RECOMMENDED GROUNDING PRACTICES FOR MODERN ELEVATOR DRIVES

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If you need some excitement in your life, put five qualified people in an elevator machine room, and ask for their recommendations on grounding. You will most likely get five or more methods on how to ground the equipment in that machine room. Some may even meet the National Electrical Code (NEC), some may not! Ordinary people can become quite animated when challenged on grounding methods!

It is also important to note that there are two primary means of grounding electrical equipment. First is to meet NEC requirements. The second is performance. This article will discuss grounding methods to maximize elevator drive performance.

The Institute of Electrical Engineers and Electricians (IEEE) used to have two "color" books on powering and grounding methods. One was the Green Book, IEEE Standard 142, *Recommended Practice for Grounding of Industrial and Commercial Power Systems* and the other was the Emerald Book, Standard 1100, *Powering and Grounding Sensitive Electronic Equipment*. Recently, IEEE recognized that in reality, virtually all electrical devices are sensitive and has combined these two guidelines into Standard 1100.

Grounding is of particular concern when you consider how many personal computers are in today's modern office buildings, not to mention how many other building systems use microprocessors to control their systems. Additionally, modernized elevator systems put new and significantly different demands on existing electrical systems that may no longer provide the best performance with new solid-state drives.

There are some obvious areas where most people can agree. Safety considerations and the NEC require that the metal chassis and cabinet components of all exposed electrical apparatus be connected to earth ground for protection of personnel. This, of course, is only common sense. However, the manner in which grounding wires are connected and installed can make a difference in the emissions of and sensitivity to electrical noise.

For elevator installations with DC drives it is common that there is a primary power isolation transformer near the drive:

a. To provide the correct VAC drive input to match the VDC requirements the secondary side is usually ungrounded, but

b. The secondary may be grounded or have a high Z ground with ground fault measurement.

c. The DSD drive control unit is mounted on a sub-panel, within an electrical enclosure.

d. The elevator hoist motor is located nearby and sits on building steel.

e. The velocity encoder is mounted on the motor frame.

f. The elevator car controller may or may not be in a separate cabinet.

Since there is always some capacitive coupling from electrical circuits to ground, some Silicon-Controlled Rectifier (SCR) switching noise will want to flow between the drive chassis and the motor, and between the drive chassis and the transformer frame. The best method to minimize interference is to give noise current a direct low resistance path in which to flow, and a higher resistance path to where it is unwanted. We recommend that:

- ◆ A grounding bus be provided in the drive enclosure cabinet, welded to the metal frame.
- ◆ A grounding wire be provided directly from the drive chassis to that bus.
- ◆ A grounding wire be provided directly from the drive sub-panel to that bus.
- ◆ A grounding wire be provided directly from the motor frame to that bus.
- ◆ A grounding wire be provided from the transformer frame to that bus.
- ◆ A grounding wire be provided from approved earth ground to that bus.
- ◆ A grounding wire be provided from the car controller enclosure to that bus.
- ◆ Size these grounding wires equal to the power conductors.

One note on using building steel. It is critical to ensure that the building steel is bonded and appropriate to be used for grounding. Many buildings do not have suitable building steel due to various foundation construction methods. A review with a knowledgeable structural engineer is required to evaluate the status of the building steel.

If a motor armature ripple filter is used, a grounding wire should be provided from the reactor core to the drive enclosure grounding bus. The panel-holding ripple filter capacitors and the metal enclosure should be ground-wire bonded to the core of the reactor.

The building electrical distribution system ground-bonding wire for primary power should be connected to the transformer frame-grounding point, and then bonded to the walls of transformer enclosure. All electrical power wiring should be encased in metal conduit rather than open electrical raceway trays.

Each wire pair (three for three-phase) should be in its own conduit. Ground-bonding wires must be sized to meet or exceed NEC fault-current requirements of the equipment size. Gannett Fleming recommends using larger than the NEC minimum ground wire sizes between the drive chassis, motor, transformer and building steel. Sizing them equal to that of the power conductors will provide improved performance over NEC minimums.

Gannett Fleming also recommends that the tachometer/encoder housing and shaft be insulated from the motor frame and shaft. Use shielded cable for encoder wiring isolated from the conduit.

