In support of the appeal to the CMP-6 ballot to CAM 70-63
NFPA 70, 334.12
Joseph Andre:

In its response to the CAM substantiation, it was stated that the Committee considered all technical documentation related to the safety of NM Cable in tall wood buildings. There is confusion as to the actual action addressed. There were two distinct actions that occurred regarding this issue; the first was the increase in effective building height allowed for NM cable based on the change in the building codes, either the International Building Code ® (IBC) or NFPA 5000®. Both of these codes were finalized after the 2020 revision cycle of the NEC was substantially complete, making it impossible for CMP-6 to have considered the impact of the building code(s) revisions. The second activity was the submission of several public inputs and subsequent Public Comments to reverse the inadvertent and unintended consequence of the building code changes.

The distinction is critical in the understanding of this issue. The Committee processed the Inputs and Comments per the regulations. However, the fact that the need for these Inputs and Comments should never have existed seems to be lost. There is a vast difference between approving such a drastic increase through the required channels and processing efforts to return the NEC® to the original intent following serious public interaction. It would require a 2/3 majority of Committee members to vote affirmative on the technical merits of the increase, acceptance of that increase by the public, no action or unsuccessful action during the Technical Committee meeting, and no or unsuccessful appeal on the increase. None of these actions had a chance to happen. Conversely, anything less than a 2/3 majority fails to return the code to what the intent and application was before the building code change. In effect, a minority of the Committee can uphold a revision that was never vetted properly in the first place.

The Panel response clearly admitted that the change to Section 334.12 of the NEC was the result of a change in the building codes. This is an admission that the Panel did nothing to effect this change, including even considering it. In fact, there could have been no consideration for the 2020 Edition of the NEC based on the timing of the changes: the deadline for Public Inputs to the 2020 Edition of the NEC® was September 7, 2017. The Second revision hearings concluded on November 3, 2018. The results of the Group A hearings and final ballot for the 2021 Edition of the was published on December 7, 2018, over a month after the NEC® technical committees concluded their deliberations. The 2021 Edition of NFPA 5000® Second Draft final ballot was sent to the Correlating Committee on January 15, 2020. Clearly, CMP-6 could not have acted on any concept of the impact of the new tall wood building construction designation would have on wiring methods for the 202 NEC®. Yet, those changes took effect through the IBC® before issuance of the 2020 NEC, and the NFPA 5000® provisions after that Edition of the NEC® was published.
The Panel response went on to say that the NEC, NFPA 5000, and IBC were developed under the ANSI guidelines. The IBC has never been developed as an ANSI document and does not come close to meeting that standard. While both of the referenced NFPA documents are developed as ANSI standards, nothing recognizes the ability of one code legitimately modifying another. The subject matter experts on the building code committees are not experts on electrical matters, and the electrical experts on the electrical committees are not recognized as experts on building code matters. To suggest otherwise would negate the essence of the NFPA/ANSI process.

The lack of process for allowing NM Cable to be used in tall wood buildings is well detailed in my CAM substantiation. What the Panel did was reject efforts to correct the unintended consequences of an action from a different document, different committee members, and in the case of the IBC®, a very different process. The Technical Committee has stated that it reviewed technical data showing that the use of NM Cable in tall wood buildings is safe and it heard from building experts that these are very safe buildings and the wiring method is not a safety concern. The problem is that there is no public record of the technical documentation, no name(s) of the building code experts, and no published reports of why the experts hold this opinion. An open and transparent process deserves much more. As a member of NFPA and the general public, I would need to see this documentation, examine it critically, and bring forward any concerns rather than accepting such generic and undocumented conclusions. “Trust me” statements have no place in the NFPA code revision process.

Please consider all of the pertinent information, or lack thereof, regarding this serious matter and grant this appeal to return the NEC to the clear intent of the Standards Council and reject allowing one code to alter another. Thank you for your careful consideration.
NM Cable height restriction history and supporting information: TIA Request
Joseph Andre
August 8, 2022

Background:
In the 1975 Edition of the National Electrical Code® (NEC®), the use of Type NM Cable was restricted to dwellings and other structures not exceeding three floors above grade. This restriction remained in place without change until the 2002 Edition of the NEC®. It should be noted that the only change to the construction requirements to NM Cable during those intervening 27 years and 9 Editions is that the insulation of the conductors in NM Cable were required to have 90°C insulation in 1984. That change did not address any other physical characteristics such as impact resistance, smoke development, flame spread, bending radius, etc.

A proposal, 7-74, was made to 336-3 of the 1999 Edition of the NEC to allow NM Cable in dwelling units in higher buildings if the cable stayed in a single dwelling unit and originated in a panel in that dwelling. The CMP developed a revision based on this proposal, but it failed to attain the 2/3 majority needed. In a comment to this proposal, the National Electrical Manufacturers Association submitted a comment opposing the concept, citing concerns in a report in 1974 by an NEC® Technical Subcommittee on this subject.

A proposal, 7-135, to the 2002 Edition of the NEC® was made to allow NM Cable to be used in buildings of Type III, IV, and V construction as defined in NFPA 220®. This proposal was rejected by the Code Making Panel (CMP-7 at that time). The ballot on that item was 12:2:1 to reject.

A different proposal during that revision cycle, 7-130 also sought to change the height restriction to construction type. That proposal was rejected by a ballot of 14:0:1. The Panes statement was that there is no technical substantiation and noted that references to other documents were noncompliant with the NEC Style Manual.

Following the 2002 NEC® revision cycle an appeal was made to the Standards Council regarding using construction types to limit the height of buildings that NM Cable could be used in. In granting the appeal on July 13, 2001, the Standards Council stated as part of the substantiation that in practice, the change to construction type limits the use of NM Cable in buildings of no more than four or five floors above grade.

As recently as the 2020 NEC® revision cycle the CMP-6 made the following statement on rejection of PC 1502 (Allow NM Cable in dwelling units if within Type I or Type II construction and the cable does not leave the floor on which it originates).

<table>
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<tr>
<th>Committee Action:</th>
<th>Resolution:</th>
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<tr>
<td>Using construction types to restrict NM Cable</td>
<td>Rejected</td>
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<td>The use of NM cable in high rise construction was addressed during the 2002 NEC revision cycle. A task group was assembled and provided extensive information and concerns on such use of NM cable. The 2002 ROP, ROC, and task group reports should be reviewed to address the concerns raised which go beyond grommets, such as physical damage</td>
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during and after installation, flame spread and smoke contribution during a fire event, and egress issues.

