



Canadian Standards Association
Mississauga, Ontario
To the Part I Committee

Subject No. 3226

Chair: V. Rowe

Date: March 21, 2005

Title: Revisions to Sealing Rules, Section 18

Submitted by: Vince Rowe of Marex Canada Limited on January 14, 2005

Proposal: Request for an amendment to Rule(s) Changes to Rule 18-002, 18-090, 18-108, 18-158 and addition of Rule 18-092 re Updating Sealing Rules in Class I Hazardous Locations. Equivalent changes have also been made to Appendix J18 Rules J18-002, J18-108 and J18-158. Additional notes have been added to Appendix B and Annex JB.

Changes to Section 18 and Appendix B

1. Add the following definitions to 18-002 Special Terminology

Primary Seal means: *A seal that isolates process fluids from an electrical system and has one side of the seal in contact with the process fluid.*

Secondary Seal means:

(a) A seal which is installed between a device incorporating a primary seal and conduit or cable systems; and

(b) A seal that is designed to prevent the passage of process fluids at the pressure it will be subjected to upon failure of the primary seal.

Conduit Seal means a seal which is installed in a conduit to prevent the passage of an explosion from one portion of the conduit system to another and which minimizes the passages of gases or vapors at atmospheric pressure.

Cable Seal means a seal which is installed at a cable termination to prevent the release of an explosion from an explosion-proof enclosure and which minimizes the passage of gases or vapors at atmospheric pressure

Rationale: *Definitions for the various types of seals have been added for use in rewriting the sealing rules.*

2. Delete Subrules (4) and (5) of Rule 18-090:

Installations in Class I, Zone 0 Locations

18-090 Equipment and Wiring (see Appendices B and F)

(1) Except as provided for in Subrules (2) and (3), electrical equipment and wiring shall not be installed in a Class I, Zone 0 hazardous location.

- (2) Electrical equipment that is approved as intrinsically safe, type i or ia, shall be permitted in Class I, Zone 0 locations.
- (3) Intrinsically safe circuits and wiring shall be designed for the application and shall be installed in accordance with the design.

~~(4) Seals shall be provided where the conduit leaves the Class I, Zone 0 location with no box, coupling, or fitting in the conduit run between the seal and the point at which the conduit leaves the location, except that a rigid unbroken conduit which passes completely through a Class I, Zone 0 area with no fittings less than 300 mm beyond each boundary, providing the termination points of the unbroken conduit are in non-hazardous areas, need not be sealed.~~

~~(5) Seals shall be provided on cables at the first point of termination after entry into the Zone 0 location.~~

Rationale: Subrules 4 and 5 are incorporated into new Rule 18-092

3. Add a new Rule 18-092 as follows:

18-092 Sealing (See Appendix B)

(1) Secondary seals shall be provided, between devices containing a primary seal and conduit or cable seals, where failure of a single component in the device containing the primary seal could allow passage of process fluids.

Rationale: The requirement for a secondary seal where there is potential for continuous gas pressure due to the failure of a primary seal, has been added.

(2) Where secondary seals are installed, drains, vents or other devices intended to make primary seal leakage obvious shall be installed.

Rationale: Failure of a primary seal is an abnormal and potentially dangerous situation. The vent on the secondary seal can be used to provide an indication of the failure (see appendix B).

(3) Seals shall be provided where the conduit leaves the Class I, Zone 0 location with no box, coupling, or fitting in the conduit run between the seal and the point at which the conduit leaves the location, except that a rigid unbroken conduit which passes completely through a Class I, Zone 0 area with no fittings less than 300 mm beyond each boundary, providing the termination points of the unbroken conduit are in non-hazardous areas, need not be sealed.

(4) Seals shall be provided on cables at the first point of termination after entry into the Zone 0 location.

4. Revise Rule 18-108 as follows:

18-108 Sealing, Class I, Zone 1 (see Appendix B)

(1) Secondary seals shall be provided, between devices containing a primary seal and conduit or cable seals, where failure of a single component in the device containing the primary seal could allow passage of process fluids.

Rationale: The requirement for a secondary seal where there is potential for continuous gas pressure due to the failure of a primary seal, has been added.

(2) Where secondary seals are installed, drains, vents or other devices intended to make primary seal leakage obvious shall be installed.

Rationale: Failure of a primary seal is an abnormal and potentially dangerous situation. The vent on the secondary seal can be used to provide an indication of the failure (see appendix B).

(3) Conduit seals shall be provided in conduit systems where:

(a) In conduit systems where:

- ~~(ia) The conduit enters an enclosure for switches, circuit breakers, fuses, relays, resistors, or other apparatus which may produce arcs, sparks, or high temperatures and shall be as close as practicable to and in no case more than 450 mm from the enclosure, with no junction box or similar enclosure in the conduit run between the sealing fitting and the apparatus enclosure;~~
- (ib) The conduit enters an explosion-proof or flameproof enclosure containing devices which may produce arcs, sparks or high temperatures, and shall be located as close as practicable to the enclosure but not further than 450 mm from the enclosure; or

Rationale: *The Rule has been reworded to remove the wording re junction boxes. Subrule 4 limits the acceptable devices that can be located between the XP box and the seal.*

(ic) The conduit is 53 (2) trade size or larger and enters an explosion-proof or flameproof enclosure housing terminals, splices, or taps, and shall be located no further than 450 mm from the enclosure; or

(id) The conduit leaves the Class I, Zone 1 location with no box, coupling, or fitting in the conduit run between the seal and the point at which the conduit leaves the location, except that a rigid unbroken conduit which passes completely through a Class I, Zone 1 area with no fittings less than 300 mm beyond each boundary, providing the termination points of the unbroken conduit are in non-hazardous areas, need not be sealed; or

(ie) The conduit enters an enclosure that is not required to be explosion-proof or flameproof, except that a seal is not required where an unbroken and continuous run of conduit connects two enclosures that are not required to be explosion-proof or flameproof.

(4) Only explosion proof unions, couplings, reducers and elbows that are not larger than the trade size of the conduit shall be permitted between the sealing fitting and an explosion-proof or flameproof enclosure.

Rationale: *Specifies the types of devices that can be located between the XP box and the seal in order to limit the increase in volume of the box.*

~~—(b) In cable systems where:~~

(5) Cable seals shall be provided in a cable system where:

- (ia) The cable enters an enclosure required to be explosion-proof or flameproof; or
- (ib) The cable enters an enclosure not required to be explosion-proof or flameproof, and:
 - (Ai) The cable leaves the Zone 1 area and is less than 10 m in length; or
 - (Bii) The equipment or devices connected to or contained in the enclosure can subject the enclosure to hazardous gas or vapour at a pressure in excess of 1.5 kPa; or
 - (Ciii) The other end of the cable terminates in a Zone 2 or non-hazardous location in which a negative atmospheric pressure greater than 0.2 kPa exists.

(26) Where secondary seals, cable seals or conduit seals are required, they shall conform to the following:

(a) The seal shall be made:

- (i) In a field-installed sealing fitting or cable gland which shall be accessible and shall comply with the requirements of Rule 18-100; or
- (ii) In a sealing fitting provided as part of an enclosure approved for the area and where the seal is factory-made, the enclosure shall be so marked to indicate that such a seal is provided.

~~(b) Sealing compound shall be approved for the purpose, shall not be affected by the surrounding atmosphere or liquids, and shall not have a melting point of less than 93°C;~~

Rationale: Removed, as this is really a Part II requirement. Notes in appendix B give more detail regarding the importance of following the manufacturer's instructions and using sealing materials specified in the manufacturer's instructions

~~(c) In the completed conduit seal, the minimum thickness of the sealing compound shall be not less than the trade size of the conduit, and in no case less than 15 mm;~~

Rationale: Same comment as previous subrule

~~(db)~~ Splices and taps shall not be made in fittings intended only for sealing with compound, nor shall other fittings in which splices or taps are made be filled with compound;

~~(ec)~~ Where there is a probability that liquid or other condensed vapour may be trapped within enclosures for control equipment or at any point in the raceway system, approved means shall be provided to prevent accumulation or to permit periodic draining of such liquid or condensed vapour; and

~~(fd)~~ Where there is a probability that liquid or condensed vapour may accumulate within motors or generators, joints and conduit systems shall be arranged to minimize entrance of liquid, but if means to prevent accumulation or to permit periodic draining are judged necessary, such means shall be provided at the time of manufacture, and shall be deemed an integral part of the machine.

~~(37)~~ Runs of cables, each having a continuous sheath, either metal or non-metal, shall be permitted to pass through a Class I, Zone 1 location without seals.

~~(48)~~ Cables that do not have a continuous sheath, either metal or non-metal, shall be sealed at the boundary of the Zone 1 location.

5. Revise Rule 18-158 as follows:

18-158 Sealing, Class I, Zone 2 (see Appendix B)

~~(1) Secondary seals shall be provided, between devices containing a primary seal and conduit or cable seals, where failure of a single component in the device containing the primary seal could allow passage of process fluids.~~

Rationale: The requirement for a secondary seal where there is potential for continuous gas pressure due to the failure of a primary seal, has been added.

