power factor to about 95%.

Power Supply: The voltage of the supply line, which can be single phase or three phase.

Preset Speed: Preset speed refers to one or more fixed speeds at which the drive will operate.

Printed Circuit Board: A board for mounting of separately manufactured components which has the connections made by printed circuitry.

Prony Brake: A simple mechanical device, normally a wooden piece with an adjustable leather strap used to test torque output. The prony brake-loads the motor and a spring scale attached to it gives a relatively accurate measurement of torque.

Pull-Out Torque: The pull-out torque of a synchronous motor is the maximum sustained torque which the motor will develop at synchronous speed with rated voltage applied at rated frequency and with normal excitation.

Pull Up Torque: The minimum torque developed during the period of acceleration from locked-rotor to the speed at which breakdown torque occurs. It is usually expressed as a percentage of full-load torque.

Pulse: A pulse is a signal of relatively short duration.

Pulse Width Modulating Inverter (PWM): A type of AC adjustable frequency drive that accomplishes frequency and voltage control at the output section (inverter) of the drive. The drive's DC bus voltage is always a constant amplitude and by "chopping" (pulse width modulating), the average voltage is controlled.

Push-Button: A push-button is a switch of relatively short duration

PWM: A type of AC adjustable frequency drive that accomplishes frequency and voltage control at the output section (inverter) of the drive. The drive's DC bus voltage is always a constant amplitude and by "chopping" (pulse width modulating), the average voltage is controlled.

QS 9000: Automotive Duty Quality Specification

Radial Magnetic Pull: The magnetic force on the rotor resulting from its radial (air gap) displacement from magnetic center.

Random Wound Coils: Also called mush wound coils -- where the turns are wound without definite placement, or, at random.

Reactance: The opposition to the flow of current made by an induction coil or a capacitor.

Reactance (Inductive): The characteristic of a coil, when connected to alternating current, which causes the current to lag the voltage in time phase. The current wave reaches its peak later than the voltage wave reaches its peak.

Rectification: Designates the process by which electric energy is transferred from an alternating current (AC) to a direct current (DC) circuit.

Rectifier: An electronic circuit which converts alternating current into direct current.

Reed Critical Frequency: Rotational elements generate natural resonance frequencies which is a function of shaft stiffness, mounting, and environment conditions (i.e., vibration from equipment nearby). Vertical motors are affected more by this condition because of mounting at one end with the other end free to move. Under normal operating conditions with the motor operating at rated speed, the resonant frequencies is not a concern. However, inverter applications changes the base speed which affects the motor harmonics and will give an unstable resonance or vibration condition. To correct for potential operation in a critical speed zone, pump manufacturers can make their discharge heads either stiff or loose.

Regeneration: The characteristic of a motor to act as a generator when the CEMF is larger than the drive's applied voltage (DC drives) or when the rotor's synchronous frequency is greater than the applied frequency (AC drives).

Regeneration Braking: The technique of slowing or stopping a drive by regeneration.

Regeneration Control: A regeneration drive contains the inherent capability and/or power semi-conductors to control the flow of power to the motor and from the motor back to the power supply.

Regulation: The ability of a control system to hold speed once it has been set. Regulation is given in percentages of either base speed or set speed. Regulation is rated upon two separate sets of conditions:

1. **Speed Regulation -** is the percentage of speed change with a defined change in load, assuming all other parameters to be constant.
2. **Line Regulation -** is the percentage of speed change with a given line voltage change, assuming all other parameters to be constant.

Relay: An electrically controlled device that causes electrical contacts to change status. Open contacts will close and closed contacts will open when rated voltage is applied to the coil of the relay.

Reluctance: The characteristic of a magnetic material which resists the flow of magnetic lines of force through it.

Remote Control: Remote Control is a control function which provides for initiation or change of a control function from a remote point.

Reset: To reset is to restore a mechanism, storage or device to a prescribed state.

Resistance: The degree of obstacle presented by a material to the flow of electric current is known as resistance and is measured in ohms.

