

# IEEE SAS/NCS Hazardous Locations Seminar

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# Canadian Electrical Code

- ▶ **Can be shortened to “CE Code”, not “CEC”**
  - ▶ CEC is reserved for California Energy Commission
- ▶ **Existing Code is 2018**
  - ▶ In-Force in Canada - generally for the next 1-1½ years
- ▶ **Next Code publishes in Jan. 2021**
  - ▶ 2021 Code comes into Force in Alberta Feb. 1, 2022



# Major Changes Outside Section 18 (& J18)

## ▶ Section 0, Definitions

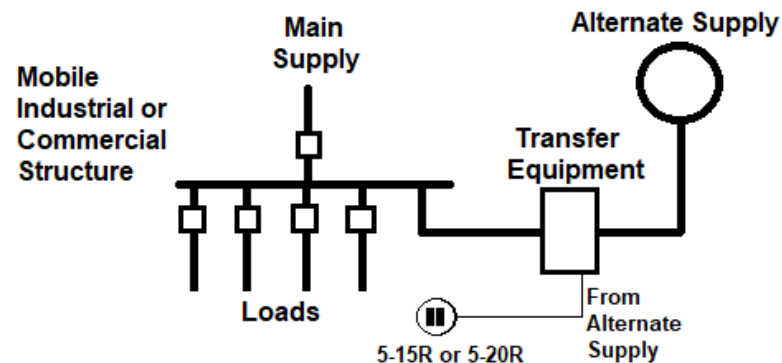
- ▶ Cable Tray – changed from “Raceway” to “supporting means”
- ▶ Explosion-proof enclosure revised to match the revised Std. No. 30
  - ▶ Added - “surface temperature is below the ignition temperature”
- ▶ Added “Flood elevation” and “Flood hazard zone” definitions
  - ▶ Several new rules throughout the Code re. floods
- ▶ Voltage – “High voltage” is exceeding 1,000 V
  - ▶ Added DC: Extra-low up to 42.4V, Low >42.4-1,060V, High >1,060V



# Major Changes Outside Section 18 (& J18)

## ▶ Section 2, General

- ▶ 2-032 Damage – added a requirement for equipment to be evaluated after exposure to water, prior to going back to service
  - ▶ Appendix B suggests Regulator involvement
  - ▶ May need to take some action by Alberta Safety Codes Council
- ▶ 2-317 Receptacle now required for mobile structure, and to be provided via alternate power system transfer equipment, if supplied
  - ▶ *may be difficult/expensive for an “industrial”*



# Major Changes Outside Section 18 (& J18)

- ▶ **Section 10, Grounding and bonding**
  - ▶ Impedance grounding systems monitoring and control requirements
    - ▶ Set by new Table 17, *i.e. details removed from the Rule*
  - ▶ Number of changes to Bonding conductors

# Major Changes Outside Section 18 (& J18)

## ▶ Section 12, Wiring

- ▶ References Table 19 for conductors/cables and their conditions of use
  - ▶ Significant overhaul of Table 19 (*a major change!*)
- ▶ 12-2202, Conductors/cables in cable tray
  - ▶ TC-ER (extended run) can be run outside of the tray
  - ▶ *Proposal (still in subcommittee) to recognize TC to run outside of tray*
  - ▶ *A new Proposal to the NEC to strap “all” for the short circuit current*
    - ▶ *IEEE doesn't support (via PCIC standards subcommittee)*
- ▶ Numerous changes in the Section and it's Appendix B

# Major Changes Outside Section 18 (& J18)

- ▶ **Section 22, Locations where corrosive liquids and vapours exist**
  - ▶ **New Subsection for farm buildings housing livestock**
- ▶ **Section 26, Electrical equipment installation**
  - ▶ **Distribution transformer energy management system recognized**
  - ▶ **All outside receptacles within 2.5 m height require GFCI Class A**



