U.S. Consumer Product Safety Commission
Engineering Staff Position Paper
on
Ground-Fault Circuit-Interrupters (GFCIs):
Major Upgrades to the Standard are Needed
April 20, 2001

The purpose of this paper is to provide the Standards Technical Panel (STP) for Ground-Fault Circuit-Interrupters with the views of the U.S. Consumer Product Safety Commission (CPSC) staff on proposals to improve the safety standard for Ground-Fault Circuit-Interrupters, UL 943.

Recent field data indicate the need to upgrade the standard for GFCIs. A nationwide survey conducted by the National Electrical Manufacturers Association and reported to the STP in January 2001 indicated that a significant percentage of installed GFCIs are inoperable. The study identified the primary causes of GFCI failure as being power surges that damage sensitive electronic parts within the GFCI, or corrosion from the effects of weather-related conditions such as dampness. In addition, the study found that receptacle GFCIs are often installed incorrectly – by unintentionally reversing the wiring to the line and load terminals – leaving the consumer unknowingly without shock protection at the GFCI outlet.

With GFCIs that are currently in use, the consumer has little or no indication when a GFCI is inoperable. Failed GFCIs can continue to provide power without shock protection. Even if failure is accompanied by a GFCI trip, the user can manually reset the failed device, restoring power but without shock protection. The user would only be aware that the GFCI was not functioning properly if they pushed the test button after resetting the tripped device and detected the no-trip condition. In addition, receptacle GFCIs installed incorrectly (line-load reversal) may respond to pushing the test button with a trip, providing the consumer with the sense that the receptacle is operating properly. However, such miswired GFCIs provide no protection at the receptacles of the GFCI itself.

The CPSC staff supports the efforts of Underwriters Laboratories Inc. (UL) and the industry to revise UL 943 to enhance the performance of GFCI devices. These efforts, with some agreement among STP members, include addressing the installation of GFCIs in humid or wet locations and enhancing their resistance to electrical surges. However, while improving surge resistance and increasing protection against hostile

environmental conditions are important and needed additions, they are not sufficient. Given the results of the field study regarding the failure of GFCIs, CPSC staff believes that the STP should take additional steps to improve GFCI test functions to provide ground fault protection more reliably. Otherwise consumers may never know that they have an unprotected electrical outlet.

The standard should incorporate new requirements that recognize fundamental design improvements to enhance GFCI effectiveness. With today's improved technology, such as the application of microprocessors and other innovative designs, GFCIs can now be designed and manufactured to be much more reliable and to reduce the reliance on consumers to determine if the shock protection capability is functioning properly. GFCIs should provide electric power only when shock protection is also provided. New requirements need to be introduced into the standard to overcome present limitations.

GFCIs should be required to deny power when the reset mechanism has been actuated and the GFCI is inoperable. For receptacle-type GFCIs, the requirement should also address the potential hazard associated with miswired GFCIs (line-load reversal). This requirement should have the earliest effective date for receptacle-type GFCIs since such "lock-out" technology has already been demonstrated. Power denial technology in some form should become a basic requirement for all GFCIs, including circuit breaker and portable types, with an effective date that allows for developing appropriate, cost-effective designs.

In addition to provisions for the lockout requirements, the CPSC staff believes that the standard should also be revised to include provisions in anticipation of other product enhancements that have been discussed in the STP, such as built-in GFCI reminder signals for periodic testing, and automatic self-testing combined with lockout. Such enhancements should be given a distinctive designation of their own to permit consumers, installation designers, and jurisdictions to select the GFCI with features to best suit their needs.

The use of audible and visual indicators to alert consumers to a failed GFCI was evaluated, but alerts may not be effective if a GFCI is located in a panel box or other upstream location that is not near the outlet the consumer is using. Furthermore, as noted in the American Institutes for Research study that was distributed to the STP members, visual indicators are often confusing and are not as effective as denying power for inoperable GFCIs.

The CPSC staff evaluated arguments against the power denial feature that were put forward to the STP. Some believe that consumers may not use or test GFCIs if the possibility of power denial exists. CPSC staff experts on human factors believe that most consumers will test GFCIs without regard to a perceived outcome of the test (including possibly losing power).

Other arguments presented to the STP criticized the power denial feature as an inconvenience that could cause consumers to bypass an out-of-service GFCI by switching to another circuit, perhaps a circuit without the benefit of GFCI protection. This argument is speculative and without substantiation. What is not speculative is that these products are currently failing in an unsafe manner and something must be done to address this in the standard. In addition to the standard, CPSC staff will continue to advocate requirements in electrical codes for GFCI protection for all general purpose receptacle outlets located inside and outside of residential properties and schools, around swimming pools and within places of temporary lodging and public assembly. Such requirements would allow consumers to readily switch from a circuit with an inoperable GFCI to another circuit with a functional GFCI, and therefore retain shock protection.

In summary, the CPSC technical staff believes that major upgrades to the standard are needed. These upgrades should include requirements to address resistance to electrical surges, resistance to effects of wet locations, miswiring, and provisions to require that GFCIs cannot be reset if the GFCI is not operable. By adding these provisions to the standard, the effectiveness of the GFCI can be greatly enhanced and additional lives can be saved.

The views in this paper are those of the technical staff and have not been reviewed by the Commission.