

# NEC Article 620: Elevators, Part 2

by David Herres

## Learning Objectives

After reading this article, you should have learned:

- ◆ Which locations require separate, dedicated branch circuits
- ◆ Which branch circuits are not to be provided with ground fault circuit interrupter (GFCI) protection
- ◆ Which locations must have one or more duplex receptacles
- ◆ Where overcurrent protection for hoistway, pit and machine-room lighting must be located
- ◆ How unsupported lengths of traveling cables are measured

In Part One of this series (ELEVATOR WORLD, April 2012), we began an examination of National Electrical Code (NEC) 2011 mandates for elevators and related equipment installations. We resume with a look at wiring methods, overcurrent protection, grounding and other NEC provisions as they relate to these installations.

A section on branch circuits for car lighting, receptacles, ventilation, heating and air-conditioning contains a number of important provisions. The basic idea is that there must be a separate, dedicated circuit for car lights, receptacles and ventilation on each car. The branch circuit is to be protected by an overcurrent device located in the machine room, control room/machinery space or control space. The lighting is not to be connected to a GFCI, because the elevator car is not a place that should experience nuisance tripping. A further requirement concerns elevator-car air-conditioning and heating. The branch circuit supplying these units is to be similarly dedicated, with the

associated overcurrent device located in the machine room or similar location.

NEC 2011 also addresses branch circuits for machine room or control room/machinery space or control-space lighting and receptacles. It is mandatory, as in the car, that these items have a separate, dedicated branch circuit, and the required lighting is not to be supplied through a GFCI. It is also essential that machine-room lighting be totally reliable and separate from the machinery supply to facilitate troubleshooting in the event of elevator problems. It is further specified the machine-room lighting switch be located at the point of entry. Furthermore, at least one 125-V, single-phase, 15- or 20-amp duplex receptacle is to be provided in each machine room or similar location. In contrast to the lighting, these receptacles must be connected to GFCI devices.

Another location that requires a separate branch circuit for lighting and receptacle(s) is the hoistway pit. This is the area within the hoistway beneath the car, and there are occasions when elevator technicians have to work in this area for maintenance and troubleshooting. Here again, the lighting is not to be connected to a GFCI, whereas such protection is required for the receptacle(s).

Additional branch circuits are to supply other utilization equipment not covered above. This equipment is restricted to that used in connection with the specific elevator, dumbwaiter, escalator, moving walk, platform lift or stairway chairlift. Overcurrent devices protecting these branch circuits are to be located in the machine room or similar location.

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## Value: I contact hour (0.1 CEU)

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NEC Article 620 Part IV, Installation of Conductors, contains key mandates for elevator wiring. It begins by considering metal and nonmetallic wireways. These are covered for generic, non-elevator specific use in earlier articles, 376 and 378, in Chapter 3, Wiring Methods and Materials. Beginning with Article 320, Armored Cable (Type AC) and concluding with Article 398, Open Wiring on Insulators, each code-sanctioned cable and raceway is treated, ranging from the familiar Type NM (trade name "Romex") to the exotic Integrated Gas Spacer Cable (Type IGS). As we have seen, a limited number of these are approved for elevator locations – car, hoistway, pit and machine room.

Requirements in Article 620 modify the articles in Chapter 3. For example, it is stated that the cross-sectional area of the individual conductors in a wireway are not to exceed 50% of the interior cross-sectional area of the wireway. (Cross-sectional areas of conductors are given in Chapter 9, Tables 5 through 8. Cross-sectional areas of conduits are given in Chapter 9, Table 4. Cross-sectional areas of wireways are found by multiplying the two inte-



Elevator drive motor: note the flexible metallic conduit as permitted to allow for motor vibration.

rior dimensions.) The basic rule for conductor fill of a metal wireway, as given in Article 376, is that the sum of the cross-sectional areas of all contained conductors at a cross section of a wireway is not to exceed 20% of the interior cross-sectional area of the wireway. The same figure applies to nonmetallic wireways. So, we see that for elevator work, greater fill is allowed. The sum of the cross-sectional area of the individual conductors in raceways is not to exceed 40% of the interior cross-sectional area of the raceway, except as permitted for wireways.