Resilient Mounting: A suspension system or cushioned mounting designed to reduce the transmission of normal motor noise and vibration to the mounting surface.

Resolution: The smallest distinguishable increment into which a quantity can be divided (e.g., position or shaft speed). It is also the degree to which nearly equal values of a quantity can be discriminated. For encoders, it is the number of unique electrically identified positions occurring in 360 degrees of input shaft rotation.

Response Time: The time required, following the initiation of a specified stimulus to a system, for an output going in the direction of necessary corrective action to first reach a specified value.

Reversing: Changing the direction of rotation of the motor armature or rotor. A DC motor is reversed by changing the polarity of the field or the armature, but not both. An AC motor is reversed by reversing the connections of one leg on the three phase power line or by reversing the leads on a single phase power line.

Reverse Torque: A torque created by harmonics in a three phase motor and often resulting in a motor running at a reduced speed. Normally the forces of the revolving field all rotate in the same direction but an improperly designed motor can cause counter rotating harmonic fields that exceed the strength of the forward field at some specific speed. This speed may be zero RPM or some speed below the rated value. This phenomenon is quite common in re-designs of motors to 10 poles or more.

Reversing: Changing the direction of rotation of the motor armature or rotor. A DC motor is reversed by changing the polarity of the field or the armature, but not both. An AC motor is reversed by reversing the connections of one leg on the three phase power line, or by reversing the leads on a single phase power line.

Rotation (Rot.): Direction in which shaft rotates:

1. CW = clockwise
2. CCW = counterclockwise
3. Rev (CW/CCW) = reversible or bi-directional rotation which can be changed.

Rotor: The rotating member of an induction motor with a shaft. Current is normally induced in the rotor which reacts with the magnetic field produced by the stator to produce torque and rotation.

Running Torque: Also called stable torque, or equilibrium torque. A term loosely used meaning available torque at full (rated) speed, as opposed to starting torque.

Saddle Torque: A torque developed, usually well below rated speed, that is much less than normal torque expected at that point. On the torque curve it creates a depression or 'saddle' and thus the name. Also called the 'cusp' of the curve.

Salient Pole: A motor has salient poles when its stator or field poles are concentrated in to confined arcs and the winding is wrapped around them (as opposed to distributing them in series of slots).

Schematic Diagram (Elementary Diagram): A schematic or elementary diagram is one that shows all circuits devices of a controller. The diagram does not show the physical arrangement of the devices or the actual wiring to the devices.

Screens: 1/4-inch mesh that covers the openings on open enclosure motors to keep rodents and other vermin from entering the motor cavity.

Seals - Double Lip: A rubber shaft seal to keep contaminants such as oil, water and dust from entering the bearing cavity.

Seals - Double Sealed Bearings: Bearings which have seals on both sides to keep the lubricant inside the bearing housing and keep out contaminants.

Seals - Labyrinth: A non-friction seal with a close fit of many turns which protects the bearing cavity from contaminants which can cause bearing failure.

Seals - Taconite: Seals which provide a seal so tight as to filter out iron ore (one of the finest dusts) from entering the bearing cavity.

Secondary Winding: The secondary winding of a motor is a winding which is not connected to the power source, but which carries current induced in it through its magnetic linkage with the primary winding.

Self-Release Coupling: A special feature of vertical hollow shaft motors which permits free spinning of the shaft while the pump water is receding without the pump shaft disengaging from the motor.

Semiconductor: A material, usually silicon or germanium, which permits limited current flow.

Service Deviation: See operating/Service Deviation.

Service Factor (SF): A multiplier which, when applied to the rated horsepower, indicates a permissible horsepower loading at rated voltage and frequency. 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.

Service Factor - Gear: A method of classifying loads and sizing gear reducers based on severity of load. The service factor for gear applications is determined by AGMA and is contingent on the duty of the gear box.