~~(2) Where secondary seals are installed, drains, vents or other devices intended to make primary seal leakage obvious shall be installed.~~

Rationale: Failure of a primary seal is an abnormal and potentially dangerous situation. The vent on the secondary seal can be used to provide an indication of the failure (see appendix B)

~~(43)~~ Seals shall be provided in a conduit system where:

~~—(a) In conduit systems where:~~

(~~ia~~) The conduit enters an enclosure that is required to be explosion-proof or flameproof and shall be located as close as practicable to the enclosure but not further than 450 mm from the enclosure, ~~with no junction box or similar enclosure in the conduit run between the sealing fitting and the apparatus enclosure~~; or

Rationale: *The Rule has been reworded to remove the wording re junction boxes. Subrule 4 limits the acceptable devices that can be located between the XP box and the seal.*

(~~ib~~) The conduit leaves the Class I, Zone 2 location with no box, coupling, or fitting in the conduit run between the seal and the point at which the conduit leaves the location, except that a rigid unbroken conduit which passes completely through a Class I, Zone 2 area with no fittings less than 300 mm beyond each boundary, providing the termination points of the unbroken conduit are in non-hazardous areas, need not be sealed; ~~and/or~~

(c) The conduit leaves a Class I, Zone 2 location outdoors, the seal may be located more than 300 mm beyond the Class I, Zone 2 boundary providing it is located on the conduit prior to entering an enclosure or building.

Rationale: *The seal at the boundary between the Zone 2 and non-hazardous areas is intended to prevent the migration of gas at atmospheric pressure into the safe area. It is interesting to note that the NEC does not require this seal to prevent transmission of an explosion, only to “minimize the amount of gas or vapor within the Division 2 (Zone 2) portion of the conduit from being transmitted to the conduit beyond the seal” (NEC Rule 501.5(B)(2)). As any gas in the conduit would leak very slowly through the threads, there is no danger of gas being released at high enough rates to form an explosive atmosphere outside the conduit in outdoor areas. The hazard would be the transmission of gas through the conduit into enclosures or buildings where the gas could become concentrated over a period of time. Locating the seal prior to entering any such device provides the required safety. This change has been proposed to deal with the issue of changes to the Zone 2 non-hazardous boundary in existing facilities. After there has been modifications to facilities or reclassification of areas, the location of the seal does not meet the existing Rule but would meet the new Rule. Under the existing Rule it would be necessary to remove the wiring from the conduit and to modify the conduit run to relocate the seal. This would add cost without improving safety.*

(4) Only explosion proof unions, couplings, reducers and elbows that are not larger than the trade size of the conduit shall be permitted between the sealing fitting and an explosion-proof or flameproof enclosure.

Rationale: *Specifies the types of devices that can be located between the XP box and the seal in order to limit the increase in volume of the box.*

(~~b5~~) Seals shall be provided ~~in~~ in a cable system where:

(~~ia~~) The cable enters an enclosure required to be explosion-proof or flameproof; or

(~~ib~~) The cable enters an enclosure not required to be explosion-proof or flameproof; and

(~~Ai~~) The cable leaves the Zone 2 area and is less than 10 m in length; or

(~~Bi~~) The equipment or devices connected to or contained in the enclosure can subject the enclosure to hazardous gas or vapour at a pressure in excess of 1.5 kPa; or

(~~Ciii~~) The other end of the cable terminates in a non-hazardous location in which a negative atmospheric pressure greater than 0.2 kPa exists.

(~~26~~) Where a run of conduit enters an enclosure that is required to be explosion-proof or flameproof, every part of the conduit from the seal to that enclosure shall comply with Rule 18-106.

(37) Runs of cables, each having a continuous sheath, either metal or non-metal, shall be permitted to pass through a Class I, Zone 2 location without seals.

(48) Cables that do not have a continuous sheath, either metal or non-metal, shall be sealed at the boundary of the Zone 2 location.

(59) Where seals are required, Rule 18-108(26) shall apply.

6. Add the following notes to Appendix B as follows:

Appendix B Notes

18-002 *Primary Seals are typically a part of electrical devices such as pressure, temperature or flow measuring devices and devices (such as canned pumps) where the electrical connections are immersed in the process fluids.*

Secondary Seals are designed to prevent flammable process fluids entering the electrical wiring system upon failure of a primary seal. These devices typically prevent passage of fluids at process pressure by a combination of sealing and pressure relief.

Conduit Seals are designed to prevent the passage of flames from one portion of the electrical installation to another through the conduit system and to minimize the passage of gases or vapors at atmospheric pressure. Unless specifically designed for the purpose, conduit seals are not intended to prevent the passage of fluids at a continuous pressure differential across the seal. Even at differences in pressure across the seal equivalent to a few inches of water, there may be passage of gas or vapor through the seal and/or through the conductors passing through the seal. Where conduit seals are exposed to continuous pressure, there may be a danger of transmission of flammable fluids to "safe areas" resulting in fire or explosions.

Cable seals are designed to prevent the escape of flames from an explosion proof enclosure. As cables are not designed to withstand the pressures of an explosion, transmission of an explosion into a cable could result in ignition of gases or vapors in the area outside enclosure.

Rationale: Notes have been added to explain the purpose of the various types of seals now defined in section 18.

18-092(2)
18-108(2)
18-158(2) *Various methods could be used to detect the failure of a primary seal. Monitoring the secondary seal vent with flow detection or gas detection are two possible means. It would also be possible to connect the vents of a number of secondary seals and monitor the common discharge. Other methods are also possible. Any method used should not restrict the venting of the seal to atmosphere.*

Rationale: Note was added to help the user understand some of the possible methods to provide detection of primary seal failure.

18-108(6) *It is important that the manufacture's instructions are closely adhered to or seals will not function properly to prevent the transmission of an explosion or to prevent the transmission of flammable fluids to non-hazardous areas where they will be exposed to unprotected ignition sources. Improper sealing has been the primary factor in a number of explosions, resulting in loss of life and/or major equipment damage. Users are reminded that only the sealing compound outlined with the instructions may be used in a seal. Use of other manufacturer's compounds in a seal may compromise the integrity of the installation.*

Rationale: Note was added to emphasize the importance of following the manufacturer's instructions for installing a seal. There have been cases of seal failure where a manufacturer's seal has been installed with another manufacturer's sealing compound.

18-158(3)(c) *This Rule allows the seal at the boundary between an outdoor Class I, Zone 2 location and an outdoor non-hazardous location, to be located further than 300 mm from the boundary of the Class I, Zone 2 location providing it is located on the conduit prior to it entering an enclosure or a building. This recognizes that as gas is only present in Class I, Zone 2*

locations for short periods, it is unlikely that gas or vapor could be released through conduit couplings at sufficiently high rates to form an explosive mixture in outdoor areas. However the seal must be located before the conduit enters an enclosure or a building as, depending on the ventilation rate, gas transmitted through the conduit may build up to flammable concentrations.

Rationale: Note was added to explain the requirement for sealing conduits passing from a Zone 2 to a non-hazardous area.

Changes to Section J18 and Annex JB

Note that in comparing this proposal to the existing section J 18, it will be necessary to use the updated version of section J18 that was approved under subject 3182. That version can be found on the section 18 workspace under the file "The Clear Corrected version. I think you will find that the good work Ken McLennan did on making appendix J18 parallel section 18 makes it much easier to process changes to both sections.

1.7. Add the following definitions to J18-002 Special Terminology

Primary Seal means: A seal that isolates process fluids from an electrical system and has one side of the seal in contact with the process fluid.

Secondary Seal means:

(a) A seal which is installed between a device incorporating a primary seal and conduit or cable systems; and

(b) A seal that is designed to prevent the passage of process fluids at the pressure it will be subjected to upon failure of the primary seal.

Conduit Seal means a seal which is installed in a conduit to prevent the passage of an explosion from one portion of the conduit system to another and which minimizes the passages of gases or vapors at atmospheric pressure.

Cable Seal means a seal which is installed at a cable termination to prevent the release of an explosion from an explosion-proof enclosure and which minimizes the passage of gases or vapors at atmospheric pressure

Rationale: Definitions for the various types of seals have been added for use in rewriting the sealing rules.

8. Revise Rule J18-108 as follows:

J18-108 Sealing, Class I, Division 1 (see Annex JB)

(1) Secondary seals shall be provided, between devices containing a primary seal and conduit or cable seals, where failure of a single component in the device containing the primary seal could allow passage of process fluids.

Rationale: The requirement for a secondary seal where there is potential for continuous gas pressure due to the failure of a primary seal, has been added.

(2) Where secondary seals are installed, drains, vents or other devices intended to make primary seal leakage obvious shall be installed.

Rationale: Failure of a primary seal is an abnormal and potentially dangerous situation. The vent on the secondary seal can be used to provide an indication of the failure (see annex JB).

