

load a starting resistor *NEMA* classification No. 15 may be used. For speed regulation resistor, classification No. 93 should be selected. On a compressor drive using an unloader, a constant torque resistor classification No. 15 should be used. If the compressor is started under load, *NEMA* classification No. 56 or 76 are used. For constant torque speed regulation, resistor No. 95 is used.

SINGLE PHASE MOTOR CONTROL

Where three phase current is not available or where single phase operation is preferred, then single phase repulsion induction, capacitor type or multispeed single phase motors may be used. Since the starting currents of all single phase motors are required to be within the starting-current limits established by the local power-supply company, a suitable type of starter may be chosen from the following selection:

1. Enclosed two pole manually operated motor starters with thermal overload protection.
2. Enclosed two pole automatic motor starter operated by a push button, thermostat or similar device, with thermal overload relay and low voltage protection.
3. A manual or magnetic resistance type starter, with low voltage protection.
4. A manual or magnetic control for pole changing motors and for adjustable varying speed motors using an auto-transformer or resistance in the primary circuit to obtain line (or terminal) voltage drop.

In selecting across-the-line control for single phase capacitor type motors it is usually very desirable to use three pole across-the-line starters. Control for multispeed, single phase capacitor motors may be selected from tables on three phase rating when consideration is given to the increased current and the necessary switching of connections.

PROBLEMS IN PRACTICE

1 ● When motors are being considered as prime movers, what are some of the basic considerations that determine the final selection of the correct unit?

- a. The kind of current available for driving the necessary motors is a primary consideration. There are two groups of motors available for driving the equipment on any job, which are the direct current type or alternating current type. The proper group selection depends entirely on the current available.
- b. It is also necessary to decide whether constant speed or variable speed operation is desired.
- c. Consideration must also be given to the type of service required.
 1. Whether variable torque or constant torque motors will be required.
 2. Whether a high starting torque is required or whether a relatively small starting torque is required.
- d. It is important to take into consideration the atmospheric conditions surrounding the motor location.

2 ● When using direct current motors: a. What three types are available as regards their windings; b. What four types are available with reference to their speed characteristics?

- a. Shunt wound, compound wound, and series wound.
- b. Constant speed, adjustable speed, adjustable varying speed, and varying speed.

3 ● With direct current motors as prime movers what type would you use: a. For driving a fan; b. For driving a compressor?

- a. A fan requires a relatively small starting torque, therefore, a shunt wound motor would be ideal for this type service.
- b. A compressor has a constant torque, therefore, a compound wound motor would be the proper selection for this duty.

4 ● What is one of the important factors that should be taken into account when a series wound direct current motor is being considered?

With a series wound motor the speed varies with the load, therefore this type should never be used where there is a possibility of the motor operating without being loaded. The resultant high speed may prove to be dangerous.

5 ● With the use of alternating current motors what two groups are generally considered?

Motors using single and polyphase power supply.

6 ● Under the alternating current group of motors what common types are available: a. For single phase duty; b. For polyphase duty?

- a. Capacitor high torque, capacitor fan—(1) high torque, (2) low torque, capacitor start-induction run, repulsion induction, and split phase.
- b. Squirrel cage—(1) general purpose, (2) medium torque, (3) high torque, automatic start high torque, normal torque normal current, normal torque low current, high torque low current, slip ring wound rotor, synchronous high speed, synchronous low speed.

7 ● What is the most commonly used of the polyphase motors?

The squirrel cage induction motor is the type most generally used for ordinary application.

8 ● With the use of squirrel cage motors what speed characteristic is available and what construction is used to make these more flexible?

The squirrel cage motor is basically a constant speed motor. However both single phase and polyphase high slip motors are used for adjustable varying speed drive through the use of line voltage control. When using an adjustable varying speed motor, particularly with a centrifugal fan and to a somewhat lesser extent, with a propeller fan, special care should be taken to assure that the fan is closely motored (*i.e.*, adequately loads the motor) in order to obtain the desired speeds under reduced speed operation. To make the squirrel cage motor more flexible, multispeed units are used quite frequently. These units may be single winding for the two speed unit or for different number of windings depending upon the number and combination of speeds required. For two speed single winding units the second speed is always one-half of top speed.

9 ● Differentiate between synchronous speed and full load speed of a motor.

Synchronous speed is the theoretical or no load speed. With the induction motor there is a certain amount of slip depending upon the load. As a rule, at full load, the speed is approximately 96 per cent of synchronous speed, however, motor manufacturers generally list full load speeds on their motor name plates.

The synchronous type of motor has a full load speed which is the same as the synchronous.

10 ● What are the general requirements usually recommended by the power company with reference to connecting polyphase motors to the power line?

For motors up to and including 5 hp, normal torque, normal starting current type of units can be connected directly to the line.

For motors from 5 to 30 hp, both high torque and normal torque, low starting current types of units can be used with across-the-line type of control.

Above these sizes, it is necessary to furnish current limiting starting equipment.

It is always advisable to check with local power companies as there are no standards for