Service Factor - Motor: A multiplier which, when applied to the rated horsepower, indicates a permissible horsepower loading at the rated voltage and frequency. The service factor advises how much extra horsepower the motor is capable of handling. For example, a 10 hp motor with 1.15 service factor can operate to 11.50 horsepower.

Service of a Controller: The service of a controller is the specific application in which the controller is to be used; for example:

1. General purpose.
2. Definite purpose.
   1.Crane and hoist.
   2. Elevator.
   3. Machine tool (Drill).

Set Speed: The desired operating speed.

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

Shaft Runout: Term used to advise how must shaft play there is at the end of the shaft extension in relation to the flange of the motor.

Shock Load: The load seen by a clutch, brake, or motor in a system which transmits high peak loads. This type of load is present in crushers, separators, grinders, conveyors, winches, and cranes.

Short-Circuit: A defect in a winding which causes part of the normal electrical circuit to be bypassed. This frequently results in reducing the resistance of impedance to such an extent as to cause overheating of the winding, and subsequent burnout.

Short Shaft Motor: NEMA standard MG-1 defines shaft length as the dimensions AH, or the distance from the face, flange or base of the machine to the end of the shaft. In a NEMA type TS frame a shorter than standard shaft extension is defined. This is usually used when the motor is direct connected to the load via couplings and no overhung load is encountered.

Silicon Controlled Rectifier (SCR): A solid state switch, sometimes referred to as a thyristor. The SCR has an anode, cathode and control rectification since it can be turned on at will. The SCR can rapidly switch large currents at high voltages. It is small sizes and low in weight.

Six Step Inverter: An old inverter design in which the outgoing produced wave takes the form of six steps, three up and three down.

Skew: Arrangement of laminations on a rotor or armature to provide a slight diagonal pattern of their slots with respect to the shaft axis. This pattern helps to eliminate low speed cogging effects in an armature, minimizes induced vibration in a rotor, and minimizes harmonic stray currents.

Skewing: Refers to time delay or offset between any two signals in relation to each other.

Slaving: A method of connecting controllers in cascade (series) or parallel. A number of slave units can be utilized, each running a drive at a different speed. When the manually operated master controller calls for a speed change, the slave units will respond in proportion, maintaining the speed ratios between them.

Slewing: An incremental motion of the motor shaft or machine table from one position to another at maximum speed without losing position control.

Slinger: A device on the shaft or rubbing on it that prevents entrance of abrasive material into the bearing. Also the washer-like attachment to a shaft or part of the shaft that prevents oil from leaking into the motor or out of the bearing.

Slip: The difference between the speed of the rotating magnetic field (which is always synchronous) and the rotor in a non-synchronous induction motor is known as slip and is expressed as a percentage of a synchronous speed. Slip generally increases with an increase in load.

Slip Compensation: Method of increasing the speed reference to the speed regulator circuit, based on the value of motor torque, to maintain motor speed as the load on the motor changes.

Slip Ring: A conductor band mounted on an armature and insulated from it. A brush slides on the band as the armature rotates. The function of the slip ring system is essentially the same as a commutator and brushes. Slip rings are also used to transmit current from the armature in a generator application.

Slip Speed: The speed difference between speed at any load and the synchronous speed.

Snowmaking Motor: A specialized motor design for use in snowmaking applications.

Space Heater: Motor accessory used to prevent moisture condensation in the motor during periods of rest. When the motor is not operational, the space heater is energized to keep the motor temperature 10 degrees above ambient.

Special Purpose Motor: A motor with special operating characteristics, special mechanical construction, or both, designed for a particular application and not falling within the definition of a general purpose or definite purpose motor as defined by NEMA.

Speed Range: The minimum and maximum speeds at which a motor must operate under constant or variable torque load condition. A 50:1 speed range for a motor with top speed of 1800 RPM means the motor must operate as low as 36 RPM and still maintain regulation within specifications.

Speed Regulation: The numerical measure in percent of how accurately the motor speed can be maintained. It is the percentage of change in speed between no load and full load.

