An **arc fault** is an unintended arc created by current flowing through an unplanned path. Arcing creates excessive heat that can easily ignite surrounding material, such as wood framing or insulation, resulting in a hazardous fire.

**Understanding the code**
Per section 201.12 of the 2014 NEC Arc Fault Circuit Interrupter Protection is expanded to include kitchens and laundry room areas in addition to other areas specified in previous versions of the code for dwelling units. Additionally, the new code will now require AFCI protection for dormitory units. The use of AFCI receptacles are permitted for use in new construction with some restrictions.

**NEC 2014 AFCI requirements 210.12**
An **AFCI breaker** protects the entire circuit from its origin in the load center for both parallel and series arcs.

**AT A GLANCE**
- The 2014 NEC allows 6 different installation methods to provide AFCI protection in new construction (see pages 8-9)
- Each application has preferred installation methods based on level of protection and practicality
Arc faults left unattended could potentially ignite surrounding material resulting in potentially deadly fires

**Typical causes of arc faults**

1. **Arcing in installed electrical wiring from physical damage such as:**
   - Wires accidentally punctured by nails or screws
   - Cables that are stapled tightly against wall stud
   - Animals and vermin chewing through wiring insulation
   - Heat, humidity and voltage stress

2. **Arcing at loose connections or joints in the circuit or at outlets**

3. **Arcing in appliance or extension cords**
   - Bent or crimped cords
   - Brittle or aged cords
   - Cords under or behind furniture

4. **Arcing internal to appliances or electrical devices**
   - Defective products
   - Damaged or products at end of life
Code compliant installations

Protection Using AFCIs

The 2014 NEC allows for various methods to protect a circuit using arc fault technology

1. **Combination AFCI Breaker**
   A combination AFCI Breaker can be used at the panel
   
   **Advantage:** Protects the whole circuit from the source
   
   **Disadvantage:** Legacy loadcenters may not accommodate AFCI breakers

2. **Branch AFCI breaker with AFCI Receptacle**
   A listed branch feeder type AFCI breaker installed at the origin of the branch circuit in combination with a listed AFCI receptacle
   
   **Advantage:** Protects the whole circuit from the source, allows local reset in most cases
   
   **Disadvantage:** Requires two AFCI devices which can be costly

3. **“Supplemental Arc Protection” breaker with AFCI Receptacle “recognized pair”**
   A listed supplemental arc protection circuit breaker installed at the origin of the branch circuit in combination with a listed AFCI receptacle
   
   **Advantage:** Allows for local reset in most cases
   
   **Disadvantage:** A supplemental arc protection breaker is not currently available. There are also limitations in homerun length and location of the first receptacle.

4. **Listed breaker + AFCI Receptacle “tested pair”**
   A listed AFCI receptacle installed at the first outlet in combination with a listed branch circuit overcurrent protective device
   
   **Advantage:** Allows for local reset in most cases
   
   **Disadvantage:** Limited tested combinations of AFCI receptacles and upstream branch breakers, limitations in homerun length and location of first receptacle

5. **Metal conduit to first AFCI Receptacle**
   Requires installation of armored cable (RMC, IMC, EMT, TYPE MC or TYPEAC) for the homerun portion of the branch circuit
   
   **Advantage:** Allows for local reset in most cases
   
   **Disadvantage:** Installation of conduit can be costly, and may be difficult to identify first receptacle in the circuit during remodel or retrofit

6. **Conduit in concrete with AFCI Receptacle**
   Metal or nonmetallic conduit or tubing or Type MC cable is encased in not less than 2 in. of concrete for the portion of the branch circuit between the branch circuit overcurrent device and the first outlet
   
   **Advantage:** Allows for local reset in most cases
   
   **Disadvantage:** Limited applications and installation of conduit can be costly

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**AFCI breaker and AFCI receptacle**
OBC AFCI breakers and/or AFCI receptacles can be used to protect a circuit under various conditions per the 2014 NEC
Code compliant installations

Each application is allowable by code with preferred installation methods based on level of protection or practicality

