1. Revise 680.42(B) to read as follows:

680.42(B) Bonding. Bonding by metal-to-metal mounting on a common frame or base shall be permitted. The metal bands or hoops used to secure wooden staves shall not be required to be bonded as required in 680.26.

Exception No. 1: The metal bands or hoops used to secure wooden staves shall not be required to be bonded as required in 680.26.

Exception No. 2: A listed self-contained spa or hot tub that meets all of the following conditions shall not be required to have equipotential bonding of perimeter surfaces installed as required in 680.26(B)(2):

(1) Is installed in accordance with manufacturer’s instructions on or above grade.
(2) The vertical measurement from all permanent perimeter surfaces within 30 horizontal inches (76 cm) of the spa to the top rim of the spa is greater than 28 inches (71 cm).

Informational Note: For further information regarding the grounding and bonding requirements for self-contained spas and hot tubs, see ANSI/UL 1563 – 2009, Standard for Electric Spas, Equipment Assemblies, and Associated Equipment.

Submitter’s Substantiation: At issue is that outdoor self-contained spas that are manufactured “appliance” units tested and listed under UL 1563, designed and intended to be installed on or above grade, are required to follow the same NEC rules as custom in-ground spas and built-in swimming pools for perimeter bonding. In reality, the two categories have very different concerns of safety and enforcement. This difference was recognized by the Code for indoor spas and for storable pools, both of which are excluded from perimeter bonding requirements of 680.26 yet have the same safety issues as listed self-contained spa or hot tub installed outdoors.

The application of 680.26 perimeter bonding requirements of the present NEC creates undue expense and extreme difficulty for homeowners who wish to simply set up a portable spa in their backyard, yet the requirements add no documented safety benefit. The result is increased numbers of un-permitted self-installations, significantly increasing safety risks and nullifying the very intent of the Code.

This TIA urgently seeks to minimize the number of at-risk non-permitted installations by excluding very specific installations of listed portable self-contained spas from perimeter bonding and giving clear guidance to AHJ’s. Its intent is also to incorporate concerns voiced by various Panel members during the discussion of this Proposal and Comment 17-100.

Emergency Nature: Left unchanged, the present 2008 and unchanged 2011 Code provisions in 680.42(B) for listed self-contained portable spas or hot tubs installed outdoors forces spa purchasers to:

- Incur exorbitant cost to tear out and re-build entire permanent patio areas for a portable spa or hot tub, without any scientifically defensible basis for such a requirement.
- Be required to install useless and ineffective perimeter bonding on or under nonconductive decks, some of which may be one or more stories above ground level where there is no risk of stray voltage in the immediate vicinity of the spa or hot tub.
- Self-install a listed self-contained portable spa or hot tub without a permit, bypassing all code enforcement inspections and nullification of the intent of the Code.

Conformance to NFPA Emergency Nature Rules

Following are specific issues that clearly mark the issues as having an “Emergency Nature”:

a) *(Rule A is not applicable).*

b) The document contains a conflict within the document or with another NFPA document.

Specifically, 680.40 lumps all spas or hot tubs together even though listed self-contained portable spas or hot tubs installed outdoors (portable outdoor spas) have the same safety issues as 680.30 Storable Pools and 680.43 Indoor Self-Contained Spas, yet must conform to 680.26 for in-ground custom pools and spas.. This presents conflicts in the various code sections and results in inappropriate and unsupportable classifications.

c) *(Rule C is not applicable)*

d) *(Rule D is not applicable)*

e) *(Rule E is not applicable)*

f) The proposed TIA intends to correct a circumstance in which the revised document has resulted in an adverse impact on a product or method that was inadvertently overlooked in the total revision process, or was without adequate technical (safety) justification for the action.

Specifically, 680.42 makes no differentiation between permanently installed in-ground custom spas or hot tubs, and listed self-contained (portable) spas or hot tubs, yet the safety concerns are vastly different. In addition, the 680.26(B)(2) perimeter bonding stipulation became far more strict in recent Code editions with the intent of ensuring safety for permanently installed in-ground pools and spas but without regard to listed self-contained (portable) spas or hot tubs.

The incorporation of the perimeter bonding requirements contained in 680.26(B)(2) into 680.42 as it pertains to listed self-contained spas or hot tubs results in no safety benefit in a portable self-contained listed spa or hot tub installation, yet it forces extraordinary expense in the installation or on-premise relocation of listed self-contained spas or hot tubs.

There is no technical (safety) justification for perimeter bonding of listed self-contained spas or hot tubs, and no history of injury or death in connection with a properly installed self-contained spa without perimeter bonding. In the 2010 ROC process, CMP-17 members reviewed the known documented cases of injury or death available from CPSC, UL field reports and elsewhere, and none involved perimeter bonding of listed self-contained spas or hot tubs, as evidenced by the discussion associated with Comment 17-100.

TIA Seeks Correction of Prior Panel Action That Was Based on Incorrect Data

As a result of the language in the existing Code, there have been a number of reported anecdotal instances where inspectors are requiring excessive and nonsensical installations of portable self-contained listed spas and hot tubs, and an unknown number of instances where inspections have been bypassed. Comment 17-100 presented to CMP-17 attempted to correct these deficiencies. Evidence presented to CMP-17 in the evaluation of Comment 17-100 demonstrated that there was no documented death or injury attributable to either deficient
or even nonexistent bonding of perimeter surfaces associated with listed self-contained spas or hot tubs installed outdoors.