(3) SealsConduit seals shall be provided in conduit systems where:

~~(a) In conduit systems where: (ia)) The conduit enters an enclosure for switches, circuit breakers, fuses, relays, resistors, or other apparatus which may produce arcs, sparks, or high temperatures and shall be as close as practicable to and in no case more than 450 mm from the enclosure, with no junction box or similar enclosure in the conduit run between the sealing fitting and the apparatus enclosure; or~~ The conduit enters an explosion-proof or flameproof enclosure containing devices which may produce arcs, sparks or high temperatures, and shall be located as close as practicable to the enclosure but not further than 450 mm from the enclosure; or

Rationale: *The Rule has been reworded to remove the wording re junction boxes. Subrule 4 limits the acceptable devices that can be located between the XP box and the seal.*

~~(ib)~~ The conduit is 53 (2) trade size or larger and enters an explosion-proof or flameproof enclosure housing terminals, splices, or taps, and shall be located no further than 450 mm from the enclosure; or

~~(iic)~~ The conduit leaves the Class I, Division 1 location with no box, coupling, or fitting in the conduit run between the seal and the point at which the conduit leaves the location, except that a rigid unbroken conduit which passes completely through a Class I, Division 1 area with no fittings less than 300 mm beyond each boundary, providing the termination points of the unbroken conduit are in non-hazardous areas, need not be sealed; or

~~(ivd)~~ The conduit enters an enclosure that is not required to be explosion-proof or flameproof, except that a seal is not required where an unbroken and continuous run of conduit connects two enclosures that are not required to be explosion-proof or flameproof.

(4) Only explosion proof unions, couplings, reducers and elbows that are not larger than the trade size of the conduit shall be permitted between the sealing fitting and an explosion-proof or flameproof enclosure.

Rationale: *Specifies the types of devices that can be located between the XP box and the seal in order to limit the increase in volume of the box.*

~~—(b) In cable systems where:~~

(5) Cable seals shall be provided in a cable system where:

~~(ia)~~ The cable enters an enclosure required to be explosion-proof or flameproof; or

~~(ib)~~ The cable enters an enclosure not required to be explosion-proof or flameproof, and:

~~(Ai)~~ The cable leaves the Division 1 area and is less than 10 m in length; or

~~(Bii)~~ The equipment or devices connected to or contained in the enclosure can subject the enclosure to hazardous gas or vapour at a pressure in excess of 1.5 kPa; or

~~(Ciii)~~ The other end of the cable terminates in a Division 2 or non-hazardous location in which a negative atmospheric pressure greater than 0.2 kPa exists.

~~(26)~~ Where secondary seals, cable seals or conduit seals are required, they shall conform to the following:

(a) The seal shall be made:

(i) In a field-installed sealing fitting or cable gland which shall be accessible and shall comply with the requirements of Rule J18100; or

(ii) In a sealing fitting provided as part of an enclosure approved for the area and where the seal is factory-made, the enclosure shall be so marked to indicate that such a seal is provided.

~~(b) Sealing compound shall be approved for the purpose, shall not be affected by the surrounding atmosphere or liquids, and shall not have a melting point of less than 93°C;~~

Rationale: *Removed, as this is really a Part II requirement. Notes in annex JB give more detail regarding the importance of following the manufacturer's instructions and using sealing materials specified in the manufacturer's instructions*

~~(c) In the completed conduit seal, the minimum thickness of the sealing compound shall be not less than the trade size of the conduit, and in no case less than 15 mm;~~

Rationale: *Same comment as previous subrule*

~~(db)~~ Splices and taps shall not be made in fittings intended only for sealing with compound, nor shall other fittings in which splices or taps are made be filled with compound;

~~(ec)~~ Where there is a probability that liquid or other condensed vapour may be trapped within enclosures for control equipment or at any point in the raceway system, approved means shall be provided to prevent accumulation or to permit periodic draining of such liquid or condensed vapour; and

~~(fd)~~ Where there is a probability that liquid or condensed vapour may accumulate within motors or generators, joints and conduit systems shall be arranged to minimize entrance of liquid, but if means to prevent accumulation or to permit periodic draining are judged necessary, such means shall be provided at the time of manufacture, and shall be deemed an integral part of the machine.

~~(37)~~ Runs of cables, each having a continuous sheath, either metal or non-metal, shall be permitted to pass through a Class I, Division 1 location without seals.

~~(48)~~ Cables that do not have a continuous sheath, either metal or non-metal, shall be sealed at the boundary of the Division 1 location.

9. Revise Rule J18-158 as follows:

J18-158 Sealing, Class I, Division 2 (see Annex JB)

~~(1) Secondary seals shall be provided, between devices containing a primary seal and conduit or cable seals, where failure of a single component in the device containing the primary seal could allow passage of process fluids.~~

Rationale: *The requirement for a secondary seal where there is potential for continuous gas pressure due to the failure of a primary seal, has been added.*

~~(2) Where secondary seals are installed, drains, vents or other devices intended to make primary seal leakage obvious shall be installed.~~

Rationale: *Failure of a primary seal is an abnormal and potentially dangerous situation. The vent on the secondary seal can be used to provide an indication of the failure (see annex JB)*

~~(43)~~ Seals shall be provided in a conduit system where:

~~—(a) In conduit systems where:~~

~~(ia)~~ The conduit enters an enclosure that is required to be explosion-proof or flameproof and shall be located as close as practicable to the enclosure but

not further than 450 mm from the enclosure, ~~with no junction box or similar enclosure in the conduit run between the sealing fitting and the apparatus enclosure~~; or

Rationale: The Rule has been reworded to remove the wording re junction boxes. Subrule 4 limits the acceptable devices that can be located between the XP box and the seal.

~~(#b)~~ The conduit leaves the Class I, Division 2 location with no box, coupling, or fitting in the conduit run between the seal and the point at which the conduit leaves the location, except that a rigid unbroken conduit which passes completely through a Class I, Zone 2 area with no fittings less than 300 mm beyond each boundary, providing the termination points of the unbroken conduit are in non-hazardous areas, need not be sealed; ~~and/or~~

(c) The conduit leaves a Class I, Division 2 location outdoors, the seal may be located more than 300 mm beyond the Class I, Division 2 boundary providing it is located on the conduit prior to entering an enclosure or building.

Rationale: The seal at the boundary between the Division 2 and non-hazardous areas is intended to prevent the migration of gas at atmospheric pressure into the safe area. It is interesting to note that the NEC does not require this seal to prevent transmission of an explosion, only to “minimize the amount of gas or vapor within the Division 2 portion of the conduit from being transmitted to the conduit beyond the seal” (NEC Rule 501.5(B)(2)). As any gas in the conduit would leak very slowly through the threads, there is no danger of gas being released at high enough rates to form an explosive atmosphere outside the conduit in outdoor areas. The hazard would be the transmission of gas through the conduit into enclosures or buildings where the gas could become concentrated over a period of time. Locating the seal prior to entering any such device provides the required safety. This change has been proposed to deal with the issue of changes to the Division 2 non-hazardous boundary in existing facilities. After there has been modifications to facilities or reclassification of areas, the location of the seal does not meet the existing Rule but would meet the new Rule. Under the existing Rule it would be necessary to remove the wiring from the conduit and to modify the conduit run to relocate the seal. This would add cost without improving safety.

(4) Only explosion proof unions, couplings, reducers and elbows that are not larger than the trade size of the conduit shall be permitted between the sealing fitting and an explosion-proof or flameproof enclosure.

Rationale: Specifies the types of devices that can be located between the XP box and the seal in order to limit the increase in volume of the box.

~~(b5)~~ Seals shall be provided in a cable system where:

~~(#a)~~ The cable enters an enclosure required to be explosion-proof or flameproof; or

~~(#b)~~ The cable enters an enclosure not required to be explosion-proof or flameproof; and

~~(A)~~ The cable leaves the Division 2 area and is less than 10 m in length; or

~~(B)~~ The equipment or devices connected to or contained in the enclosure can subject the enclosure to hazardous gas or vapour at a pressure in excess of 1.5 kPa; or

~~(C)~~ The other end of the cable terminates in a non-hazardous location in which a negative atmospheric pressure greater than 0.2 kPa exists.

~~(26)~~ Where a run of conduit enters an enclosure that is required to be explosion-proof or flameproof, every part of the conduit from the seal to that enclosure shall comply with Rule J18-106.

(37) Runs of cables, each having a continuous sheath, either metal or non-metal, shall be permitted to pass through a Class I, Division 2 location without seals.

(48) Cables that do not have a continuous sheath, either metal or non-metal, shall be sealed at the boundary of the Division 2 location.

(59) Where seals are required, Rule J18-108(26) shall apply.

10. Add the following notes to Annex JB as follows:

Annex JB Notes

J18-002 *Primary Seals are typically a part of electrical devices such as pressure, temperature or flow measuring devices and devices (such as canned pumps) where the electrical connections are immersed in the process fluids.*

Secondary Seals are designed to prevent flammable process fluids entering the electrical wiring system upon failure of a primary seal. These devices typically prevent passage of fluids at process pressure by a combination of sealing and pressure relief.

Conduit Seals are designed to prevent the passage of flames from one portion of the electrical installation to another through the conduit system and to minimize the passage of gases or vapors at atmospheric pressure. Unless specifically designed for the purpose, conduit seals are not intended to prevent the passage of fluids at a continuous pressure differential across the seal. Even at differences in pressure across the seal equivalent to a few inches of water, there may be passage of gas or vapor through the seal and/or through the conductors passing through the seal. Where conduit seals are exposed to continuous pressure, there may be a danger of transmission of flammable fluids to "safe areas" resulting in fire or explosions.

Cable seals are designed to prevent the escape of flames from an explosion proof enclosure. As cables are not designed to withstand the pressures of an explosion, transmission of an explosion into a cable could result in ignition of gases or vapors in the area outside enclosure.

