



Canadian Standards Association
Mississauga, Ontario
To the Part I Committee

Subject No. 2968

Chair: R. Leduc

Date: March 11, 2003

Title: Outlet Branch Circuit AFCI, Appendix B Note to Rule 26-704(13)

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Proposal: Amend Rule 26-704(13) by adding an Appendix B reference to Rule 26-704 (new text underlined).

26-704 - Branch Circuit in Residential Occupancies (see Appendix B)

Add the following note to Appendix B -

26-704(13) *Branch circuit may be protected by a Branch/Feeder arc-fault circuit interrupter or by an Outlet Branch Circuit arc-fault circuit interrupter. The Branch/Feeder arc-fault interrupter shall be located at the origin of the branch circuit. The Outlet Branch Circuit arc-fault circuit interrupter shall be located at the first outlet in the branch circuit.*

Reasons for Request: Both the Branch Feeder AFCI and the Outlet Branch Circuit AFCI provide the branch circuit arc-fault protection required by the Code. Adding this note provides the installer with important information regarding the type of AFCI that provides the protection required by the Code as well the location where the AFCI must be installed in the branch circuit.

Supporting Information: When this requirement was adopted there was only one type of AFCI available that provided protection of the branch circuit conductors. Since adoption of this requirement, a new “type” of AFCI that provides branch circuit protection has been developed. This new type of AFCI is called an “Outlet Branch Circuit AFCI”. The definition of the Outlet Branch Circuit AFCI follows:

“Outlet Branch Circuit AFCI - A device intended to be installed as the first outlet in a branch circuit. It is intended to provide protection to downstream branch circuit wiring, cord sets and power-supply cords against the unwanted effects of arcing. This device also provides protection to upstream branch circuit wiring.”

The Outlet Branch Circuit AFCI is UL listed and has been submitted to CSA for certification.

There are now two different types of AFCI’s that provide branch circuit protection. The two types of AFCI are identified as a Branch/Feeder AFCI and an Outlet Branch Circuit AFCI. The Branch/Feeder

AFCI is typically a circuit breaker device installed at the panel and the Outlet Branch Circuit AFCI is a receptacle type device.

UL has conducted a fact-finding study which verifies the branch circuit arc-fault protection afforded by the Outlet Branch Circuit AFCI.

The fact-finding study also identifies other significant forms of arc-fault protection provided by the Outlet Branch Circuit AFCI, such as series arc protection of two wire branch circuits, extension cords and power supply cords as well as arcing faults that may occur at loose wire binding screws, push in connections and twist on wire connectors. Although the Code only requires protection of the bedroom branch circuit, these additional forms of protection are important benefits that will be obtained by permitting the installation of the Outlet Branch Circuit AFCI for protection of the branch circuit.

The attached table illustrates the type of arc scenarios for which the agency standards and fact-finding study testing procedures verify the ability of the two types of AFCI to mitigate arcs.

Clearly indicating in the Code that either type of AFCI complies with the CEC will enable the installer to use to select the method of compliance.

A copy of the UL fact-finding report is included with this proposal. It is important to note that the UL fact-finding study was designed to provide technical data and facts concerning the capability of the Outlet Branch Circuit AFCI to provide branch circuit arc fault protection in accordance with the CEC requirement.

Chair's Comments:

For information:

As a result of subject 2836 Rule 26-704 was amended at the 103rd meeting of the CEC Code Part I Steering Committee by adding Subrules (12) and (13). Subsequently at the 105th meeting, subject 2838 was passed renumbering the rules in question as 26-722 (f) and (g) as follows:

Branch circuits that supply receptacles installed in sleeping facilities of a dwelling unit shall be protected by an arc-fault circuit interrupter.

For the purpose of Paragraph (f), an arc-fault interrupter means a device intended to provide protection from the effects of arc-faults by recognizing characteristics unique to arcing and functioning to de-energize the circuit when an arc-fault is detected.

I agree with the proposal to add an Appendix B Note as submitted.

Subcommittee Deliberations (1st Round)

Ten out of 13 Subcommittee members replied with 4 agreeing with the submission and six disagreeing. It is interesting to note that those disagreeing did not disapprove of the device but had some concerns on things like nuisance tripping, de-energizing only the downstream portion of the circuit, certification, etc. I have also received two documents that I will share with the subcommittee, one identifying some concerns with the OC/AFCI and another rebutting the first document (see attachments.) Following are the comments from those disagreeing with the submission including my comments in *italics*.

1. An Outlet Branch Circuit Arc-Fault circuit interrupter will not protect the complete branch circuit as required by the wording of rule 26-722(f) and will not de-energize the branch circuit when the arc-fault is detected. It will only de-energize the circuit downstream of the device. In order to adopt these

devices both rules need to be amended to state that this type of protection is designed to de-energize the circuit downstream of the device only.

