GROUND FAULT PROTECTION METHODS

2014 & 2017 National Electric Code

legrand®

Ground Fault Protection Methods

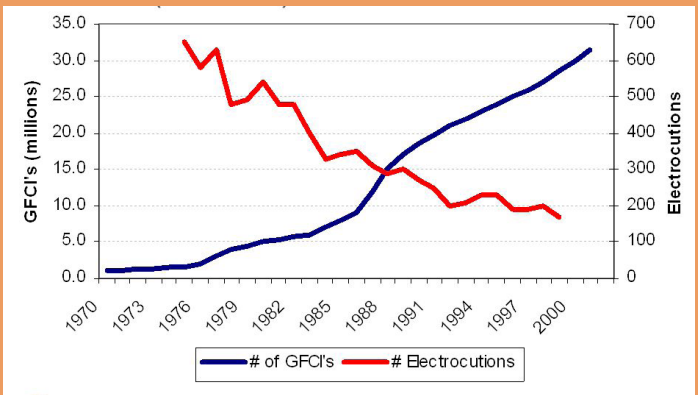
A Ground Fault Circuit Interrupter, or GFCI, is a device that functions to de-energize a circuit when it senses the potential risk of electric shock. GFCIs are very sensitive, and will trip when sensing an abnormal difference of current in excess of 4-6 milliamps – significantly below the level that would cause injury to a healthy person. For example, if you are using a hairdryer in your bathroom, the hairdryer is typically drawing 15 amps from the GFCI receptacle, all the while comparing current on the hot wire with current on the neutral wire. If the GFCI senses the same current level, up to 15 amps, on both the hot and neutral wires, the face and feed-through output circuits remain connected, allowing the hairdryer to function normally. If the hairdryer is dropped into a sink full of water, then current can escape through the water as a path to ground. This creates an imbalance in the current on the hot versus the neutral wire, and would typically result in an electrical incident or possible electrocution. With a GFCI device installed, power to the hairdryer would instantly be shut off upon the sensing of an imbalance in the current.

History

In 1961, Charles Dalziel, a professor of electrical engineering and computer sciences at UC Berkeley, invented the concept of ground fault circuit interruption while studying the effects of electricity on humans and animals. In 1972, Pass & Seymour became the first company to commercialize and market this concept with the introduction of the GFCI receptacle, making users' lives safer and easier with simple test and reset functions available directly at the point of use.

In the early 70's, GFCIs were initially required for underwater light fixtures in swimming pools, at construction sites, and outdoors in residential dwellings. As the life-saving benefits of GFCIs became more apparent, the National Electric Code (NEC) added requirements for these devices in kitchens and bathrooms, garages, marinas and boatyards, near spas and hot tubs, on rooftops, and more. According to the Electrical Safety Foundation, GFCIs have saved thousands of lives and have helped cut the number of home electrocutions in half since their introduction in the 70s.[i] Before the installation of GFCIs, nearly 700 people died annually from household electrocutions. Now, less than 200 people die annually from household electrocutions.[ii]

Electrocutions Associated with Consumer Products (US data)



Code Requirements

The National Electrical Code is updated every three years. These updates can make it a challenge for electricians to stay current with the latest requirements. The 2014 and 2017 versions of the National Electrical Code require both Arc Fault and Ground Fault protection on all kitchen and laundry circuits.

GFCI Solutions for Meeting Code in Kitchens and Laundry Rooms

Contractors and electricians have several solutions that adhere to National Electrical Code requirements for kitchens and laundry rooms: One option is the Dual Function AFCI/GFCI Breaker; the other is to pair an AFCI circuit breaker with a GFCI receptacle. Here we explore both options, addressing the application and pros and cons of each.

Solution 1: Dual Function Breaker

Developed in 2014 , Dual Function breakers combine both AFCI and GFCI into a product that is still unproven. Dual Function breakers are typically installed in the service panel and located in the basement or garage.

PROS:

- One device does it all.

- If the breaker is labeled properly, it is easy for users to determine the area to be reset.