# Major Changes Outside Section 18 (& J18)

## ▶ Section 62, Electric Heating

- ▶ “Heating cable” term changed to “trace heater”
- ▶ Series trace heater field repair/modification/assembly – a no. of changes
  - ▶ Manufacturer training and kits required
  - ▶ Repair of embedded for non-industrial allowed
- ▶ Impedance heating Rule overhauled, + many Appendix B additions, new Table
- ▶ Requires use of “Application Guides” for Impedance and HazLoc trace heating
  - ▶ Consistent with Skin Effect trace heating now, “engineered systems”

# Major Changes Outside Section 18 (& J18)

## ▶ **Section 64, Renewables**

- ▶ **Numerous changes throughout, in particular “batteries”**
- ▶ **Added new subsection “Energy storage systems”**

# Tables

- ▶ **1-4** added mm<sup>2</sup> column, under “size”
- ▶ **6A-6K** significant revision
- ▶ **9A-9P** significant revision, replaced with 9A-9H
- ▶ **17** new, Impedance grounding monitoring and control
- ▶ **18** significant revision, mostly formatting, some technical
- ▶ **18A** new, Division/Zone Group equivalencies
- ▶ **19** significant revision, formatting and technical
- ▶ **20, 39** deleted
- ▶ **XX** new, Impedance heating requirements
- ▶ **Others** minor changes to several Tables

# Hazardous Locations Seminar

## Canadian Electrical Code

Section 18	Hazardous Locations
Section 18	Appendix B, Notes on Rules
Appendix E	Dust-free rooms
Appendix F	Engineering guidelines for preparing descriptive system documents
Appendix H	Combustible gas detection equipment for use in explosive gas atmospheres
Appendix J	
- Annex J18	Hazardous locations classified using the Division system
- Annex JB	Notes to Rules for Annexes J18 and J20
Appendix L	Engineering Guidelines for determining hazardous areas

## Seals - New Definitions (*Sections 18 & J18*)

- ▶ **Explosion seal** – prevent transmission of explosion through the wiring system, and ignition of an outside flammable atmosphere
  - ▶ Will minimize transmission of flammable fluids at atmospheric pressure
- ▶ **Flammable fluid migration seal** – minimizes the transmission of flammable fluids through the wiring system at or near atmospheric pressure
- ▶ ***Explosion and flammable fluid migration seals – conduit and cable***

## Seals - New Definitions (*Sections 18 & J18*)

- ▶ **Process seal** – prevents migration of process fluids into electrical equipment that is in direct contact with process fluids
  - ▶ **Primary process seal** – seal in direct contact with process fluids
  - ▶ **Secondary process seal** – backup seal if the Primary seal fails
  - ▶ **Process sealed equipment** – seal that is integral to and certified as part of the equipment.
    - ▶ Can be listed as Single Seal or Dual Seal equipment
- ▶ ***Seals applies to gases only (Zone 0, 1 & 2 and Class I locations)***

## Seals Requirements – General (S18 & J18)

- ▶ **Flammable fluid migration seals – identify permanently**
- ▶ **All seals – accessible after installation, have no taps/splices inside fittings, and have means to prevent liquid accumulation**
- ▶ **Optical fiber cable – same sealing requirements as for electrical cable**
  - ▶ **Cables that have fiber and conductors are considered “electrical cables”**

# Seals Requirements – Zone 0

- ▶ **Flammable fluid migration seal**
  - ▶ Conduit – near the Zone 0 boundary
  - ▶ Cable – where it first terminates in Zone 0
- ▶ **Explosion seal – no requirements**
  
- ▶ *The following sealing requirement descriptions - high level summaries*
  - ▶ *Many other details are in the Rules - some same or similar to existing, with revisions for clarity, and some new*