At the most recent NFPA Safety Conference and Technical Meeting it was emphasized that there are hundreds of tall wood buildings either constructed or under construction worldwide. As the requirements of the NEC® stand, in every edition from 2002 to present that might be adopted anywhere, these buildings could be wired in NM Cable without the benefit of thorough technical review, public input, technical committee approval, etc.

**Conclusion:**

- The stated intent of the Standards Council in the 2001 decision was, in effect, to allow NM Cable in buildings up to four or five floors above grade. The increase to 18 stories maximum (IBC®) or 24 Stories (NFPA 5000®) was never anticipated.
- The words of the NEC have not changed since 2002 regarding the uses of NM Cable in Type III, IV, and V buildings. What changed is the drastic change in the use and construction of these buildings. The same issue exists regardless of the edition of the NEC® from 2002 through 2020.
- Without even the possibility of there having been a discussion of the merits of such a drastic change, it is imperative for the safety of the occupants of those buildings to maintain the restrictions enacted by the Standards Council in the 2002 Edition.
- There are jurisdictions utilizing various older editions of the NEC®. It would be hollow to not include those editions in the TIA as numerous tall wood buildings could be completed with a wiring method not deemed suitable for the application.
- Leaving older editions of the NEC® unchanged could result in increased resistance to updating to the most recent edition, leaving the increased safety and new technology unadopted as well.
- There could not be a more urgent action the Council could consider as being of an emergency nature as this. The industry and the public need the in-depth technical analysis and open, public discourse required and anticipated in the Regulations to ensure their safety.

The reference below is to a UL report on NM Cable. It notes how easily it may be damaged by a single hammer strike or a staple being over-driven, both common occurrences during installation.

UL Report on damaged NM Cable:
On 13 July 2001, the Standards Council considered the appeal of Jeffery Shapiro, International Code Consultants, representing the National Multi-Housing Council (NMHC). The appeal requested that the Standards Council accept either Comment 7-52 or Proposal 7-137 on the proposed 2002 edition of NFPA 70, National Electrical Code® (NEC). After a hearing, the Council reviewed and considered all of the information available to it and voted to uphold the appeal in part by accepting Proposal 7-137. The effect of this decision is to allow, with certain limitations, the use of nonmetallic-sheathed cable in multi-family dwellings and other structures that are of Types III, IV and V construction.

This appeal involves the question whether the NEC should allow the use of nonmetallic-sheathed cable (NM cable) in dwellings or other structures exceeding three floors above grade. This issue has received lengthy consideration within the NFPA codes and standards development process, most recently during the 1999 revision cycle of the NEC. The background is as follows.

Since the 1974 edition, the NEC has contained a prohibition against the use of NM cable in any dwelling or structure exceeding three floors above grade (the three-floor limitation). During the 1999 revision cycle of the NEC, persons representing the interests of developers of multi-unit housing submitted several proposals seeking, in various alternative ways, to either eliminate or substantially modify the three-floor limitation. These proposals and related comments were all rejected by Code-Making Panel 7 (Panel 7) and the NEC Technical Correlating Committee. Motions were then made at the 1998 Annual Meeting in Cincinnati, Ohio, to accept each of the proposals or their associated comments and each of the motions failed. An appeal to the Standards Council then followed. The appellants raised numerous procedural issues related to the fairness of the processing of the proposals and comments, all of which were considered and rejected by the Council. (See Standards Council Decision #98-22, July 17, 1998.) The appellants also argued that the refusal of the consensus process to eliminate or modify the three-floor limitation could not be supported on technical grounds. The Council reviewed the technical arguments for and against the three-floor limitation and concluded, based on a review of the entire record, that the concerns raised by those opposed to the elimination or modification of the three-floor limitation were sufficient to support the Panel's decision to reject the various proposals and comments. In doing so, the Council accorded its usual deference to the standards development process on technical questions. Specifically, the Council stated:
Although the Council has the authority to reject the result yielded by the codes and standards development process, it would do so only where a clear case has been made that the conclusion reached by the process is without technical or other support. Here, this case has not been made. Although [Panel 7’s] written substantiation for the rejection of the Proposals could have been more detailed, the concerns over the expanded use of NM cable have been discussed and debated in this and in previous cycles, and the Council believes, on the basis of the entire record, that the safety concerns about rejection or modification of the three-floor limit are legitimate.

While the Council agreed that the concerns raised within the standards development process were then sufficient to justify rejection or modification of the three-floor limitation, the Council indicated that some eventual relaxation of the three-floor limitation might be possible and that the various proposed approaches to the expanded use of NM cable were deserving of careful further study. The Council noted:

Many new products or new uses of existing products have achieved acceptance within the NEC over time, with the addition of technical substantiation or the development of new approaches which offer adequate assurance of safety. As to the three-floor limitation, the Council notes that, although this issue has been raised before the Panel in past cycles, this is the first occasion on which the position of [Panel 7] has been called into question through a complaint or an appeal to the Standards Council. The Council believes that the entire issue is deserving of continued study.

The Council, therefore, directed,

. . . that the in-coming chair of [Panel 7] appoint a task group including a representative of the National Multi-Housing Council and others as appropriate, and that the task group do an in-depth review of the Proposals at issue with consideration to whether any one or a combination or modification of these Proposals could be approved and the basis for such approval. If it believes that acceptance of any revision to the three-floor limit could not be achieved based on the existing substantiation, the task group should provide clear direction relative to what substantiation would be required before favorable consideration could be given to proposals to eliminate or modify the three-floor limit. Based on the work of the task group or otherwise, proponents of elimination or modification of the three-floor limit may proceed to make proposals on the issue for processing during the next revision cycle, or if they believe it to be of an emergency nature, as a Tentative Interim Amendment.

A task group was thereafter formed and met in accordance with the Standards Council decision (the NM Cable Task Group). In a report to the NEC Technical Correlating Committee dated August 9, 1999, the NM Cable Task Group recommended a modest relaxation of the three-floor limitation. Specifically the Task Group in its report stated
that “based on the findings identified in this report, the task group agrees that some expanded use of nonmetallic-sheathed cable, particularly in multi-family dwellings, could be permitted.”

The Task Group reviewed the history of the three-floor limitation and noted that many of the concerns that prompted the original rule had been mitigated in various ways through various code and other technical improvements. (See Task Group report, dated August 9, 1999, at page 5). In these circumstances, it viewed a modest increase in the number of floors permitted for the use of NM cable in multifamily dwellings and other structures to be appropriate in some circumstances.