CONS:

- Usually installed in a remote location such as a basement, breakers are more of a challenge to access. For seniors, people with disabilities or parents watching small children, going to the breaker panel due to a loss of power and/or lighting is a problem.

- No failure indication at the point-of-use: trips can easily go unnoticed, leading to bigger problems, like power loss in sump pumps, refrigerators, freezers, or air conditioning condensate pumps. This can result in flooded basements or even more expensive property damage.

- Breakers can be confusing and unfamiliar to some homeowners, making it difficult to determine reasons for power loss.

- Dual Function breakers are only required to respond to 5 of 7 End of Life events: End of Life is defined by UL as when a GFCI is incapable of providing ground fault protection and fails to pass its internal test function.

- Dual Function breakers trip for a variety of reasons, allowing more opportunities for power loss. This relatively new technology has resulted in a growing number of inconclusive nuisance trips which is worrisome especially as today's appliances become more and more electrically sophisticated.

Solution 2: GFCI Receptacle with AFCI Breaker

On kitchen and laundry room circuits, GFCI receptacles can be installed along with an AFCI circuit breaker, to provide easy reset available at the point of use. GFCI receptacles are designed to protect other non-GFCI outlets downstream for an added layer of safety.

PROS:

- It is easy to see and easy to reset trips with GFCI receptacles, because the controls are available at the point of use. 86% of electrical contractors surveyed said GFCI receptacles installed in the living space are more accessible than Dual Function breakers.

- Required by UL to respond to 7 out of 7 End of Life events, GFCI receptacles meet a higher standard of protection than GFCI breakers.

- GFCI receptacles only trip for ground faults – Dual Function breakers trip for many reasons. 88% of electrical contractors surveyed said that it's easier to troubleshoot a ground fault trip when using an AFCI breaker and GFCI receptacle than a Dual Function AFCI/GFCI circuit breaker.

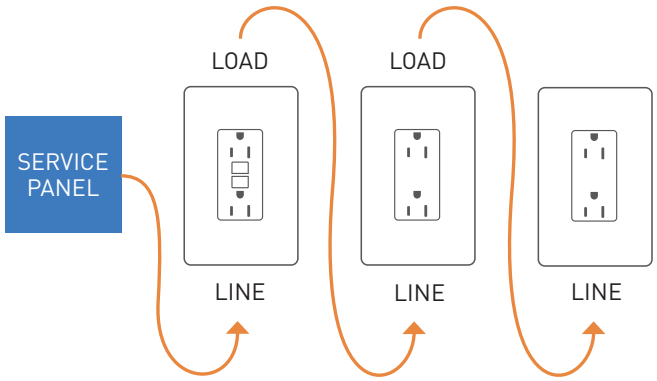
- GFCI receptacles are located at the point of use and have an easy-to-see trip indicator light. When a ground fault occurs, it is likely that a homeowner will be able to figure out why they lost power, unplug the tool or appliance, and reset the receptacle. They are less likely to have to call the contractor back to the job.

CONS:

- Features two components: GFCI receptacle and AFCI breaker.

- Not for use in areas you cannot see, i.e., behind refrigerators.

For installation convenience, GFCI receptacles can be wired to protect ordinary outlets downstream.



Ground fault trips can be problematic for homeowners and costly for contractors. GFCI receptacles are a proven, reliable method of protection, easier to install and troubleshoot, with fewer callbacks than Dual Function breakers. Using AFCI breakers combined with GFCI receptacles, electrical contractors can minimize call backs while sufficiently meeting code. When trips do occur, GFCI receptacles make it easier to resolve issues with devices that reset at the point of use, not hidden in the electrical box. Quicker issue resolution reduces call backs, saving contractors time and money.

[i] www.esfi.org/resource/ground-fault-circuit-interrupters-gfci-204

[ii] **Understanding GFCIs, 2012. NEMA:** www.nema.org/Products/Documents/NEMA-GFCI-2012-Field-Representative-Presentation.pdf