Spherical Roller Bearing: A special bearing design used for extended life or higher thrust when designs merit. This bearing will take some radial load, but only if thrust is applied at all times. Spherical roller bearings, provided on U.S. MOTORS® brand products, employs sprig loading to ensure the bearing will not be damaged during starting and momentary upthrust conditions. These springs push up against the lower the lower race so the lower race is kept in contact. Since the spring pressure may be several thousand pounds, a considerable load is imposed on the guide bearing during start-up. Care must be taken not to specify life factors that would cause bearing failures due to insufficient load during normal operation.

Stability: The ability of a drive to operate a motor at constant speed (under varying load) without "hunting (alternately speeding up and slowing down). It is related to the characteristics of the load being driven and the electrical time constants of the drive's regulator circuits.

Stable Torque: The torque of a motor is stable if the motor torque required for a load never exceeds 75-80% of the maximum motor torque allowed.

Stacked Bearing: A ball or roller bearing that is preloaded, with two bearings in opposition, or just two bearings (thrust) together on one shaft. Used where weight or thrust exceed the capacity of a single bearing or where there is a heavy thrust in both directions parallel to the shaft.

Stalling Torque: The torque at which the load causes the motor to stall (or stop). The maximum torque a motor can deliver while running at rated voltage and frequency. No more than 80% of this value should be used for stable operation.

Starting - Across The Line (Full Voltage): Standard starting method used on motors. In this starting method, the motor terminal voltage equals the line voltage, the motor current equals the line current, and the starting torque equals the rated starting torque. This type starting is used where system capacity and stiffness are sufficient to stand the high starting current without excessive voltage drop.

Starting - Autotransformer Reduced Voltage: In this starting method, an autotransformer is placed in series with the motor during starting. The transformer action reduces the voltage applied to the motor terminals. Because of the transformer action the line current is less than the motor current. For a given starting current on the line side, the motor terminal voltage can be higher than for other reduced voltage start methods. Thus, this method gives the highest motor torque per line ampere.

Starting - Capacitor: In this method, large capacitors are connected with the motor so that the capacitors supply much of the current during the start cycle. Careful sizing and switching of the starting capacitors is required to ensure that the capacitor current is not all placed on the line at once, and that the capacitors are not left connected with the motor after acceleration is accomplished.

Starting - Double Delta: This method accomplishes the equivalent of reduced voltage starting by changing a delta connected winding from parallel groups to series groups during the start. Frequently called "double delta part winding".

Starting - Part Winding Start: This starting method uses only a portion (usually 1/2, but sometimes 2/3) of the motor winding, increasing the impedance seen by the power system. It is to be used only for voltage recovery, and must not be left on the start connection for more than 2-3 seconds. The motor is not expected to accelerate on the start connection, and may not even turn.

Starting - Series Reactance Reduced Voltage: In this method, a voltage-dropping reactance is placed in series with the motor during starting. The impedance seen by the power system then is that of the reactance plus that of the motor.

Starting - Series Resistance Reduced Voltage: This starting method has a voltage-dropping resistance placed in series with the motor during starting. The impedance seen by the power system then is that of the resistance plus that of the motor.

Starting - Solid State Reduced Voltage: In this method, a solid-state starter, consisting of power SCR’s controlled by logic circuits, is used to chop the sine-wave power so that only a portion of the wave is applied to the motor.

Starting - Solid State Variable Frequency: In this method, a solid state variable frequency inverter is used to start the motor. With the variable frequency power source, the motor can supply full torque at full load current for the duration of acceleration. The initial applied frequency is very low, and the frequency is gradually increased to the desired running speed.

Starting Torque: The torque exerted by the motor during the starting period (a function of speed or slip).

Starting Variable Speed Drive: In this method, a variable speed drive (VFD) is installed between the motor and the driven load. This drive may be an eddy current clutch or fluid clutch (sometimes called fluid coupling). Use of such a drive allows the motor to accelerate without accelerating the driven load. After the motor is ramped up to speed, then the load is brought up to operating speed.

