

*Exception No. 1: For motors rated 1000 volts or less, a single motor controller rated at not less than the equivalent horsepower, as determined in accordance with 430.110(C)(1), of all the motors in the group shall be permitted to serve the group under any of the following conditions:*

- (1) *Where a number of motors drive several parts of a single machine or piece of apparatus, such as metal and wood-working machines, cranes, hoists, and similar apparatus*
- (2) *Where a group of motors is under the protection of one overcurrent device in accordance with 430.53(A)*
- (3) *Where a group of motors is located in a single room within sight from the motor controller location*

*Exception No. 2: A branch-circuit disconnecting means serving as the motor controller in accordance with 430.81(A) shall be permitted to serve more than one motor.*

**430.88 Adjustable-Speed Motors.** Adjustable-speed motors that are controlled by means of field regulation shall be equipped and connected so that they cannot be started under a weakened field.

*Exception: Starting under a weakened field shall be permitted where the motor is designed for such starting.*

The torque and speed of a dc motor depend on the amount of current passing through the armature. This current is a function of the shunt field strength and the RPM of the armature. A reduction of the shunt field magnetic flux causes a reduction of the counterelectromotive force in the armature, resulting in an increase in armature current, thereby increasing torque, which increases speed.

**430.89 Speed Limitation.** Machines of the following types shall be provided with speed-limiting devices or other speed-limiting means:

- (1) Separately excited dc motors
- (2) Series motors
- (3) Motor-generators and converters that can be driven at excessive speed from the dc end, as by a reversal of current or decrease in load

*Exception: Separate speed-limiting devices or means shall not be required under either of the following conditions:*

- (1) *Where the inherent characteristics of the machines, the system, or the load and the mechanical connection thereto are such as to safely limit the speed*
- (2) *Where the machine is always under the manual control of a qualified operator*

Use of dc motors is common where speed control is essential, such as electric railways and elevators, where a smooth start, controlled acceleration, and a smooth stop are necessary. If the load is removed from a series motor when it is running, the speed of the motor will increase until it is dangerously high. To produce the necessary counterelectromotive force with a weakened field,

the armature must turn correspondingly faster. Series motors are commonly used as gear-drive traction motors of electric locomotives and, thus, are continuously loaded.

Unless the exception applies, the motors, motor (compound-wound dc) generators, and (synchronous) converters must be provided with speed-limiting devices, such as a centrifugal device on the shaft of the machine or a remotely located over-speed device. This device can be set to operate a set of contacts at a predetermined speed and thereby trip a circuit breaker and de-energize the machine.

**430.90 Combination Fuseholder and Switch as Motor Controller.** The rating of a combination fuseholder and switch used as a motor controller shall be such that the fuseholder will accommodate the size of the fuse specified in Part III of this article for motor overload protection.

*Exception: Where fuses having time delay appropriate for the starting characteristics of the motor are used, fuseholders of smaller size than specified in Part III of this article shall be permitted.*

## Part VIII. Motor Control Centers

**430.92 General.** Part VIII covers motor control centers installed for the control of motors, lighting, and power circuits.

Motor control centers are made up of several motor starters, controls, and disconnect switches. Motor control centers are allowed to be used as service equipment if provided with a single main disconnecting means. A second service disconnecting means, however, is permitted in the motor control center if it is provided to serve other loads.

In addition to Part VIII, installation requirements, including access and working space clearances, for motor control centers are covered in Section 110.26. The requirements of 110.26(E) specify dedicated space for a motor control center and physical protection from mechanical systems that might leak or otherwise adversely affect a motor control center.

**430.94 Overcurrent Protection.** Motor control centers shall be provided with overcurrent protection in accordance with Parts I, II, and VIII of Article 240. The ampere rating or setting of the overcurrent protective device shall not exceed the rating of the common power bus. This protection shall be provided by (1) an overcurrent protective device located ahead of the motor control center or (2) a main overcurrent protective device located within the motor control center.

**430.95 Service Equipment.** Where used as service equipment, each motor control center shall be provided with a single main disconnecting means to disconnect all ungrounded service conductors.

*Exception No. 1: A second service disconnect shall be permitted to supply additional equipment.*