



Canadian Standards Association
Mississauga, Ontario
To the Part I Committee

Subject No. 2894

Chair: V.G. Rowe

Date: January 22, 2004

Title: Bonding of IS Circuits, Rule 18-066

Submitted by: R. Leduc of Alberta Municipal Affairs, 8th Floor, 10809 - 99th Ave., Edmonton, Alberta, Tel: (780) 415-0481, Fax: (780) 427-8686 on September 28, 1999.

Proposal: Amend Rule 18-066 as follows:

(Specifically Worded):

Change "18-380" in Subrule (1) to 18-378, add a Subrule (2) as follows and re-number Subrules (2), (3), (4) to (3), (4), (5).

(2) Notwithstanding Subrule (1), the bonding provisions of Rule 18-132 continues to apply for intrinsically safe and associated circuits in all hazardous locations.

or alternatively

Change "18-380" in Subrule (1) to 18-378, add a Subrule (2) as follows and re-number Subrules (2), (3), (4) to (3), (4), (5).

(2) Grounding and bonding of intrinsically safe and associated circuits shall be in accordance with the design referenced in Subrule (1) and the requirements of Section 10 need not apply.

Reasons for Request: There are two schools of thought regarding the safety value of requiring bonding of IS circuits. There are instances of IS installations that by design do not incorporate a bonding conductor with IS circuits under the assumption that bonding requirements are exempted by Subrule (1).

It is not clear that the exemption of Rules 18-100 to 18-380 (should be 18-378) in Subrule (1) apply to bonding even though Rules 18-132, 18-182, 18-226, 18-276, 18-328 and 18-378 that deal with bonding are part of that exemption. Either bonding is or is not required.

Supporting Information:

The NEC continues to require that IS circuits in hazardous locations be bonded according to the more stringent requirements we specify for services.

Rule 504-60 reads:

504-60 Bonding

Hazardous Locations. In hazardous (classified) locations, intrinsically safe apparatus shall be bonded in the hazardous (classified) location in accordance with Section 250-100.

Rule 250-100 reads:

250-100 Bonding in Hazardous (Classified) Locations. Regardless of the voltage of the electrical system, the electrical continuity of non-current-carrying metal parts of equipment, raceways, and other enclosures in any hazardous (classified) location as defined in Article 500 shall be ensured by any of the methods specified for services in Section 250-94 that are approved for the wiring method used.

Appendix F of the CEC suggests that precautions against shock hazard (such as grounding and bonding) are only required when the IS circuits operate at voltage and current levels sufficient to constitute a shock hazard.

F2.4 When intrinsically safe circuits operate at voltage and current levels sufficient to constitute a shock hazard, the same precautions against shock hazard are necessary when installing or servicing such circuits as with non-intrinsically safe circuits.

Appendix F also indicates that an intrinsically safe circuit should be grounded only as provided for in the approved description of the intrinsically safe circuit, implying that approved design should determine grounding provisions.

F2.5 In order to prevent the development of possible hazardous ground loop currents due to differences in ground voltage between field-mounted equipment and control room equipment during normal operation or under fault conditions, an intrinsically safe circuit should be grounded only as provided for in the approved description of the intrinsically safe circuit, the source equipment, or the barrier device itself.

Chair's Comments:

Mr. Leduc and I have discussed this submission at length and we have agreed to the following wording for the mail ballot. Note we are balloting only on the revised version not the original submission, as Mr. Leduc has agreed to modify the original proposal. Note that this item will also apply to the corresponding rules in Section J and JB.

Revised Proposal

Delete Rules 18-132, 18-182, 18-226, 18-276, 18-328 and 18-378. These will be covered by a new rule to be added to the general section as follows:

18-074 Bonding (see Appendix B). Regardless of the voltage of the electrical system, the electrical continuity of non-current carrying metal parts of equipment, raceways, and enclosures in all hazardous locations and in non-hazardous locations from which hazardous locations are supplied shall be ensured by:

- (a) Meeting the requirements of Rule 10-606(1)(a), (c) and (d), and 10-606(2); or
- (b) Demonstrating that an alternate bonding means is suitable.