Starting - Wye Start/Delta Run: This method is actually reduced voltage, but is accomplished by changing the motor phase connections such that a winding that is designed to run with phase

voltage equal to line voltage on delta connection is wye connected for starting to put less than line voltage on each phase.

Stator: That part of an induction motor's magnetic structure which does not rotate. It usually contains the primary winding.

Steady Bushing: An option to vertical hollowshaft motors which enable the motor to give impression of operating as a solid shaft motor.

Stiffness: The ability of a device to resist deviation due to load change.

Stopping - Counter Torque Braking for Reverse-Running Loads: A form of reversing used in wound rotor motors. (Wound rotor motors are not part of the U.S. MOTORS® brand product line.)

Stopping - DC Dynamic Braking: A form of braking and stopping the motor which does not cause rotation is reverse is to circulate direct current in the stator windings. This sets up a magnetic field that is stationary and tends to oppose the motion of the squirrel-cage through the field. The speed-torque curve for this situation is like that for normal running, except that the curve starts at synchronous speed and goes toward a peak torque near zero speed.

Stopping - Eddy-Current Braking: An electrical method of slowing a machine or load. Similar in principle to the DC dynamic braking of a squirrel cage motor. Stationary magnetic coils set up a controllable magnetic field throughout which a conducting disc or cylinder can turn. This disc or cylinder is coupled mechanically to the shaft that is to be brakes. When it turns through the magnetic field, eddy currents are generated and these cause a drag on the rotating shaft, just as a torque is set up in a squirrel-cage when currents flow in its short-circuited conductors.

Stopping - Mechanical Braking: Mechanical brakes are either disc type or shoe (or drum) type. Commonly, the shoes are raised from the wheel by an electromagnet and are set by a spring when the magnet is de-engerized.

Stopping - Plugging: A type of motor braking provided by reversing either voltage polarity or phase sequence so that the motor develops a counter-torque which exerts a retarding force to brake the motor.

Submersible Motor: A motor whose housing and terminal box is designed so that the motor can run under water (or another allowable liquid) -- completely submerged at a temperature of water not above 25° C.

Surge: A transient wave of current, voltage, or power in the electric circuit. **Note:** A transient has a high rate of change of current or voltage in the system.

Surge Protection: The process of absorbing and clipping voltage transients on an incoming AC line or control circuit. MOVs (Metal Oxide Varistors) and specially designed RC (Resistor-capacitor) networks are usually used to accomplish this.

Switch: A switch is a device for opening and closing or for changing the connections of a circuit. **Note:** A switch is understood to be manually operated unless otherwise stated.

Synchronous Speed: The speed of an AC induction motor's rotating magnetic field. It is determined by the frequency applied to the stator and the number of magnetic poles present in each phase of the stator windings. Mathematically it is expressed as Speed (RPM) = 120 x Applied Frequency (Hz) / Number of Poles Per Phase.

System Efficiency: The ratio of the mechanical power supplied to load to the total input power under specified operating conditions. The input power includes requirements for auxiliary functions, such as motor field, phase control, switching equipment, overload protection, and fans.

Tachometer: A small generator normally used as a speed sensing device.

Tachometer Generator (Tach): A generator, mechanically coupled to a rotating machine whose function is to generate a voltage, the magnitude or frequency of which is used either to determine the speed of rotation of the common shaft or to supply a signal to a control circuit to provide speed regulation.

Temperature Codes: In hazardous location motors, the temperature code is assigned by the National Electrical Code (NEC) to group together flammable liquids, vapors, dusts, and flyings into groups with similar flashpoints.

Temperature, Ignition: In hazardous location motors, the temperature at which once attained will cause an explosion to occur in the volatile environment.

Temperature Rise: The measurable rise above the ambient temperature at which the fully loaded motor operates. This temperature rise is the result of the heat losses in the stator winding, core, and rotor. 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.