This may then expose anyone effecting repairs to a potentially dangerous situation of the upstream circuit remaining energized. Similar wording to 26-700(13) or 26-702(19) may be helpful

Chair's comment: I agree that the OC/AFCI will not de-energize the entire branch circuit but it will de-energize that portion of the circuit it is intended to protect in much the same way that a GFCI does. I think that the Subcommittee can come up with appropriate wording.

2. Although I support the spirit of the proposal, I don't think that the wording for Appendix B is consistent with clause C12.3 of Appendix C. I'm prepared to concur with the submission provided the following is done:

- Wording of the proposed Appendix b will read: The intent of this rule may be met by utilizing a breaker type AFCI or an outlet type AFCI. When the outlet type AFCI is used, it is intended to be located at the first outlet in the branch circuit.
- New definition of an "Outlet Branch Circuit AFCI" should be introduced into the Code as suggested in the submission. This definition would be very beneficial to Code users.
- Confirmation should be obtained from our C&T experts whether this product is indeed certified in Canada and whether the extent of its certification includes upstream protection up to the point of connection of the branch circuit wiring to the branch circuit breaker.

Chair's Comment: I agree that Clause C12.3 is being breached here, but I believe we can come up with appropriate wording. I also agree that Code users would benefit from the definition of an OC/AFCI. I understand that work is currently underway for a Canadian Standard for this product. Until that is done, the product is not available in Canada. However, that shouldn't prevent us from recognizing it in the Code so that once it's available, we have the rules to deal with it.

3. I am not convinced that nuisance tripping will not occur from faults occurring upstream from the panel (i.e., in a neighbour's house fed upstream from the secondary of the same transformer). Also in the new rule 26-704(14) it states that the AFCI must function "to de-energize the circuit". How does the OBC/AFCI do this on upstream faults. It may de-energize the circuit from the outlet on but if the fault is on the branch circuit wiring between the panel and the outlet, how can we be assured the breaker will trip. I think it is a good product and will have its use, but it does not meet the requirements of Rule 26-704(14).

Chair's Comment: Apparently the UL standard for this device has requirements for testing against unnecessary tripping; I suspect the CSA requirements will be similar. We should only be concerned that the device meets the requirements of the Standard. Once that is achieved we should not be concerned with nuisance tripping unless we are not satisfied with the product standard requirements. The circuit breaker AFCI is also required to meet the Standard requirements for nuisance tripping.

We shouldn't need to de-energize the entire circuit when a series arc is detected upstream of the breaker (such as a loose connection on the breaker) as long as the load is de-energized. Without a load the upstream arc cannot be sustained. The tripped device signifies a problem that must be rectified before the downstream load can be re-energized.

3. I have trouble understanding how a downstream device can protect a branch circuit. It can detect some arcs and trip the load but the branch circuit is still live.

Chair's Comment: I have trouble understanding it too but as long as the product meets the Standard requirements, we should be satisfied that it is doing the job for which it was designed (see also comments to no. 4 above re: de-energizing load). A GFCI receptacle also de-energizes the load without de-energizing the entire branch circuit.

5. I do not see the need for Appendix B to identify that there are 2 types of AFCIs. It is no different than GFCI protection. Also if the OBC/AFCI is required to be in the first outlet, this should be stated in the rule rather than an appendix.

Chair's Comment: I agree that AFCI protection, no matter what type of device (as long as it meets the Standard requirements), should be recognized. I also agree that if it is required that a OC/AFCI be installed in the first outlet it should be stated in the rule. However, the intent of the rule is to protect receptacles in bedrooms because of the higher risk of having damaged cords causing fires while the occupants are asleep. Although it is better for a OC/AFCI to be installed in the first outlet, it does not have to be to meet the intent of the rule. Therefore it is more appropriate to explain this in the Appendix B note in a non-mandatory fashion as a recommended practice.

Chair's Proposal (Second Round)

Even though a majority of the S/C members did not agree with the proposal, I sense that most members were in agreement with the intent to recognized outlet branch circuit AFCIs. Based on this I propose the following:

1. Add (see **Appendix B**) after “**26-722 Branch Circuits in Dwelling units**”
2. Amend 26-722(f) to read as follows:
 3. ~~Branch Circuits that supply~~ Receptacles installed in sleeping facilities of a dwelling unit shall be protected by an arc-fault circuit interrupter.

Rationale: This addresses the comment from #1. above that paragraph (f) as currently written could be interpreted as only allowing the breaker type AFCI. The intent of the rule is to provide for protection of receptacles in bedrooms; this amendment more accurately describes the intent. This should also address the comments in #5. above suggesting that we should treat the AFCI like we treat GFCIs.

3. Add an Appendix B note as follows:

26-722(f) An Arc-Fault Circuit Interrupter (AFCI) is a device intended to provide protection from the effects of arc faults by recognizing characteristics unique to arcing and functioning to de-energize the circuit when an arc-fault is detected.