Supports for cables or raceways in a hoistway or in an escalator or moving-walk wellway or platform lift and stairway chairlift runway must be securely fastened to the guide rail, escalator or moving-walk truss, or to the hoistway, wellway or runway construction. A raceway that comes loose on the inside of a hoistway could catch on a moving car, causing immense damage and hazard to users.

The next section, 620.36, concerns different systems in one raceway or traveling cable. It is conditionally provided that fiber-optic cables and conductors for operating devices, operation and motion control, power, signaling, fire alarm, lighting, heating and air-conditioning circuits of 600 V or less are permitted to be run in the same traveling cable or raceway system. The condition is that all conductors must be insulated for the maximum voltage applied to any conductor within the cables or raceway system, and all live parts of the equipment must be insulated from ground for this maximum voltage. The traveling cable or raceway is also permitted to include shielded conductors and/or one or more coaxial cables. These must also be insulated for the maximum voltage applied to any conductor within the cable or raceway system. These conductors may be covered with suitable shielding for telephone, audio, video or higher-frequency communications circuits.

Section 620.37 re-emphasizes that only wiring used in connection with the elevator is permitted within the hoistway, machine room, control room/machinery space or control space. This may include wiring for signals, communication with the car, lighting, heating, air-conditioning and ventilation of the car or hoistway for fire-detecting systems and pit sump pumps.

Bonding of elevator rails to a lightning-protection system grounding conductor is permitted, but the conductor itself is not to be located in the hoistway. The code notes that elevator rails or other hoistway equipment are not to be used as the grounding conductor for lightning-protection systems. The elevator rails, like the ground system of the entire building electrical structure, are to be bonded to the lightning-system ground electrode so these all remain at the same potential even during a lightning event, ensuring side flash does not occur.

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Main feeders that supply elevator power must be kept outside the hoistway unless one of the following applies:

- ◆ Feeders for elevators are permitted within an existing hoistway (provided they are not spliced within the hoistway) by special permission of the AHJ.
- ◆ Feeders may be installed within the hoistway where the elevator has a driving-machine motor in the hoistway or on the car or counterweight.

NEC Article 620 Part V, Traveling Cables, is driven by two major issues. First, the traveling cable must be composed of very fine-stranded conductors so it can flex with a minimum of internal stresses, ensuring long service life and reliability. Second, it must be configured so as to eliminate any chance of tangling or chafing against the inner surface of the hoistway or items mounted on it. Additionally, ampacities of the individual conductors and flame-retardant properties of the overall cable are important factors.

It is stated that traveling cables are to be suspended at the car and hoistway ends, or counterweight end where applicable, so as to reduce the strain on the individual copper conductors to a minimum. Traveling cables are to be supported by one of these means:

- ◆ Their steel supporting member(s)
- ◆ Looping the cables around supports for unsupported lengths less than 100 ft.
- ◆ Suspending the cables from the supports by a means that automatically tightens around the cable when tension is increased for unsupported lengths up to 200 ft.

An NEC Informational Note defines unsupported lengths. When the elevator car is at the top landing, it is the length of cable as measured from the point of suspension on the car to the bottom of the loop. With the elevator car at the bottom landing, it is the length of cable as measured from the point of suspension in the hoistway to the bottom of the loop. Thus, the traveling cable must be supported by a steel supporting member.

Traveling cables are to be approved for hazardous locations and must comply with the appropriate sections for each hazardous-location class that covers use of flexible cords. (To design and install an elevator for a Class I, Division 1 location would be quite an undertaking.)

Section 620.43, Location of and Protection for Cables, provides that traveling cable supports are to be located so as to reduce the possibility of damage due to the cables coming in contact with the hoistway construction or equipment in the hoistway to a minimum. Where necessary, it is mandated that suitable guards be provided to protect the cables against damage. Because they need to move and flex, traveling cables are not required to be in a raceway. They are permitted to be run without raceway when used inside the hoistway, on the elevator car, hoist-

way wall, counterweight, or controllers and machinery located inside the hoistway, provided they are in their original sheaths. The traveling cable, moreover, may be run without raceway from inside the hoistway to elevator-controller enclosures and to the elevator car and machine room and similar locations outside the hoistway for a distance not exceeding 6 ft. The conductors must be in their original sheaths or grouped together and taped or cored.