Temperature, Ultimate: The highest temperature of any spot to which a specific class of insulating materials can be continuously subjected without marked decrease in the system’s designed life.

Terminal Blocks or Strips: An accessory available to titan frame motors which fits into the conduit box and provides a means to group terminating leads from accessories separately from the main leads.

Test - Complete Initial: A motor test which consists of full load heat run, percent slip, no load current, full load current, locked rotor current, locked rotor torque, breakdown torque (calculated), efficiency and power factor at 100%, 75% and 50% full load, winding resistance, high potential, and bearing inspection. Complete initial tests are per IEEE 112 Method B and performed on a dyno.

Test - Noise: A motor test of the sound levels produced by the motor at certain distances. All sound tests are performed at no load in a free field. Noise tests are per IEEE 85.

Test - Short Commercial: Motor test conforming to NEMA MG1-12.51, consisting of no load current, locked rotor current, winding resistance, high potential, and bearing inspection.

Test - Spray: A test of the motor stator on sealed, form wound stators only. The stator is sprayed with water and then measured for seepage in the winding.

Test - Vibration: A test of the motor when operating to ensure the vibration does not exceed certain levels.

Thermal Overload Relay: A thermal overload relay functions (trips) by means of a thermally responsive system.

Thermal Protector: A protective device for assembly as an integral part of the machine and which, when properly applied, protects the machine against dangerous overheating due to overload and, in a motor, failure to start. Especially important for motors that start automatically, are located remotely, unattended or out-of-sight of operator.

Notes:

1. It may consist of one or more temperature sensing elements integral with the machine and a control device external to the machine;
2. When a thermal protector is designed to perform its function by opening the circuit to the machine and then automatically closing the circuit after the machine cools to a satisfactory operating temperature, it is an automatic reset thermal protector;
3. When a thermal protector is designed to perform its function by opening the circuit to the machine but must be reset manually to close the circuit, it is a manual reset thermal protector.

Basic types:

1. Automatic Reset (Auto) – After motor cools, thermal protector automatically restores power. Should not be used where unexpected restarting would be hazardous.
2. Manual Reset (Man.) – An external button must be pushed to restore power to motor. Preferred where unexpected restarting would be hazardous, as on saws, conveyors, compressors, etc.
3. Impedance (Imp.) or 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.

Thermal Protector, Winding - Therma-Sentry: A complete thermal protection system for U.S. MOTORS® brand products for windings, protecting the motor from running overloads. It will also protect the motor from abnormally high ambient temperatures, voltage unbalance, high or low voltage, ventilation failure and single phasing. It consists of three thermistors, solid state control for mounting in the customer supplied panel, with 3 amps control circuit capacity.

Thermal Protector, Winding - Thermistors: A non-linear resistance temperature detector made from semi-conductor material. There are two general types, positive temperature coefficient (PTC) which has a resistance that increases with increasing temperature, and negative temperature coefficient (NTC) that has a resistance that decreases with increasing temperature. Standard on U.S. MOTORS® brand products is PTC. Lines should not exceed 50 ohms.

Thermal Protector, Winding - Thermocouples: A pair of two dissimilar materials which generates a minute voltage in proportion to its temperature. Such devices may be used as a signal source in indicating instruments and control equipment.

Thermal Protector, Winding - Thermostats: Snap action, bi-metallic, temperature actuate switches installed in the connection end-turns of the motor winding. Their purpose is to activate a warning device or shutdown the motor upon excessive winding temperatures.

Thermal Protector, Winding - Winding RTD's: Precision, wire-wound resistors with a known temperature-resistance characteristic. Recognized for their accuracy, the RTDs resistance increases with temperature rise in a known and highly repeatable manner. 2 RTDs per phase/6 per motor are standard offerings on U.S. MOTORS® brand products.