Looking to how a revision to the three-floor limitation might be approached, the Task Group noted that under the three-floor limitation, the use of NM cable was permitted in all construction types, combustible and noncombustible, in multifamily dwellings or other structures as long as the building did not exceed three floors above grade. Whatever the justification for this indiscriminate approach might have once been, the Task Group noted that types of construction are described in consistent terms today. These construction types are basically similar in the current building codes and are consistent with the identification of construction types in NFPA 220, *Standard on Types of Building Construction*. Construction types are identified as Type I through V. Types I and II are primarily composed of non-combustible structural elements while Types III, IV and V primarily composed of various levels of wood and other combustible structural elements. The five construction types are further subdivided according to the hourly fire resistance ratings of the various structural elements of a building. Seeking to rationalize the limitations on the use of NM cable, the Task Group recommended that the permitted uses of NM cable be based on building construction types.

The Task Group determined that NM cable was acceptable, with certain limitations, in multifamily dwellings and other structures that are permitted to be of combustible type construction. This conclusion recognized that NM cable was already in wide use in multifamily and other structures using wood frame construction and was considered safe for that purpose. Specifically, the Task Group proposed revising sections 336-4 and 336-5 of the NEC to permit the use of NM cable in multifamily dwellings and other structures, subject to certain limitations, in buildings that are permitted to be of types III, IV and V construction. (The proposal developed by the Task Group would eventually be designated as “Proposal 7-137” and, for convenience, this decision will refer to the proposal by that name.)

Because of the combustibility of buildings of construction types III, IV, and V, there are generally accepted limits on the heights of such structures. These limits, as expressed in NFPA 101, *Life Safety Code®,* the existing model building codes, as well as in the draft NFPA building code, generally restrict the height of combustible type construction to between two and five floors above grade. The number of floors varies according to the specific construction type, the fire resistance rating subdivision of the construction type, the nature of the occupancy, as well as the presence of other fire protection features such as automatic sprinklers. In practical terms, therefore, Proposal 7-137 in some
circumstances limits the use of NM cable to only two floors above grade. In other circumstances, the three-floor limitation would remain unchanged. In yet other circumstances, however (where, for example, structural elements have greater fire resistance ratings or where the structure will be protected by sprinklers), NM cable would be permitted in four, or in some cases, five floors above grade. In sum, therefore, Proposal 7-137 yields a modest, discriminate, but significant relaxation of the three-floor limitation in some cases.

Following the drafting of the NM Cable Task Group Report, the Task Group voted by letter ballot on the proposals developed in the Report. At one point during the balloting, a two-thirds favorable vote was achieved in favor of Proposal 7-137. The final vote after recirculation of negatives, however, showed more than a majority but less than two-thirds of the Task Group to be in favor of the Proposal. Because none of the proposals developed in the Report received a two-thirds favorable vote, the NEC Technical Correlating Committee declined to submit the Task Group proposals as Technical Correlating Committee Proposals. Mr. Nickson of the NMHC, however, did submit the proposals, including Proposal 7-137, for the consideration of the Panel 7. The Panel rejected Proposal 7-137 along with all other proposals seeking to modify or eliminate the three-floor limitation.

Reacting to Panel 7’s actions on the proposals, representatives of the NMHC and others sought the intervention of the Standards Council, making various claims of unfairness in the processing of the issue up to that point and seeking the formation of a new special task group or the reconvening of the existing task group. The Council saw no reason to interfere with the ongoing standards development process, and, therefore, declined to make conclusions or take any action to set up a new special task group. The Council directed the existing NM Cable Task Group to continue to work toward arriving at a set of recommendations, either through agreement with its original report or through a revised report. It urged both the NM Cable Task Group and Panel 7 to provide clear explanation and substantiation for any positions that they took. Also, given the concerns about toxicity of the products of combustion of NM Cable that had been raised, the Council directed the NEC Technical Correlating Committee to refer these issues to the Toxicity Technical Advisory Committee prior to the NEC Report on Comments meeting for the 2002 edition. (See Standards Council Decision #00-18, April 28, 2000).

In keeping with the directive of the Standards Council, the NM Cable Task Group reconvened. Leaving aside questions of toxicity, which had been referred to the Toxicity Technical Advisory Committee, the Task Group declined to recommend any modification to the three-floor limitation. (See minutes of the Task Group meetings of July 20-21, 2000 and August 27-30, 2000.) In particular, it recommended that the Panel continue to reject Proposal 7-137.

Likewise, in its Report on Comments, Panel 7 continued to reject all efforts to modify the three-floor limitation. In particular, it continued to reject Proposal 7-137 and, contrary to the urging of the Standards Council, provided no appreciable substantiation for that rejection. (See Comments 7-31, 7-41, 7-44). (The Panel did, however, accept the
conclusions of the Toxicity Technical Advisory Committee that toxicity concerns were not a valid basis for rejecting modification of the three-floor limitation. See especially Comment 7-45.)

Having failed to persuade the Panel to accept any modification of the three-floor limitation, the NMHC proceeded to raise the issue with the membership at the 2002 Annual Meeting in Anaheim, California. Specifically a motion was made to accept Comment 7-52. This Comment was a revision to an earlier proposal, 7-45, which permitted the use of NM cable in multi-family dwellings exceeding three floors above grade where specific conditions were met. This would have permitted the use of NM cable in multi-family dwelling occupancies, subject to the specified conditions, in buildings of any height and any construction type. The motion failed by a vote of 199 to 143. A motion was then made to accept proposal 7-137. After a debate, this motion failed as well on a vote of 191 to 94. This appeal then followed.

This issue comes before the Council with a recommendation by the standards development process that no modification to the three-floor limitation be incorporated into the 2002 edition of the NEC. In the absence of clear and substantial reasons for doing otherwise, the Standards Council will respect the results yielded by the codes and standards development process. In particular, the Council gives great deference to the technical judgments that have been made by the responsible technical committees, especially when those judgments have been supported, as they have here, by the NFPA membership.

Nevertheless, the Standards Council, as the body responsible for the issuance of NFPA documents and for hearing appeals related to procedural as well as substantive issues, has an independent obligation to ensure that any consensus arrived at within the NFPA process has been based on reasonable technical justification. In fulfilling that obligation, the Council will not generally conduct a detailed technical inquiry or substitute its judgment for that of the technical committee. It also recognizes that the burden of providing adequate technical substantiation for new products or methods generally rests with the proponents of these new products or methods. Where, however, a technical committee rejects a new product, or, as in this case, rejects an expanded use of an existing product, the Standards Council must assure itself that, at a minimum, a reasonable basis for that rejection has been articulated and can be discerned from a review of the full record. In this case, at least with respect to the panel’s rejection of Proposal 7-137, the Council, after careful review of the entire record, has simply found no such basis.