Add the following Appendix B Note:

18-074 *The intent of bonding non-current-carrying parts of electrical equipment to ground is outlined in the definition for bonding in Section 0. In certain situations the non-current-carrying parts of electrical circuits may already be effectively bonded by other methods and may not require the additional bonding outlined in Rule 10-606. One example of this situation would be a flow transmitter housing attached to a process vessel that is already bonded to ground. In this situation the connection of the transmitter housing to the process vessel may provide adequate bonding. In determining whether an alternate bonding means is suitable, the requirements of Rule 10-814 provide guidance. Rule 10-824 requires that "the size of a bonding conductor shall not be less than that given in Table 16, but in no case does it need to be larger than the largest ungrounded conductor in the circuit". In other words the bonding conductor needs to be able to safely carry the same amount of current as the largest conductor in the circuit. In the example above, if the largest conductor in the circuit is No. 18 AWG, the "alternate bonding means" must provide an equivalent bonding path to a No. 18 AWG conductor.*

Subcommittee Deliberation: We have one negative and ten in agreement. I think the suggestion in the negative ballot would change the reference to Rule 10-606 to "meeting the requirements of Section 10". As this is changing a part of the rules we had not touched, I think it would more properly be handled as a new subject. I am therefore declaring consensus and ask that you forward it to Part I for ballot.

Subcommittee Recommendation:

(1) Delete Rules 18-132, 18-182, 18-226, 18-276, 18-328, 18-378, J18-130 and J18-178. These will be covered by new rules to be added to the general sections.

(2) Add new Rules:

18-074 Bonding (see Appendix B). (And **J18-074 Bonding (see Annex JB).**) Regardless of the voltage of the electrical system, the electrical continuity of non-current carrying metal parts of equipment, raceways, and enclosures in all hazardous locations and in non-hazardous locations from which hazardous locations are supplied shall be ensured by:

- (a) Meeting the requirements of Rules 10-606(1)(a), (c) and (d), and 10-606(2); or
- (b) Demonstrating that an alternate bonding means is suitable.

(3) Add the following Note to Appendix B and Annex JB:

18-74 *The intent of bonding non-current-carrying parts of electrical equipment to ground is outlined in the definition for bonding in Section 0. In certain situations the non-current-carrying parts of electrical circuits may already be effectively bonded by other methods and may not require the additional bonding outlined in Rule 10-606. One example of this situation would be a flow transmitter housing attached to a process vessel that is already bonded to ground. In this situation the connection of the transmitter housing to the process*

vessel may provide adequate bonding. In determining whether an alternate bonding means is suitable, the requirements of Rule 10-814 provide guidance. Rule 10-824 requires that "the size of a bonding conductor shall not be less than that given in Table 16, but in no case does it need to be larger than the largest ungrounded conductor in the circuit". In other words the bonding conductor needs to be able to safely carry the same amount of current as the largest conductor in the circuit. In the example above, if the largest conductor in the circuit is No. 18 AWG, the "alternate bonding means" must provide an equivalent bonding path to a No. 18 AWG conductor.

Chair's Comments (Second Round):

This subject was sent back to the Subcommittee by the Part I Steering Committee on the basis that it was felt the original question regarding whether it was necessary to bond electrical equipment in intrinsically safe circuits and concern that "demonstrating that an alternate bonding means is suitable" would be difficult to enforce.

I've had discussions with the submitter and we came to the conclusion that IS circuits may present a shock hazard under certain conditions and therefore bonding them should be required. In order to clarify the requirement for bonding IS circuits and to clarify the acceptable bonding means in Hazardous Locations the submitter has proposed the following new wording:

(1) Delete Rules 18-132, 18-182, 18-226, 18-276, 18-328, and 18-378

Rationale: Rules 18-182, 18-226, 18-276, 18-328, and 18-378 all reference Rule 18-132 so basically Rule 18-132 applies to all hazardous locations. Therefore it is more appropriate to locate the requirement in the General Subsection of Section 18. Furthermore, it would apply to Zone 0 locations and IS circuits where 18-090 is currently silent on bonding requirements.