Rationale: *Notes have been added to explain the purpose of the various types of seals now defined in appendix J18.*

J18-108(2) *Various methods could be used to detect the failure of a primary seal. Monitoring the secondary seal vent with flow detection or gas detection are two possible means. It would also be possible to connect the vents of a number of secondary seals and monitor the common discharge. Other methods are also possible. Any method used should not restrict the venting of the seal to atmosphere.*

Rationale: *Note was added to help the user understand some of the possible methods to provide detection of primary seal failure.*

J18-108(6) *It is important that the manufacture's instructions are closely adhered to or seals will not function properly to prevent the transmission of an explosion or to prevent the transmission of flammable fluids to non-hazardous areas where they will be exposed to unprotected ignition sources. Improper sealing has been the primary factor in a number of explosions, resulting in loss of life and/or major equipment damage. Users are reminded that only the sealing compound outlined with the instructions may be used in a seal. Use of other manufacturer's compounds in a seal may compromise the integrity of the installation.*

Rationale: *Note was added to emphasize the importance of following the manufacturer's instructions for installing a seal. There have been cases of seal failure where a manufacturer's seal has been installed with another manufacturer's sealing compound.*

J18-158(3)(c) *This Rule allows the seal at the boundary between an outdoor Class I, Division 2 location and an outdoor non-hazardous location, to be located further than 300 mm from the boundary of the Class I, Zone 2 location providing it is located on the conduit prior to it entering an enclosure or a building. This recognizes that as gas is only present in Class I,*

Division 2 locations for short periods, it is unlikely that gas or vapor could be released through conduit couplings at sufficiently high rates to form an explosive mixture in outdoor areas. However the seal must be located before the conduit enters an enclosure or a building as, depending on the ventilation rate, gas transmitted through the conduit may build up to flammable concentrations.

Rationale: Note was added to explain the requirement for sealing conduits passing from a Division 2 to a non-hazardous area.

Reason for Request:

The existing sealing Rules in Section 18 and Appendix J18 have been a source of confusion and in some situations can lead to unsafe installations. Currently the rules do not deal properly with the situation where the seal in electrical devices intended to provide isolation of conduit and cable systems from the pressurized processes containing flammable fluids. There have been a number of cases of serious explosions as the result of process fluids entering non-hazardous areas via the wiring systems. An explosion resulting in destruction of a compressor station and serious injury to a worker occurred in Canada in December, 2000, occurred as the result of natural gas transmission through motor feeder cables. A general overhaul of the sealing Rules to deal with the above issues is being proposed.

Supporting Information:

There has been discussion of these issues over the last code cycle. The serious issue of pressurized gas transmission has been a catalyst for an overhaul of the sealing Rules. Discussions both formal and informal have taken place with various members of the Section 18 subcommittee. As the cutoff date for the next Code is rapidly approaching, the submitter consulted with three members of the section 18 SC in an attempt to avoid recycling at the Subcommittee level.

Chair's Comments to First Round Ballot

There were eleven replies, six in agrees, three agree with comments and two negatives. One of the negatives found the concept of a secondary seal confusing but agreed to withdraw his negative if a diagram showing the sealing arrangement was included. One will be attached to the second round proposal.

The second negative had three major concerns:

1. He pointed out that in some cases enclosures are approved and marked as requiring a seal at a distance less than 450mm. Revisions have been made to the second round proposal to satisfy that concern.
2. He felt that it was not necessary to install a seal at the entry to Ex e enclosures and pointed out that it is not required in 60079-14. Discussions with other SC members felt the seal is required to retain the explosion-proof rating of the conduit. NEC also requires a seal at the entry to Ex e enclosures. I do believe this subject requires further discussion but as the clause was not changed in the initial proposal and discussion around this subject will take longer than the time we have before our cutoff date, I would like to deal with it as a new subject. A note to this Rule has been added to appendix B to explain the reason for the seal.
3. He felt that the 18-108(4) requirement that reducers be no larger than the trade size of the conduit would exclude the application where a reducer enters an enclosure through a hub

that is larger than the conduit size. An appendix B note has been added to point out that application is acceptable.

Comments from those in agreement pointed out other corrections to the text. These have been made to the text for the second round. For the second round text I have removed the changes shown in the first round and I have shown only the changes to the first round text and my comments where necessary. As the time to our cutoff date is short the deadline for ballots will be 21 days. If you have concerns or issues I would appreciate if you could discuss them with me prior to balloting.

Second Round Text (also see attached diagram)

Changes to Section 18 and Appendix B

11. Add the following definitions to 18-002 Special Terminology

***Primary Seal** means: A seal that isolates process fluids from an electrical system and has one side of the seal in contact with the process fluid.*

***Secondary Seal** means [VGR1]a seal that is designed to prevent the passage of process fluids at the pressure it will be subjected to upon failure of the primary seal.*

***Conduit Seal** means a seal which is installed in a conduit to prevent the passage of an explosion from one portion of the conduit system to another and which minimizes the passages of gases or vapors at atmospheric pressure.*

***Cable Seal** means a seal which is installed at a cable termination to prevent the release of an explosion from an explosion-proof enclosure and which minimizes the passage of gases or vapors at atmospheric pressure*

12. Delete Subrules (4) and (5) of Rule 18-090:

Installations in Class I, Zone 0 Locations

18-090 Equipment and Wiring (see Appendices B and F)

- (4) Except as provided for in Subrules (2) and (3), electrical equipment and wiring shall not be installed in a Class I, Zone 0 hazardous location.
- (5) Electrical equipment that is approved as intrinsically safe, type i or ia, shall be permitted in Class I, Zone 0 locations.
- (6) Intrinsically safe circuits and wiring shall be designed for the application and shall be installed in accordance with the design.

13. Add a new Rule 18-092 as follows:

18-092 Sealing Class I, Zone 0(See Appendix B)

- (5) Secondary seals shall be provided, between devices containing a primary seal and conduit or cable seals, where failure of a single component in the device containing the primary seal could allow passage of process fluids.
- (6) Where secondary seals are installed, drains, vents or other devices intended to make primary seal leakage obvious shall be installed.

- (7) Conduit seals shall be provided where the conduit leaves the Class I, Zone 0 location with no box, coupling, or fitting in the conduit run between the seal and the point at which the conduit leaves the location, except that a rigid unbroken conduit which passes completely through a Class I, Zone 0 area with no fittings less than 300 mm beyond each boundary, providing the termination points of the unbroken conduit are in non-hazardous areas, need not be sealed.
- (8) Cable seals shall be provided on cables at the first point of termination after entry into the Zone 0 location.

14. Revise Rule 18-108 as follows:

18-108 Sealing, Class I, Zone 1 (see Appendix B)

- (1) Secondary seals shall be provided, between devices containing a primary seal and conduit or cable seals, where failure of a single component in the device containing the primary seal could allow passage of process fluids.
- (2) Where secondary seals are installed, drains, vents or other devices intended to make primary seal leakage obvious shall be installed.
- (3) Conduit seals shall be provided in conduit systems where:
 - (a) The conduit enters an explosion-proof or flameproof enclosure containing devices which may produce arcs, sparks or high temperatures, and shall be located as close as practicable to the enclosure, or as marked on the enclosure[VGR2], but not further than 450 mm from the enclosure; or
 - (b) The conduit is 53 (2) trade size or larger and enters an explosion-proof or flameproof enclosure housing terminals, splices, or taps, and shall be located no further than 450 mm from the enclosure; or
 - (c) The conduit leaves the Class I, Zone 1 location with no box, coupling, or fitting in the conduit run between the seal and the point at which the conduit leaves the location, except that a rigid unbroken conduit which passes completely through a Class I, Zone 1 area with no fittings less than 300 mm beyond each boundary, providing the termination points of the unbroken conduit are in non-hazardous areas, need not be sealed; or
 - (d) The conduit enters an enclosure that is not required to be explosion-proof or flameproof, except that a seal is not required where an unbroken and continuous run of conduit connects two enclosures that are not required to be explosion-proof or flameproof.[VGR3]
- (4) Only explosion proof or flameproof unions, couplings, reducers and elbows that are not larger than the trade size of the conduit shall be permitted between the sealing fitting and an explosion-proof or flameproof enclosure.[VGR4]
- (5) Cable seals shall be provided in a cable system where:
 - (a) The cable enters an enclosure required to be explosion-proof or flameproof; or
 - (b) The cable enters an enclosure not required to be explosion-proof or flameproof, and:

- (i) The cable leaves the Zone 1 area and is less than 10 m in length; or
- [VGR5](ii) The other end of the cable terminates in a Zone 2 or non-hazardous location in which a negative atmospheric pressure greater than 0.2 kPa exists.

(6) Where secondary seals, cable seals or conduit seals are required, they shall conform to the following:

(a) The seal shall be made:

- (i) In a field-installed sealing fitting or cable gland which shall be accessible and shall comply with the requirements of Rule 18-100; or
- (ii) In a sealing fitting provided as part of an enclosure approved for the area and where the seal is factory-made, the enclosure shall be so marked to indicate that such a seal is provided.

(b) Splices and taps shall not be made in fittings intended only for sealing with compound, nor shall other fittings in which splices or taps are made be filled with compound;

(c) Where there is a probability that liquid or other condensed vapour may be trapped within enclosures for control equipment or at any point in the raceway system, approved means shall be provided to prevent accumulation or to permit periodic draining of such liquid or condensed vapour; and

(d) Where there is a probability that liquid or condensed vapour may accumulate within motors or generators, joints and conduit systems shall be arranged to minimize entrance of liquid, but if means to prevent accumulation or to permit periodic draining are judged necessary, such means shall be provided at the time of manufacture, and shall be deemed an integral part of the machine.