NEC Article 620 Part VI, Disconnecting Means and Control, is rather exacting. It is of great importance that power to the various elevator functions can be quickly and reliably removed from the loads in case of emergency or for maintenance and troubleshooting. Of particular importance is the location of the disconnecting means so it can be found by an individual who may not be familiar with the installation. A single means for disconnecting all ungrounded main power-supply conductors is required and must be designed so no pole can be operated independently. Where multiple driving machines are connected to a single elevator, there is to be one disconnecting means to disconnect the motor(s) and control-valve-operating magnets.

It is important, where mandated, that there be no more than a single disconnecting means, so if emergency action is required, first responders will not be able to power down the equipment from one location. It is further stated that the disconnecting means are not to disconnect the branch circuits required in sections 620.22, 620.23 and 620.24. These are the individual branch circuits required for car lighting, receptacles, auxiliary lighting and ventilation on each elevator car; individual branch circuits for machine-room and similar location lighting and receptacle; and branch circuits for hoistway pit lighting and receptacle(s).

The disconnecting means is to be an externally enclosed, operable, fused motor circuit switch or circuit breaker capable of being locked in the open position. The locking capability is important so during maintenance, the equipment will not be inadvertently energized. The disconnecting means is also to be a listed device. It is further stressed that no provision is to be made to open or close the disconnecting means from any other part of the premises. Notwithstanding, if sprinklers are installed in hoistways, machine rooms or the like, the disconnecting means is permitted to automatically open the power supply to the affected elevator(s) prior to the application of water. No provision is to be made to automatically restore power.

NEC Article 620 contains numerous other disconnect provisions, which must be carefully scrutinized prior to design work so the installation is compliant. Besides the power-supply disconnect discussed, it is provided that

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Elevator power disconnect (with utility feed marking) located in the machine room or other permitted location

elevators have a single means for disconnecting all ungrounded car lights, receptacles and ventilation power-supply conductors for that elevator car. The disconnecting means is to be in the machine room or similar location, with provision for being locked in the open position. Similar provisions are attached to elevator-car heating and air-conditioning disconnecting means, and to other utilization equipment.

Part VII, Overcurrent Protection, divides this topic into four categories for elevators and similar equipment, depending upon the nature of the specific equipment:

- ◆ For operating devices and control and signaling circuits, protection against overcurrent is in accordance with the requirements of Sections 725.43 and 725.45. These are part of Article 725, Class 1, Class 2 and Class 3 Remote-Control, Signaling, and Power-Limited Circuits. The article stands apart from the rest of the code in the sense it exempts these categories of circuits from the general requirements for wiring in most occupancies, found in Chapter 3. Specifically, Section 725.43 provides that overcurrent protection for conductors 14 AWG and larger is to be provided in accordance with the conductor ampacity without applying ampacity adjustment and correction factors. Section 725.45 concerns the location of overcurrent devices and provides for feeder and branch-circuit taps, transformer primary side overcurrent device location and overcurrent device location at the input side of electronic power sources.
- ◆ Overload protection for motors is to conform with Article 430, Part III, the general code area that covers motor and branch-circuit overload protection for all motors. Additionally, duty on elevator and dumbwaiter motors

is rated as intermittent, whereas duty on escalator and moving-walk motors is considered continuous. For platform lifts and stairway chairlifts, the duty is intermittent.

- ◆ Motor feeder short circuit and ground-fault protection must be as required in Article 430, Part V for all motors.
- ◆ Similarly, motor branch-circuit short circuit and ground-fault protection must be as required in Article 430, Part IV, for all motors.

Section 620.62, Selective Coordination, is central to multi-elevator installations and must be closely observed. It provides that where more than one driving-machine disconnecting means is supplied by a single feeder, the overcurrent protective devices in each disconnecting means are to be selectively coordinated with any other supply side overcurrent protective devices. Proper selective coordination in a multi-elevator installation on the same feeder ensures if one elevator develops a fault, the other units will not be shut down.

Part VIII, Machine Rooms, Control Rooms, Machinery Spaces, and Control Spaces, states elevator and similar-installation driving machines, motor-generator sets, motor controllers and disconnecting means are to be installed in a room or space set aside for that purpose. This room is to be secured against unauthorized access (kept locked). In case of emergency, electricians, maintenance personnel and any elevator technicians called in to the premises should have ready access to the key.