Arc- Fault Circuit Interrupters come in a variety of different types of devices as follows:

Branch/Feeder Arc-Fault Circuit Interrupter - A device intended to be installed at the origin of a branch circuit of feeder, such as a panelboard. It is intended to provide protection of the branch circuit wiring, feeder wiring, or both, against unwanted effects of arcing. The device also provides limited protection to branch circuit extension wiring. It may be a circuit breaker type device or a device in its own enclosure mounted at or near a panelboard.

Combination Arc-Fault Circuit Interrupter - An AFCI which complies with the requirements of both branch/feeder and outlet circuit AFCIs. It is intended to protect downstream branch circuit wiring and cord sets and power-supply cords.

Cord Arc-Fault Circuit Interrupter - A plug-in device intended to be connected to a receptacle outlet. It is intended to provide protection to the power-supply cord connected to it against the unwanted effects of arcing. The cord may be integral to the device. The device has no additional outlets.

Outlet Circuit Arc-Fault Circuit Interrupter - A device intended to be installed at a branch circuit outlet, such as at an outlet box. It is intended to provide protection to downstream branch circuit wiring, cord sets and power supply cords connected to it (when provided with receptacle outlets) against the unwanted effects of arcing. The device also provides protection of upstream branch circuit wiring and may provide feed through protection of the cord sets and power-supply cords connected to downstream receptacles.

All except the “Cord Arc-Fault Circuit Interrupter” are acceptable devices for the purpose of complying with Rule 26-722(f). When using an “Outlet Arc-Fault Circuit Interrupter” with feed through capability to protect the receptacles in sleeping facilities, consideration should be given to installing the device in the first outlet of the branch circuit. This will provide optimum protection in the event of any upstream series arc faults.

Rationale: Besides defining Arc-Fault Circuit Interrupter, the Appendix B note describes the different types of AFCIs. Furthermore, the Appendix B note provides the user with guidelines for installing OC/AFCIs so as to provide optimum protection to a branch circuit on which the device is installed.

4. Delete Paragraph (g) of Rule 26-722

Rationale: Paragraph (g) basically provides a definition for AFCI. This is now achieved through the Appendix B Note. Furthermore, I have never been comfortable with using a installation rules to provide definitions. Rules should be to address installation requirements. Definitions should be in a special area created for the purpose such as in Section 0 or in a Special Terminology clause at the beginning of a Section. When a term is not found in the body of the rules or is only used once (as in this case), I think the Appendix B is appropriate.

Subcommittee Deliberations (2nd Round)

10 out of 13 members plus the submitter responded. 8 agreed with the chair’s 1st round proposal, 3 with comments summarized below and the Chair’s comments in *italics*:

4. I just want to point out an item of history which we need to address in Subject 2968. During the committee discussions in processing of Subject 2836, which was the subject that gave us the Subrule which requires AFCIs in all bedroom branch circuits, a condition was imposed on the Subrule. The condition being that the part I subject could not be finalized until CSA had published certification requirements for the product. The subject was put in abeyance until CSA published the Technical Information Letter that contained certification requirements for the product. This note is just a reminder to the committee on Section 26 that we should follow the precedent that was set.

Chair’s Comment: I recall the proviso to 2836 for ensuring that CSA would have a standard and certification program in place before applying the rule. It only makes sense that we cannot mandate something for which an approved product is not yet available.

Since CSA now has a TIL for the breaker type AFCI, I don't think the rule will pose a problem. It will mandate an AFCI for bedroom receptacles and if the outlet type AFCI is not yet available due to not having a TIL for it, the installer will still be able to meet the rule by using the breaker type AFCI. Once a TIL for the outlet AFCI is completed and a certification program available, the rule will permit installers to have a choice between the two types of AFCI.

5. Seems the fairest compromise (unless you want to mandate one of each).
6. The Definition of an Outlet Branch Circuit AFCI as proposed by UL and CSA is:
“Outlet Branch Circuit AFCI - A device intended to be installed as the first outlet in a branch circuit. It is intended to provide protection to downstream branch circuit wiring, cord sets and

power-supply cords against the unwanted effects of arcing. The device also provides protection to upstream branch wiring.”

Chair’s Comment: I agree that Part I should reflect terminology used by Part II.

2 members disagreed summarized as follows:

1. Editorial: “Outlet circuit Arc-Fault Circuit Interrupter” should be worded as “Outlet Arc-Fault Circuit Interrupter”.

I'm concerned with the proposed amendment to Subrule 26-722(f). By deleting the requirement "to protect branch circuits that supply" receptacles installed in sleeping facilities of a dwelling unit we might inadvertently distort the very intent of the original proposal for AFCI's - which was to protect circuit conductors when their integrity is compromised via broken conductors or deteriorated insulation and as such electrical arcs may occur.

