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Motor Control Circuits: To Ground or Not to Ground?

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Should motor control circuits be grounded? Here are some guidelines: If a motor control circuit is tapped from the motor circuit and does not leave the controller enclosure (the push buttons are in the cover), then it need not be grounded. [90-7 ¶ 2, 300-1(b), 450-1 Exc.No.2] If the control circuit transformer primary is tapped from the motor circuit and the control circuit leaves the controller enclosure, and is less than 50 volts, it must be grounded if: (1) the transformer primary supply system exceeds 150 volts to ground, (2) the transformer primary supply system is ungrounded, or (3) the control circuit is run outdoors overhead. [250-20(a)] Whether supplied through a transformer or not, the control circuit, if it leaves the controller enclosure, shall be grounded if: (1) it can be grounded so that the maximum voltage to ground does not exceed 150 volts, or (2) where the system includes a grounded conductor, as a 3Ø four-wire wye with a neutral, or a 3Ø four-wire delta with one phase winding center tapped. [250-20(b)] A control circuit derived from a transformer with a primary not over 1000 volts need not be grounded if: (1) only qualified persons will service the installation, (2) continuity of control power is required, and (3) ground detectors are installed on the control circuit. [250-21] Unless a user is controlling an especially important load and ground detectors are present for other circuits on the premises, he or she is unlikely to want to have ground detectors installed on an ungrounded control circuit, considering the supervision required. Usually, a grounded control circuit is more practical. Now, if it has been determined that the control circuit must be grounded, how is this accomplished? If the control circuit is

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supplied through a transformer, then it is a "separately derived system" as defined in Article 100, and could be grounded as requ by Sec. 250-30; that is, by a grounding electrode conductor to the nearest of building steel, or to an effectively grounded water pipe within the first 5 feet of its entry into the building. But, for control circuits, there is a much easier way. If the transformer is rated not over 1,000 volt-amperes, a grounding electrode conductor not smaller than No. 14 copper is permitted to bond one conductor of the secondary to the grounded switchboard frame or transformer enclosure. [250-30(a)(1) Exc.No.2; 250-30(a)(2) Exception.] Another requirement pertaining to grounded control circuits is found in Sec. 430-73, second paragraph. The motor control circuit must be arranged so that an accidental ground on the circuit outside the controller enclosure will not start the motor, nor will it bypass manual or automatic shutdown devices so that the motor cannot be stopped. This requires that the grounded conductor of the control circuit be run directly and as short as possible to the coil in the motor controller, and that the conductor run outside the controller to all of the control devices be the ungrounded conductor. Where there is a long run between the controller and the motor, and also a control station (start-stop) at the motor end, follow the recommendation in Sec. 90-8(b) and run the motor circuit conductors and the control conductors in separate raceways. In long runs, the control conductors can pick up enough voltage from adjacent current-carrying conductors by means of capacitive linkage to keep the holding coil energized, even though the stop button is depressed. Once such a control coil is energized, it needs only about 50 percent of the rated voltage to keep it from dropping out. SCHWAN is an electrical code consultant in Hayward, Calif. He can be reached a bevschwan@aol.com (mailto:bevschwan@aol.com).

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