(7) Runs of cables, each having a continuous sheath, either metal or non-metal, shall be permitted to pass through a Class I, Zone 1 location without seals.

(8) Cables that do not have a continuous sheath, either metal or non-metal, shall be sealed at the boundary of the Zone 1 location.

15. Revise Rule 18-158 as follows:

18-158 Sealing, Class I, Zone 2 (see Appendix B)

(1) Secondary seals shall be provided, between devices containing a primary seal and conduit or cable seals, where failure of a single component in the device containing the primary seal could allow passage of process fluids.

(2) Where secondary seals are installed, drains, vents or other devices intended to make primary seal leakage obvious shall be installed.

(3) Seals shall be provided in a conduit system where:

(a) The conduit enters an enclosure that is required to be explosion-proof or flameproof and shall be located as close as practicable to the enclosure, or as marked on the enclosure[VGR6], but not further than 450 mm from the enclosure; or

(b) The conduit leaves the Class I, Zone 2 location with no box, coupling, or fitting in the conduit run between the seal and the point at which the conduit leaves the location, except that a rigid unbroken conduit which passes completely through a Class I, Zone 2 area with no fittings less than 300 mm

beyond each boundary, providing the termination points of the unbroken conduit are in non-hazardous areas, need not be sealed; or

(c) The conduit leaves a Class I, Zone 2 location outdoors, the seal may be located more than 300 mm beyond the Class I, Zone 2 boundary providing it is located on the conduit prior to entering an enclosure or building.

(4) Only explosion proof or flameproof unions, couplings, reducers and elbows that are not larger than the trade size of the conduit shall be permitted between the sealing fitting and an explosion-proof or flameproof enclosure.[VGR7]

(5) Seals shall be provided in a cable system where:

(a) The cable enters an enclosure required to be explosion-proof or flameproof; or

(b) The cable enters an enclosure not required to be explosion-proof or flameproof; and

(i) The cable leaves the Zone 2 area and is less than 10 m in length; or

[VGR8](ii) The other end of the cable terminates in a non-hazardous location in which a negative atmospheric pressure greater than 0.2 kPa exists.

(6) Where a run of conduit enters an enclosure that is required to be explosion-proof or flameproof, every part of the conduit from the seal to that enclosure shall comply with Rule 18-106.

(7) Runs of cables, each having a continuous sheath, either metal or non-metal, shall be permitted to pass through a Class I, Zone 2 location without seals.

(8) Cables that do not have a continuous sheath, either metal or non-metal, shall be sealed at the boundary of the Zone 2 location.

(9) Where seals are required, Rule 18-108(6) shall apply.

16. Add the following notes to Appendix B as follows:

Appendix B Notes

18-002 **Primary Seals** are typically a part of electrical devices such as pressure, temperature or flow measuring devices and devices (such as canned pumps) where the electrical connections are immersed in the process fluids.

Secondary Seals are designed to prevent flammable process fluids entering the electrical wiring system upon failure of a primary seal. These devices typically prevent passage of fluids at process pressure by a combination of sealing and pressure relief.

Conduit Seals are designed to prevent the passage of flames from one portion of the electrical installation to another through the conduit system and to minimize the passage of gases or vapors at atmospheric pressure. Unless specifically designed for the purpose, conduit seals are not intended to prevent the passage of fluids at a continuous pressure differential across the seal. Even at differences in pressure across the seal equivalent to a few inches of water, there may be passage of gas or vapor through the seal and/or through the conductors passing through the seal. Where conduit seals are exposed to continuous pressure, there may be a danger of transmission of flammable fluids to "safe areas" resulting in fire or explosions.

Cable seals are designed to prevent the escape of flames from an explosion proof enclosure. As cables are not designed to withstand the pressures of an explosion, transmission of an explosion into a cable could result in ignition of gases or vapors in the area outside enclosure.

- 18-092(1)
18-108(1)
18-158(1)
- Where devices such as pressure switches, flow devices etc, are connected to a process containing flammable fluids, failure of the seal (primary) in these devices could release the flammable fluids into the wiring system where they may migrate to a safe area where electrical or other devices are not constructed to prevent explosions. As conduit and cable seals are not designed to seal against continuous pressure and will allow slow passage of flammable fluids secondary seals which are designed to prevent the passage of flammable fluids into the wiring system are required.
- 18-092(2)
18-108(2)
18-158(2)
- Various methods could be used to detect the failure of a primary seal. Monitoring the secondary seal vent with flow detection or gas detection are two possible means. It would also be possible to connect the vents of a number of secondary seals and monitor the common discharge. Other methods are also possible. Any method used should not restrict the venting of the seal to atmosphere.
- 18-108(3)(d)
- Seals are required on conduit systems where a conduit enters an enclosure not required to be explosion-proof or flameproof (typically a type "e" enclosure) as the conduit system is required to be maintained as an explosion-proof or flameproof wiring system in a Class I, Zone 1 Hazardous Location. Note that the conduit entry into a type "e" enclosure must also meet the ingress protection rating of the enclosure
- 18-108(4)
- Reducers may have one side larger than the trade size of the conduit where the entry to the explosion-proof or flameproof enclosure is larger than the trade size of the conduit.
- 18-108(6)
- It is important that the manufacture's instructions are closely adhered to or seals will not function properly to prevent the transmission of an explosion or to prevent the transmission of flammable fluids to non-hazardous areas where they will be exposed to unprotected ignition sources. Improper sealing has been the primary factor in a number of explosions, resulting in loss of life and/or major equipment damage. Users are reminded that only the sealing compound outlined with the instructions may be used in a seal. Use of other manufacturer's compounds in a seal may compromise the integrity of the installation.
- 18-158(3)(c)
- This Rule allows the seal at the boundary between an outdoor Class I, Zone 2 location and an outdoor non-hazardous location, to be located further than 300 mm from the boundary of the Class I, Zone 2 location providing it is located on the conduit prior to it entering an enclosure or a building. This recognizes that as gas is only present in Class I, Zone 2 locations for short periods, it is unlikely that gas or vapor could be released through conduit couplings at sufficiently high rates to form an explosive mixture in outdoor areas. However the seal must be located before the conduit enters an enclosure or a building as, depending on the ventilation rate, gas transmitted through the conduit may build up to flammable concentrations.

Changes to Section J18 and Annex JB

17. Add the following definitions to J18-002 Special Terminology

Primary Seal means: *A seal that isolates process fluids from an electrical system and has one side of the seal in contact with the process fluid.*

Secondary Seal means [VGR9] *a seal that is designed to prevent the passage of process fluids at the pressure it will be subjected to upon failure of the primary seal.*

Conduit Seal means *a seal which is installed in a conduit to prevent the passage of an explosion from one portion of the conduit system to another and which minimizes the passages of gases or vapors at atmospheric pressure.*

Cable Seal means *a seal which is installed at a cable termination to prevent the release of an explosion from an explosion-proof enclosure and which minimizes the passage of gases or vapors at atmospheric pressure*

18. Revise Rule J18-108 as follows:

J18-108 Sealing, Class I, Division 1 (see Annex JB)

- (1) Secondary seals shall be provided, between devices containing a primary seal and conduit or cable seals, where failure of a single component in the device containing the primary seal could allow passage of process fluids.
- (2) Where secondary seals are installed, drains, vents or other devices intended to make primary seal leakage obvious shall be installed.
- (3) Conduit seals shall be provided in conduit systems where:
 - (a) The conduit enters an explosion-proof or flameproof enclosure containing devices which may produce arcs, sparks or high temperatures, and shall be located as close as practicable to the enclosure, or as marked on the enclosure[VGR10], but not further than 450 mm from the enclosure; or
 - (b) The conduit is 53 (2) trade size or larger and enters an explosion-proof or flameproof enclosure housing terminals, splices, or taps, and shall be located no further than 450 mm from the enclosure; or
 - (c) The conduit leaves the Class I, Division 1 location with no box, coupling, or fitting in the conduit run between the seal and the point at which the conduit leaves the location, except that a rigid unbroken conduit which passes completely through a Class I, Division 1 area with no fittings less than 300 mm beyond each boundary, providing the termination points of the unbroken conduit are in non-hazardous areas, need not be sealed; or
 - (d) The conduit enters an enclosure that is not required to be explosion-proof or flameproof, except that a seal is not required where an unbroken and continuous run of conduit connects two enclosures that are not required to be explosion-proof or flameproof.[VGR11]
- (4) Only explosion proof unions, couplings, reducers and elbows that are not larger than the trade size of the conduit shall be permitted between the sealing fitting and an explosion-proof or flameproof enclosure.[VGR12]

- (5) Cable seals shall be provided in a cable system where:
- (a) The cable enters an enclosure required to be explosion-proof or flameproof; or
 - (b) The cable enters an enclosure not required to be explosion-proof or flameproof, and:
 - (i) The cable leaves the Division 1 area and is less than 10 m in length; or [VGR13]
 - (ii) The other end of the cable terminates in a Division 2 or non-hazardous location in which a negative atmospheric pressure greater than 0.2 kPa exists.
- (6) Where secondary seals, cable seals or conduit seals are required, they shall conform to the following:
- (a) The seal shall be made:
 - (i) In a field-installed sealing fitting or cable gland which shall be accessible and shall comply with the requirements of Rule J18-100; or
 - (ii) In a sealing fitting provided as part of an enclosure approved for the area and where the seal is factory-made, the enclosure shall be so marked to indicate that such a seal is provided.
 - (b) Splices and taps shall not be made in fittings intended only for sealing with compound, nor shall other fittings in which splices or taps are made be filled with compound;
 - (c) Where there is a probability that liquid or other condensed vapour may be trapped within enclosures for control equipment or at any point in the raceway system, approved means shall be provided to prevent accumulation or to permit periodic draining of such liquid or condensed vapour; and
 - (d) Where there is a probability that liquid or condensed vapour may accumulate within motors or generators, joints and conduit systems shall be arranged to minimize entrance of liquid, but if means to prevent accumulation or to permit periodic draining are judged necessary, such means shall be provided at the time of manufacture, and shall be deemed an integral part of the machine.
- (7) Runs of cables, each having a continuous sheath, either metal or non-metal, shall be permitted to pass through a Class I, Division 1 location without seals.
- (8) Cables that do not have a continuous sheath, either metal or non-metal, shall be sealed at the boundary of the Division 1 location.