The inclusion of portable self-contained spas in 680.26 for perimeter bonding was based on incorrect, unsupported evidence. The original “substantiations” for 2004 Proposal 17-122 stated:

“Numerous instances have been encountered where voltage gradients have been found to exist between a properly grounded and bonded swimming pool, packaged or self-contained spa or hot tub and the interlocking paving stone deck surface installed surrounding it. Investigations of such conditions typically reveal that the paving stone surface does not possess suitable means by which bonding can be established and thus the necessity of creating an equipotential ground surface has been neglected.”

Also, the “substantiations” for 2004 Proposal 17-136 stated:

“Numerous instances have been encountered where voltage gradients have been found to exist between a properly grounded and bonded packaged or self- contained spa or hot tub and the concrete or paver stone surface upon which it is installed. Investigations of such conditions typically reveal that the concrete or paver stone surface has not been bonded to the spa or hot tub equipment. Consideration of a spa or hot tub as a variation of a permanently installed swimming pool would suggest that the same grounding and bonding practices apply. However, the requirements to properly bond the reinforcing metal of a deck surface when installing a spa or hot tub is not explicit enough in the code.”

These “substantiations” do not in fact demonstrate that “numerous instances . . . have been found to exist,” or that “a [listed self-contained] spa or hot tub as a variation of a permanently installed swimming pool would suggest that the same grounding and bonding practices apply,” or that there is any perceptible safety risk associated with listed self-contained spas or hot tubs installed outdoors installed without perimeter bonding. Instead, the documented evidence reveals the complete opposite. As stated above, in the 2010 ROC process, CMP-17 members reviewed the known documented cases of injury or death available from CPSC, UL field reports and elsewhere, and none involved perimeter bonding of listed self-contained spas or hot tubs, as evidenced by the discussion associated with Comment 17-100.

Consequently, this TIA is intended to correct a 2004 Panel decision that was based on incorrect supporting data.

Extraordinary and Unnecessary Requirements Nullify Purpose of Code

The current language of 680.42 can be and has been legitimately interpreted by AHJs to require such extraordinary and unnecessary measures as:

- Requiring tearing up and re-building of entire existing permanent concrete patios if listed self-contained portable spas or hot tubs are placed on them.
- Requiring the installation of No. 8 AWG bare perimeter bonding conductors stapled to the bottom of non-conducting decks made of wood or other similar materials that may even be one or more stories above ground level.
- Requiring that buried perimeter bonding rings be placed in the earth below such non-conducting decks, even if the deck is elevated well above ground level and/or prohibits contact with the listed self-contained spa or hot tub by persons standing on the ground.

The existence of these legitimate but extraordinary interpretations of 680.42 often results in the installation or on-premise relocation of listed self-contained spas or hot tubs without permits, nullifying the Code entirely and circumventing the inspection of very legitimate safety items associated with the electrical installation such as GFCI protection, proper cord sizing and physical protection, the existence of a disconnecting means, etc. An
example of the catastrophic results of bypassing code compliance is illustrated in the supporting documentation in the Letter to CMP-17 Regarding Spa Safety Issues and Perimeter Bonding.

**Supporting Documentation Attachments:**

- Detailed Discussion of Spa Perimeter Bonding
- Illustrations of Differences for Self-Contained Spa and In-Ground Pool
- Photo of Typical Self-Contained Spa or Hot Tub
- Example of User’s Guide for Electrical Connections of Spa
- UL 1563 Content Summary
- Letter to CMP-17 Regarding Spa Safety Issues and Perimeter Bonding
Supporting Documentation

Detailed Discussion of Spa Perimeter Bonding .......................................................... 2
  1. Introduction ............................................................................................................. 2
  2. Listed Spa Definition and Features ....................................................................... 2
  3. Perimeter Bonding of Spas and Pools .................................................................. 3
  4. Spa Wall Height Reduces Step Potential Concerns .............................................. 3
  5. Inappropriate Application of Pool Code to Outdoor Self-Contained Spas ............ 4
  6. Safety History of Listed Self-Contained Spas and Hot Tubs ............................... 4
  7. Proposed Amendment ......................................................................................... 4
  8. Conclusion ............................................................................................................ 5

Illustrations of Differences for Self-Contained Spa and In-Ground Pool ................. 6
Photo of Typical Listed Self-Contained Spa or Hot Tub ............................................. 7
Example of User’s Guide for Electrical Connections of Spa .................................... 8
UL 1563 Content Summary ....................................................................................... 9
  CONSTRUCTION .................................................................................................. 9
  PERFORMANCE ................................................................................................. 10
  MANUFACTURING AND PRODUCTION-LINE TESTS ...................................... 11
  RATINGS ........................................................................................................... 11
  MARKINGS ......................................................................................................... 11
  INSTRUCTIONS ................................................................................................. 12

