(B) Portable Electric Equipment.

This section applies to the use of cord- and plug-connected equipment, including cord sets (extension cords).

(1) Handling.

Portable equipment shall be handled in a manner that will not cause damage. Flexible electric cords connected to equipment shall not be used for raising or lowering the equipment. Flexible cords shall not be fastened with staples or hung in such a fashion as could damage the outer jacket or insulation.

All electrical equipment that receives its energy through a cord/plug/receptacle and is easily moved from one position to another is considered to be portable electric equipment. For instance, a drill motor, which is connected by a cord and plug, is portable and covered by the requirements of this section. Although a battery-operated drill motor is not covered by the requirements of this section, this section covers the battery charger that provides energy to the battery unless it is permanently wired in a fixed position.

Moving or lifting the flexible equipment by the cord often damages the cord. Flexible cords are constructed to resist damage from use; however, the damage sometimes occurs if the portable cord is placed in a fixed position and held in place by staples or similar devices that tend to crush or abrade the cord. When a portable cord is installed through a doorway, it is subjected to crushing when the door closes. When necessary to install a portable cord through a doorway, the door should be blocked from closing to prevent the cord from being pinched if the door should close.

Employees could be tempted to move cord-connected portable equipment by holding the cord and pulling the cord cap from a receptacle by grasping the cord instead of the cord cap. Practices such as these often damage the cord and expose conductors, so these practices must be discouraged.

Flexible cords connected to portable equipment and extension cords must be protected from potential damage when in use. When installing supports for
flexible cords, employees must avoid support mechanisms that might damage the insulation.

(2) Grounding-Type Equipment.

(a) A flexible cord used with grounding-type utilization equipment shall contain an equipment grounding conductor. Including a grounding conductor in the supply conductor is one primary protective measure to prevent exposure to shock and electrocution. Double insulation is another protective measure. Either of these protective measures provides significant protection from shock or electrocution. Ground-fault circuit-interrupters (GFCIs) are another primary protective measure that is discussed in a later section. Unless the portable equipment is rated as double insulated, the cord supplying the energy must include a grounding conductor. The plug must be a grounding-type attachment plug and the receptacle must be a grounding-type receptacle.

The grounding conductor is an integral part of the safety system built into equipment by manufacturers for tools and devices that are not double insulated. The integrity of the grounding conductor is paramount to minimizing the chance that an employee becomes a part of the electrical circuit providing power to the tool. Each person must visually inspect the tool before it is used. Any defect, such as a cord cap with a missing or damaged ground pin, is a sufficient indication to cause the tool to be removed from use. If a defect is found in the visual inspection, the tool must be removed from service until it is repaired and the integrity of the flexible cord reaffirmed.

Grounding conductors are not required on tools that are rated by the manufacturer as double insulated. These tools are required to be inspected for indication of damage.

(b) Attachment plugs and receptacles shall not be connected or altered in a manner that would interrupt continuity of the equipment grounding conductor.

Additionally, these devices shall not be altered in order to allow use in a manner that was not intended by the manufacturer. Since the grounding conductor is a primary protective measure, the integrity of the grounding conductor is important. All components of the circuit must provide
the same integrity as the grounding conductor. Plugs and receptacles are constructed, tested, and listed for specific use. Altering the plug (or receptacle) in a manner not intended by the manufacturer destroys the integrity of the grounding conductor. Employees sometimes remove the grounding pin on a plug or twist the hot and neutral pins to enable the plug to mate with a different receptacle. Either of these actions is prohibited by this requirement.

(c) Adapters that interrupt the continuity of the equipment grounding conductor shall not be used. Employees sometimes field-fabricate an adapter by installing a plug of one construction on one end and a cord cap of a different construction on the other to enable portable equipment or cord to mate with a receptacle of different configuration. This practice must be avoided.


By their nature, cords and plugs installed on portable electric equipment are subjected to use and subsequent damage. When the cord or plug is damaged, the employee might be exposed to shock or electrocution by a fault in the equipment, a damaged grounding conductor, or by damage to the insulation on the circuit conductors. Although a visual inspection might not identify all possible problems, a thorough visual inspection provides significant assurance that the integrity of the cord will function as intended.

When performing the inspection, the employee should visually observe each end of the cord or cord set and ensure that all pins are in place and unmodified. The employee then should begin at one end and run his or her hand along the complete surface of the cord to the other end. The surface should be smooth with no indentations, cuts, or abrasions. Any indentation, cut, or abrasion should be inspected further to ensure that the full insulating quality of the cord is complete. Indentations from crushing or pinching should trigger further inspection to ensure that conductivity of the grounding conductor is complete.

(a) Frequency of Inspection. Before each use, portable cord- and plug-connected equipment shall be visually inspected for external defects (such as loose parts or deformed and missing pins) and for evidence of possible internal damage (such as a pinched or crushed outer jacket). Cords and plugs can be damaged while in storage or while being moved from one
position to another. The cord and plug must be visually inspected to identify any damage before being energized for use. See Exhibits 110.4 and 110.5.

Exception: Cord- and plug-connected equipment and flexible cord sets (extension cords) that remain connected once they are put in place and are not exposed to damage shall not be required to be visually inspected until they are relocated.