19. Revise Rule J18-158 as follows:

J18-158 Sealing, Class I, Division 2 (see Annex JB)

- (1) Secondary seals shall be provided, between devices containing a primary seal and conduit or cable seals, where failure of a single component in the device containing the primary seal could allow passage of process fluids.
- (2) Where secondary seals are installed, drains, vents or other devices intended to make primary seal leakage obvious shall be installed.
- (3) Seals shall be provided in a conduit system where:

(a) The conduit enters an enclosure that is required to be explosion-proof or flameproof and shall be located as close as practicable to the enclosure, or as marked on the enclosure[VGR14], but not further than 450 mm from the enclosure; or

(b) The conduit leaves the Class I, Division 2 location with no box, coupling, or fitting in the conduit run between the seal and the point at which the conduit leaves the location, except that a rigid unbroken conduit which passes completely through a Class I, Zone 2 area with no fittings less than 300 mm beyond each boundary, providing the termination points of the unbroken conduit are in non-hazardous areas, need not be sealed; or

(c) The conduit leaves a Class I, Division 2 location outdoors, the seal may be located more than 300 mm beyond the Class I, Division 2 boundary providing it is located on the conduit prior to entering an enclosure or building.

(4) Only explosion proof unions, couplings, reducers and elbows that are not larger than the trade size of the conduit shall be permitted between the sealing fitting and an explosion-proof or flameproof enclosure.[VGR15]

(5) Seals shall be provided in a cable system where:

(a) The cable enters an enclosure required to be explosion-proof or flameproof; or

(b) The cable enters an enclosure not required to be explosion-proof or flameproof; and

(i) The cable leaves the Division 2 area and is less than 10 m in length; or

[VGR16](ii) The other end of the cable terminates in a non-hazardous location in which a negative atmospheric pressure greater than 0.2 kPa exists.

(6) Where a run of conduit enters an enclosure that is required to be explosion-proof or flameproof, every part of the conduit from the seal to that enclosure shall comply with Rule J18-106.

(7) Runs of cables, each having a continuous sheath, either metal or non-metal, shall be permitted to pass through a Class I, Division 2 location without seals.

(8) Cables that do not have a continuous sheath, either metal or non-metal, shall be sealed at the boundary of the Division 2 location.

(9) Where seals are required, Rule J18-108(6) shall apply.

20. Add the following notes to Annex JB as follows:

Annex JB Notes

J18-002 **Primary Seals** are typically a part of electrical devices such as pressure, temperature or flow measuring devices and devices (such as canned pumps) where the electrical connections are immersed in the process fluids.

Secondary Seals are designed to prevent flammable process fluids entering the electrical wiring system upon failure of a primary seal. These devices typically prevent passage of fluids at process pressure by a combination of sealing and pressure relief.

Conduit Seals are designed to prevent the passage of flames from one portion of the electrical installation to another through the conduit system and to minimize the passage of gases or vapors at atmospheric pressure. Unless specifically designed for the purpose, conduit seals are not intended to prevent the passage of fluids at a

continuous pressure differential across the seal. Even at differences in pressure across the seal equivalent to a few inches of water, there may be passage of gas or vapor through the seal and/or through the conductors passing through the seal. Where conduit seals are exposed to continuous pressure, there may be a danger of transmission of flammable fluids to “safe areas” resulting in fire or explosions.

***Cable seals** are designed to prevent the escape of flames from an explosion proof enclosure. As cables are not designed to withstand the pressures of an explosion, transmission of an explosion into a cable could result in ignition of gases or vapors in the area outside enclosure.*

J18-108(1)
J18-158(1) Where devices such as pressure switches, flow devices etc, are connected to a process containing flammable fluids, failure of the seal (primary) in these devices could release the flammable fluids into the wiring system where they may migrate to a safe area where electrical or other devices are not constructed to prevent explosions. As conduit and cable seals are not designed to seal against continuous pressure and will allow slow passage of flammable fluids secondary seals which are designed to prevent the passage of flammable fluids into the wiring system are required

J18-108(2)
J18-158(2) Various methods could be used to detect the failure of a primary seal. Monitoring the secondary seal vent with flow detection or gas detection are two possible means. It would also be possible to connect the vents of a number of secondary seals and monitor the common discharge. Other methods are also possible. Any method used should not restrict the venting of the seal to atmosphere.

J18-108(4)
J18-158(4) Reducers may have one side larger than the trade size of the conduit where the entry to the explosion-proof or flameproof enclosure is larger than the trade size of the conduit..

J18-108(6) It is important that the manufacture’s instructions are closely adhered to or seals will not function properly to prevent the transmission of an explosion or to prevent the transmission of flammable fluids to non-hazardous areas where they will be exposed to unprotected ignition sources. Improper sealing has been the primary factor in a number of explosions, resulting in loss of life and/or major equipment damage. Users are reminded that only the sealing compound outlined with the instructions may be used in a seal. Use of other manufacturer’s compounds in a seal may compromise the integrity of the installation.

J18-158(3)(c) This Rule allows the seal at the boundary between an outdoor Class I, [Division 2](#) location and an outdoor non-hazardous location, to be located further than 300 mm from the boundary of the Class I, [Division 2](#) location providing it is located on the conduit prior to it entering an enclosure or a building. This recognizes that as gas is only present in Class I, [Division 2](#) locations for short periods, it is unlikely that gas or vapor could be released through conduit couplings at sufficiently high rates

to form an explosive mixture in outdoor areas. However the seal must be located before the conduit enters an enclosure or a building as, depending on the ventilation rate, gas transmitted through the conduit may build up to flammable concentrations.

Subcommittee Deliberation: There were ten replies to the second round ballot, all in favor with no comments.

Subcommittee Recommendation: Recommendation is the following. A diagram has been added to clarify the location of primary, secondary and conduit or cable seals.

Changes to Section 18 and Appendix B

1. Add the following definitions to 18-002 Special Terminology

Primary Seal means: *A seal that isolates process fluids from an electrical system and has one side of the seal in contact with the process fluid.*

Secondary Seal means *a seal that is designed to prevent the passage of process fluids at the pressure it will be subjected to upon failure of the primary seal.*

Conduit Seal means *a seal which is installed in a conduit to prevent the passage of an explosion from one portion of the conduit system to another and which minimizes the passages of gases or vapors at atmospheric pressure.*

Cable Seal means *a seal which is installed at a cable termination to prevent the release of an explosion from an explosion-proof enclosure and which minimizes the passage of gases or vapors at atmospheric pressure*

2. Delete Subrules (4) and (5) of Rule 18-090:

Installations in Class I, Zone 0 Locations

18-090 Equipment and Wiring (see Appendices B and F)

- (7) Except as provided for in Subrules (2) and (3), electrical equipment and wiring shall not be installed in a Class I, Zone 0 hazardous location.
- (8) Electrical equipment that is approved as intrinsically safe, type i or ia, shall be permitted in Class I, Zone 0 locations.
- (9) Intrinsically safe circuits and wiring shall be designed for the application and shall be installed in accordance with the design.

3. Add a new Rule 18-092 as follows:

18-092 Sealing Class I, Zone 0(See Appendix B)

- (9) Secondary seals shall be provided, between devices containing a primary seal and conduit or cable seals, where failure of a single component in the device containing the primary seal could allow passage of process fluids.
- (10) Where secondary seals are installed, drains, vents or other devices intended to make primary seal leakage obvious shall be installed.
- (11) Conduit seals shall be provided where the conduit leaves the Class I, Zone 0 location with no box, coupling, or fitting in the conduit run between the seal and the point at which the conduit leaves the location, except that a rigid unbroken conduit which passes completely through a Class I, Zone 0 area with no fittings less than 300 mm beyond each

boundary, providing the termination points of the unbroken conduit are in non-hazardous areas, need not be sealed.

(12) Cable seals shall be provided on cables at the first point of termination after entry into the Zone 0 location.