# Seals Requirements – Zone 1 & Class I, Div. 1

## ▶ Explosion seal – for conduit

- ▶ Entering explosion-proof or flameproof enclosure
  - ▶ That has devices that produce ignition-capable arcs or temperatures; or
  - ▶ Conduit is trade size 53 or larger
- ▶ Crossing the Zone 1/Division 1 boundary, near the boundary
  - ▶ Not required if conduit passes completely through Zone 1/Division 1 uninterrupted

## ▶ Explosion seal – for cable

- ▶ Entering an enclosure required to be explosion-proof or flameproof

## ▶ *“Flameproof” not included in Class 1, Division 1, as not allowed*



# Seals Requirements – Zone 1 & Class I, Div. 1

- ▶ **Flammable fluid migration seal – for conduit**
  - ▶ No requirement
- ▶ **Flammable fluid migration seal – for cable**
  - ▶ Where it first terminates in Zone 1/Division 1
  - ▶ Deleted requirement for seal on cables with non-continuous sheath

# Seals Requirements – Zone 2 & Class I, Div. 2

- ▶ **Explosion seal – for conduit and cable**
  - ▶ Entering an enclosure required to be explosion-proof or flameproof
- ▶ **Flammable fluid migration seal – for conduit**
  - ▶ Where it leaves the Zone 2/Division 2 location, near the boundary
  - ▶ Not required if conduit passes completely through the Zone 2/Division 2 uninterrupted, and the termination points are in a non-hazardous area
- ▶ **Flammable fluid migration seal - for cable**
  - ▶ Deleted requirement for seal when non-hazardous area has a negative pressure
  - ▶ Deleted requirement for seal on cables with non-continuous sheath

# Seals Additional Info. – Appendix B, Annex JB

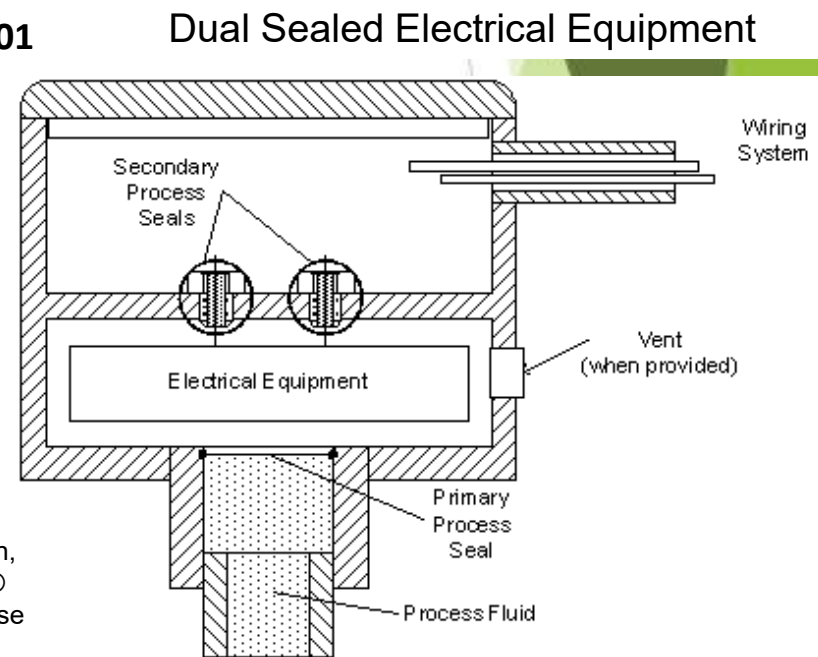
## ▶ Appendix B, Annex JB

### ▶ Significant additions/modifications explaining the sealing Rules

- ▶ Clarification that wiring to downhole equipment requires process sealing, such as at oil & gas wells
- ▶ Process sealed equipment can be certified using **UL122701** or **IEC TS 60079-40**, as no Canadian standard
- ▶ Field installed secondary seals can be certified to **IEEE 1673**