Cords that supply equipment other than portable equipment such as a water cooler (NEC 2011 Section 422.52 requires GFCI on water coolers), drill press, or computer terminal should be inspected when installed. Although no additional inspection is required until the equipment is moved to another location, periodic inspection of the grounding conductor integrity is recommended.

(b) Defective Equipment. If there is a defect or evidence of damage that might expose an employee to injury, the defective or damaged item shall be removed from service, and no employee shall use it until repairs and tests necessary to render the equipment safe have been made. When a defect is identified in portable electric equipment or a cord set, the equipment or cord set must be removed from service. A tag or other method that identifies the equipment or cord set as defective should be attached. The tag or label should warn personnel that the equipment or cord set should not be used. The warning should remain with the equipment or cord set until repairs have been completed and the operability of the equipment or cord set has been verified by testing.

The integrity of the grounding conductor of any portable or cord-connected tools and devices must be verified by tests prior to returning the tool or device to service. The integrity of the insulating system for double-insulated tools must be verified by tests after repairs have been made.

(c) Proper Mating. When an attachment plug is to be connected to a receptacle, the relationship of the plug and receptacle contacts shall first be checked to ensure that they are of mating configurations. When cord-and-plug-connected equipment is placed into service, the pin
configuration of the plug must match the configuration of the receptacle. Pins must not be damaged or removed. Attachment devices that permit the installation of devices with pin configurations that do not match must ensure the integrity of all connecting pins of the cord cap.

Moisture can provide a conducting path from the hot conductor in a cord cap to the surface of the device. A person inserting a wet cord cap into an energized receptacle is exposed to a shock hazard. The person handling the wet cord cap must be wearing PPE that is rated at least as great as the circuit voltage. If the cord-connected equipment is subject to moisture ingress, a listed GFCI must protect the cord. Some work environments could contain another conductive compound. A GFCI must protect any cord-connected equipment or device installed in these areas.

(d) Conductive Work Locations. Portable electric equipment used in highly conductive work locations (such as those inundated with water or other conductive liquids), or in job locations where employees are likely to contact water or conductive liquids, shall be approved for those locations. In job locations where employees are likely to contact or be drenched with water or conductive liquids, ground-fault circuit-interrupter protection for personnel shall also be used.

Any conductive path from a person’s hand to an energized conductor exposes that person to shock or electrocution. A person standing in water or other conductive material must wear adequate insulating gloves when removing the plug from an energized receptacle. If the environment contains highly conductive compounds, gloves with adequate voltage rating are required. If the receptacle or plug is wet from water or other conductive material, adequately rated gloves are required.

Interior work locations that are wash-down areas should be considered conductive unless the possibility of moisture does not exist. The best option is to use a GFCI installed at the supply end of the cord set or portable cord-connected equipment if the equipment is plugged directly into a permanently installed receptacle.

As noted previously, if the cord-connected equipment is used outdoors, it
is subject to moisture ingress and a listed ground-fault circuit-interrupter must protect the cord. Some work environments could contain another conductive compound. A GFCI must be used to protect any cord-connected equipment or device installed in these areas.

Informational Note: The hazard/risk evaluation procedure could also include identifying when the use of portable tools and equipment powered by sources other than 120 volts ac, such as batteries, air, and hydraulics, should be used to minimize the potential for injury from electrical hazards for tasks performed in conductive or wet locations.

(4) Connecting Attachment Plugs.

(a) Employees’ hands shall not be wet when plugging and unplugging flexible cords and cord- and plug-connected equipment if energized equipment is involved.

Moisture can provide a conducting path from the hot conductor in a cord cap to the surface of the device. An employee inserting a wet cord cap into an energized receptacle is exposed to a shock hazard. The employee handling the wet cord cap must be wearing PPE that is rated at least as great as the circuit voltage.

Any conductive path from an employee’s hand to an energized conductor exposes that employee to shock or electrocution. If the employee is standing in water or covered by another conductive material, he or she must wear adequate insulating gloves when removing the plug from an energized receptacle.

(b) Energized plug and receptacle connections shall be handled only with insulating protective equipment if the condition of the connection could provide a conductive path to the employee’s hand (for example, if a cord connector is wet from being immersed in water).

Any conductive path from an employee’s hand to an energized conductor exposes that employee to shock or electrocution. An employee standing in water or other conductive material must wear adequate insulating gloves when removing the plug from an energized receptacle. If the environment contains highly conductive compounds, gloves with adequate voltage rating are required. If the receptacle or plug is wet from water or other conductive material, adequately rated gloves are required.
(c) Locking-type connectors shall be secured after connection. Some attachment plugs are intended to be held in place mechanically by twisting the plug after the conducting pins have been fully inserted into place. Other forms of mechanical interlocks also are available. Any interlocking mechanism provided by the manufacturer should be secure after the connection is complete.

Locking-type plugs and receptacles, such as the Twist-lock® plug system shown in Exhibit 110.6, and some other portable cord-connecting devices are designed to provide a connection that is secure from accidental withdrawal. Devices that provide the additional security must be inserted so that the design intent of the device is complete. For instance, these plugs must be turned to the secure position.