For breaker type AFCI's the original intent may be met even with the newly proposed wording. However, an outlet types AFCI may not necessarily protect upstream conductors of the branch circuit in their entirety, although this device will, indeed, protect a receptacle (where these arcing faults may not exist) and a portion of a flexible cord connected to that receptacle. In fact, the original TIL # M-02 published by the CSA in September 1999 in respect to the AFCI type breakers, is very clear on the intent of the AFCI function - to protect circuit conductors.

When this requirement was introduced into the CE Code, all reasons that were presented to the S/C, have been substantiated by the statistics related to the arcs originated in a branch circuit conductors. This matter (to amend the NEC wording) was extensively discussed by our U.S. colleagues and it was felt that the change to Article 210-12 (b) similarly to that as is recommended by Chair under the second round of this proposal, is not warranted.

I'm inclined to leave our existing wording without any changes. If the approved devices (as outlined in the proposed Appendix B definitions) are available on the market - to meet the requirement of the Code "to protect branch circuits", then such devices will be installed without any obstacles. The latter would be (and should be) dealt with by our certification experts.

Chair’s Comment: I would like to point out that the original proposal in subject 2836 was to require that “All receptacles located in bedrooms be protected by an arc fault circuit interrupter.” Based on that intent, I would submit that the biggest safety concern was with fires caused by faulty cords and equipment that were intended to be attached to these receptacles. Furthermore, the OBC-AFCI does protect the entire branch circuit, albeit only in regards to series faults upstream of the receptacle. The wording proposed in the 1st round of this proposal meets the original intent to ensure the bedroom receptacles are AFCI protected.

2. What happens if there is a L-N or L-G fault that is between the Panel and the first AFCI receptacle? Even when the AFCI trips the fault will continue.

Chair’s Comment: This is quite correct in that upstream of the receptacle, the OBC-AFCI detects series arc-faults and will not detect parallel arc-faults. But we must remember that the original intent was to protect bedroom receptacles. Protection of anything other than bedroom receptacles is a bonus (i.e., upstream detection of series arc faults). This approach is no different than how we deal with GFCIs; while it’s nice to be able to protect the entire circuit up to the receptacle, the intent is really to protect the receptacle and anything plugged into it, anything else is bonus.

Subcommittee Recommendation

Taking into consideration the editorial comments and the original intent to protect bedroom receptacles, I declare consensus for the following Subcommittee recommendation:

1. Add (see Appendix B) after “**26-722 Branch Circuits in Dwelling units**”
2. Amend 26-722(f) to read as follows:
 - A. ~~Branch Circuits that supply~~ Receptacles installed in sleeping facilities of a dwelling unit shall be protected by an arc-fault circuit interrupter.
3. Add an Appendix B note as follows:

26-722(f) An Arc-Fault Circuit Interrupter (AFCI) is a device intended to provide protection from the effects of arc faults by recognizing characteristics unique to arcing and functioning to de-energize the circuit when an arc-fault is detected.

Arc- Fault Circuit Interrupters come in a variety of different types of devices as follows:

Branch/Feeder Arc-Fault Circuit Interrupter - A device intended to be installed at the origin of a branch circuit of feeder, such as a panelboard. It is intended to provide protection of the branch circuit wiring, feeder wiring, or both, against unwanted effects of arcing. The device also provides limited protection to branch circuit extension wiring. It may be a circuit breaker type device or a device in its own enclosure mounted at or near a panelboard.

Combination Arc-Fault Circuit Interrupter - An AFCI which complies with the requirements of both branch/feeder and outlet circuit AFCIs. It is intended to protect downstream branch circuit wiring and cord sets and power-supply cords.

Cord Arc-Fault Circuit Interrupter - A plug-in device intended to be connected to a receptacle outlet. It is intended to provide protection to the power-supply cord connected to it against the unwanted effects of arcing. The cord may be integral to the device. The device has no additional outlets.

Outlet Branch Circuit Arc-Fault Circuit Interrupter - A device intended to be installed as the first outlet in a branch circuit. It is intended to provide protection to downstream branch circuit wiring, cord sets and power-supply cords against the unwanted effects of arcing. The device also provides protection to upstream branch wiring.

All except the “Cord Arc-Fault Circuit Interrupter” are acceptable devices for the purpose of complying with Rule 26-722(f). When using an “Outlet Circuit Arc-Fault Circuit Interrupter” with feed through capability to protect the receptacles in sleeping facilities, consideration should be given to installing the device in the first outlet of the branch circuit. This will provide optimum protection in the event of any upstream series arc faults.

- 3.Delete Paragraph (g) of Rule 26-722.

Chair’s Comments (3rd Round)

The Part I Steering Committee rejected this subject at the Letter ballot stage, but at their June 2001, 106th meeting in Newfoundland, it was agreed that it should go back to the Subcommittee for review.