Letter to CMP-17 Regarding Spa Safety Issues and Perimeter Bonding .................. 13
  1. Investigation of Various Incident Reports ............................................................. 13
     a. Fatal shock report from CPSC (10/18/2003) ..................................................... 13
     b. Cases reported by Greg Olsen of Public Service Electric and Gas ................ 16
     c. Other Non-fatal CPSC shock reports .............................................................. 17
  2. Increased Risk with Equipotential Grid ................................................................. 17
     a. Utility Faults .................................................................................................. 17
     b. Most Common Faults .................................................................................. 17
     c. Self-Contained Listed Spa versus In-ground Spa or Pool ............................. 17
     d. Major Spa Improvements that Contribute to Safety ...................................... 18
  3. Code Interpretations ............................................................................................ 18
  4. Conclusion ........................................................................................................... 18

Shock Hazard in a Self-Contained Spa with Bonded Perimeter Grid ....................... 20
Example of a Self-Contained Listed Spa ................................................................. 21
Email from David Livingston at PDC Spas to Larry Nicholson, Electrical Engineer .. 22
Detailed Discussion of Spa Perimeter Bonding

1. Introduction

Equipotential bonding of pools and spas is intended to reduce shock hazards either from local faulty equipment and wiring, or from nearby stray voltages. Faulty equipment and wiring is by far the most prevalent potential shock danger and most likely to cause injury or death, prevention of which is the central intent of the Code. Equipotential bonding is also a means to mitigate issues with stray voltages from nearby “leaks”, but the voltage levels are typically of “tingle” level and below any known, documented threshold of concern associated with the practical safeguarding of persons and property.

As the focus of this TIA, listed self-contained portable spas or hot tubs have a myriad of safety features built-in to protect against equipment and wiring failures, as required by UL 1563. As a result, there have never been any injuries or deaths reported for a self-contained listed spa that was installed in accordance with the manufacturers’ directions and to Code, and without any equipotential bonding of perimeter surfaces.

2. Listed Spa Definition and Features

The differences between a listed self-contained portable spa and a custom field-assembled spa are significant. For better understanding, a “listed self-contained spa or hot tub” (generally referred to in the industry and the press as a “portable self-contained spa or hot tub”) is a completely self-contained factory-built unit that:

- Incorporates a manufactured and completely plumbed tub assembly of acrylic, fiberglass, or a similar non-conductive material.
- Incorporates a pre-installed, connected and electrically bonded frame, pump, filtration, heating, low-voltage lighting and control equipment.
- Provides for electrically grounding of conductive portions of the entire manufactured assembly.
- Is tested and listed under UL 1563, which stipulates numerous specific electrical safety features mentioned here.
- Is sold by a dealer or manufacturer and purchased as an appliance unit by the consumer completely ready for use.
- Is transported as a unit, and set up at the purchaser’s designated location by placing its base on a supporting surface.
- Is required to be electrically connected with a properly-sized and protected grounding-type wiring arrangement (cord-and-plug or hard-wired)
- Is required to have GFCI-protection and a disconnecting means.
- Is placed on a supporting surface that can include the earth, a patio, floor or similar slab, supporting blocks such as CMU, or a wood or composite deck.
- Is constructed by the manufacturer with an enclosure on all four sides extending from the base to the top of the tub, and therefore it not intended, designed or manufactured to be either partially or completely buried in the earth or abutted by berms or other similar structures.
- The listed self-contained spa or hot tub is designed and intended to be capable of being readily relocated (i.e., it is truly portable)

In stark contrast, a custom field-assembled spa or hot tub is:

- Comprised of individual components or groups of components that are sold separately and not as a unit.
- Intended to be assembled, plumbed and internally wired or connected on-site at the purchaser’s premises.
• Installed either above or in the earth.
• Not manufactured, sold and delivered to the purchaser as a single listed unit immediately ready for connection to power and operation
• Not listed or self-contained, regardless of whether or not the individual components or groups of components assembled together in the field to form the spa or hot tub are manufactured and listed or recognized
• Not intended to be covered by this TIA.

3. Perimeter Bonding of Spas and Pools

Section 680.26 requires equipotential bonding of perimeter surfaces that is not only impractical for self-contained portable spa installations, but adds no discernable safety value. Perimeter bonding is intended to mitigate any electrical potential between the water and the surfaces around the pool or spa to help prevent injury or death from electrical shock when a user is in contact with both at the same time, but its drawbacks far outweigh potential benefit for a self-contained spa.

For an in-ground pool or spa, an equipotential bonding grid is installed in or under the surrounding deck per 680.26(B) during the construction of the pool or spa. The grid is tied electrically to all other electrical components and to the under-pool grid, assuring a single electrical potential.

For a listed self-contained portable spa or hot tub, which is simply placed on the deck surface, any existing deck must be torn up and re-built with the added perimeter bonding grid at a great cost even though the spa itself is portable. If the listed self-contained spa or hot tub is subsequently moved, the entire tear-up rebuild process must be repeated. Since the self-contained spa employs a non-conductive shell, the only path to tie the water and surrounding deck to establish a single electrical potential is through individual wires with greater potential for damage and bad connections (unlike the in-ground pool installation where the pool shell and surrounding deck are one contiguous structure).

4. Spa Wall Height Reduces Step Potential Concerns

Manufactured listed self-contained portable spas and hot tubs are designed and intended to be (and usually are) placed on a deck surface and have relatively tall perimeter walls, making it extremely unlikely for a user to be immersed in the water and making solid contact with the perimeter surfaces at the same time.