### ▶ Added Figure showing examples of process sealing

### ▶ Added flow charts for seals selection for conduit and cable

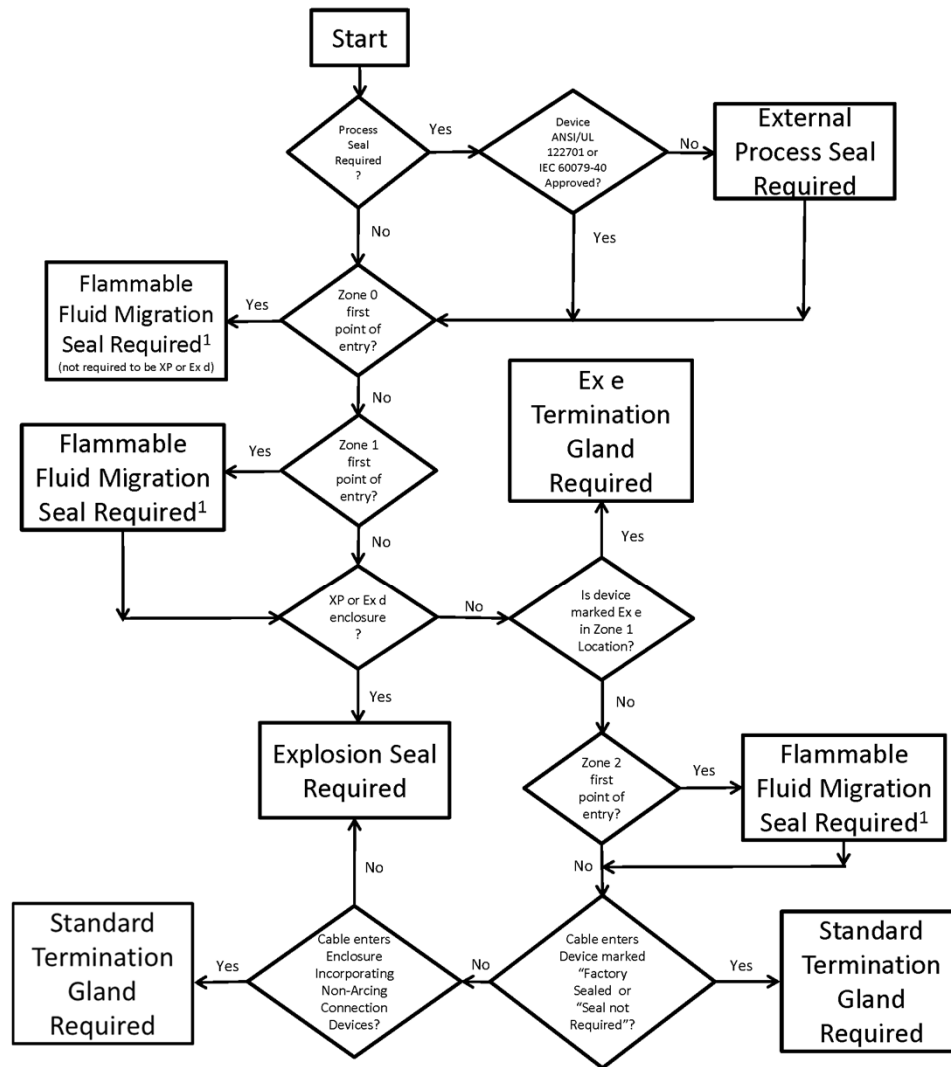


(Source: **Figure B18-1**, CSA C22.1:21, Canadian Electrical Code, Part I, 25th edition, Safety Standard for Electrical Installations. © 2021 Canadian Standards Association. Please visit [store.csagroup.org](http://store.csagroup.org))

# Seals

## Additional Info. – Appendix B, Annex JB

### Example Flowchart - Cable Sealing Selection for Zones



(Source: **Figure B18-2**, CSA C22.1:21, Canadian Electrical Code, Part I, 25th edition, Safety Standard for Electrical Installations. © 2021 Canadian Standards Association. Please visit [store.csagroup.org](http://store.csagroup.org))

1. May consist of an Ex e or standard termination gland filled with electrical duct seal putty or silicon sealant to prevent gas migration. Flammable fluid seals must be permanently identified.