The original drive for mandating arc-fault protection was the result of the introduction of new products using micro-processing technology enabling these products to identify the electronic signature of an arc

and subsequently, cut-off the source of energy to that arc. The technology has evolved to the point where the devices can differentiate between non-hazardous arcs (such as the making and breaking of contacts when plugging in an appliance or flipping a switch) and those that can potentially create fires (such as frayed cords, bad connections, damaged wiring, etc.).

Like GFCIs, this new technology is seen to provide a potentially higher level of safety for the public. While the GFCI provides superior shock protection, the AFCI provides superior fire protection. To further support the potential benefits of the AFCI, proponents have made reference to statistical data related to residential fire losses such as a report put out by the U.S. Product Safety Commission entitled “1996 Residential Fire Loss Estimates”. The executive summary of that report is attached and the entire report can be viewed at <http://www.cpsc.gov/library/fire96.pdf>. Other documents on AFCIs published by the CPSC can be viewed at:

<http://www.cpsc.gov/cpscpub/pubs/afcifac8.pdf>

<http://www.cpsc.gov/cpscpub/pubs/afci.html>

The original proposal to mandate arc-fault protection in Canada was CSA Subject 2836, which resulted in the current requirements in the CE Code, 26-722(f) & (g). Subsequently, a new proposal to recognize receptacle type arc-fault protection was submitted in late 2000 generating this current Subject No. 2968. Despite our Subcommittee recommendation to revise the current Code Rules, the Part I Steering Committee rejected this subject at the Letter ballot stage, as was mentioned above.

Some of the concerns expressed were regarding the recognition of outlet AFCIs and the absence of Canadian Standards for the product. Because of the absence of a Standard, a proper definition for Canadian products had yet to be developed.

Since this subject was last discussed, CSA has published an updated Technical Information Letter (TIL) for interim Certification of Arc-Fault Circuit Interrupters and Arc-Fault Protection Devices that now includes requirements for manufacturing various Arc-Fault Protection Devices including the “Receptacle Type”

To proceed with discussions on this subject, I believe we need to rationalize the following questions:

- **What is the main objective for mandating Arc-Fault Protection in sleeping facilities?**
- **Should this protection be limited to sleeping facilities in dwelling units?**

Main objective for mandating Arc-Fault Protection

If we look at the report used to substantiate the use of AFCI, we see some compelling statistics on fires cause by electrical installations and devices. The report provides general statistics of all types of electrical fires but it does not specifically identify those fires occurring in sleeping facilities and much less the cause of fires occurring in sleeping facilities. So, why then is arc-fault protection limited to protecting sleeping facilities?

Recalling discussions on the original Subject 2836, some of the following arguments were made:

- Unlike other areas of a house, a bedroom is unsupervised when someone is sleeping in that room. If a fire from an electrical arc starts in that room, the sleeping person will not notice it and is more likely to fatally succumb to the smoke and fire. Generally, in other areas of the home, people are awake and more aware of the onset of a fire.
- Smoke detectors provide early warning for fires occurring outside of sleeping facilities, allowing a sleeping person in a bedroom to be alerted and evacuate.

- A smoke detector located in the hallway would likely not respond quickly enough from a fire starting in a bedroom.
- We should harmonize with the U.S.

Therefore, we can see that there were some compelling arguments for introducing arc-fault protection in sleeping facilities.

Sleeping facilities in dwelling units

As for why we limited the application of arc-fault protection to the sleeping facilities in dwelling units, if I recall, one of the main reasons was that we should adopt a progressive approach to implementing this requirement. Other comment were centred around:

- cost to industry
- staying aligned with the NEC

The main difference between a dwelling unit and some other residential occupancy is that a dwelling unit is defined as having cooking facilities. We must ask ourselves what the significance between someone asleep in the sleeping facility of a dwelling unit (with cooking facilities) and someone asleep in the sleeping facility of a residential occupancy (without cooking facilities).

For this reason, I propose we look at moving the requirement into the area of residential occupancies.

Another question we should consider is due to the fact that receptacle type arc-fault protection is now available as a certified product in Canada, should we be recognizing this in the Code.

Finally, with the new T.I.L. incorporating our Canadian definitions for arc-fault protection devices, an Appendix B note would align with Part II requirements.

Therefore, to begin our deliberations anew, and to ensure we maintain the intent of the original proposal, I propose the following:

1. Delete Paragraphs (f) & (g) of Rule 26-722

Rationale: Arc-fault protection requirements are re-located to Rule 26-710 and detailed descriptions of the various types of arc-fault protection are in an Appendix B note.

2. Add a new paragraph to Rule 26-710 as follows:

- (o) Receptacles installed in sleeping facilities shall be protected with arc-fault protection.

Rationale: The proposed rule allows flexibility in selecting the type of arc-fault protection best suited to protect the receptacles (i.e., the receptacle type is more user-friendly in renovations to older homes). The Appendix B note will describe the various types of arc-fault protection and distinguish which are suitable for meeting the requirements of the rule.