Motor controllers are permitted outside the spaces specified above. They must be in enclosures with doors or removable panels that can be locked in the closed position. The disconnecting means is to be located adjacent to or an integral part of the motor controller. If the disconnecting means is an integral part of the motor controller, it is to be operable without requiring opening of the enclosure. Elevators with driving machines located on the car or counterweight, or in the hoistway are permitted outside the specified spaces.

Part IX, Grounding, states that metal raceways, Type MC cable, Type MI cable or Type AC cable attached to elevator cars are to be bonded to metal parts of the car bonded to the equipment grounding conductor. (All intentionally grounded elements must be held at equal potential.) Both electric and nonelectric elevators are to comply with Article 250, the code article that covers grounding and bonding in general.

Section 620.85, GFCI Protection for Personnel, provides that 125-V, single-phase, 15- and 20-amp receptacles installed in pits, hoistways, machinery spaces, machine rooms, escalators and moving walks, and on elevator car tops are to be GFCIs. A single dedicated receptacle sup-

plying a permanently installed sump pump does not have to be a GFCI type.

Part X, Emergency and Standby Power Systems, is simple and straightforward. It states an elevator is permitted to be run by an emergency or standby power system. For elevators that regenerate power back into a power source unable to absorb the regenerative power under overhauling elevator load conditions, a means to absorb this power is to be provided. Other building loads, such as power and lighting, may function as the energy absorbing means, provided these loads are automatically connected to the emergency or standby power system operating the elevators and large enough to absorb the regenerative power.

The disconnecting means must disconnect the elevator from the emergency, standby and normal power systems.

These are the principle NEC 2011 Article 620 mandates. Adhering to the requirements will ensure a hazard-free electrical installation. Other codes and standards interact with the NEC, and it is necessary to see how they all work together in order to create safe and compliant elevator designs/installations.



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- ♦ Which equipment requires a separate branch circuit in the elevator car?
- ♦ Is lighting required to be GFCI protected in the machine room?
- ♦ Where is the lighting switch to be located in the machine room?
- ♦ What is the maximum raceway conductor fill in an elevator hoistway?
- ♦ How many disconnecting means are required for an elevator power supply?



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1. Which location(s) require dedicated lighting branch circuits?
  - a. Car.
  - b. Machine room.
  - c. Hoistway pit.
  - d. All of the above.
2. Which location does not require a 125-V, single-phase, 15- or 20-amp duplex receptacle?
  - a. Car.
  - b. Machine room.
  - c. Hoistway pit.
  - d. None of the above.
3. Traveling cables are to be suspended by:
  - a. Their steel supporting members.
  - b. Looping the cables around supports for unsupported lengths less than 100 ft.
  - c. Suspending from the supports by a means that automatically tightens around the cable where tension is increased for unsupported lengths up to 200 ft.
  - d. Any of the above.
4. Traveling cables may be installed without raceway:
  - a. Inside the hoistway.
  - b. Outside the hoistway.
  - c. Neither.
  - d. Both, under certain conditions.
5. If sprinklers are installed in the hoistway:
  - a. The disconnecting means is to be omitted.
  - b. The disconnecting means may be automatic.
  - c. Both of the above.
  - d. Neither of the above.
6. Only wiring associated with the elevator is permitted within the:
  - a. Hoistway.
  - b. Machine room.
  - c. Control room/machinery space.
  - d. All of the above.
7. Bonding of elevator rails to lightning down conductors is:
  - a. Prohibited.
  - b. Required.
  - c. Optional.
  - d. Asking for trouble.
8. Disconnecting means for car lighting:
  - a. Is not required.
  - b. May be located at the building entrance panel.
  - c. Is usually located in the car.
  - d. Is required to be in the machine room.
9. Motor overload protection:
  - a. Is covered in Article 430.
  - b. Is required for over 25 hp only.
  - c. Takes the place of branch-circuit, short-circuit and ground-fault protection.
  - d. Is always built into the motor.
10. For elevators that regenerate power back into the power source:
  - a. A separate means is sometimes required to absorb excess power.
  - b. The power has to be separately metered by the utility.
  - c. Other building loads, such as power and lighting, are prohibited from absorbing the excess.
  - d. All of the above.

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