<table>
<thead>
<tr>
<th>Application</th>
<th>New Construction</th>
<th>Remodel</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Single Family</td>
<td>Multi-Family</td>
</tr>
<tr>
<td>1. Combination AFCI breaker</td>
<td>P</td>
<td>P</td>
</tr>
<tr>
<td>A combination AFCI Breaker can be used at the panel</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Branch AFCI breaker with AFCI receptacle</td>
<td>NR</td>
<td>NR</td>
</tr>
<tr>
<td>A listed branch feeder type AFCI breaker installed at the origin of the branch circuit in combination with a listed arc fault receptacle</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. “Supplemental Arc Protection” breaker with AFCI receptacle (“recognized pair”)</td>
<td>NR</td>
<td>NR</td>
</tr>
<tr>
<td>A listed supplemental arc protection circuit breaker installed at the origin of the branch circuit in combination with a listed arc fault receptacle</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Listed breaker + AFCI receptacle (“tested pair”)</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>A listed arc-fault receptacle installed at the first outlet in combination with a listed branch circuit overcurrent protective device</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Metal conduit to first AFCI receptacle</td>
<td>NR</td>
<td>✓</td>
</tr>
<tr>
<td>RMC, IMC, EMT, Type MC, or steel armored Type AC cables installed for the portion of the branch circuit homerun</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Conduit in concrete with AFCI receptacle</td>
<td>NR</td>
<td>NR</td>
</tr>
<tr>
<td>Metal or nonmetallic conduit or tubing or Type MC Cable is encased in not less than 2 in. of concrete for the portion of the branch circuit between the branch circuit overcurrent device and the first outlet</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

P = Preferred
✓ = Code Compliant
NR = Not recommended due to cost or insufficient protection

Types of Arcing

Arcing can be classified into two types:

- High current “Parallel” arcs
- Low current “Series” arcs

Parallel arcing is typically found between two parallel conductors. Series arcs typically occur within one conductor or at termination points.

Both AFCI breakers and receptacles are designed to detect both types of arcing conditions. However, an AFCI receptacle will not mitigate parallel arcing taking place upstream of the device as the current path does not flow through the AFCI receptacle. Therefore, it is reliant on the upstream breaker to provide protection against parallel arcing in the homerun section of the circuit.

<table>
<thead>
<tr>
<th>Types of Arcing</th>
<th>AFCI Breaker</th>
<th>AFCI Receptacle</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upstream</td>
<td></td>
<td></td>
</tr>
<tr>
<td>High Current “Parallel” Arcs</td>
<td>✓</td>
<td>NO</td>
</tr>
<tr>
<td>Low Current “Series” Arcs</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Downstream</td>
<td></td>
<td></td>
</tr>
<tr>
<td>High Current “Parallel” Arcs</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Low Current “Series” Arcs</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>
Arc fault technology saves lives

**Things you should know**

**Technological Maturity**

Arc Fault technology saves lives and has been an industry standard in new construction for over 15 years. Today’s arc fault technology has been proven through arc fault breakers and has gone through several iterations to reduce unwanted tripping due to interference from devices or appliances. Arc fault circuit interrupters have been established as a stable technology which can be used in conjunction with various loads through the home in both AFCI breakers and AFCI receptacles.

**Other Considerations**

Due to the restrictions of use per the 2014 NEC, there are several considerations to take into account when deciding whether to use a Receptacle AFCI or Breaker AFCI:

- **Length Restrictions** – Due to length restrictions, AFCI receptacles must be placed within the specified distances to the load centers per the 2014 NEC.

- **Location of the First Receptacle** – The AFCI receptacle must be placed as the first outlet. Care must be taken to ensure this location is easily accessible, it cannot be blocked by any furniture or appliances and the location must make logical sense for the end user should the device need to be reset.

- **Wiring Practices** – Because the AFCI receptacle must be placed in the first outlet, the contractor may need to change their wiring practices. Each circuit, including dedicated lighting circuits, would need to flow through an AFCI outlet before proceeding to the other outlets.

**The last word**

Remember your local (AHJ) Authority Having Jurisdiction (inspector) has the ultimate say in the application and use of electrical equipment per the prevailing Electrical Code.

It’s clear arc fault protection saves lives by mitigating arcing that could be an ignition source of a fire. The 2014 code mandates AFCI protection in designated areas of dwelling units and dormitories and allows several installation methods. It’s important to consider the application and then choose the best installation method to provide the safest form of protection.

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Eaton is a diversified power management company providing energy-efficient solutions that help our customers effectively manage electrical, hydraulic and mechanical power.

The Residential and Wiring Device Division is a leader in electrical connectivity and load management providing a full line of innovative solutions for residential, commercial and industrial applications. From the load center to the receptacle, Eaton provides proven AFCI, GFCI, Surge Protection and connectivity solutions required to keep power accessible, reliable and safe.