3. Add an Appendix B note for paragraph (o) of Rule 26-710 as follows:

- 26-710(o) *Arc-Fault Protection is technology that provides protection from the effects of arc faults and is defined by the term:*

ARC-FAULT CIRCUIT INTERRUPTER (AFCI) - A device intended to mitigate the effects of arcing by functioning to de-energize the circuit when an arc-fault is detected.

Following are defined terms for various types of Arc-Fault Protectors:

ARC-FAULT CIRCUIT INTERRUPTER - CIRCUIT BREAKER TYPE - An arc-fault circuit interrupter integral with a circuit breaker.

ARC-FAULT PROTECTION DEVICE - CORD TYPE - An arc-fault circuit interrupter integral with a power supply cord.

ARC-FAULT PROTECTION DEVICE - PORTABLE TYPE - An arc-fault circuit interrupter integral with one or more outlets.

ARC-FAULT PROTECTION DEVICE - RECEPTACLE TYPE - An arc-fault circuit interrupter integral with a receptacle or other outlet.

For the purposes of applying Paragraph (o) of Rule 26-710, only the “circuit breaker type” and the “receptacle type” provide the intended protection:

The “circuit breaker type” will protect the entire branch circuit from the breaker to the end of the circuit including end devices, appliances and associated attachment cords.

The “receptacle type” provides protection for devices, appliances and associated attachment cords connected to the receptacle and if the “receptacle type” has feed-through capability, the entire circuit downstream from the receptacle will be protected.

Rationale: *This Appendix B note now uses Canadian terminology directly from the CSA T.I.L. (see excerpt attached) The T.I.L. will form part of the Standards for circuit breakers, ground-fault circuit interrupters, receptacles, and cord sets (C22.2 Nos. 5, 144, 42, and 21). It also provides information on the protection afforded by circuit-type and receptacle-type AFCIs as meeting the intent of the Rule.*

Please review all of the previous information on this subject and the new information provided. That along with the intent of the original proposal forms the basis for the above proposal and guides us on our future discussions regarding this subject.

2 DEFINITIONS (taken from technical information letter no. M-02A)

2.1 The following definitions apply in this Technical Information Letter.

ARCING - A luminous discharge of electricity across an insulating medium, usually accompanied by the partial volatilization of the electrodes.

ARCING FAULT - An unintentional arcing condition in a circuit.

ARC-FAULT CIRCUIT INTERRUPTER (AFCI) - A device intended to mitigate the effects of arcing by functioning to de-energize the circuit when an arc-fault is detected.

ARCING HALF CYCLE - An 8.3 m-sec time period of 60 Hz fundamental current flow characterized by multiple current spikes resulting from arcing between two electrodes.

ARC-FAULT CIRCUIT INTERRUPTER - CIRCUIT BREAKER TYPE - An arc-fault circuit interrupter integral with a circuit breaker.

Note: These interrupters are intended for installation in accordance with Rule 26-722(f) of the CEC, Part I.

ARC-FAULT PROTECTION DEVICE - CORD TYPE - An arc-fault circuit interrupter integral with a power supply cord.

Note: These devices provide protection to the power-supply cord connected to it against the unwanted effects of arcing.

ARC-FAULT PROTECTION DEVICE - PORTABLE TYPE - An arc-fault circuit interrupter integral with one or more outlets.

Note These devices are intended to provide protection to connected cord sets and power-supply cords against the unwanted effects of arcing.

ARC-FAULT PROTECTION DEVICE - RECEPTACLE TYPE - An arc-fault circuit interrupter integral with a receptacle or other outlet.

Note: These devices are intended to provide protection to connected cord sets and power-supply cords against the unwanted effects of arcing.

CARBONIZED PATH - A conductive or potentially conductive carbon path formed through or over the surface of a normally insulating material.

OPERATION INHIBITION - Denotes the concealment of an arc-fault by the normal operation of certain circuit components.

UNWANTED TRIP B - A tripping function in response to an arcing condition that is not an arc-fault but a condition that occurs as part of the normal or anticipated operation of circuit components.

Executive Summary

The attached tables present estimated product-related fire losses that occurred in U.S. residential structure fires attended by the fire service during 1996, the most recent year for which these data are available. In addition, data for the latest five years and the benchmark years¹ are presented. These estimates were derived from data provided by the U.S. Fire Administration (USFA) and the National Fire Protection Association (NFPA).

