WorkSafe Bulletin

Using ground-fault circuit interrupters (GFCIs) in the motion picture production, television production, live venue, and performing arts industries

Ground-fault circuit interrupters (GFCIs) have saved thousands of lives. After GFCIs were adopted in Canada more than 40 years ago, the number of people who have died from electrical contact has dropped from more than 800 a year to fewer than 200.

What is a Class A GFCI?

A Class A GFCI is a device that detects current leakage in an electrical circuit and interrupts the circuit whenever the current leakage is between 4 and 6 milliamperes (mA). Class A GFCIs are limited to 120-volt systems. They react in a predetermined time to shut off power to the electrical device.

Why are GFCIs important for temporary and outdoor work?

Temporary electrical systems provide power for live performances and motion picture productions. Per the Occupational Health and Safety (OHS) Regulation, GFCIs are always required outdoors because weather conditions can change rapidly.

You are required to use GFCIs for 15- and 20-amp-rated receptacles when they are installed outdoors or in a wet or damp location. Keep this in mind when planning to ensure the appropriate electrical equipment is budgeted for, secured, and installed safely.

Technical Safety BC offers certification for generator operators (genny ops) as "full entertainment field safety representatives." Genny ops are qualified to supervise the installation and use of temporary electrical systems.

If the outdoor equipment isn't protected by GFCIs and a fault occurs, workers may be at risk of serious or fatal injuries. If GFCIs are not installed and an incident occurs, it could pose significant liabilities for the employer, production manager, and workers such as the genny op.

What is the hazard?

GFCIs are designed to save people's lives during inadvertent electrical fault incidents. The design is based on two thresholds:

- *Let-go threshold* is the maximum value of the touch current at which a worker can let go of the electrical equipment.
- *Fibrillation threshold* is the minimum value of the touch current through the body that causes ventricular fibrillation.

Most adults will be able to let go if their fingers are wrapped around an energized piece of equipment with a current of less than 6 mA. In the 9 to 22 mA range, more than 99 percent of adults will not be able to let go. If a person can't break free from an electrical contact, the skin's contact resistance is a factor limiting the flow of the touch current through the body.

The severity of an electric shock injury depends on the amount of touch current and the length of time the current passes through the body. Higher amounts of current can cause severe electrical burns and tissue damage. Even small currents (60 to 100 mA) can cause heart failure, unless the power is interrupted.

When do I have to use GFCIs?

Under the OHS Regulation, GFCIs must be used in certain situations unless another acceptable means of protection is provided. Class A GFCIs must be installed at the receptacle or on the circuit panel for 120-volt, 15-amp, and 20-amp portable electrical equipment when used:

- Outdoors, rain or shine
- Indoors in wet or damp locations

The risk of receiving an electrical shock from powered equipment such as lights, tools, fans, or heaters increases when using the equipment outdoors or in wet or damp environments.

If a Class A GFCI isn't installed, water or moisture in contact with the energized conductors within equipment can cause the entire piece of equipment to become energized. Water and moisture in the equipment will cause the current to flow to ground by a path other than the ground conductor of the circuit, such as through a person.

How can I use GFCIs effectively?

GFCI response times range from 0.15 seconds at 30 mA to 1.5 seconds at 6 mA. As the fault current increases, the response time decreases to ensure that let-go and fibrillation thresholds are not exceeded.

Multiple pieces of equipment

GFCIs with fast response times are more likely to trip when placed within an electrical distribution system that provides power to multiple pieces of equipment. This is because the GFCI monitors the current leakage of all the equipment added together. You are less likely to experience GFCI tripping if each piece of equipment is protected by a separate GFCI. Each GFCI only monitors the current leakage from one piece of equipment, which makes it easier to quickly investigate and correct tripping issues.

Nuisance tripping

Although WorkSafeBC recognizes industry concerns and challenges regarding the effective use of GFCIs, nuisance tripping is not accepted as a reason for not using them. GFCIs trip at the let-go and fibrillation thresholds to protect human life.

Non-linear loads

Some equipment, such as electronic lighting ballasts, pull non-linear loads from electrical systems. Tripping is likely to occur if you use GFCIs with fast response times because the GFCI reads the non-linear load as current leakage. Use GFCIs with response times of at least three seconds or install filters with this equipment.

Continuous measuring and monitoring indicators

Some manufacturers build current measuring and monitoring indicators into their GFCI products, or include them with the product, so you can monitor circuit and equipment leakage.

What types of GFCIs can I use?

Your application will determine the type of GFCI system and the type of GFCIs you should use. GFCI systems can be set up with blanket, branch, or tiered protection. The following GFCI types are commercially available:

- GFCI circuit breakers
- GFCI duplex receptacles
- GFCI portable adapters
- Portable power distribution units with GFCI
- GFCI quad strings
- Equipment with integrated GFCI

Employer responsibilities

Different rules apply for different situations and equipment. Devices have different classes and ratings. Employers must understand this and mitigate the hazards of electricity by doing the following:

- Use trained, qualified, and certified workers.
- Follow established procedures that comply with applicable regulations and codes.
- Conduct a risk assessment.
- Use equipment that is in good condition, approved for its use, and appropriate for the work environment.

How can I prevent nuisance tripping?

To prevent nuisance tripping of GFCIs, consider the following work practices:

- Plan for the safety requirements that apply to electrical equipment, including the use of GFCIs.
- Make sure your intended generators, distribution cords, lighting, and GFCI devices are all compatible.
- Make sure the equipment is rated for use outdoors and in wet environments.
- Make sure the generator has bonded neutral wiring. Ground the generator as required by the manufacturer and the BC Electrical Code.
- Inspect all components of the equipment carefully. Don't use damaged equipment.
- Test equipment after set-up and before use to ensure it operates as designed.
- Consider where GFCIs will be located in the circuit (blanket, branch, or tiered protection).
- Keep cable connections clean and dry.
- If practicable, keep equipment and connections off the ground.
- Cover equipment and tools with suitable protection.
- Avoid touching energized, wet electrical equipment. Turn off power when making adjustments. Don't unplug connectors under load.
- Have a provision for storing equipment in a dry location when not in use (e.g., overnight).
- Contact the rental company and/or equipment manufacturer for equipment guidance.

For more information

Refer to section 19.15(1) of the OHS Regulation, and to G19.15(1)-1 of the OHS Guidelines.

More information and resources are available on the following pages on worksafebc.com:

- Electricity
- Motion picture & television production
- Performing arts

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