(2) Add a new Rule 18-074 as follows:

18-074 Bonding in Hazardous Locations

- (1) Exposed non-current-carrying metal parts of electrical equipment, including the frames or metal exteriors of motors, fixed or portable lamps or other utilization equipment, lighting fixtures, cabinets, cases, and conduit shall be bonded to ground in accordance with Section 10.
- (2) The bonding path continuity and adequacy in a hazardous location and in a non-hazardous location from which the hazardous location is supplied shall be ensured by:
 - (a) The use of bonding conductors, or threaded couplings and threaded bosses on enclosures with joints made up tight where rigid metal conduit is used; or
 - (b) The use of bonding conductors or bonding jumpers meeting the requirements of Rules 10-614 and 10-906; or
 - (c) Other devices (not standard locknuts and bushings) such as grounding bushings equipped with bonding jumpers meeting the requirements of Rule 10-614.

(3) Notwithstanding Paragraph (c) of Subrule (2), box connectors with standard locknuts shall be permitted for bonding the armour of those types of cable assemblies incorporating an internal bonding conductor where the armour is not permitted to be used for bonding purposes.

Rationale: This is basically Rule 18-132 but instead of referencing the Rules in Section 10 regarding Service continuity, it is rewritten here to avoid confusing the user with a service continuity Rule and more specifically direct it to hazardous locations.

(3) Revise Subrule (1) of Rule 18-066 by changing the reference to "18-380" to "18-376"

Rationale: Rule 18-380 does not exist and Rule 18-378 is deleted as a result of the proposal.

I believe this addresses the concerns expressed by the Part I Committee so the proposed wording above is submitted for another round of balloting.

Chair's Comments (Third Round):

This subject originated as a result of Rule 18-066 which appeared to exempt intrinsically safe circuits from the requirements for bonding to ground. Along the way in consultation with the submitter the subject has evolved to clearing up the overall concerns with the bonding rules in hazardous areas. Moving the rule into the general section will require that intrinsically safe circuits are bonded to ground. The requirement in the existing Rule 18-132 to bond in accordance with Rule 10-606 has been confusing and has been inconsistently interpreted and has often required bonding conductors sized well above the need and in some large installations too small for the need.

During the balloting process which initially resulted in one negative, 6 in favor and one in favor with comments, in consultation with the submitter, both he and I decided to change our ballots from positive to negative and the submitter proposed the following to replace his earlier wording:

(2) Add a new Rule 18-074 as follows:

18-074 Bonding in Hazardous Locations

(1) Exposed non-current-carrying metal parts of electrical equipment, including the frames or metal exteriors of motors, fixed or portable lamps or other utilization equipment, lighting fixtures, cabinets, cases, and conduit shall be bonded to ground using:

(a) Bonding conductors sized in accordance with 10-814; or

(b) Rigid metal conduit with threaded couplings and threaded bosses on enclosures with joints made up tight.

(2) Notwithstanding Subrule (1), where raceways or cable assemblies incorporate an internal bonding conductor, box connectors with standard locknuts shall be permitted to bond the metallic armour or raceway.

Rationale: Our main objective is to ensure that we maintain a low impedance path in the bonding system capable of carrying available fault currents. We omit

other bonding means such as 'threadless fittings', 'dual locknuts', or similar means for bonding in hazardous locations because of the risk of increased impedance introduced through poor connections and thus increased risk of explosion due to arcing at poor connections. the exception is where armour or metallic raceway in which a bonding conductor is installed. In this case the metallic armour or raceway becomes supplementary to the bonding conductor not intended to main bonding means and therefore should be permitted to be bonded using standard locknuts.

The submitter's new wording appears to better address the requirement for bonding intrinsically safe circuits and improves the rule for bonding in Hazloc locations in general. Therefore I am submitting the above wording for another round of balloting.

Subcommittee Deliberation: The third round produced six ballots in favor and four in favor with comments. The comments were really asking for confirmation that with the addition of Rule 18-074, Rules 18-132, 18-182, 18-226, 18-276, 18-328 and 18-378 would be deleted. That was my error in not making it clear in the third ballot that they would be deleted.

Subcommittee Recommendation: Accept the wording to add a new Rule 18-074 as written in the third round and to delete Rules 18-132, 18-182, 18-226, 18-276, 18-328 and 18-378.