The proposals to modify or eliminate the three-floor limitation have taken two general approaches. First, the proposals exemplified by Comment 7-52 have sought to allow use of NM cable at any height and in all construction types, subject to certain specified conditions. Those proposals, whatever their merits, involve a significantly expanded use of NM cable into high-rise occupancies. Such occupancies raise egress issues that are not encountered in low-rise buildings where NM cable is currently in wide use. In addition, these proposals, whatever their merits, constitute a substantial expansion of the use of
NM cable in buildings of non-combustible construction types and thus raise the question whether NM cable can meet the more stringent standards generally applied in these buildings.

The second approach to modification of the three-floor limitation is exemplified by Proposal 7-137. Specifically that Proposal does not eliminate height limitations and does not permit expansion in the use of NM cable in non-combustible type construction (except where combustible-type construction is also permitted.) Instead, the Proposal limits its reach to buildings in which combustible construction types III, IV and V are permitted, i.e., construction types where NM cable is already in wide and safe use. In practice, this permits the use of NM cable in buildings no greater than four or five floors above grade, depending on such factors as specific construction type, the fire resistance ratings of structural elements, and the presence of sprinklers.

The Council is prepared to defer to the judgment of the Panel as to the first approach to expansion of the use of NM cable, which eliminates all height restrictions. After careful review, however, the Council has concluded that the arguments made in opposition to the second more limited approach simply do not constitute a reasonable basis on which to reject the approach. In so concluding, the Council has examined all of the concerns expressed about the expanded use of NM cable. Nothing in any of these concerns is more rationally addressed by a rigid three-floor limitation than by a rule that limits use of NM cable from two to five floors above grade depending on permissible construction type and related features. Without attempting to review and analyze every facet of every argument that has been made, the Council makes the following observations.

First, as a prerequisite for the expanded use of NM cable, Panel 7 took the position that proponents should be required to provide a fact-finding report showing the equivalency of NM cable to other wiring methods. Such a fact-finding report might address the concerns of those who argue that NM cable has not been shown to be equivalent to wiring methods that are currently considered safe and acceptable for use in high-rise, non-combustible type construction. Proposal 7-137, however, does not expand the use of NM cable into such buildings. Rather, Proposal 7-137 merely expands the permissible use of NM cable within low-rise buildings where combustible type construction is permitted. NM cable is already in wide use and is generally accepted as safe in such buildings, at least up to three floors above grade. Since NM cable is currently allowed in low-rise, combustible type construction, any investigation of the equivalency of NM cable with wiring methods currently allowed in such construction would entail the meaningless comparison of NM cable with itself. It is not reasonable, therefore, to require an “equivalency” fact-finding report in support of Proposal 7-137.

Second, Proposal 7-137 does not materially implicate the concerns raised about egress issues in high-rise buildings. The proposal does not permit the use of NM cable in high-rise construction. Rather, the proposal expands NM cable use by one or two floors, and it calibrates that expansion according to the combustibility of the construction type and related safety features. It is, of course, legitimate to ask whether there is any reason why the use of NM cable in buildings up to four or five floors above grade is any less safe in
the circumstances permitted by Proposal 7-137 than it is in buildings up to three floors. No such reason has been plausibly presented, however. In particular, no one has presented any egress concerns specifically implicated by the Proposal’s modest and rational expansion of the three-floor limit, and the Council can perceive none.

Third, toxicity concerns, which have been frequently raised in opposition to relaxation of the three-floor limitation, have now been adequately addressed by the Toxicity Technical Advisory Committee. This committee concluded generally that the NM cable issue is an issue of fire hazard analysis and less one of toxic hazard. The committee noted that the combustible mass of NM cable in a structure is a small fraction of the combustibles present in buildings, and it stressed that NM cable is not likely to add significantly to the toxic hazard posed by the normal, unregulated combustibles present in buildings that conform to modern building codes. The committee also concluded that there was no basis for differentiating the toxic hazard of NM cable on the basis of building height. (See Comment 7-45). Panel 7 itself accepted these conclusions. Toxicity concerns, therefore, provide no reasonable basis for rejecting Proposal 7-137.

Another set of objections to the expanded use of NM cable has been that it is subject to physical damage. A particular concern has been the potential for damage as the cable is pulled through metal studs where openings in the studs have not been adequately protected with grommets. As has been pointed out however, use of NM cable in metal stud construction is currently allowed by the NEC in structures up to three floors in height and it has not been demonstrated that any problem exists nor, if a problem does exist, why the addition of one or two floors would add to any such problem. In any case, the issue of physical damage in metal construction has been addressed in the 2002 edition of the NEC by the acceptance of a proposal requiring the use of grommets listed for the purpose of cable protection in metal studs (See Comment 7-82) and by a new listing requirement for NM cable. (See Comment 7-92 and 7-89, accepting Proposal 7-194).

As to several other concerns that have been voiced, the Council has reviewed and found them to be unsupported with respect to Proposal 7-137. There has been no evidence, for example, that NM cable presents either a significant ignition source or a flame propagation or smoke generation problem. As proponents have pointed out, the existing fire data have shown no fire problem from the use of NM cable, even in those jurisdictions where it is already permitted above three floors. There is no evidence that NM cable presents any added fire propagation concerns in buildings with combustible type construction. Indeed, it is difficult to argue that the presence of NM cable materially adds to the combustible loading or to the problems of flame propagation and smoke generation already present in such buildings. Finally, the new listing requirement for NM cable directly addresses concerns voiced about the consistency and quality of NM cable.

The various concerns expressed during the course of the long debate over NM cable may be sufficient to justify a complete prohibition in the use of NM cable in high-rise, non-combustible-type buildings. While such a prohibition may be open to legitimate debate, the Council believes that a reasonable basis has been articulated to justify Panel 7’s
conservative approach to the use of NM cable in such buildings. The Council, therefore, is able accord its usual deference to Panel 7 on this aspect of the NM cable issue. None of the concerns that have been raised about NM cable, however, can reasonably justify a prohibition on the use of NM cable, in carefully limited circumstances, at four or five stories above grade, where combustible construction is permitted. In this regard, it is useful to note that the original three-floor limitation was introduced into the NEC in 1974 at a time when multi-dwelling structures frequently did not have sprinklers, fire alarms, or even smoke alarms. Today these features are generally mandated in any structures above three floors. These new conditions alone demand some rational reconsideration of the three-floor limitation. Proposal 7-137 represents just such reconsideration, and, in the view of the Council, no reasonable basis has been articulated for rejecting it. The Council, therefore, after consideration of the entire record, has found a clear and substantial basis for upholding the appeal in part and has voted to accept Proposal 7-137 for the 2002 edition of the NEC.