If all other safety measures were to fail (which is very unlikely with a listed self-contained spa or hot tub), and there is a voltage difference between the spa water and the perimeter surface, users within the spa will not be able to make solid contact with the perimeter surface as might occur in an in-ground spa (i.e., no foot-to-foot contact is possible as a practical matter because of the wall height of the spa or hot tub, particularly with the minimum 28 inch height (71 cm) above all peripheral surfaces within 30 inches (76 cm) of the spa or hot tub as proposed in the TIA). Users approaching such a spa or hot tub would never be able to sustain contact with both water and the perimeter surface for any period long enough to cause serious injury or death, if at all. Any shock would cause the person to react and jolt away without secondary injury, as might not happen in an in-ground installation.

If “stray voltage” is present in the surrounding surfaces of the spa, the wall height will tend to position a person who touches both water and perimeter surface such that any startle reaction will simply make them jolt away, again without secondary injury, and with no practical opportunity to fall into the spa or hot tub.
5. Inappropriate Application of Pool Code to Outdoor Self-Contained Spas

Section 680.42 requires that all outdoor spas and hot tubs conform to perimeter surface bonding provisions applicable to permanently installed swimming pools and spas, and does not differentiate between UL-listed self-contained spas and unlisted custom-built field-assembled in-ground spas (which should require perimeter bonding), yet the safety and installation concerns are vastly different. At the same time, the Panel recently adopted an exception for indoor spa installations from perimeter bonding (680.43 Exception 2) and already excludes Storable Pools from such requirements. Safety concerns for listed self-contained spas and hot tubs are, as a practical identical or pose less risk than those associated with storable pools, whether indoors or out.

This proposed TIA grants exception to specific listed self-contained spa and hot tub installations to assure that all spas are installed in the safest manner with the least ambiguity.

6. Safety History of Listed Self-Contained Spas and Hot Tubs

The practical safeguarding of persons and property is the primary purpose of the National Electric Code®. A listed self-contained (manufactured) portable spa has numerous features that help assure this safety, such as:

- Third-party tested and listed to rigorous safety requirements per UL 1563. See attached UL 1563 Content Summary illustrating the lengthy requirements of this standard.
- Use of a plastic non-conductive shell (electrical isolation reduces shock potential).
- Factory-built to uniform standards. (in contrast to a custom spa)
- Minimal potential for corrosion when at or above grade. (Degradation of safety features over time is minimized).
- Fully GFCI protected.
- Full internal bonding.
- ISO-9000 quality manufacturing systems assure consistent products.

It is very important to note that there have never been any documented deaths or serious injuries in properly installed listed self-contained spas or hot tubs even with millions of units in use.

In contrast, built-in and field-erected pools and spas do have documented records of injury and/or death, are not manufactured, but are individually built to varying standards, would never be able to pass UL1563, and the final safety is left to the individual installer and inspector.


7. Proposed Amendment

The proposed amendment to 680.42(B) defines a very specific exclusion from perimeter bonding for certain self-contained spa installations.

The proposed TIA amending 680.42(B) limits the perimeter bonding requirement as follows:

- Exclusion is limited to spas that are listed self-contained manufactured units, not modular units and not field-assembled units. Good Manufacturing Practices assure consistent quality of safety features. Many manufacturers comply with ISO 9001 Quality System standards, further assuring consistency and quality.
Exclusion is limited to properly installed spas, per manufacturer’s instructions. Important safety aspects of manufacturer’s instructions are defined by UL 1563. See excerpt from a typical spa manual, attached.

- Exclusion is limited to spas that are listed per UL1563, which is a very rigorous safety standard for spas and requires third-party validation. Refer to the UL 1563 Content Summary attached below.
- Exclusion is limited to spas that are installed on or above grade, eliminating drainage and other concerns associated with sinking an electric appliance in the ground. This is a primary reason for the need to differentiate self-contained spas from custom-built in-ground pools and spas.
- Exclusion is limited to spa installations that have exterior walls that are at least 28 inches (vertically) above the surrounding deck for a distance of 30 inches out from the spa. For a spa installed on the deck surface, the tall wall significantly reduces the likelihood of serious shock between perimeter surfaces and the water. When coupled with the many safety features of a properly installed listed spa, the risk of serious shock is essentially zero. This is evidenced by the long safety record of properly installed listed self-contained portable spas, as discussed previously.

8. Conclusion

The Proposed Tentative Interim Amendment is urgently needed as the present Code is nearly shutting down legitimate spa installations in several areas of the United States, often pushing consumers to more than double their costs for a spa, simply not purchase a spa, or to install the spa without inspection, which raises serious safety concerns and is contrary to the purpose of the Code.

With this Tentative Interim Amendment, there will be clear and practical direction to inspectors to ensure consumers and installers willingly conform to the Code and the spas are as safe as possible.
Illustrations of Differences for Self-Contained Spa and In-Ground Pool

Approaching listed self-contained portable spa or hot tub installed per manufacturer’s instructions on or above ground level: If all safety features fail, user will jolt back if shock occurs.

User within listed self-contained portable spa or hot tub installed per manufacturer’s instructions on or above ground level: With failed safety, user cannot make contact with water and perimeter simultaneously.

Permanently installed in-ground pool: With failed safety, user can easily make contact with both water and perimeter, with potential for injury.
Photo of Typical Listed Self-Contained Spa or Hot Tub

Contains all pumps, heaters, controls and lights, all factory wired and bonded internally according to UL 1563. Fully tested “appliance” unit. No custom installations.

