Inverter Duty Motor Terminology

Ambient Temperature
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 ingoing 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.

Axis
A principal direction along which movement of the tool or work piece occurs. The term “axis” also refers to one of the reference lines of a coordinate system.

Back of a Motor
The back of a motor is the end that carries the coupling or driving pulley (NEMA). This is sometimes called the drive end (D.E.) or pulley end (P.E.).

Base Speed
Base speed is the manufacturer’s nameplate rating where the motor will develop rated HP at rated load and voltage. With AC systems, it is commonly the point where 60 Hz is applied to the induction motor.

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

Motor Mounted or Separately Mounted Brake
This is a positive action, mechanical, and 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 that is located on some part of the mechanical drive train other than the motor.)

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

Breakdown Torque
The breakdown torque of an AC motor is the maximum torque that it will develop with rated voltage applied at rated frequency while rotating.

Cogging
A condition in which a motor does not rotate smoothly but "steps" or “jerks” from one position to another during shaft revolution. Cogging is most pronounced at low motor speeds and can cause objectionable vibrations in the driven machine.

Continuous Duty
The continuous rating is 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.

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 a particular type of application (NEMA).

D-Flange (Motor Mounting)
This type of motor mounting is used when the motor is to be built as part of the machine. The mounting holes 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.

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

Duty Cycle
The relationship between the operating and resting times or repeatable operation at different loads.
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.

Eddy-Current
The electrical current induced in metallic components from the change in magnetic fields. Motor stators are often laminated to reduce the eddy-current effect. Eddy-currents are used to produce torque coupling in eddy-current type drives.

Eddy-Current Brake
An eddy-current brake consists 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. Controlling the current in the field coil retards rotation of the rotor.

Eddy-Current Drive
An eddy-current drive consists 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
Ratio of power output to power input indicated as a percent. In motors, it is the effectiveness to which a motor converts electrical power into mechanical power.

Error
Difference between the set point signal and the feedback signal. An error is necessary before a correction can be made in a controlled system.

Fault Current
Fault current is a current that results from the loss of insulation between conductors or between a conductor and ground.

Floating Ground
A circuit whose electrical common point is not at earth ground potential or the same ground potential as circuitry it is associated with. A voltage difference can exist between the floating ground and earth ground.

Frame Size
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.

Front of a Motor
The end opposite the coupling or driving pulley (NEMA). This is sometimes called the opposite pulley and (O.P.E.) or commutator end (C.E.).

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.

Full Load Torque
The full load torque of a motor is the torque necessary to produce rated horsepower at full load speed.

General Purpose Motor
This motor has a continuous duty rating and NEMA A or B design, listed and offered in standard ratings with standard operating characteristics and mechanical construction for use under usual service conditions without restriction to a particular application or type of application (NEMA).

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 a column of water 30 feet high.

Horsepower
A measure of the amount of work that a motor can perform in a given period of time.

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.

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 velocity. The velocity can be either linear or rotational.

The moment of inertia \( (W K^2) \) 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.

**Integral Horsepower Motor**
A motor built in a frame having a continuous rating of 1 HP or more and having a 3 digit frame designation (such as 143, 256, etc.).

**Interruption Duty**
A motor that never reaches equilibrium temperature (equilibrium), but is permitted to cool down between operations. For example, a crane, hoist or machine tool motor 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.

**Jogging**
Jogging is 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.

**Locked Rotor Current**
Steady state current taken from the line with the rotor at standstill (at rated voltage and frequency). This is the current when starting the motor and load across the line.

**Locked Rotor Torque**
The minimum torque that a motor will develop at rest for all angular positions of the rotor (with rated voltage applied at rated frequency).

**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.

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

**Multi-speed Motor**
An induction motor that can obtain two, three, or four discrete (fixed) speeds by the selection of various stator-winding configurations.

**NEC**
The National Electrical Code (NEC) 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.

**NEMA**
The National Electrical Manufacturers Association is a non-profit organization organized and supported by manufacturers of electrical equipment and supplies. Some of the standards NEMA specifies are HP ratings, speeds, frame sizes and dimensions, torques and enclosures.

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

**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 that occur for a short time as a motor is started or jogged are considered normal operating overloads for a control apparatus.

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

A. Dripproof machine is an open type 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 degrees downward from vertical.

B. 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.
C. Semi-guarded 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.

D. 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 inches in diameter.

E. Dripproof Guarded Machine is a dripproof machine whose ventilating openings are guarded in accordance with the definition of a guarded machine.

F. Open Externally Ventilated Machine is one that 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 forced-ventilated machine.

G. Open Pipe Ventilated Machine is basically an open machine 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).

H. 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 0.75 inch 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.

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 that exerts a retarding force to brake the motor.

Power
Work done per unit of time. Measured in horsepower or watts:

\[ 1 \text{ HP} = 33,000 \text{ ft. lb./min.} = 746 \text{ watts} \]

Power Factor
A measurement of the time phase difference between the voltage and current in an AC circuit. It is represented by the cosine of the angle of this phase difference. Power factor is the ratio of real power (kW) to total kVA or the ratio of actual power (W) to apparent power (volt-amperes).

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

Rotor
The rotating member of a machine with a shaft.

Service Factor
When used on a motor nameplate, a number which indicates how much above the nameplate rating a motor can be loaded without causing serious degradation (i.e. a motor with 1.15 S.F. can produce 15% greater torque than one with 1.0 S.F.).

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.

Skew
The arrangement of laminations on a rotor or armature to provide a slight angular pattern of their slots with respect to the shaft axis. This pattern helps to eliminate low speed cogging in an armature and minimize induced vibration in a rotor as well as reduce associated noise.

Slip
The difference between rotating magnetic field speed (synchronous speed) and rotor speed of AC induction motors. Usually expressed as a percentage of synchronous speed.

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 (NEMA).

**Speed Range**
The minimum and maximum speeds at which a motor must operate under constant or variable torque load conditions. 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.

**Starting Torque**
The torque exerted by the motor during the starting period.

**Stator**
The stationary portion of the magnetic circuit and the associated windings and leads of a rotating machine.

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

A. Totally Enclosed Fan Cooled is a totally enclosed machine equipped for exterior cooling by means of a fan or fans integral with the machine, but external to the enclosing parts.

B. Explosion-proof 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 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.

C. 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.

D. 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 automatic 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.

E. Totally Enclosed Water Cooled Machine is a totally enclosed machine that 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.

F. Totally Enclosed Water-Air Cooled Machine is a totally enclosed machine that is cooled by circulating air which, in turn, is cooled by circulating water. It is provided with a water-cooled heat exchanger for cooling the internal air and a fan for fans. integral with the rotor shaft or separate, for circulating the internal air.

G. Totally Enclosed Air to Air Cooled Machine is a
totally enclosed machine that 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.

H. 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 the fan. Such openings shall not permit the passage of a cylindrical rod 0.75 inches in diameter, and a probe shall not contact the blades, spokes, or other irregular surfaces of the fan.

I. Totally Enclosed Air-Over Machine is a totally enclosed machine intended for exterior cooling by a ventilating means external to the machine.

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

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