4. Revise Rule 18-108 as follows:

18-108 Sealing, Class I, Zone 1 (see Appendix B)

- (1) Secondary seals shall be provided, between devices containing a primary seal and conduit or cable seals, where failure of a single component in the device containing the primary seal could allow passage of process fluids.
- (2) Where secondary seals are installed, drains, vents or other devices intended to make primary seal leakage obvious shall be installed.
- (3) Conduit seals shall be provided in conduit systems where:
 - (a) The conduit enters an explosion-proof or flameproof enclosure containing devices which may produce arcs, sparks or high temperatures, and shall be located as close as practicable to the enclosure, or as marked on the enclosure, but not further than 450 mm from the enclosure; or
 - (b) The conduit is 53 (2) trade size or larger and enters an explosion-proof or flameproof enclosure housing terminals, splices, or taps, and shall be located no further than 450 mm from the enclosure; or
 - (c) The conduit leaves the Class I, Zone 1 location with no box, coupling, or fitting in the conduit run between the seal and the point at which the conduit leaves the location, except that a rigid unbroken conduit which passes completely through a Class I, Zone 1 area with no fittings less than 300 mm beyond each boundary, providing the termination points of the unbroken conduit are in non-hazardous areas, need not be sealed; or
 - (d) The conduit enters an enclosure that is not required to be explosion-proof or flameproof, except that a seal is not required where an unbroken and continuous run of conduit connects two enclosures that are not required to be explosion-proof or flameproof.
- (4) Only explosion proof or flameproof unions, couplings, reducers and elbows that are not larger than the trade size of the conduit shall be permitted between the sealing fitting and an explosion-proof or flameproof enclosure.
- (5) Cable seals shall be provided in a cable system where:
 - (a) The cable enters an enclosure required to be explosion-proof or flameproof; or
 - (b) The cable enters an enclosure not required to be explosion-proof or flameproof, and:
 - (i) The cable leaves the Zone 1 area and is less than 10 m in length; or
 - (ii) The other end of the cable terminates in a Zone 2 or non-hazardous location in which a negative atmospheric pressure greater than 0.2 kPa exists.
- (6) Where secondary seals, cable seals or conduit seals are required, they shall conform to the following:
 - (a) The seal shall be made:

(i) In a field-installed sealing fitting or cable gland which shall be accessible and shall comply with the requirements of Rule 18-100; or

(ii) In a sealing fitting provided as part of an enclosure approved for the area and where the seal is factory-made, the enclosure shall be so marked to indicate that such a seal is provided.

(b) Splices and taps shall not be made in fittings intended only for sealing with compound, nor shall other fittings in which splices or taps are made be filled with compound;

(c) Where there is a probability that liquid or other condensed vapour may be trapped within enclosures for control equipment or at any point in the raceway system, approved means shall be provided to prevent accumulation or to permit periodic draining of such liquid or condensed vapour; and

(d) Where there is a probability that liquid or condensed vapour may accumulate within motors or generators, joints and conduit systems shall be arranged to minimize entrance of liquid, but if means to prevent accumulation or to permit periodic draining are judged necessary, such means shall be provided at the time of manufacture, and shall be deemed an integral part of the machine.

(7) Runs of cables, each having a continuous sheath, either metal or non-metal, shall be permitted to pass through a Class I, Zone 1 location without seals.

(8) Cables that do not have a continuous sheath, either metal or non-metal, shall be sealed at the boundary of the Zone 1 location.

5. Revise Rule 18-158 as follows:

18-158 Sealing, Class I, Zone 2 (see Appendix B)

(1) Secondary seals shall be provided, between devices containing a primary seal and conduit or cable seals, where failure of a single component in the device containing the primary seal could allow passage of process fluids.

(2) Where secondary seals are installed, drains, vents or other devices intended to make primary seal leakage obvious shall be installed.

(3) Seals shall be provided in a conduit system where:

(a) The conduit enters an enclosure that is required to be explosion-proof or flameproof and shall be located as close as practicable to the enclosure, or as marked on the enclosure, but not further than 450 mm from the enclosure; or

(b) The conduit leaves the Class I, Zone 2 location with no box, coupling, or fitting in the conduit run between the seal and the point at which the conduit leaves the location, except that a rigid unbroken conduit which passes completely through a Class I, Zone 2 area with no fittings less than 300 mm beyond each boundary, providing the termination points of the unbroken conduit are in non-hazardous areas, need not be sealed; or

(c) The conduit leaves a Class I, Zone 2 location outdoors, the seal may be located more than 300 mm beyond the Class I, Zone 2 boundary providing it is located on the conduit prior to entering an enclosure or building.

(4) Only explosion proof or flameproof unions, couplings, reducers and elbows that are not larger than the trade size of the conduit shall be permitted between the sealing fitting and an explosion-proof or flameproof enclosure.

(5) Seals shall be provided in a cable system where:

(a) The cable enters an enclosure required to be explosion-proof or flameproof; or

(b) The cable enters an enclosure not required to be explosion-proof or flameproof; and

- (i) The cable leaves the Zone 2 area and is less than 10 m in length; or
- (ii) The other end of the cable terminates in a non-hazardous location in which a negative atmospheric pressure greater than 0.2 kPa exists.

(6) Where a run of conduit enters an enclosure that is required to be explosion-proof or flameproof, every part of the conduit from the seal to that enclosure shall comply with Rule 18-106.

(7) Runs of cables, each having a continuous sheath, either metal or non-metal, shall be permitted to pass through a Class I, Zone 2 location without seals.

(8) Cables that do not have a continuous sheath, either metal or non-metal, shall be sealed at the boundary of the Zone 2 location.

(9) Where seals are required, Rule 18-108(6) shall apply.

6. Add the following notes to Appendix B as follows:

Appendix B Notes

- 18-002 **Primary Seals** are typically a part of electrical devices such as pressure, temperature or flow measuring devices and devices (such as canned pumps) where the electrical connections are immersed in the process fluids.
- Secondary Seals** are designed to prevent flammable process fluids entering the electrical wiring system upon failure of a primary seal. These devices typically prevent passage of fluids at process pressure by a combination of sealing and pressure relief.
- Conduit Seals** are designed to prevent the passage of flames from one portion of the electrical installation to another through the conduit system and to minimize the passage of gases or vapors at atmospheric pressure. Unless specifically designed for the purpose, conduit seals are not intended to prevent the passage of fluids at a continuous pressure differential across the seal. Even at differences in pressure across the seal equivalent to a few inches of water, there may be passage of gas or vapor through the seal and/or through the conductors passing through the seal. Where conduit seals are exposed to continuous pressure, there may be a danger of transmission of flammable fluids to "safe areas" resulting in fire or explosions.
- Cable seals** are designed to prevent the escape of flames from an explosion proof enclosure. As cables are not designed to withstand the pressures of an explosion, transmission of an explosion into a cable could result in ignition of gases or vapors in the area outside enclosure.
- 18-092(1) Where devices such as pressure switches, flow devices etc, are connected to a process
18-108(1) containing flammable fluids, failure of the seal (primary) in these devices could release the
18-158(1) flammable fluids into the wiring system where they may migrate to a safe area where
 electrical or other devices are not constructed to prevent explosions. As conduit and cable
 seals are not designed to seal against continuous pressure and will allow slow passage of
 flammable fluids secondary seals which are designed to prevent the passage of flammable
 fluids into the wiring system are required.
- 18-092(2) Various methods could be used to detect the failure of a primary seal. Monitoring the
18-108(2) secondary seal vent with flow detection or gas detection are two possible means. It would
18-158(2) also be possible to connect the vents of a number of secondary seals and monitor the common
 discharge. Other methods are also possible. Any method used should not restrict the venting
 of the seal to atmosphere.
- 18-
108(3)(d) Seals are required on conduit systems where a conduit enters an enclosure not
 required to be explosion-proof or flameproof (typically a type "e" enclosure) as the
 conduit system is required to be maintained as an explosion-proof or flameproof
 wiring system in a Class I, Zone 1 Hazardous Location. Note that the conduit entry

into a type "e" enclosure must also meet the ingress protection rating of the enclosure

- 18-108(4) Reducers may have one side larger than the trade size of the conduit where the entry to the explosion-proof or flameproof enclosure is larger than the trade size of the conduit.
- 18-108(6) It is important that the manufacture's instructions are closely adhered to or seals will not function properly to prevent the transmission of an explosion or to prevent the transmission of flammable fluids to non-hazardous areas where they will be exposed to unprotected ignition sources. Improper sealing has been the primary factor in a number of explosions, resulting in loss of life and/or major equipment damage. Users are reminded that only the sealing compound outlined with the instructions may be used in a seal. Use of other manufacturer's compounds in a seal may compromise the integrity of the installation.
- 18-158(3)(c) This Rule allows the seal at the boundary between an outdoor Class I, Zone 2 location and an outdoor non-hazardous location, to be located further than 300 mm from the boundary of the Class I, Zone 2 location providing it is located on the conduit prior to it entering an enclosure or a building. This recognizes that as gas is only present in Class I, Zone 2 locations for short periods, it is unlikely that gas or vapor could be released through conduit couplings at sufficiently high rates to form an explosive mixture in outdoor areas. However the seal must be located before the conduit enters an enclosure or a building as, depending on the ventilation rate, gas transmitted through the conduit may build up to flammable concentrations.