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Example of User’s Guide for Electrical Connections of Spa

**Electrical Requirements**

Your Hot Spring® spa has been carefully designed to give you maximum safety against electrical shock. Connecting the spa to an improperly wired circuit will negate many of the spa’s safety features. Improper wiring may also cause electrocution, risk of fire, and other risks of injuries. Please read and follow the electrical installation requirements and instructions for your specific spa model completely!

**SERVICE NOTE:** All Hot Spring spa model's, except Custom Cabinet models (CC), are equipped with a power indicator (Hot Spring Logo blue light) which, in addition to showing the spa has power to it, has a diagnostic function as well. It will begin blinking if the heater high-limit thermostat has tripped. If the power indicator light is blinking, follow the instructions in the Troubleshooting section to identify and correct the cause. The power indicator will stop blinking once the problem has been corrected. The Power and Ready indicator lights on the control panel also provide the same diagnostic function.

HOT SPRING SPAS MUST BE WIRED IN ACCORDANCE WITH ALL APPLICABLE LOCAL ELECTRICAL CODES. ALL ELECTRICAL WORK SHOULD BE DONE BY AN EXPERIENCED, LICENSED ELECTRICIAN. WE RECOMMEND THE USE OF APPROPRIATE ELECTRICAL CONDUIT, FITTINGS, AND WIRE FOR ALL CIRCUITS.

An electrical subpanel containing two GFCI breakers is included with each 230 volt spa. We recommend that this subpanel be used to supply power and protect the spa.
This subpanel requires a 50 amp, single phase, 230 volt, four wire service (two line, one neutral, one ground). The grounding conductor must be at least the same gauge as the line conductors, but not less than #8 AWG. Mount the subpanel in the vicinity of the spa, but not closer than five feet away, in accordance with all local codes. (N.E.C. 680-38 to 41-A-3)

*(Wiring drawings and specific instructions also included)*

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UL 1563 Content Summary

Following is a partial listing of the various sections contained in UL 1563 Safety Standard for Portable Spas. Each spa must be designed and constructed to meet the standards defined in 1563, then testing by a third party to validate the design. This includes strict requirements for bonding, current collectors, electrical spacing, etc. In addition, instructions and labeling have clearly defined requirements to assure safety and proper installation, including such items as GFCI, bonding, voltage warnings, electrical wiring diagrams and so forth.

The advantage of a listed self-contained spa is its’ consistent conformance to safety standards, and resultant safety track record for the consumer.

UL 1563 is © Underwriters Laboratories

CONSTRUCTION

General
8 Frame and Enclosure
  8.1 General
  8.2 Metal enclosures
  8.3 Nonmetallic enclosures
  8.4 Drainage
  8.5 Mounting pads or holes
  8.6 Barriers
  8.7 Ventilating openings
9 Mechanical Assembly
10 Securement with Adhesives
11 General Accessibility Requirements
12 Accessibility Requirements For Spas
13 Resistance to Corrosion
14 Power Supply Connections – Cord-Connected and Convertible Spas and Equipment Assemblies
15 Power Supply Connections – Permanently Connected Units
  15.1 General
  15.2 Terminal compartments for supply connection
  15.3 Wiring terminals and leads
  16 Grounding
17 Bonding
18 Leakage Current Collectors
19 Live Parts
20 Wiring
  20.1 General
  20.2 Splices and connections
  20.3 Wiring between component enclosures
21 Heating Elements
22 Separation of Circuits
23 Electrical Insulation
24 Printed-Wiring Boards
25 Spacings
  25.1 General
  25.2 Field wiring terminals
  25.3 Spacings at other than field wiring terminals or on printed wiring boards
  25.4 Spacings on printed wiring boards
26 Internal Bushings
27 Gaskets
28 Thermal Insulation
29 Motors
   29.1 General
   29.2 Motor circuit overload protection
30 Overcurrent, Thermal, or Overload Protective Devices
31 Transformers and Power Supplies
32 Switches and Controllers
33 Capacitors
34 Lampholders and Receptacles
35 Temperature-Regulating Controls
   35.1 General
   35.2 User controls – standard settings
   35.3 User controls – special temperature settings
   35.4 Water temperature indication
   35.5 Construction
36 Temperature-Limiting Controls
37 Reduction of Risk of Injury to Persons
   37.1 General
   37.2 Stability
   37.3 Risk of scald injury
   37.4 Heater protection
   37.5 Water backflow
   37.6 Safety controls and safety circuits
   37.7 Reliability
   37.8 Ozone generators
38 Suction Openings
39 Ground-Fault Circuit-Interrupters
40 Pump Shut-Off Devices
41 Audio/Video Components