- An estimated 428,000 residential structure fires were attended by fire departments in 1996. These fires resulted in an estimated 4,080 civilian deaths, 19,300 civilian injuries, and \$4.96 billion in property loss.² (Table 1)
- Fires in residential properties accounted for about 74 percent of all structure fires in 1996 and resulted in 97 percent of civilian deaths and 88 percent of civilian injuries in all structure fires.
- Among products within CPSC jurisdiction (which excludes cigarettes), the products most frequently involved in fire deaths were mattresses/bedding (17%), upholstered furniture (16%), and heating equipment (15%). Electrical distribution systems, mainly home wiring and light fixtures, and cooking equipment each accounted for 9 percent of all residential structure fire deaths. (Tables 1 and 2)
- Cooking equipment, primarily ranges and ovens, was the most frequent product type involved in residential fires and injuries (about 25 percent for both). Most cooking equipment-related fires and injuries involved electrical products (13 percent and 15 percent, respectively, of all residential structure fires and injuries.) Heating equipment was the second leading product type involved in fires (15%). (Table 1)
- Between 1980 and 1996, estimated residential structure fires decreased about 43 percent. Estimated deaths associated with these fires decreased about 26 percent and estimated injuries decreased about 9 percent.

Fire loss estimates presented in this report are fires, deaths, and injuries associated with consumer products. Only selected product categories are presented in the attached tables; therefore, the detail of the product categories may not add to the total number of residential structure fires, deaths, injuries, and property loss. The product categories selected represent most of the products within the jurisdiction of CPSC. The remaining product categories include medical and industrial equipment and other miscellaneous items.

¹ Tables 9, 13, 15, and 17 contain benchmark data from 1990 and all other tables contain benchmark data from 1980.

² Michael J. Karter, Jr., "1996 U.S. Fire Loss", NFPA Journal, Sept./Oct.1997, pp. 77 - 83

Subcommittee Deliberations (4th round)

Eight of 13 regular members responded. In addition 1 temporary member involved with the original subject 2836 also responded. 5 agreed with the Chair's latest comments and proposal and 4 disagreed.

Those that disagreed basically felt that the subject had gone beyond the original intent and commented as follows:

1. It now goes much further than the original proposal. The NEC requires AFCI for Bedroom Branch Circuits while we are using the term Sleeping Facilities. There's a big difference between the two. We are not aligning with NEC. Now that we have a TIL there is no reason to disagree with the original proposal. As well I consider the move to extend the AFCI requirement to all residential occupancies to be non-germane. The intent of the original proposal is to clean up the definition and recognize the outlet AFCI This was accomplished in round 3 except that we did not have the TIL in place.
2. You have two types of construction, combustible and non-combustible. For combustible construction the entire branch circuit should be protected. For non-combustible construction, the receptacle AFCI should be acceptable. Also the "portable type" and the "cord type" should not be in the defined category as these would not be part of the installation.
3. Since this subject is getting so messed around, would it be an idea to close it and open one with the intent you want? There seems to be a lot in the report about the original intent and what it was etc. Seems that now it has grown beyond that one.
4. Is not in line with the original intent of introducing AFCI protection. Refer to subject 2836. Current proposal disregards all of the investigative work and technical analysis by the CPSC, UL, Industry Section 26 S/C and Part I. Oppose introducing requirements that would permit the outlet AFCI unless there was provision requiring it to be installed near the panel.

Those agreeing with the Chair latest direction offered comments to improve the wording as follows:

1. Suggest the rule read:- "Receptacles installed in sleeping facilities shall be of the arc-fault protection type or shall be protected by an arc-fault circuit interrupter."

This covers both systems and is more correct as a receptacle with integral protection does not protect the receptacle, rather the circuit supplied from it. The line side is left energized. An arcing fault on the line side terminal would be left arcing.

I notice this is now the chairs proposal and on a point of order, not expediency, this should probably have a new number. What happened to the original submittor???? The chair has done a good job nevertheless.

2. To be consistent with the current layout of 26-722(f) and (g), the definition should be placed in 26-710(p), however, it should be modified: "... functioning to de-energize the circuit on the load side of the device and an arc-fault is detected."
3. My compliments to the S/C Chair for his patience and persistence with this subject. The receptacle type AFCI is presently certified for use in Canada and the proposed change

will recognize this product and will allow the Code users for additional flexibility.
My comments are as follows:

Although I agree with the spirit of Chair's proposal of the 3rd round of deliberations (as shown on page 10 of the submission), I feel that the wording needs additional modification. The definition should be retained in the body of the Code (similarly to the current definition of AFCI and to all other definitions) and not in Appendix B Note.

I'd like to propose the following modification to the wording of items 2 and 3 of the Chair's proposal:

Item 2:

Add new Paragraph 26-710(o) to read:

26-710(o) Receptacles installed in sleeping facilities shall be protected by an arc-fault circuit interrupter.

Reason: To be consistent with wording of other similar requirements in the Code (see Rule 26-700(11); Rule 68-068(7), etc.) and to be consistent with terminology used in the NEC (Article 210.12) and in relevant Part II documents.

Add new paragraph 26-710 (p) to read:

26-710(p): For the purpose of Paragraph (o), "arc-fault circuit interrupter" means a device intended to provide protection from the effects of arc-faults by recognizing characteristics unique to arcing and functioning to de-energize the circuit when arc-fault is detected.