Thermistor: A non-linear resistance temperature detector made from semi-conductor material. The thermistor trip point is defined as the point where resistance suddenly rises or falls depending on the type of thermistor. It is usually used with a solid state controller that monitors the thermistor resistance and performs a preprogrammed f unction at the thermistor trip point. Thermistors are available with a multitude of preset non-adjustable trip points. This type of temperature detection device is used in the THERMASENTRY motor protection device.

Thermocouple: A junction of two dissimilar materials which generates a minute voltage in proportion to its temperature. Such devices may be used as a signal source in indicating instruments and control equipment.

Thermostat: A temperature sensing device, with external leads, which must be properly connected to the control circuit of the motor controller to limit the frame or winding temperature of the motor.

Thread Speed: A fixed low speed, usually adjustable, supplied to provide a convenient method for loading and threading machines. May also be called a preset speed.

Thrust: In vertical motors an unusually heavy weight or load in one or both directions.

Thrust Bearing: A specialized bearing design to handle heavy weights or loads in one or both directions.

Thyristor: A three junction semiconductor device that can be switched from the off state to the on state or vice versa.

Time Delay: A time interval that is purposely introduced in the performance of a function.

Torque: A turning force applied to a shaft, tending to cause rotation. Torque is normally measure in pound/feet and is equal to the force applied times the radius through which it acts.

Torque, Breakdown: The maximum torque the motor will develop with rated voltage applied at rated frequency without an abrupt drop in speed. Usually expressed as a percentage of full-load torque.

Torque, Constant: An application which requires the same torque at all operating speeds. Horsepower varies directly with the speed. Examples of constant torque applications include conveyors, hoists, and positive displacement pumps.

Torque Control: Motor torque is regulated instead of motor speed.

Torque, Full-Load: The torque necessary to produce its rated horsepower at full-load speed.

Torque, Locked-Rotor: The torque the motor will develop at rest (for all angular positions of the rotor) with rated voltage and frequency applied.

Torque, Locked Rotor or Starting Torque: The maximum torque produced at initial start.

Torque, Pull-Up: The minimum torque developed during the period of acceleration from locked-rotor to the speed at which breakdown torque occurs. For motors which do not have a definite breakdown torque (NEMA design D), pull-up torque is the minimum torque developed up to the rated full-load speed. Usually expressed as percentage of full-load torque.

Torque, Variable: An application in which the torque required varies as the square of its speed. Horsepower requirements increase as the cube of the speed. Examples include: centrifugal pumps and blowers, turbine pumps, and fans.

Totally Enclosed Machine (Motor): A totally enclosed machine is one so enclosed as to prevent the free exchange of air between the inside and the outside of the case, but not sufficiently enclosed to be termed airtight.

1. **Totally Enclosed Fan-Cooled -** is totally enclosed machine equipped for exterior cooling by means of a fan or fans integral with the machine, but external to the enclosing parts.
2. **Hazardous Location Machine -** is a totally enclosed machine whose enclosure is designed and constructed to withstand an explosion of a specified gas or vapor which may occur within it and to prevent the ignition of the 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.
3. **Dust-Ignition-Proof Machine -** is a totally enclosed machine whose enclosure is designed and constructed in a manner which will exclude ignitable amounts of dust or amounts that might affect performance or rating and 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.
4. **Waterproof Machine -** is a totally enclosed machine constructed so that it will keep out water sprayed onto it. Leakage may occur around the shaft but will be prevented from entering the oil reservoir. Provision is made for automatically draining the machine. The means for automatically draining may be a check valve or a tapped hole at the lowest part of the frame which will serve for application of a drain pipe.
5. **Totally Enclosed Water Cooled Machine -** is a totally enclosed machine which is cooled by circulating water, the water or water conductors coming in direct contact with the machine parts.
6. **Totally Enclosed Water-Air Cooled Machine -** is totally enclosed machine which is cooled by circulating air which, in turn, is cooled by circulating water. It is provided with a water cooled heat exchange for cooling the internal air and a fan or fans, integral with the rotor shaft or separate, for circulating the internal air.
7. **Totally Enclosed Air to Air Cooled Machine -** is a totally enclosed machine which is cooled by circulating the internal air through a heat exchanger which, in turn, is cooled by circulating external air. It is provided with an air to air heat exchanger for cooling the internal air, a fan or fans, integral with the rotor shaft or separate, for circulating the internal air and a separate fan for circulating the external air.