**PERFORMANCE**

42 General
43 Leakage Current Test
44 Available Current Test
45 Insulation Resistance Test
46 Starting Current Test
47 Power Input Test
48 Leakage Current Test or Insulation Resistance Test Following Humidity Conditioning
49 Dielectric Voltage-Withstand Test
50 Temperature Test
51 Water Temperature Test
52 Abnormal Water Temperature Tests
   52.1 Temperature-limiting control test
   52.2 Kinetic heating test
53 Motor Protector Test
   53.1 General
   53.2 Temperature
   53.3 Locked rotor protection
   53.4 Endurance
53.5 Limited short circuit
54 Water Exposure Test
   54.1 General
   54.2 Splashing
   54.3 Seal test
   54.4 Simulated rain
55 Leakage Current Test in Water
56 Test for Resistance to Impact
57 Ozone Offgas Test
58 Abnormal Operation Tests
   58.1 Low water and no water test
   58.2 Interrupted power
   58.3 Water flow interruption
   58.4 Water back flow
   58.5 Reverse hydrostatic pressure
   58.6 Electrolytic capacitor test
   58.7 Transformer test
   58.8 Electronic component test
59 Flow Rate Test
60 Strain-Relief Test
61 Metallic Coating Thickness Test
62 Structural Integrity Tests
   62.1 General
   62.2 Static loading test
   62.3 Impact load test

MANUFACTURING AND PRODUCTION-LINE TESTS

63 Grounding Continuity Test
64 Dielectric Voltage-Withstand Test

RATINGS

65 Cord-Connected Products
66 Permanently-Connected Products
67 Convertible Products
68 Supply Conductor Ampacity and Rating of Overcurrent Protection

MARKINGS

69 General
70 Wiring Diagram
71 Temporary Markings for Spas
72 Additional Markings
   72.1 General
   72.2 Spas
   72.3 Equipment assemblies
   72.4 blowers
   72.5 Controls
   72.6 Audio/video components
   72.7 Double-insulated pumps and blowers
INSTRUCTIONS

73 General
74 Important Safety Instructions
  74.1 General
  74.2 For all units
  74.3 Spas
  74.4 Equipment assemblies
  74.5 Blowers
  74.6 Audio/video components
30 December, 2009

Don Jhonson
NEC CMP-17 Panel Members

RE: 17-203 Spa Perimeter Bonding Proposal

Mr. Jhonson and Panel Members,

The APSP is pleased to have had an opportunity to present its proposals to the Panel during the course of the recent hearings for the 2011 NEC, including our proposal 17-203 that seeks to clarify the perimeter bonding requirements for self-contained spas. This letter is presented to the Panel to bring to light additional very important safety findings pertaining to this subject.

During discussions by the panel, several members stated they recall that a handout was distributed in 2004, as part of the 2005 NEC development process, which suggested the existence of injuries arising out of the lack of a perimeter bonding grid around or under a self contained spa. Based on this representation, a number of members voted against the proposal, pending production of this handout.

Having communicated with our members and other leading manufacturers, we have confirmed that none of them are aware of such a report or handout, or of any incidences of injury that would fit the above description.

While subsequent communications have referenced certain incidents reported to the Consumer Product Safety Commission, as explained below, none of these incidents involve a serious injury or death in a self-contained spa that was installed on or above the ground, as would be required under our proposal.

1. Investigation of Various Incident Reports

We have reviewed data provided from the CPSC regarding spa shock incidents, as well as the two reports provided to the Panel from Greg Olson of PSEG. In reviewing the reports, we excluded reports of shock during a repair of the electrical systems as this is not pertinent to the perimeter grounding issue.


In this case, a 39 year-old woman died while stepping out of a “hot tub”. Her son was also shocked but survived. The thermostat had just been replaced a few days prior. To clarify what occurred, we communicated with investigating authorities and several of the parties involved in the litigation arising out of this incident.
Vaughn’s Pool and Spa in Jefferson City, MO, was contacted regarding this incident since they performed the thermostat repair on-site on the spa and observed the installation. We also contacted the Dave Livingston who is the president of PDC Spas, the manufacturer of the spa, to confirm the details. Both were intimately familiar with the matter and the specific PDC unit. Mr. Livingston had provided three days of deposition testimony in the litigation. These interviews confirm that 1) the spa was installed in ground or below grade; 2) the unit was not a self-contained spa as that term is used in the NEC, and therefore would not be exempt under proposal 17-203; and 3) this incident would not have occurred in a self-contained spa.

Vaughn and Mr. Livingston both confirmed that the spa was not a self-contained product. It was a “ready-to-install” manufactured system provided as a fully-plumbed tub, but with a separate pump and heater unit. As stated in the manufacturer’s instructions, the unit was designed to be installed in a deck, or in-ground, as was the case in this installation.

Mr. Livingston also confirmed that while the same installation instructions required the use of a GFCI circuit breaker (referencing the GCFI 27 times in the instructions), and called for proper connection of a ground wire, neither instruction was followed. Instead, the installer left the ground wire disconnected, connected to two 50 amp standard circuit breakers instead of a 30 amp GFCI, and the sub-panel was described as a “rat’s nest”. In addition, the pressure switch, which must close at low flow rates to enable heating, was installed incorrectly above the water level. All of the above demonstrates utter disregard for code compliance or following manufacturer’s directions.
The Osage County Sheriff’s department performed an on-site investigation. They also confirmed that the spa was installed in-ground (below grade).

In addition to the three witness accounts cited above, it is also clear from CPSC report that the spa rim had to be at-grade for the son to be shocked when petting the cat, and for the woman and the son to be shocked while stepping out of the spa, then falling back into the spa. The spa was clearly not installed in accordance with manufacturer’s directions, or in accordance with the NEC. This installation would NOT be exempt from the equipotential perimeter bonding requirements of the NEC under proposal 17-203. The NEC and any required installation bonding are meaningless to rogue installations such as this.