## Seals Additional Info. – Appendix B, Annex JB

- ▶ **Clarified meaning of “Factory Sealed” or “Seal Not Required”**
  - ▶ Markings are interchangeable and apply to conduit installations only
  - ▶ Marking for Zone 1 and Class I, Division 1 indicates
    - ▶ Conduit installations do not require an explosion seal, but cable installations do
  - ▶ Marking for Zone 2 and Class I, Division 2 indicates
    - ▶ Conduit and cable installations do not require an explosion seal
- ▶ **Provides examples of flammable fluid migration seal**
  - ▶ E.g. filling end of cable connector where conductors exit with silicone or similar
  - ▶ Explosion seal is a means of providing

# Equipment - General

- ▶ Division equipment can be used in Zones and vice versa, and the equivalent Group shall be matched
  - ▶ Table 18 shall be followed for acceptable equipment - significant re-formatting for clarity (*2.5 pages increased to 5 pages*)
  - ▶ New Table 18A shall be followed for equivalent Group Classification
- ▶ Optical fiber cable is acceptable, using cable sealing requirements

Equivalent Zone – Division “GROUP” Classification

	<u>GROUP, for Zones</u>	<u>GROUP, for Divisions</u>
<u>GASES</u>	<u>IIC</u>	<u>A, B, C, D</u>
	<u>(IIB + H<sub>2</sub>)*</u>	<u>B, C, D</u>
	<u>IIB</u>	<u>C, D</u>
	<u>IIA</u>	<u>D</u>
<u>DUSTS</u>	<u>IIIC</u>	<u>Class II, Group E</u>
	<u>IIIB</u>	<u>Class II, Group F, G</u>
	<u>IIIA</u>	<u>Class III</u>

(Source: **Table 18A**, CSA C22.1:21, Canadian Electrical Code, Part I, 25th edition, Safety Standard for Electrical Installations. © 2021 Canadian Standards Association. Please visit [store.csagroup.org](http://store.csagroup.org))





# Equipment, Zone 2 and Class I, Division 2

- ▶ **18/J18-150 Subrule 2 provides equipment exemption allowances**
  - ▶ Electromagnetic devices such as solenoids, transformers
  - ▶ Conduit and cables (*per acceptable wiring methods*)
  - ▶ Non-sparking, non-heating equipment in Type 4 or IP65 or better enclosures
  - ▶ Current limiting Fuses for equipment subject to overload
    - ▶ non-indicating, filled type, or
    - ▶ Indicating, filled type, where the indicator does not penetrate the fuse body
  - ▶ Fuses for short circuit
  - ▶ Rotating machines exemption allowances, Subrules 3 and 4
    - ▶ Added Subrule 4 - shaft brushes, where energy calculated is not sufficient for ignition  
(*Calculation: Zone 2 uses a CSA document, Division 2 uses a UL document*)

# Equipment, Zone 2 and Class I, Division 2

- ▶ **Possible issue for these 18/J18-150 2) exemptions**
  - ▶ RTDs and thermocouples that are not in a Type 4 or IP65 or better enclosure, and capacitors no longer fit
  - ▶ Needs to be addressed by CSA, or Provinces e.g. AB Safety Codes Council
- ▶ ***Currently, IP markings cannot be used without an Enclosure Type***
  - ▶ ***There's a Section 2 proposal to allow IP markings only***
    - ▶ ***IP equivalent to "Type" for ingress protection only, i.e. no other factors***

# Equipment, Additional Info. – Appendix B

- ▶ New table added showing equivalent Zone – Division classification
- ▶ Increased safety motors, Ex eb, requirements for use: IEC 60079-14
  - ▶ Details are deleted, replaced with the reference and brief description
  - ▶ Ex eb motors cannot be used in Class I, Division 1