In making this decision, the Council has chosen to focus on the technical issues presented by this appeal. This is in keeping with the Council’s repeated urging that the Task Group and Panel 7 give particular care to technical justification of any positions they took. The Council acknowledges that the Task Group went to great effort to fulfill its charge, and in particular made great strides in developing Proposal 7-137 and in providing a persuasive case in favor of the Proposal in its August 1999 report. Far less thorough or persuasive, however, were the Task Group’s subsequent work product, which provided little to refute the Task Group’s initial recommendation or shed light on why the Task Group had abandoned its support for Proposal 7-137. (See minutes of the Task Group meetings of July 20-21, 2000 and August 27-30, 2000.) In addition, Panel 7, the body ultimately responsible for substantiating its own actions, has not provided a reasonable basis for rejecting Proposal 7-137. Overall, the concerns articulated by the Task Group, by Panel 7, and by others opposed to modification of the three-floor limitation have been largely relevant to the area of high-rise non-combustible construction, not to the specific circumstances presented by Proposal 7-137.

Because the Council has chosen to focus on the substantive issues raised by this appeal, it is not necessary to focus in any detail on the procedural allegations that have been made. Some of these allegations are similar to allegations that were made in the previous revision cycle, and what the Council said at that time remains true and valid today. (See Standards Council Decision #98-22, July 17, 1998). In any event, the Council has reviewed the record concerning alleged procedural irregularities or unfairness and has failed to find any violation of the Regulations Governing Committee Projects or other unfairness in the processing of this matter. NFPA rules, however, and the importance placed by the NFPA process on technical justification for its consensus decisions require that technical committees be able to support any decisions that they make. In this case, the Council has concluded that, with respect to Proposal 7-137, the panel has simply failed to provide a reasonable basis for rejection of the proposal. Accordingly, it has voted to accept Proposal 7-137 for the 2002 edition of the NEC.
Council member James T. Pauley did not participate in the deliberation or voting on this issue.
August 2, 2022

Dawn Bellis, Council Secretary
NFPA Standards Council
1 Batterymarch Park
Quincy, MA 02169

Dear Ms. Bellis,

Please accept this submission for NFPA Standards Council consideration in accordance with Section 1.6.4 of the Regulations Governing the Development of NFPA Standards. This submission responds to the appeal submitted by the American Bimetallic Association contesting the votes on CAM 70-126 and CAM 70-128, and the treatment of CAMs 70-129, -127, and -60. Southwire opposes this appeal and contends that the code making panel decisions were properly reached. As a result, Southwire asks the Standards Council to uphold the NEC code making process and deny this appeal.

If you have any questions for Southwire, please do not hesitate to contact us at 470-955-3316 or by email at dave.watson@southwire.com.

Sincerely,

[Signature]

Dave Watson
Principal Applications & Consulting Engineer
Codes & Standards
Applications Engineering
Southwire® Company LLC
Appellant

Southwire Company, LLC

Represented by: Dave Watson
Principal Applications & Consulting Engineer
Codes and Standards
Applications Engineering
Southwire Company, LLC
One Southwire Drive
Carrollton, GA 30119

and/or its other designated representative(s)

Statement Identifying Appeal Relating to this Response

Southwire is responding to the appeals submitted by the American Bimetallic Association, 22-8-5-y and 22-8-5-aa-1, contesting the votes on CAM 70-126 and CAM 70-128, and the treatment of CAMs 70-129, -127, and -60.

The American Bimetallic Association wrongly contends that the process underlying these votes violated the National Fire Prevention Association’s Guide for the Conduct of Participants in the NFPA Standards Development Process by not “maintain[ing] a process that is open, honest, and fair to all participants”; “promot[ing] the development of codes and standards that are scientifically and technically sound, that promote creativity and innovation in the development of new methods and technologies, and that set reasonable standards intended to minimize the possibility and effects of fire and related hazards”; and alleging that Southwire “attempt[ed] to withhold or prohibit information or points of view from being disseminated…”.

Southwire strongly disagrees with this characterization. It maintains that the standards development process for these CAMs was based on substantial evidence and conducted in an open and honest manner that took into account all viewpoints. Therefore, there was no violation of the Guide for the Conduct of Participants in the NFPA Standards Development Process, and the American Bimetallic Association’s appeal should be rejected. Its proposed relief, implementing the above-mentioned CAMs, should not be granted, and the Standards Council should recommend further testing of 14 American Wire Gauge (“AWG”) Copper Clad Aluminum (“CCA”) and other smaller gauges of conductors and cables in line with Panel 6’s recommendations from October 2021.

Argument

I. Introduction

Southwire opposes the appeal submitted by the American Bimetallic Association (“ABA”), which continues to improperly assert that 14 AWG CCA conductors and cables should be included in the National Electric Code (“NEC”) for use in power and lighting circuits at the following amperages: 10 amperes at 60°C, 15 amperes at 75°C, and 20 amperes at 90°C. Southwire firmly disagrees and endorses the findings of Code Making Panel 6 - that additional testing must first be done in order to ensure 14 AWG CCA products operate within temperature ranges determined to be safe for their intended use.
As discussed in detail below, the linchpin to the ABA’s appeal is that the NFPA’s code making process is illegitimate, as it makes conspiratorial claims that Panel 6 members engaged in “subversion” that “deceiv[ed] certain panel members with sham tests.”\(^1\) ABA claims that its opponents “skewed the balloting”\(^2\) and violated the NFPA’s Guide for the Conduct of Participants in the NFPA Standards Development Process (“the Guide”) by failing to provide a “a process that is open, honest, and fair to all participants.”\(^3\) ABA alleges that its opponents engaged in this behavior in order to restrain trade and harm ABA members.\(^4\)

Contrary to ABA’s claims, the NFPA’s underlying code making process is both reasonable and common across code making bodies.\(^5\) It is built on the expertise of industry associations, which select representatives that vote in a way that represents the diverse views of their members. ABA’s reliance on allegations of foul play reeks of desperation and demonstrates that they have no meritorious claims to offer in this appeal.

II. ABA Falsely Claims That NFPA’s Code-Making Process Lacks Integrity Because Representatives Who Vote on Panel 6 Unduly Influence Their Trade Associations

The ABA falsely claims that those who voted against its amendment unfairly wielded influence over their trade associations during the code making process. The ABA essentially claims that there is no rational basis for opposing its amendment and, ultimately, questions the legitimacy of the NFPA’s standards development process.