In contrast to this installation and other in-ground pools, the self-contained spas designated in 17-203 are typically installed on or above grade, making the top rim 28” to 36” above the surrounding deck. In a self-contained spa, this fatal shock scenario would be physically impossible.

In analysis of all the witness reports as well as CPSC and coroner investigations, the initial heating problem arose out of an improperly installed pressure switch that was installed above the water level, preventing the system from heating if the filter was dirty. In the repairs, the service technician came out twice and first installed a new thermostat, then the next day cleaned the filter. Most likely, the victim’s husband attempted a repair after the new thermostat did not heat the water. In this tinkering, he most likely managed to move the copper capillary tube on the bulb thermostat to where it was touching the high voltage terminal of the heater.
Without a proper ground connection, any time the heater turned on, all internally bonded parts and the water would be at 120 volts above earth. The heater was off initially and turned on when the jets were turned off since many spas do not allow concurrent high pump speed and heating. When the son and the victim touched both the water and the perimeter deck, current would have flowed through the water, through the victim, and through the ground back to the common earth-neutral point since there was no ground to shunt fault current. The standard circuit breaker would not trip since it was not a GFCI. Had the perimeter deck been bonded but the rogue installation left the ground wire disconnected, the lower impedance of the deck could have also killed the son and the husband! The incident would not have occurred at all had the system been grounded or a GFCI been installed, and without an equipotential grid. Nor would the incident have occurred if the unit were a self-contained spa installed on or above the ground, as 17-203 stipulates.

b. Cases reported by Greg Olsen of Public Service Electric and Gas

Neither of the two cases that follow resulted in an injury or death, only a mild tingling or “shock, which does not warrant the imposition of added requirements under the NEC.” In addition, both were the fault of events external to the spa installation, as explained below:

i. Case #1: This case involves mild electrical shock “sensations” felt when exiting a “manufactured” spa sitting on a concrete deck. It is claimed that the spa was grounded properly. If this is true, this could be a case of “stray voltage” from the utility company. However, note that the shock was merely a tingle, which is most likely in accordance with utility company design guidelines as discussed later in this document. This type of stray voltage is the responsibility of the utility company, not the consumer, and a perimeter grid requirement is simply is a “band-aid” over a system problem. Requiring a perimeter grid forces the consumer to deal with a utility system issue, and will simply shift the step voltage to another point and will not eliminate the shock hazard.

ii. Case #2: This case involved the user receiving a shock when a metal pole was used to clean the spa. The fault was in a very old farmhouse next door where the wiring was touching a water pipe which led to a well.

This case is not substantiation of the need for a perimeter grid at all. Neither the problem nor the solution is in the spa, but in the faulty next-door wiring. A shock would have been felt from any grounded object (electric saw, storable pool water, pump motor
housing, etc.). A perimeter grid would have simply shifted the step voltage to a different point, but the hazard would remain. The shock was again in the “tingle” range.

Since PSEG is in New Jersey, Suzanne Borak, Code Specialist with the State of New Jersey was also contacted. She indicated that there have been no injuries or deaths, but only a few “tingle” reports, in relation to a properly installed self-contained spa.

c. Other Non-fatal CPSC shock reports

While information provided by the CPSC references other “spa” or “hot tub” related incidents, none reference a serious injury or death. Nor does the CPSC data enable one to determine whether most of spa incidents reported involved a self-contained spa, as opposed to an in-ground custom installation. Had any of these incidents occurred in a self-contained spa with a non-conductive shell, the presence of a external low impedance perimeter grid would have increased the shock hazard and most likely have resulted in more severe injuries. The shock was commonly caused by a faulty component, such as a chlorinator or ozone generator, and the grounding and GFCI provisions would have been faulty. Again, the incidents would not have occurred at all had they been a self-contained spa installed in accordance with manufacturer’s directions and NEC code, and without an equipotential grid.

None of the cases attributed the fault to a utility company or stray voltage gradients in the soil.

2. Increased Risk with Equipotential Grid

Discussion also took place at the Panel meetings with regard to the risks that may be presented by improper bonding of a self-contained spa. As mentioned above, our further investigation and analysis of this issue shows that a bonded perimeter grid around a self-contained spa may increase the risk injury or death. (See attached drawing).

a. Utility Faults

While the bonded equipotential grid was discussed relative to voltage gradients in the soil, utility companies specifically design their distribution systems to limit stray voltages to safe levels. (Kinectrics Inc., Ontario, Canada, “Stray Voltage Mitigation” 9 April, 2008). In addition, the probability of a dangerous utility power fault, in a system that is consistently installed to code and professionally maintained, is far less than the probability of a fault occurring in the spa installation itself. This is clearly illustrated by the evidence in the CPSC reports.

b. Most Common Faults

In the most common fault conditions such as equipment failure, bonding failure, rogue installations, or improper repair, a bonded equipotential grid will decrease the impedance from a victim back to the common neutral-ground point. If the installer chooses to bond the perimeter back to the subpanel, and there is also an equipment ground fault such as a poor installation, broken wire, or user-modified cord set, this decreased impedance will increase fault current through the victim and substantially increase the chance of injury or death. If the installer chooses to bond to the internal spa bond, and there is a ground fault, the perimeter bond will do nothing to prevent injury.

c. Self-Contained Listed Spa versus In-ground Spa or Pool
For an in-ground spa, the perimeter grid adds to the safety by unifying the shell and the surrounding deck to one potential because all are in electrical contact with the earth. In contrast, the self-contained spa shell is non-conductive, and the internal structure while bonded together, is electrically isolated from the earth requiring grounding back to earth-neutral. In the event of a ground fault, the presence of a neutral-earth bonded perimeter grid in the deck will lower its impedance, increase fault current, and guarantee a current return path through the victim! A storable pool, already excluded from the equipotential grid requirement of the NEC, would present the identical aggravated shock hazard if a bonded perimeter grid were installed.

