The 2015 Canadian Electrical Code

Combination Arc Fault Circuit Interrupters (CAFI)

In Simple Terms

Section 26 of the 2015 CEC expands the use of AFI protection to most 125V, 15A or 20A receptacles in residential dwelling units and these circuits must be protected by new combination arc fault circuit interrupters (CAFIs).

What is an Arc Fault?

Arc faults are any current arcing across an unintended path.

Arc faults may be parallel to the load, occurring in wires where the insulation has been damaged. The arc flows from line to ground (L-G), line to neutral (L-N) or line to line (L-L).

Series arc faults occur along the length of the wire occurring in areas such as:

- a broken conductor inside the insulation
- a loose terminal on a device or
- a loose connection inside a wire nut

These arcs are in series with the load and only occur when the load is turned on. Sometimes a homeowner will claim “nuisance tripping” when they turn on a load connected to this damaged wire.

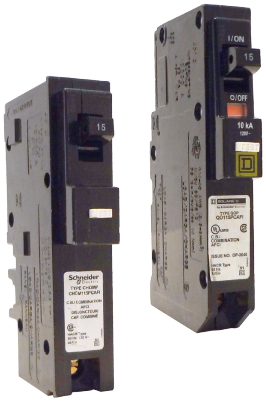
CAFIs protect better than AFIs

What is a combination AFI?

AFI technology has been developed over the course of a few decades. The original AFI technology required in the CEC detected series and parallel arcs in branch circuit wiring, however, they were limited because they could not sense arc faults in extension cords and plug connected loads.

Studies show that appliance and extension cords are the source of ignition for 27%[1] of residential electrical distribution fires. Up to now these cords have been left unprotected. With a CAFI breaker installed, a homeowner can be assured that the entire circuit is protected from the panel to the load.

CAFI technology “combines” the benefits of an AFI plus enhanced series and parallel arc sensing protection to extension cords and plug connected loads – hence the term “combination AFI” or CAFI.



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The following clauses are from the 2015 CEC.

26-720 Special Terminology

In this Subsection, the following definitions apply:
Arc fault protection – a means of recognizing characteristics unique to both series and parallel arc faults and de-energizing the circuit when an arc-fault is detected.

Combination type arc-fault circuit interrupter – a device that provides both series and parallel arc fault protection to the entire branch circuit wiring including cord sets, and power supply cords connected to the outlets, against the unwanted effects of arcing.

Outlet branch circuit type arc-fault circuit interrupter – a device that provides both series and parallel arc fault protection to downstream branch circuit wiring, cord sets, and power-supply cords against the unwanted effects of arcing and also provides series arc fault protection to upstream branch circuit wiring.

Rule 26 -724

(f) each branch circuit supplying 125 volt receptacles rated 20 A or less shall be protected by a combination type arc fault circuit interrupter except for branch circuits supplying
(i) receptacles installed in accordance with
    (A) 26-710(f); and
    (B) 26-712(d)(i), (iii), (iv) and (v); and
(ii) a single receptacle for a sump pump where
    (A) the receptacle is labelled in a conspicuous, legible, and permanent manner identifying it as a sump pump receptacle; and
    (B) the branch circuit does not supply any other receptacles; and
(g) Notwithstanding item (f), the entire branch circuit is not required to be provided with arc fault protection where
    (i) an outlet branch circuit type arc-fault circuit interrupter is installed at the first outlet on the branch circuit; and
    (ii) the wiring method for the portion of the branch circuit between the branch-circuit over current device and the first outlet is comprised of metal raceway, armoured cable, or non-metallic conduit or tubing.

87% of electrical fires occur outside the sleeping areas.

Why Have CAFIs Been Expanded to Cover Most Residential Receptacles?

In 2014, the Electrical Safety Authority (ESA) and the Office of the Fire Marshall studied the Ontario data for "Fires with Electricity as the Fuel." The data revealed for the years 2000 to 2011:

- 5667 fires originated in residential electrical distribution wiring
- 27% associated with appliance and extension cords
- 87% started outside the sleeping area
- $291.4M estimated property damage
- 469 injuries were reported
- Fewer fires on AFI protected circuits.[1]

The compelling personnel and property safety, the significantly improved technology and the fire reduction data lead the adoption of CAFIs and their expanded use in the 2015 CEC.

Why are there Exemptions for CAFI Protection?

The reason for exemptions is that the code making committees are taking a phased in approach. This allows:

- the technology to prove its cost/benefit as a fire prevention strategy and
- CAFI and other fire safety technology to mature to meet the changing home construction needs.