Reason: To legitimize the definition by placing it in the body of the Code, similarly to all other relevant definitions and to use the wording presently shown in the Code, which is also consistent with the wording used by Article 210.12 of the NEC.

Item 3:

To add Appendix B Note on Paragraph 26-710(o) to read:

Appendix B Note on Paragraph 26-710(o):

The intent of this Paragraph is to provide a required arc-fault circuit interrupter (AFCI) protection only by utilizing an arc-fault circuit interrupter integral with a circuit breaker or by using an arc-fault circuit interrupter integral with a receptacle or other outlet.

The "circuit breaker type" AFCI provides protection of the entire branch circuit from the breaker to the end of the circuit including end devices, appliances and associated attachment cords.

The "receptacle type" AFCI provides protection for devices, appliances and associated attachment cords connected to the receptacle, and if the receptacle type" AFCI has "feed-through" capability, the entire circuit connected downstream from that receptacle will also be protected.

Reason: To clarify types of AFCI that are intended to be allowed for this purpose and to simplify the Appendix B Note by deleting unnecessary terminology (comparing to the wording proposed by the Chair).

On a personal note, I'd like to comment that the proposed change will allow for a greater level of flexibility in achieving an AFCI protection, will make installations safer without compromising electrical and fire safety, will recognize the types of devices existing in the Canadian (and U.S.) marketplace and certified for the application and will most likely

assist in respective amendments to the NEC, as the original submitter of this proposal represents the Canadian affiliation of the U.S. manufacturer.

Chair's Comments (4th Round)

Comments on disagreeing members

3 of the four disagreeing members and one member in agreement suggest that the subject has gone beyond the original intent, which was basically to recognize the outlet type AFCI. The Chair disagrees; the latest proposal maintains the intent to recognize outlet type AFCIs.

The move to broaden the use to include sleeping facilities in all residential occupancies rather than the existing requirement, which only affects dwelling units, could be seen as going too far with the original intent. However, I believe it is the responsibility of the Subcommittee to identify issues where the existing rules may be inconsistent with other related requirements of the Code and take advantage of the opportunity to eliminate those inconsistencies as long as the original intent of the proposal is not compromised. In this case, the idea that sleeping facilities in residential occupancies are somehow different than sleeping facilities in dwelling units seems to be inconsistent.

One disagreeing member suggests that we should be looking at distinguishing between combustible and non-combustible construction. I rule this to be non-germane and should be submitted as a new subject.

Another disagreeing comment suggests that the proposal does not align with the original intent as concluded under subject 2836. This is a valid argument but because Subject 2968 essentially changes some of the concepts of 2836 the conclusions of 2968 will not necessarily agree with the conclusions of 2836. In any case, subject 2836 was originally worded in such a way that it would have recognized outlet type AFCIs once they became available but for some reason the original submitter of that proposal proposed changes to the wording. No rationale for that change was identified in the Subcommittee report (see Subcommittee report for Subject 2836 dated April 26, 1999).

Comments on Agreeing Members

The agreeing members offer wording suggestions to improve clarity. One of those suggestions is to put the definition of the AFCI in the body of the Code in much the same way the existing rules are. I personally disagree with this approach because I believe that the body of the code should address installation requirements and statements to clarify the meaning of something should be in Appendix B or if necessary in the definitions of the Code. However, to avoid losing consensus, I am prepared to deal with the definition issue as a new subject.

Another suggestion is to word the rule in such a way that it makes reference to both types of arc-fault protection, the outlet type and the breaker type. I believe this objective can be achieved by adjusting the rule containing the definition.

Ruling one negative to be non-germane and the other three negatives to be non-persuasive, I declare consensus for the following:

Subcommittee Recommendation

- 1. Delete Paragraphs (f) & (g) of Rule 26-722**

2. Add two new paragraphs to Rule 26-710 as follows:

- (o) Receptacles installed in sleeping facilities shall be protected by an arc-fault circuit interrupter; and
- (p) For the purpose of Paragraph (o), “arc-fault circuit interrupter” means a device intended to provide protection from the effects of arc-faults by recognizing characteristics unique to arcing and functioning to de-energize the circuit on the load side of the device when an arc-fault is detected.

3. Add an Appendix B note for paragraph (o) of Rule 26-710 as follows:

- 26-710(o) *The intent of this Paragraph is to provide arc-fault circuit interrupter (AFCI) protection by utilizing an arc-fault circuit interrupter integral with a circuit breaker or an arc-fault circuit interrupter integral with a receptacle or other outlet.*

The “circuit breaker type” AFCI provides protection of the entire branch circuit from the breaker to the end of the circuit including end devices, appliances and associated attachment cords.

The “receptacle type” AFCI provides protection for devices, appliances and associated attachment cords connected to the receptacle, and if the receptacle type AFCI has “feed-through” capability, the entire circuit connected downstream from that receptacle will be protected.