**Equivalent ZONE – DIVISION Classification**

<b>GASES</b>	Zone 0	<b>Class I, Division 1</b>
	Zone 1	
	Zone 2	<b>Class I, Division 2</b>
<b>DUSTS</b>	Zone 20	<b>Class II and Class III, Division 1</b>
	Zone 21	
	Zone 22	<b>Class II and Class III, Division 2</b>

(Source: **Table B18-2**, CSA C22.1:21, Canadian Electrical Code, Part I, 25th edition, Safety Standard for Electrical Installations. © 2021 Canadian Standards Association. Please visit [store.csagroup.org](http://store.csagroup.org))

# HazLoc Wiring

## ▶ Zone 0

- ▶ Cable and conduit that carries non-intrinsically safe circuits - allowed to pass through a Zone 0 area, with no terminations in Zone 0
  - ▶ Rigid metal conduit, uninterrupted
  - ▶ HL marked cable with continuous outer jacket
  - ▶ Appendix B has an example of a wiring application with cable

## ▶ Zone 1 and Class I, Division 1

- ▶ Revised to indicate certified fittings for rigid metal conduit is required

## ▶ Zone 2 & 22, and Class I/II/III, Division 2, and Class III, Division 1

- ▶ Armoured fire alarm and signal cable has been added

# Additional

- ▶ **Appendix E, Dust Free Rooms – deleted**
  - ▶ **Contained some building construction guidelines**
    - ▶ **Actual requirements are in the National Building Code**
  - ▶ **Contained no added electrical information than what's in rest of the CE Code**

# API RP500/505 Area Classification

- ▶ **API RP505 2<sup>nd</sup> Edition (Zones) has been published**
- ▶ **API RP500 4<sup>th</sup> Edition (Class/Divisions) has been balloted**
  - ▶ **Passed with comments**
  - ▶ **Committee is addressing the ballot comments**
    - ▶ **Since API doesn't do online meetings, the 2020 Spring and Fall meetings have not been held, hampering the completion of comment resolution**
    - ▶ **No significant items to address, biggest item is diagrams updates from API editing**
  - ▶ **Main technical changes**
    - ▶ **Combustible gas detection moved to Annex G, but still normative**
      - ▶ **Moved out of "body" as not classification, but it can be used as a protection technique**
      - ▶ **Plan to delete in future editions, RP505 3<sup>rd</sup> edition, or convert to informative**
    - ▶ **Inclusion of LNG facilities in Section 14**
      - ▶ **Different parts of plants have similarities to other Sections**

## Q&A (summary of answers, with clarifications)

- ▶ **On Page 28 Does termination mean also splices?**
  - ▶ **Splice means a Box and terminations, and therefore interrupts the conduit or cable run, so this would not be allowed in Zone 0.**
- ▶ **Are we moving away from AWG wire sizes?**
  - ▶ **No, we are starting to introduce international wire sizing as an alternate. AWG will be around for a very long time and may never go away. We have strong linkages with the US and they are slow to move.**
- ▶ **Is there any clarification for patch cord sealing?**
  - ▶ **Assuming this means ethernet cabling (but not really sure), there has been no updates. The S18 subcommittee intends to do some testing of coax and other communication cables for explosion sealing, but has not arranged that yet. The existing Appendix B note is left as-is for pairs, triads, etc. If the cable is not marked appropriately, the shields need to be removed for sealing around the conductors.**
- ▶ **When the TECK cable enters the class1 div1 non-explosion-proof instrument box, is it not necessary to seal the cable?**
  - ▶ **Really needed clarification on this question. Was it intended to mean “division 1 area” or “division 2 area”, or something else? In Division 1, the instrument box needs to be explosion proof, therefore an explosion seal is required. In Division 2, the box does not have to be explosion proof (can by Type 4/IP65) if devices inside meet the criteria “non-arcing and not heating”, in which case an explosion seal is not required.**

