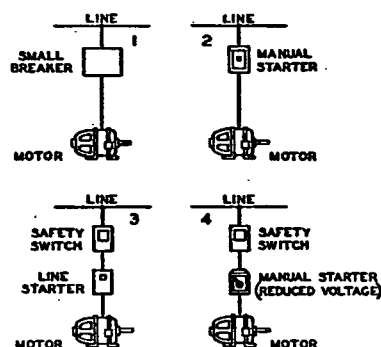


tion is ended. The second type, called low voltage protection, causes the motor line contactor to drop out on low voltage, but prevents restarting when the voltage returns to normal except by the action of an operator. This latter type of protection is desirable where it is necessary for the operator to make initial starting adjustments on the machine.

Manual control for an alternating or a direct current motor is usually located near the motor. When so located an operator must be present to start and stop or change the speed of the motor by operating the control mechanism. Manual control is sometimes employed only as a device to give overload protection, and another device is employed to start and stop the motor. Manual control is used particularly on small motors which operate unit heaters, small blowers, and room coolers in an air conditioning system. In other cases manual control in the form of drums, when used with multi-speed motors, is used only as a speed setting device, while the



Arrangements 2, 3 and 4 are optional for motors up to 7½ hp, 220 volts.

FIG. 9. RECOMMENDED CONTROLS FOR SINGLE PHASE MOTORS

starting and stopping functions operate automatically through thermostats and pressure switches.

Because of the increasing complexity of air conditioning systems, the equipment is operated preferably by automatic control, and less dependence is placed on manual operation and regulation.

Automatic control of motor starters may be accomplished by the use of remote push button stations, by a thermostat, float switch, pressure regulator, or other similar pilot devices. An added advantage of automatic control is that the main wiring for the starter may be installed near the motor, while the starter may be operated by a remote control device.

GLOSSARY

General Definitions

NEMA is the abbreviation for the *National Electrical Manufacturers Association*.

AEIC is the abbreviation for the *Association of Edison Illuminating Companies*.

EI is the abbreviation for the *Edison Electric Institute*.

Speed Regulation (d-c motors) is the change in speed between no-load and full-load, expressed in percent of full-load speed; for example, a motor having a no-load speed of 1200 rpm and a full-load speed of 1140 rpm would have a speed regulation of 5.26 percent.

Slip (a-c induction motors) is the difference between the motor speed and synchronous speed expressed in percent of synchronous speed, e.g., a 1200 rpm motor operating at 1140 rpm would have a slip of 5 percent.

Torque is an expression of the turning effort developed by the motor at the shaft, and is usually expressed in ounce-feet for fractional horsepower motors, and in pound-feet for motors of larger ratings.

Primary is the term usually applied to the high voltage or line side of a transformer or motor. In the case of the wound rotor motor the primary is the stator winding.

Secondary is the term usually applied to the low voltage or load side of a transformer or motor. In the case of the wound rotor motor the secondary is the rotor winding.

NEMA Classification of Motor Enclosures

Open motors (40 C rise, rated load, 50 C rise, service factor load) are self-ventilated machines having no restriction to ventilation other than that necessitated by mechanical construction.

Guarded motors (50 C Rise) have all ventilating openings limited in size by either design of structural parts, perforated covers or screens preventing direct access to live or rotating parts.

Semi-Guarded motors (50 C rise) have the ventilating openings in the top half of the frame only protected by perforated covers.

Drip Proof motors (50 C rise) are so constructed that drops of liquid or solid particles falling on the machine at any angle not greater than 15 deg from the vertical, cannot enter the machine either directly or by striking and running along a horizontal or inclined surface.

Splash Proof motors (50 C rise) are so constructed that drops of liquid or solid particles falling on the machine or coming toward it in a straight line at any angle not greater than 100 deg from the vertical, cannot enter the machine either directly or by striking and running along the surface.

Totally Enclosed Non-Ventilated motors (55 C rise) are so constructed as to prevent exchange of air between inside and outside of the case, but are not air tight and are not equipped with external cooling means.

Totally Enclosed Fan-Cooled motors (55 C rise) are similar to totally enclosed, non-ventilated machines, except that exterior cooling is provided by means of a fan or fans integral with the machine.

Explosion Proof motors (55 C rise) have an enclosing case designed to withstand an explosion of a specified gas or vapor which may occur within it, and to prevent ignition of the gas or vapor surrounding the motor by sparks, flashes, or explosions of the gas or vapor which may occur within the machine casing.

Dust Explosion Proof motors (55 C rise) have an enclosing case designed and constructed so as not to cause the ignition or explosion of an atmosphere of the specific dust, or to cause ignition of dust on or around the machine. (Proper overload protection and cleanliness are required for successful operation).

Water Proof motors (55 C rise) are so constructed as to exclude water applied in the form of a stream from a hose.

Motor Speed Classifications

A **Constant Speed** motor is one in which the speed remains practically constant with changes in load; e.g., a d-c shunt wound motor or a-c squirrel-cage motor with low slip.

A **Varying Speed** motor is one in which the speed varies with the load, usually decreasing when the load increases; e.g., a d-c series motor or an induction motor with large slip.

An **Adjustable Varying Speed** motor is one in which the speed can be adjusted gradually, but when once adjusted for a given load will vary in considerable degree with change in load; e.g., a shunt wound d-c motor adjusted by armature resistance control.

An **Adjustable Speed** motor is one in which the speed can be varied gradually over a considerable range, but when once adjusted remains practically unaffected by the load; e.g., a d-c shunt motor with field resistance control. The standard ratings for open type, adjustable speed motors, having a speed range of 3 to 1 and greater are in accordance with the following:

- (1) A standard continuous horsepower rating at 150 percent of minimum speed with a temperature rise of 40 C.
- (2) The next higher standard continuous horsepower rating at 3 times minimum speed with a temperature rise of 40 C.