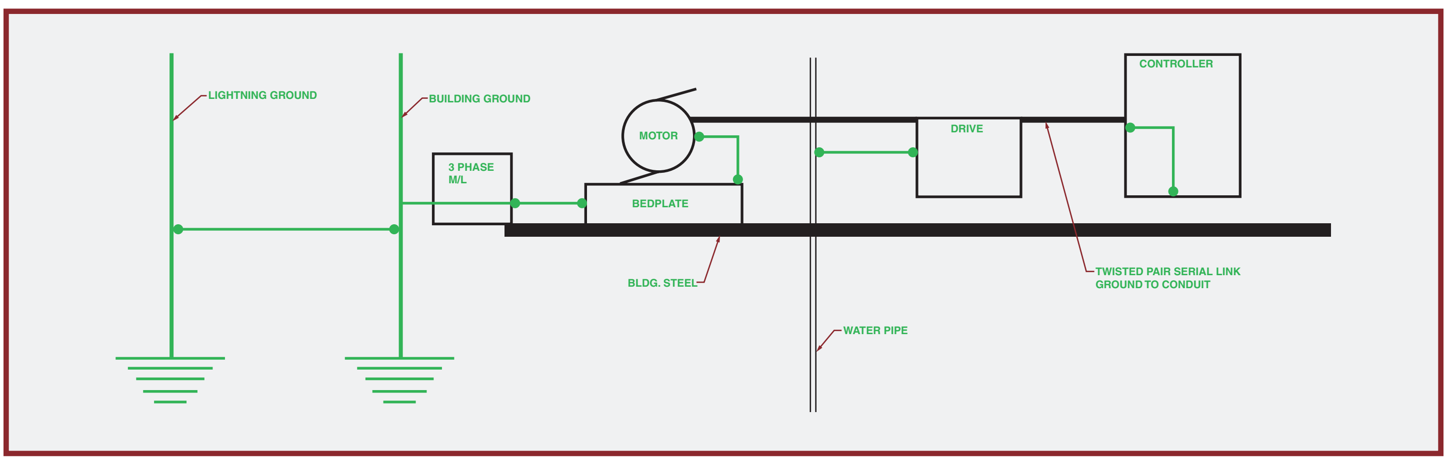
For analog signal exchange between the drive and car controller, it is preferred that differential signaling be used, with the car controller circuit common also grounded appropriately. Second best is to ground the car controller single-ended analog circuits via a common wire tie from car controller to drive. Logic signal circuits 24V have the negative side grounded at the drive via the connection above. If 24V signaling is used, rather than relay contacts, be sure to provide a tie wire between drive controller and car controller circuit commons. If serial communications are used, it is preferred that it be RS422 with optically isolated receivers. If RS232 is used, circuit commons of both the drive and car controller must be grounded as indicated above.

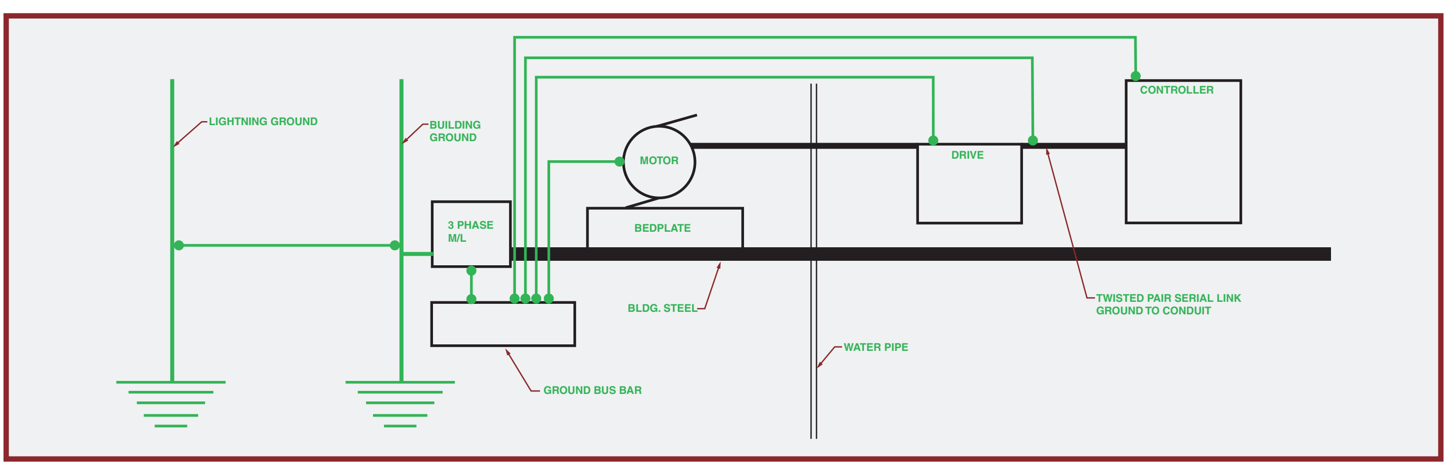
A key concept to understand is "isolated ground." This does not mean a separate ground, it means only that the conduit is isolated from the wires. Conduit is not recommended for grounding to earth since can be changed outside the elevator machine room on its way to a proper earth ground.

Grounding considerations for VVVF drives for AC motor control are similar, except using input reactors instead of a transformer. With AC drives, use four wire-shielded power cables from drive to motor, with the fourth wire providing the controller/motor frame bonding. EMI-filtering components may be required on input and output wiring. Control panel layout should carefully consider the location and wiring of EMI reduction components.

One of the important points of this issue is lightning protection. If all of the elevator equipment is properly wired to a single point earth ground, the voltage of a lightning strike can rise equally over all the equipment. Differential grounding resulting from improper grounding can cause fatal errors.

In the end, this discussion of grounding methods is intended to open a dialogue and to get installers and elevator manufacturers to think beyond the main line disconnect.





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