Changes to Section J18 and Annex JB

7. Add the following definitions to J18-002 Special Terminology

Primary Seal means: *A seal that isolates process fluids from an electrical system and has one side of the seal in contact with the process fluid.*

Secondary Seal means *a seal that is designed to prevent the passage of process fluids at the pressure it will be subjected to upon failure of the primary seal.*

Conduit Seal means *a seal which is installed in a conduit to prevent the passage of an explosion from one portion of the conduit system to another and which minimizes the passages of gases or vapors at atmospheric pressure.*

Cable Seal means *a seal which is installed at a cable termination to prevent the release of an explosion from an explosion-proof enclosure and which minimizes the passage of gases or vapors at atmospheric pressure*

8. Revise Rule J18-108 as follows:

J18-108 Sealing, Class I, Division 1 (see Annex JB)

- (6) Secondary seals shall be provided, between devices containing a primary seal and conduit or cable seals, where failure of a single component in the device containing the primary seal could allow passage of process fluids.
- (7) Where secondary seals are installed, drains, vents or other devices intended to make

primary seal leakage obvious shall be installed.

- (8) Conduit seals shall be provided in conduit systems where:
- (a) The conduit enters an explosion-proof or flameproof enclosure containing devices which may produce arcs, sparks or high temperatures, and shall be located as close as practicable to the enclosure, or as marked on the enclosure, but not further than 450 mm from the enclosure; or
 - (b) The conduit is 53 (2) trade size or larger and enters an explosion-proof or flameproof enclosure housing terminals, splices, or taps, and shall be located no further than 450 mm from the enclosure; or
 - (c) The conduit leaves the Class I, Division 1 location with no box, coupling, or fitting in the conduit run between the seal and the point at which the conduit leaves the location, except that a rigid unbroken conduit which passes completely through a Class I, Division 1 area with no fittings less than 300 mm beyond each boundary, providing the termination points of the unbroken conduit are in non-hazardous areas, need not be sealed; or
 - (d) The conduit enters an enclosure that is not required to be explosion-proof or flameproof, except that a seal is not required where an unbroken and continuous run of conduit connects two enclosures that are not required to be explosion-proof or flameproof.
- (9) Only explosion proof unions, couplings, reducers and elbows that are not larger than the trade size of the conduit shall be permitted between the sealing fitting and an explosion-proof or flameproof enclosure.
- (10) Cable seals shall be provided in a cable system where:
- (a) The cable enters an enclosure required to be explosion-proof or flameproof; or
 - (b) The cable enters an enclosure not required to be explosion-proof or flameproof, and:
 - (i) The cable leaves the Division 1 area and is less than 10 m in length; or
 - (ii) The other end of the cable terminates in a Division 2 or non-hazardous location in which a negative atmospheric pressure greater than 0.2 kPa exists.
- (6) Where secondary seals, cable seals or conduit seals are required, they shall conform to the following:
- (a) The seal shall be made:
 - (i) In a field-installed sealing fitting or cable gland which shall be accessible and shall comply with the requirements of Rule J18-100; or
 - (ii) In a sealing fitting provided as part of an enclosure approved for the area and where the seal is factory-made, the enclosure shall be so marked to indicate that such a seal is provided.
 - (b) Splices and taps shall not be made in fittings intended only for sealing with compound, nor shall other fittings in which splices or taps are made be filled with compound;
 - (c) Where there is a probability that liquid or other condensed vapour may be trapped within enclosures for control equipment or at any point in the raceway system, approved means shall be provided to prevent accumulation or to permit periodic draining of such liquid or condensed vapour; and
 - (d) Where there is a probability that liquid or condensed vapour may accumulate within motors or generators, joints and conduit systems shall be arranged to minimize

entrance of liquid, but if means to prevent accumulation or to permit periodic draining are judged necessary, such means shall be provided at the time of manufacture, and shall be deemed an integral part of the machine.

(7) Runs of cables, each having a continuous sheath, either metal or non-metal, shall be permitted to pass through a Class I, Division 1 location without seals.

(8) Cables that do not have a continuous sheath, either metal or non-metal, shall be sealed at the boundary of the Division 1 location.

9. Revise Rule J18-158 as follows:

J18-158 Sealing, Class I, Division 2 (see Annex JB)

(1) Secondary seals shall be provided, between devices containing a primary seal and conduit or cable seals, where failure of a single component in the device containing the primary seal could allow passage of process fluids.

(2) Where secondary seals are installed, drains, vents or other devices intended to make primary seal leakage obvious shall be installed.

(3) Seals shall be provided in a conduit system where:

(a) The conduit enters an enclosure that is required to be explosion-proof or flameproof and shall be located as close as practicable to the enclosure, or as marked on the enclosure, but not further than 450 mm from the enclosure; or

(b) The conduit leaves the Class I, Division 2 location with no box, coupling, or fitting in the conduit run between the seal and the point at which the conduit leaves the location, except that a rigid unbroken conduit which passes completely through a Class I, Zone 2 area with no fittings less than 300 mm beyond each boundary, providing the termination points of the unbroken conduit are in non-hazardous areas, need not be sealed; or

(c) The conduit leaves a Class I, Division 2 location outdoors, the seal may be located more than 300 mm beyond the Class I, Division 2 boundary providing it is located on the conduit prior to entering an enclosure or building.

(4) Only explosion proof unions, couplings, reducers and elbows that are not larger than the trade size of the conduit shall be permitted between the sealing fitting and an explosion-proof or flameproof enclosure.

(5) Seals shall be provided in a cable system where:

(a) The cable enters an enclosure required to be explosion-proof or flameproof; or

(b) The cable enters an enclosure not required to be explosion-proof or flameproof; and

(i) The cable leaves the Division 2 area and is less than 10 m in length; or

(ii) The other end of the cable terminates in a non-hazardous location in which a negative atmospheric pressure greater than 0.2 kPa exists.

(6) Where a run of conduit enters an enclosure that is required to be explosion-proof or flameproof, every part of the conduit from the seal to that enclosure shall comply with Rule J18-106.

(7) Runs of cables, each having a continuous sheath, either metal or non-metal, shall be permitted to pass through a Class I, Division 2 location without seals.

(8) Cables that do not have a continuous sheath, either metal or non-metal, shall be sealed at the boundary of the Division 2 location.

(9) Where seals are required, Rule J18-108(6) shall apply.

10. Add the following notes to Annex JB as follows:

Annex JB Notes

J18-002 ***Primary Seals** are typically a part of electrical devices such as pressure, temperature or flow measuring devices and devices (such as canned pumps) where the electrical connections are immersed in the process fluids.*

***Secondary Seals** are designed to prevent flammable process fluids entering the electrical wiring system upon failure of a primary seal. These devices typically prevent passage of fluids at process pressure by a combination of sealing and pressure relief.*

***Conduit Seals** are designed to prevent the passage of flames from one portion of the electrical installation to another through the conduit system and to minimize the passage of gases or vapors at atmospheric pressure. Unless specifically designed for the purpose, conduit seals are not intended to prevent the passage of fluids at a continuous pressure differential across the seal. Even at differences in pressure across the seal equivalent to a few inches of water, there may be passage of gas or vapor through the seal and/or through the conductors passing through the seal. Where conduit seals are exposed to continuous pressure, there may be a danger of transmission of flammable fluids to "safe areas" resulting in fire or explosions.*

***Cable seals** are designed to prevent the escape of flames from an explosion proof enclosure. As cables are not designed to withstand the pressures of an explosion, transmission of an explosion into a cable could result in ignition of gases or vapors in the area outside enclosure.*

J18-108(1)
J18-158(1) Where devices such as pressure switches, flow devices etc, are connected to a process containing flammable fluids, failure of the seal (primary) in these devices could release the flammable fluids into the wiring system where they may migrate to a safe area where electrical or other devices are not constructed to prevent explosions. As conduit and cable seals are not designed to seal against continuous pressure and will allow slow passage of flammable fluids secondary seals which are designed to prevent the passage of flammable fluids into the wiring system are required

J18-108(2)
J18-158(2) Various methods could be used to detect the failure of a primary seal. Monitoring the secondary seal vent with flow detection or gas detection are two possible means. It would also be possible to connect the vents of a number of secondary seals and monitor the common discharge. Other methods are also possible. Any method used should not restrict the venting of the seal to atmosphere.

J18-108(4)
J18-158(4) Reducers may have one side larger than the trade size of the conduit where the entry to the explosion-proof or flameproof enclosure is larger than the trade size of the conduit..

J18-108(6) It is important that the manufacture's instructions are closely adhered to or seals will not function properly to prevent the transmission of an explosion or to prevent the transmission of flammable fluids to non-hazardous areas where they will be exposed to unprotected ignition sources. Improper sealing has been the primary factor in a number of explosions, resulting in loss of life and/or major equipment damage. Users are reminded that only the sealing compound outlined with the instructions may be used in a seal. Use of other manufacturer's compounds in a seal may compromise the integrity of the installation.

J18-
158(3)(c)

This Rule allows the seal at the boundary between an outdoor Class I, Division 2 location and an outdoor non-hazardous location, to be located further than 300 mm from the boundary of the Class I, Division 2 location providing it is located on the conduit prior to it entering an enclosure or a building. This recognizes that as gas is only present in Class I, Division 2 locations for short periods, it is unlikely that gas or vapor could be released through conduit couplings at sufficiently high rates to form an explosive mixture in outdoor areas. However the seal must be located before the conduit enters an enclosure or a building as, depending on the ventilation rate, gas transmitted through the conduit may build up to flammable concentrations.