As noted above in the CEC clause 26-724(g)(i) and (ii), use of Outlet Branch Circuit (OBC) AFIs, in place of a CAFI circuit breaker is allowed with restrictions. These devices are a receptacle type CAFI device, but they do not protect 100% of the circuit like the CAFI circuit breaker.

How Does a CAFI Breaker Differ From an Outlet Branch Circuit (OBC) AFI?

First, the OBC-AFI, like any receptacle, must be fed from an over current device (a breaker).

Second, the OBC-AFI receptacle provides series and parallel arc fault protection downstream. They do not provide parallel arc fault protection upstream from the device to the panel.

The lack of parallel arc fault protection upstream when using OBC- AFIs is why the CEC specifically requires mechanical protection, in the form of armored cable or conduit, from the panel to the first device in order to minimize the risk of damage to the conductor and insulation that is not fully protected by the OBC-AFI.

A CAFI breaker provides 100% series and parallel arc fault protection from the panel to the connected load.

The Impact on Your Business

What are the Implications for Wiring a Residence?

Bottom line, there will be more CAFI protection installed in a residence. There is no denying this fact. However, if CAFIs are only installed on receptacles then the way in which a home is wired will change.

Since lighting is exempt, contractors have the choice of separating receptacles from lighting which may change the number of circuits and the routing of wires in a job. This may add additional circuits or wire and changes the material and labour calculations. However, when considering use by the homeowner, does it make sense to separate lights and receptacles for a specific room?

Another choice would be to maintain current wiring practices providing CAFI protection for lighting which is not required by Code. The contractor/builder may consider a couple choices:

- offer extra CAFI protection – a higher level of safety or
- determine if providing extra CAFIs is less than the material/labour to separate the circuits to minimize cost

Contractors may also consider OBC-AFIs over CAFI breakers, however this means calculating the added cost and labour to install armored cable or conduit on portions of the circuit.

Each contractor will need to find the wiring solution that best fits their needs and the needs of their customers.

Figure 1[2] – AFI Protection Required in Bedrooms per the 2012 CEC
(AFI required for areas highlighted below)

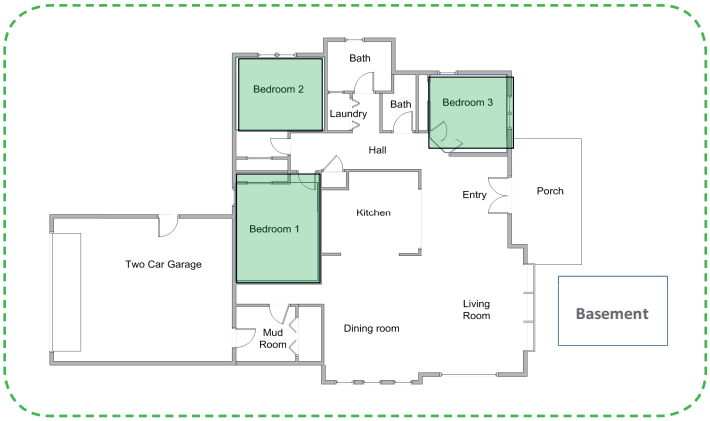
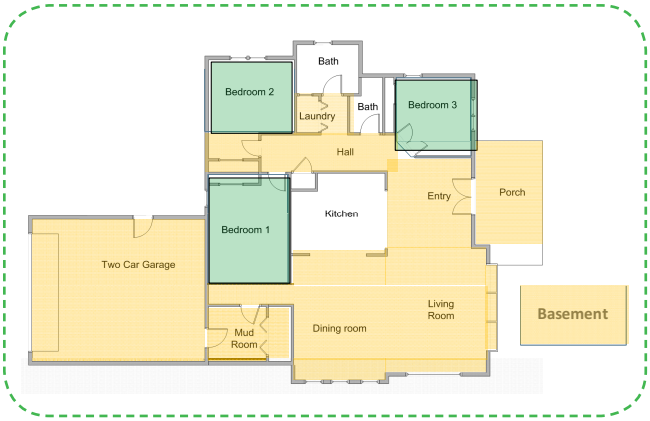


Figure 2[2] – Expanded CAFI Protection Required per the 2015 CEC
(CAFI expansion areas highlighted in yellow)



1. Moody, Dr Joel, ESA Presentation – "Electrical Distribution Fires in Ontario: Can AFCI Technology Reduce the Risk," Presented June 17, 2014 to the CEC Part I Committee.
2. Moody, "Electrical Distribution Fires in Ontario."

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