**d. Major Spa Improvements that Contribute to Safety**

Designed-in safety of self-contained listed spas has continually improved over the last 20 years. A listed spa must comply to the rigors of UL 1563 that produce inherently safe spas with multiple layers of protection. In addition, compliance with the already established NEC rules for grounding, bonding, and GFCI add even more layers of protection. Many spa companies are also ISO 9001 certified meaning that a third party watchdog assures that their standards for consistency and quality are very high, assuring the consumer will receive a safe product.

Of particular note is the transition from 120 volt control circuits and to very low voltage digital controls. This limits the exposure of higher voltages and adds more layers of safety through the use of intelligent controls. Had the control system been electronic with low voltage sensors and circuits, the probability of death in the above CPSC incident would have been much lower, even with a rogue installation.

### 3. Code Interpretations

Section 680.42 and 680.26 can be interpreted in various ways. These sections also do not clarify the vast difference between an in-ground spa and a self-contained above-grade spa with non-conductive shell built to rigid standards. Most regions interpret 680.42(B) to except a self-contained spa with metal frame from the perimeter bonding of Article II that applies to pools. However, a few regions treat the self-contained spa like an in-ground pool. There have even been reports that wooden decks, which are considered non-conductive, be “bonded”. Suzanne Borak of the State of New Jersey confirmed that while this makes no sense, New Jeresy reads the current code that way and emphasizes the need for 17-203 for proper interpretations.

It is the intent of 17-203 to clarify this in order that the code is interpreted consistently to continue to ensure safety.

### 4. Conclusion

As explained above, a review of the materials submitted by Mr. Olsen, of reports from the State of New Jersey, and of CPSC incidents confirm the absence of a single substantiated report of electrical related injury or death to a user of a self-contained listed spa that was installed on or above grade, which would be exempt of perimeter bonding requirements under 17-203. We submit that this should alleviate any concerns expressed by certain members of the panel about such a risk.

Based on the above analysis, the absence of a single confirmed report of a serious injury or death in an installation that would be exempt under 17-203, and the materials presented in the December 7 hearing, we also submit that there is no genuine safety benefit achieved by requiring an equipotential grid around a listed self-contained spa installed in accordance with manufacturer’s directions. We also urge the Panel to recognize that the perimeter equipotential grid will aggravate the shock risk in the most
common fault conditions of a self-contained spa installation, while seldom protecting a user from minor stray voltage situations.

Acceptance of 17-203 will help achieve the safety that the Panel has so diligently developed over the years, as well as clarifying the correct interpretation.

As requested by the Panel, we are also sending the complete Power Point presented on this issue. We thank you for your time and consideration.

Cordially,

Carvin DiGiovanni  
Association of Pool and Spa Professionals  

Attachments Follow for Reference.
Shock Hazard in a Self-Contained Spa with Bonded Perimeter Grid

Non-conductive shell electrically isolates water from deck so fault current will flow through victim if ground bond is not present or faulty.

Faulty or No GFCI

Deck without bonded grid presents much higher impedance back to Neutral-Earth bond point, reducing fault current and shock danger.

Bonded Grid lowers impedance to conduct current readily from victim through deck. Guarantees current path through victim.
Example of a Self-Contained Listed Spa

- Rim height 28” to 38” above deck
- Non-conductive step
- Electrically isolated from deck surface
- All electrical components pre-wired and contained inside spa skirt
Email from David Livingston at PDC Spas to Larry Nicholson, Electrical Engineer

Larry:

The PDF file is five pictures, four of which were from the site and one of an equipment assembly for comparison.

Picture one is of the equipment as placed on sheltered at the site.

Picture two is the only picture I have of the spa as it was installed within the concrete slab.

Picture three shows the outside disconnect and breaker for the spa which was not a GFCI breaker.

Picture four is the main house panel box grounding bar. The loose copper wire not within the ground bar is the feed
  Ground wire from the spa to the disconnect box and to the main panel box.

Picture five is the spa assembly control box. While there were many alterations, in the upper left corner you can see the copper capillary tube that was placed on the heater connections. (the source of electricity to the water)

Picture six is of new equipment assembly similar to how supplied.

The spa was sold and installed in 1995. As discussed there were many issues with the installation that are two lengthy and not related to the grounding grid situation you are currently working on. What was important, and would have prevented the accident from happening, would have been the following of our installation manual, standard NEC codes, GFCI Breakers, and Grounding procedures already in place.

If you have further questions, or I can be of further help, give me a call. You may share this e-mail with others at if you find it beneficial.

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