Like any other code making panel, Panel 6 has representatives of major industry associations: the Steel Tube Institute, the National Electronics Manufacturing Association (“NEMA”), Copper Development Association, and the Aluminum Association, among others. Though each organization has its own processes for selecting representatives and determining how their representatives vote on

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1  Appeal Nos. 22-8-5-y and 22-8-5-aa-1, at 3 (hereinafter “ABA Appeal”).
2  ABA Appeal at 5.
3  ABA Appeal at 3.
4  ABA Appeal at 1, 8.
5  See ABA Appeal at 5 (indicating that various members of code-making Panel 6 have representative seats on other code making panels).
any given code making panel, most of these industry associations hold an open debate among their members and vote on their preferred position. For example, NEMA (which ABA claims corrupted the Panel 6 process) has a written policy outlining how its representative votes on any code making panel. This policy requires the NEMA representative to vote as directed by the NEMA Codes and Standards Committee, rather than in line with their personal beliefs. The NEMA Codes and Standards Committee develops its recommendations for its designated representative by seeking input and recommendations from relevant NEMA product groups, which will determine their respective recommendations through a vote. Given that NEMA is a large organization with 325 members representing varied interests, no one person can unduly influence the outcome. Indeed, NEMA’s membership is so varied that Copperweld, ABA’s lead member, is a member of NEMA, and thus has the opportunity to work within that association to advocate for its position. Other associations on Code Making Panel 6 contain many members: the Copper Development Association represents 36 companies, the Aluminum Association represents 55 producers, and the Steel Tube Institute represents 15 producers. Therefore, there is no basis to believe that trade associations are unduly influenced by voting representatives.

Ultimately, Copperweld and the ABA lost their argument, and now attempt through this appeal to blow up the code making process. As ABA demonstrates, Panel 6 industry representatives hold representative positions or cross-memberships with associations on Panels 3, 5, 8, 13, 15, and 17, which shows how common this voting structure is across other code making panels.

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7 Id. at § 13.3.2.
8 NEMA, Member Companies (accessed July 29, 2022), https://www.nema.org/directory/manufacturers#C; available at Exhibit 2.
9 Id.
13 ABA Appeal at 5.
across industry associations is inevitable, as these groups are large and important players in the industries that a particular code making panel impacts. ABA seeks to have the NFPA assume these individuals are suspect and unreliable due to cross-membership.\textsuperscript{14} In fact, ABA’s proposal would simply reduce the number of reliable experts that have the perspective to consider amendments to the NEC. ABA relies only on insinuation to claim that the individuals reported on page 5 of its appeal lack the integrity to participate on Panel 6, which fails to establish a basis to conclude that the deliberations at issue in this appeal were somehow tainted.

Finally, ABA also questions the legitimacy of the code making panels by focusing on Technical Session vote margins. However, the NFPA specifically designs the code making process to ensure that expert panels review the recommendations of Technical Sessions. At a Technical Session, any member of the NFPA may vote;\textsuperscript{15} it does not matter if they are an expert on the relevant issue being raised in any given amendment. In order to ensure that the NEC does not contain amendments affirmed by voters that may not have technical background in the subject, any amendment approved at a Technical Session must be voted on by the code making panel overseeing the section the amendment would impact.\textsuperscript{16} Instead of respecting this check on the code making process, ABA claims it as evidence that the system is rigged.\textsuperscript{17} Once again, instead of respecting the NFPA’s code making process, ABA seeks to undermine it with false allegations of subversion and corruption.

III. Organizations that Voted Against the ABA’s Proposal Do Not Seek to Restrain Trade

ABA falsely claims that Southwire or anyone else opposed to these amendments do not manufacture CCA products, fears competition, and seeks to restrain trade.\textsuperscript{18} Those allegations are

\textsuperscript{14} Id. at 5.
\textsuperscript{15} NFPA, Regulations Governing the Development of NFPA Standards § 4.5.3.4 (2021).
\textsuperscript{16} Id. at § 4.6.
\textsuperscript{17} ABA Appeal at 9.
\textsuperscript{18} ABA Appeal at 8; \textit{e.g.} Technical Session Day 2 Transcript (June 9) at 198 (Cronin) (“When you are looking at some of these CAMs, you want to see what is the real agenda of those who are opposing it. And if you look in general at those who are opposing it. And if you look in general at those who are opposing it, they’re the people who don’t mate it. You want to follow the money.”) (hereinafter Tr.); Tr. at 199 (Cronin) (“When it went back to the Committee, the special interests, unfortunately, basically wanted to… get them out of the market.”).
false. Southwire is capable of producing CCA products. Indeed, Southwire produced 14 AWG CCA THHN/THWN conductors and 14-2 CCA NM-B Cable to conduct the tests that were provided to Code Making Panel 6. 19

CCA products have been allowed in the NEC for decades. 14 AWG CCA products are already permitted in signal and control circuits, and 12 AWG CCA products are already permitted for use in 10 ampere power and lighting circuits. 20 ABA’s allegation of some vast, anti-CCA conspiracy strains credulity, as the opponents to ABA’s amendments have made no attempt to restrict the use of CCA products in any of these contexts, and indeed welcome their inclusion in the marketplace as already permitted.

If Southwire or any other company feared competition from CCA products, then they would have sought to include only 16 AWG copper products for 10 ampere circuits, and not the equivalent 14 AWG CCA products in the NEC. 21 This would have effectively secured the 10 ampere circuit market in power and lighting circuits for copper products at the expense of CCA products. However, that did not happen. By not supporting the entry of both 14 AWG CCA and 14 AWG copper for power and lighting circuits into the NEC, ABA’s opponents have been consistently focused on operating temperature, mechanical performance, and potential misuse issues – not on restraining trade as ABA falsely claims. 22

19 Tr. at 183 (Watson) (“Look, Southwire can make this product. In fact,… we’ve already made it for testing purposes.”).

20 See NEC Tables 310.16 and 310.17

21 Copper conductors having the same ampacity as aluminum or CCA conductors are typically 1-2 sizes smaller. See NEC Tables 310.16 and 310.17 for the exact ampacities.

