

Compatibility Between Smoke Alarms and Arc Fault Circuit Interrupters Why Smoke Alarm Power Circuits Should Not Be Exempt

Retain for future use.

Background

The 2014 National Electrical Code (NEC®) requires arc-fault circuit interrupter (AFCI) protection for all 15 and 20 ampere branch circuits that supply outlets or devices in dwelling unit kitchens, family rooms, dining rooms, living rooms, parlors, libraries, dens, bedrooms, sunrooms, recreation rooms, closets, hallways, laundry areas, or similar rooms or areas. This requirement includes the circuit that supplies the smoke alarm located in these rooms or areas.

NEC Code Making Panel 2 has addressed numerous proposals and comments to exempt smoke alarm circuits from AFCI protection. In each and every case, the Panel rejected the proposals and comments and stated that the intent is to have protection on all 15 and 20 ampere circuits that supply the designated areas.

Purpose of AFCI Protection

The NEC established the requirement for AFCIs to provide protection of branch circuits from low-level arcing faults. The arcing fault hazard and the need for the protection has been studied and investigated by the National Electrical Manufacturers Association (NEMA®), the US Consumer Product Safety Commission (CPSC), National Association of State Fire Marshalls (NASFM), Underwriters Laboratories® (UL®) and others. AFCIs are a form of circuit protection in the same manner as overload and short circuit protection. The primary function of an AFCI is to improve protection of the circuit by detecting arcing conditions that reduce the incidence of fires of electrical origin.

AFCI/Smoke Alarm Compatibility

In the Spring of 2005, the NFPA 72 committee for “Single- and Multiple-Station Alarms and Household Fire Alarm Systems” received a proposal (72-530) to require that smoke alarms not be permitted to be supplied by an AFCI protected circuit. The proposal claimed that smoke alarms were “unwanted” tripping AFCIs. The information was anecdotal at best and expressed unfounded opinions of the submitter. Regardless, the issue was discussed and taken seriously by all involved parties.

When Schneider Electric™ discovered this proposal, company personnel reviewed internal reports of field complaints and found no verified unwanted tripping calls regarding AFCIs and smoke alarms. Other AFCI circuit breaker manufacturers did the same and also found no verified instances of unwanted tripping. Given the number of AFCIs installed to date, this is a significant point.

In addition, Schneider Electric completed a thorough investigation of the incompatibility claims in our laboratory. The company’s findings have shown that there is no compatibility issue with a properly wired smoke alarm installation.

During that laboratory analysis, there was no tripping of the AFCI during normal operation or during alarm conditions of the smoke alarm. This included circuits with interconnected smoke alarms wired per the manufacturers’ instructions.

However, there were two situations simulated where the AFCI could be forced to trip. In both situations, the smoke alarm installation had to be improperly wired. The following two diagrams outline those situations:

Figure 1: Smoke Alarms Supplied Through Two Different Circuits

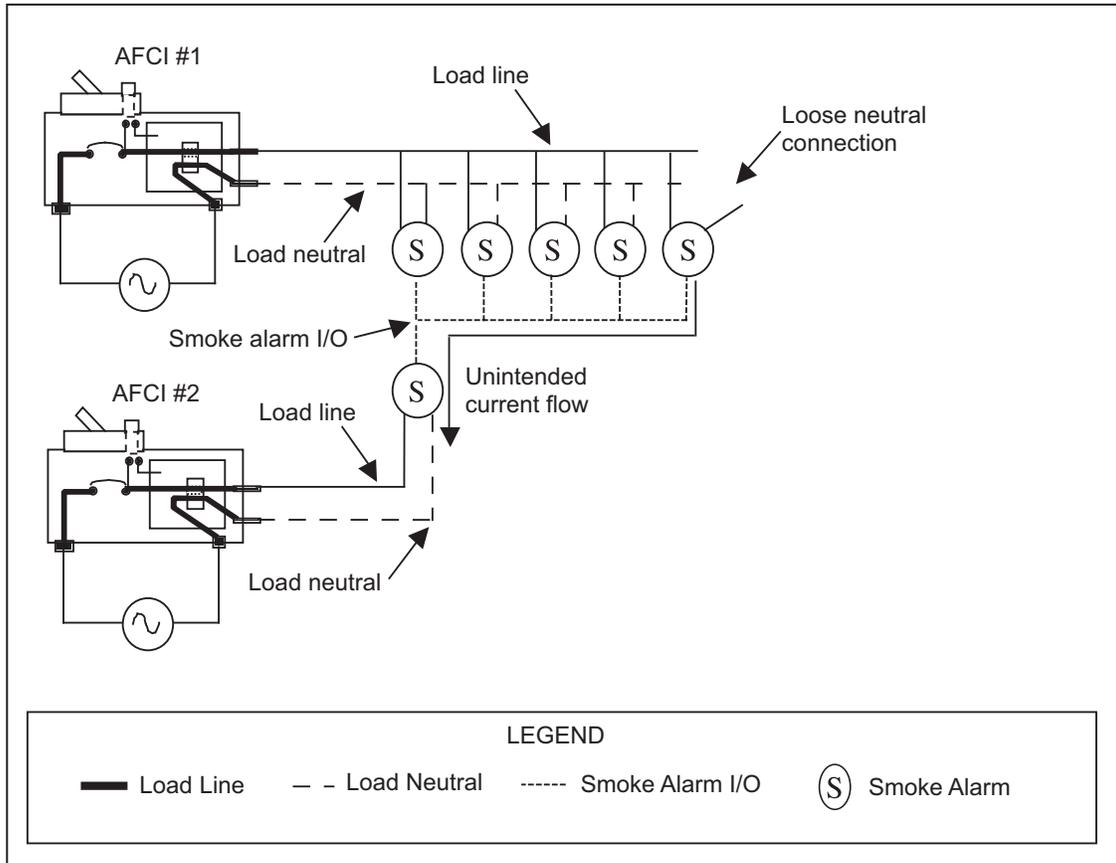
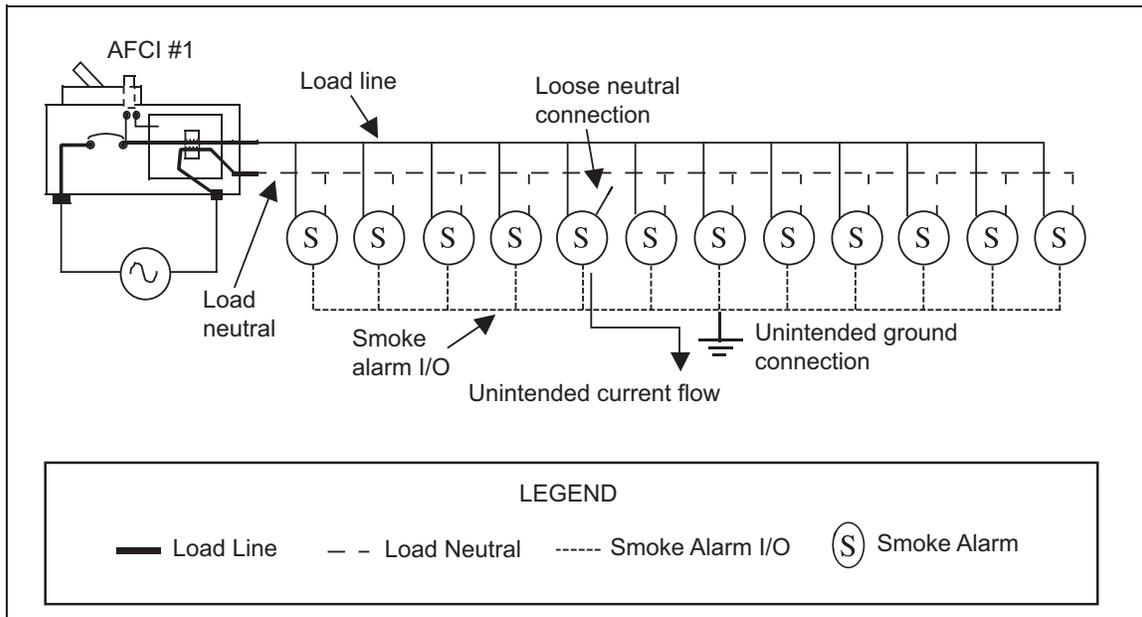


Figure 2: Single Circuit Installation



After extensive testing and reviewing of the technical facts about smoke alarm operation and AFCI operation, the following points can be made regarding the issue of compatibility:

- There have been no verified cases of incompatibility between smoke alarms and AFCIs in the field.
- Laboratory testing shows that there is no compatibility issue—either during normal operation or during alarm conditions.
- One of the major smoke alarm manufacturers stated they have heard of field issues. However they have stated that they cannot create a tripping situation in their laboratory. In addition, they have not been able to supply any specific information about alleged field installation issues.
- Improper wiring of the smoke alarms can trip an AFCI—however this is a condition that should be detected and corrected in the field.
- The current levels drawn by a smoke alarm (even by multiple devices in alarm condition) are insufficient to even be in the arc detection region of an AFCI.
- The bottom line is that there are no compatibility issues between AFCIs and smoke alarms.

Power Supply Reliability

One claim of the proponents to exempt smoke alarm circuits is that the addition of an AFCI decreases the reliability of the power supply. This is a misleading statement. AFCIs increase the protection of the electrical circuit and, as discussed earlier, have been shown to be compatible with smoke alarm installations. The addition of an AFCI does not decrease the availability of reliable power.

It is important to note that the NFPA 72 committee has had to consider the loss of primary AC power due to a number of causes. These include utility outages, overloads, short circuits, turning off the circuit breaker, and so on. To address these issues, the committee has added extensive requirements for back-up power and loss of power indication for a smoke alarm.

These extensive requirements can be found in NFPA 72 in Clause 11.6. A quick summary of a few of the requirements are shown below.

The smoke alarm must have:

- A commercial power source (AC power) and a secondary battery source that will operate the detector for at least 7 days in the normal condition followed by 4 minutes of alarm.
- A visible “power on” indicator.
- A distinctive audible or visible trouble signal upon removal or disconnection of a battery or a low-battery condition.

Summary

AFCIs provide increased fire protection for the electrical installation. There is no evidence that the circuit supplying smoke alarms should be exempt from these increased protection requirements. AFCIs are circuit protection and the level of circuit protection is clearly within the purview of the NEC.

Power supply reliability for smoke alarms is not impacted by the installation of an AFCI. At the same time, the protection of that branch circuit from being a source of an electrical fire is increased.

AFCI protection of branch circuits adds an important element of protection and should not be compromised on information that is inaccurate and cannot be verified.