8. **Totally Enclosed Fan Cooled Guarded Machine -** is a totally enclosed fan cooled machine in which all openings giving direct access to the fan are limited in size by the design of the structural parts or by screens, grilles, expanded metal, etc. to prevent accidental contact with a cylindrical rod 0.75 inch in diameter, and a probe shall not contact the blades, spokes or other irregular surfaces of the fan.
9. **Totally Enclosed Air-Over Machine -** is a totally enclosed machine intended for exterior cooling by a ventilating means external to the machine.

Transducer: A device that converts one energy form to another (e.g., mechanical to electrical). Also, a device that when actuated by signals from one or more systems or media, can supply related signals to one or more other systems or media.

Transient: A momentary deviation in an electrical or mechanical system.

Translator: A solid state, three terminal device that allows amplification of signals and can be used for switching and control. The three terminals are called the emitter, base and collector.

Trigger Circuit: The circuit used to gate a thyristor that causes it to conduct current.

Turn: A complete encirclement of the slots into which the coil is placed.

UL Component Recognition: A classification by Underwriter's Laboratories which recognizes the components of a given product meet UL standards, although the actual finished product may not be UL listed.

UL Listed Product: A classification by Underwriter's Laboratories for equipment which met certain evaluations of concern as determined by UL.

Undervoltage Protection: Undervoltage or low voltage protection is the effect of a device, operative on the reduction or failure of voltage, to cause and maintain the interruption of power to the main circuit. The main objective of the device is to prevent restarting of the equipment on an undervoltage condition.

Variable Resistor: A resistor connected in series with a motor which can be adjusted to vary the amount of current available and thereby alter motor speed.

Variable Torque: A multi-speed motor wound so that the horsepower varies as the square of the speed.

Vector: A quantity that has magnitude and direction. This quantity is commonly represented by a directed line segment whose length represents the magnitude and whose orientation in space represents the direction.

Ventilated Enclosure: A ventilated enclosure is provided with means to permit circulation of sufficient air to remove an excess of heat, fumes or vapors.

Viscosity: The friction in liquid particles that prevents the liquid from flowing freely. The viscosity value is a number for a specific temperature, in comparison with a known liquid.

Voltage: The force that causes a current to flow in an electrical circuit. Analogous to pressure in hydraulics, voltage is often referred to as electrical pressure.

Voltage Relay: A voltage relay operates at a predetermined value of voltage. It may be an overvoltage relay, an undervoltage relay or a combination of both.

Volts per Hertz (V/Hz): The basic measurement of proper AC motor excitation level for adjustable frequency AC drive operation.

VVI (Variable Voltage Inverter): A type of AC adjustable frequency drive that controls the voltage and frequency to the motor to produce variable speed operation. A VV. type drive controls the voltage in a section other than the output section where frequency generation takes place. The frequency control is accomplished by an output bridge circuit which switches the variable voltage to the motor at the desired frequency.

Watt: Unit of electrical power. Watt = El x PF

Wiring (or Connection) Diagram: A wiring, or connection, diagram is one which locates and identifies electrical devices, terminals and interconnecting wiring in an assembly.

Work: A force moving an object over a distance. Measured in foot pounds (ft. lbs.). Work = Force X Distance.

Wound Rotor Motor: A slip ring induction motor with the rotor wound into definite poles. (Not offered in the U.S. MOTORS® brand product line).

Zero Speed Switch: A motion sensing switch that is used to prevent the motor from being plugged while the motor shaft is in motion.

- See more at: http://www.usmotors.com/TechDocs/ProFacts/Motor-Machinery-Terminology.aspx#sthash.Mh7lBtXL.dpuf