22 In opposing ABA’s specific request to include 14 AWG CCA products in the NEC in power and lighting applications, companies like Southwire that can produce 14 AWG CCA products also seek to shield themselves from significant liability risks if 14 AWG CCA products enter the power and lighting market and ultimately overheat. As 14 AWG CCA and 14 AWG copper bare conductors look very similar, the risk of a contractor installing the wrong conductor type (or installing a 14 AWG CCA conductor into a device using the backstab method) is higher if both are included in the NEC. In situations with foreseeable risk like this, it is imperative that code making panels ensure that 14 AWG CCA products do not carry excessive fire risk in the event of an accidental installation. See also Southwire, CCA Insulation Strip and Outlet Backstab Testing (Oct. 25, 2021), available at Exhibit 6.
Indeed, the ABA may well be the ones seeking to restrain trade by advocating exclusively for 14 AWG CCA products for use in 10 ampere circuits. None of the 2023 NEC Public Inputs related to 14 AWG CCA included the equivalent copper conductor for 10 ampere circuits. During the 2023 NEC First Draft meeting, Code Making Panel 6 added 16 AWG copper at the same proposed ampacities as 14 AWG CCA. This First Draft, which the Panel endorsed under the assumption that more tests would be done, came in response to ABA’s push to limit the amendment to only 14 AWG CCA. In contrast, the Panel determined it was appropriate to consider 14 AWG CCA and 16 AWG copper in parallel. Despite the Panel’s intent to consider both products in parallel, ABA has consistently limited its amendments to only 14 AWG CCA. If ABA’s amendments pass as written, they would exclude functionally equivalent 16 AWG copper from the NEC, which would block its use in construction projects. This would allow 14 AWG CCA to be the only small conductor specifically called out in the NEC for use in 10 ampere power and lighting circuits at the expense of 16 AWG copper.

IV. ABA Falsely Claims That Southwire’s Test Results Showing Fire Risk Were a “Sham”

Southwire’s test results on power and lighting branch circuits indicates that there is a significant risk of overheating when 14 AWG CCA products are installed in insulation (modeling typical residential and commercial installation practices) and operated at the proposed ampacities. On October 25, 2021, Southwire finished its report of tests completed at its Cofer Center laboratory and the test results show that the conductor temperature ratings in NEC Table 310.16 are exceeded when using the ampacities proposed by the ABA (10 amperes at 60°C for 14 AWG CCA NM-B Cable, 15 amperes at 75°C for 14 AWG CCA THWN conductors installed in flexible metallic conduit, and 20 amperes at 90°C for 14 AWG CCA THHN conductors installed in flexible metallic conduit) while the

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23 See Tr. at 190 (Hunter).
24 Tr. at 179 (Newman-Scarce).
25 See ABA appeal.
26 Southwire’s Cofer Center laboratory is a 60,000 square foot research facility located in Carrollton, Georgia that conducts research, wire and cable specification and compliance, and laboratory development. Southwire, DB Cofer Technology Center (2021), available at Exhibit 7.
products are installed within insulated walls and ceilings/attics that are typical of residential and commercial installations. These results indicate an increased fire risk under these conditions.

ABA attempts to discredit Southwire’s report in a variety of ways – none with merit. Contrary to ABA’s assertion, Southwire’s testing details and methodologies were disclosed in the report submitted to the Panel. Indeed, the reported testing methodology was so thorough that it became the basis for Copperweld’s additional testing as well. ABA also claims that Southwire’s test is unreliable because it does not conform to specific testing standards. However, ABA knows this allegation is specious – there is no industry standard for electrical wire temperature tests conducted in insulation. Therefore, there was no industry testing standard to which Southwire could have conformed in conducting this particular test. Southwire, however, confirmed that the conductor material used for testing consisted of an 8000 Series aluminum base metal with an oxygen-free copper cladding that met the Underwriter Laboratories (“UL”) 1581 direct-current resistance (as required in UL 83 for Thermoplastic Conductors and UL 719 for Nonmetallic-Sheathed Cable) and copper thickness requirements for solid 14 AWG copper-clad aluminum. Finally, ABA’s claim that Southwire withheld testing on 14 AWG copper wire makes little sense, given that ABA’s amendments only relate to 14 AWG CCA wire. Simply put, Southwire tested 14 AWG CCA NM-B Cable in 10 ampere circuits and 14 AWG CCA THHN/THWN conductors in 15 and 20 ampere circuits, and the results indicate that in typical residential installations, 14 AWG CCA products may exceed their maximum temperature ratings and therefore present a fire hazard.


ABA appeal at 3.


Compare id. at 6-7 with Copperweld, Comparative Performance in Thermal Insulation of 14 AWG Copper and 14 AWG Copper-Clad Aluminum at the Applicable or Proposed (Dec. 15, 2021) at 6-7, available at https://www.copperweld.com/resources/downloads/copperweld-thermal-insulation.

ABA Appeal at 4.

Southwire’s Response to Comments Submitted by Chuck Mello (Consultant to the BiMetallic Association) at 6 (2021), available at Exhibit 9.
Southwire’s test was separately confirmed by Cable Technology Laboratories (“CTL”) and Hampton Tedder.33 These tests come from certified testing laboratories. For instance, Southwire’s Cofer Center lab holds certifications from the CSA’s Supervised Manufacturer’s Testing for Certification Program and UL’s Client Test Data Program, and both the Cofer Center and CTL hold ISO 17025 certification.34 Combined, these test results provided sufficient basis for Panel 6 to take the action that it did.

These reports were provided to Panel 6 as soon as practicable, under the circumstances. These tests were conducted during the COVID-19 pandemic and many laboratories were experiencing supply chain issues or were unable to operate under lock down. Southwire, other wire and cable manufacturers, and third-party testing laboratories worked as quickly as possible to provide reliable testing results under laboratory-controlled conditions as soon as they were able. The test results were submitted to Panel 6 in advance of the second draft of the NEC, in time for them to be considered.35 Therefore, the test results were not inappropriately delayed, and provided in advance of the vote for the relevant amendments.

Moreover, these tests were necessary. Contrary to ABA’s claims,36 14 AWG CCA products are not currently permitted for power and lighting applications, and as such there is no “field evidence” for these products. Before voting on the first draft of the NEC, Panel 6 only received test results from the Bimetallics Task Group, which tested 14 AWG CCA products only in open-air applications.37 As residential circuits are frequently installed in insulation, testing in insulation was an important data point for the Panel to consider.

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36 ABA Appeal at 7.
37 Tr. at 182 (Watson).
In response to this information, and contrary to ABA’s claims that Panel 6 did not provide clear guidelines for future testing, Panel 6 issued a detailed statement outlining the tests it needed to review before 14 AWG CCA products could be included in the NEC. This panel statement is the product of roughly eight hours of detailed discussion and debate among the code making panel members, and according to a number of long-time NEC code experts, it is one of the longest and most detailed panel statements ever produced. The statement (included in an addendum) provides eleven specific recommendations to test 14 AWG CCA and 16 AWG copper products on 10 ampere power and lighting branch circuits in insulation.

However, instead of using this statement as a guide for future testing, Copperweld, an ABA member, conducted its own test in December 2021 after the Second Draft meetings. Copperweld’s test results were not confirmed by an independent lab, although someone from Intertek Laboratories apparently “witnessed” a test through a remote video link and submitted a separate test report summarizing those same test results that they witnessed.

Without further confirmatory testing from independent third-party labs, there is no basis to grant this appeal. More testing is needed to accurately assess the risk of using 14 AWG CCA products in power and lighting circuits, and code making panels should be allowed to review other independent test reports in line with Panel 6’s recommendations.

IV. Conclusion

38 ABA Appeal at 10.
39 Tr. at 184 (Newman-Scarce) (“I would like to go on record as stating CMP 6 probably has the longest Committee Statement on record.”).
Based on the information and evidence discussed above, ABA’s appeal should be denied. The ABA’s tactic is to attack – from the designated voters on Panel 6, to the trade associations that these voters represent, and ultimately the NFPA’s process for maintaining the NEC. By alleging a vast conspiracy against it, the ABA attempts to seriously question the legitimacy of the NEC and NFPA’s Standards Development Process. As such, ABA has clearly violated the intent and spirit of the code making process. As NFPA’s Guide clearly states:

In all discussion, debate, and deliberation within the standards development process, participants should confine their comments to the merits of the scientific, technical, and procedural issues under review. Although participants may forcefully advocate their views or positions, they should be candid and forthcoming about any weaknesses in their position, and they should refrain from debate and discussion which is disrespectful or unprofessional in tone or which is unduly personalized or damaging to the overall process of achieving consensus.43

Regardless, the record before Panel 6 provided a substantial factual basis to reject ABA’s proposed amendment. ABA fails to demonstrate otherwise and, therefore, this appeal should be denied.

Statement of Recommended Standards Council Action

For the reasons detailed above, the Standards Council should not include CAM 70-126, CAM 70-128, and CAMs 70-129, -127, and -60, in the 2023 NEC.

The Council should recommend that ABA follows the detailed recommendations already provided by Code Making Panel 6 in its October 26, 2021 statement.44 Southwire welcomes additional work by the NFPA and UL (or other appropriate groups) on standards to address the temperatures of small conductors such as this in insulated walls and ceilings.

Addendum – NFPA Code Making Panel 6 Statement for Second Revision No. 8432-NFPA 70-2021 (Excerpted from Exhibit 11)

Committee Statement:

The panel acted to revert to 2020 code language for the minimum size of conductors for 310.3(A), Tables 310.16 and 310.17, and wiring methods in multiple articles, including Articles 320, 330, 334, 336, and 340. To ensure public safety, further time is needed to study 14 AWG copper-clad aluminum and 16 AWG copper as minimum conductor sizes. All of the public comments submitted on this topic were considered by the panel. Multiple test reports were presented to the panel as substantiation for the public comments in the 2023 revision cycle covering 14 AWG copper-clad aluminum conductor

heating at certain ampacity levels under insulation to replicate a real-world installation. The reports point to the need for a deeper understanding of the performance of 14 AWG copper-clad aluminum.

During the 2023 NEC revision cycle, the panel received reports and presentations from:

1) the Bimetallics Task Group (conducted at an Eaton facility)
2) the Copper Development Association (conducted at a Hampton Tedder facility)
3) the Southwire company (conducted at the DB Cofer laboratory)
4) the Cable Technologies Laboratory (conducted at their facility)
5) the Cerrowire company (conducted at the Marmon Innovation and Technology Center)

The Panel also considered reports from the 2020 NEC revision cycle, including the NSF International report.

After considering all the information and results presented in the reports, public inputs, and public comments, concerns were recognized about conductor overheating in common, everyday installations that need to be addressed prior to reducing the allowable branch circuit conductor size. Primarily, the evidence of excessive heat rise that occurs when wiring methods are installed in thermal insulation needs to be addressed. Voltage drop was also identified as a concern and needs to be addressed.

To determine the appropriate code requirements to ensure the installation of reduced branch circuit conductor sizes is both practical and safe, additional information is required. The panel requests public input that includes the following information obtained from credible sources and qualified testing laboratories:

1) Testing of representative wiring methods with 14 AWG copper-clad aluminum and 16 AWG copper shall be performed. Representative wiring methods could include those with non-metallic jackets, metallic sheaths, and those in metallic and non-metallic raceway systems.
2) Each wiring method shall have three current-carrying conductors.
3) At a minimum, testing of 16 AWG copper and 14 AWG copper-clad aluminum in thermal insulation is required. To address questions that were raised about existing branch circuit conductor sizes and heat rise in thermal insulation, the panel is also requesting testing of:
   a. 14 AWG copper and 12 AWG copper-clad aluminum
   b. 12 AWG copper and 10 AWG copper-clad aluminum
4) Equivalent testing of aluminum conductors is also welcomed.
5) For each wiring method, testing shall be performed at the 60C, 75C, and 90C ampacity values as appropriate as indicated or proposed in Table 310.16. Each test shall continue for a minimum of 3 hours or until thermal stability is reached, unless the temperature exceeds 150C at which point the test will be terminated. Conductor temperature shall be no more than 2C above ambient when each test begins.
6) At a minimum, testing shall include one continuous 100-foot length of wiring between the supply and load connections. Thermal insulation R-values and types shall comply with International Residential Code (IRC) Table N1102.1.3 minimum values for climate zone 5. A minimum of 90% of
the wiring method shall be placed inside the thermal insulation. Testing that provides comparisons of differing thermal insulation types and R-values is encouraged.

7) Testing shall include installations that are representative of both attic and wall locations.

8) Thermocouples shall be affixed in contact with the insulation of a current-carrying conductor inside the wiring method. For cable wiring methods the jacket or sheath shall be replaced/restored over the thermocouple.

9) Thermocouples shall not be placed on or next to framing members or any other building components other than thermal insulation and the conductor insulation. Thermocouples shall be placed no less than every 10 feet along the wire within the wiring method and temperature data values shall be recorded no less than every 30 seconds. Thermocouples shall be placed on the conductor insulation within one foot of the supply and load connections. Ambient temperature shall be recorded continuously.

10) Voltage and current at the supply and load connections shall be monitored and values shall be recorded at a minimum of every 30 seconds.

11) All conductors shall be tested under equivalent conditions. The panel has also identified remediating actions that could be taken to prevent overheating in this type of installation, including installation restrictions, reduced ampacity values in the Article 310 tables, or ampacity adjustment requirements.

The panel has also identified remediating actions that could be taken to prevent overheating in this type of installation, including installation restrictions, reduced ampacity values in the Article 310 tables, or ampacity adjustment requirements.