## Q&A

- ▶ **Will electrical inspectors approve systems with components with only IEC marking, or do they need an IEC-C mark?**
  - ▶ **Not sure what IEC-C mark means? IEC or IECEx marks are not acceptable in Canada. If it was meant - an Ex marking with a “c” in the 8 o’clock position on the certifier’s logo (or is a CSA logo for Canada only), then that is acceptable in Canada. Otherwise, to use that device, a field certification by a Certification Body (CB) can be done, or a variance can be taken out. Variance (or deviation) is relatively easy in Alberta, especially with the Safety Codes Council now acknowledging equipment acceptance variances (not so easy in other provinces). With field certification, the CB also needs to verify ordinary locations fire and shock safety, as that is not done with the IECEx certification. Otherwise the inspector cannot approve the use of the equipment.**
    - ▶ *Field certification would apply to that device only. An Alberta equipment acceptance **(not approval)** variance can be much broader than a single device, e.g. same device throughout a project, or corporate wide.*
    - ▶ *Certification Bodies for Canada are accredited by Standards Council of Canada (SCC). Certification Body, Certification Organization, Certification Agency – means the same*
- ▶ **When we have 2 gases e.g. Methane and Hydrogen Sulphide present in a hazardous location, do we use the gas with the more stringent requirement to classify the area on the drawing?**
  - ▶ **Normally yes, but that also depends if the materials are in a mixture or not. If 2 materials can be leaked from within an area, the more stringent requirements should be applied on area classification.**
  - ▶ **If the 2 materials are in a mixture, a flammable mixture analysis is needed to determine the Group classification and AIT. This is an area classification design issue and beyond the scope of this presentation.**



## Q&A

- ▶ **Legally speaking, if anything were to happen, how would you defend the implied ratings in your design? Is there any possibility the manufacturer would not support the implied ratings or should they be confirmed anyway prior to use?**
  - ▶ **Although “implied” was used in the presentation, it probably shouldn’t have. The equipment is marked for it’s specified use by testing/verification with a 3<sup>rd</sup> party Certification Body. There is nothing implied in the ratings, they are as they are listed. For markings that are not included on the nameplate:**
    - ▶ **if the Temperature Code (or Temperature) is not marked (for Zone 0, 1 and 2), the maximum surface temperature is 100°C**
    - ▶ **if Class is marked without Division, it includes both Division 1 and 2**
  - ▶ **Manufacturers will stand by their ratings, as the ratings are not implied**
- ▶ **Is the cross ref table for Class / Zone included in IEC 60079-10-1 ? Or CEC?**
  - ▶ **No. The only IEC hazloc standard that has Divisions in it, is 60079-30-1 Trace Heating (in an Appendix) and only because that is a joint IEC/IEEE standard, which incorporated the IEEE 515 hazloc requirements in it. CEC is not an acceptable acronym; it is CE Code. If you are referring to the new Table B18-2, that info. has been available for decades and from several sources, e.g. IEEE PCIC papers. The existing Table 18 shows that relationship. The reason Table B18-2 has been created is that the new Table 18 format will no longer show that relationship. The “Group” equivalencies in new Table 18A has been available for same length of time, just less publicized.**

# Q&A

## ▶ Where does "Listed" fit in to this, i.e.: UL Listed?

- ▶ Listed is a term used by UL. Some other CB's use the term "approved" as does UL (and other terms e.g. "classified"). In Canada, these are all considered "certified", having a certificate of conformity (CoC). The only entity that can "approve equipment" for use in Canada is the Authority Having Jurisdiction (AHJ), typically the provincial regulatory authority. They adopt the CE Code; and "Approved" definition/Rule 2-024 states; "approved equipment" is that which has been certified by an accredited Certification Body, or other equipment that they accept (i.e. the AHJ can approve equip. that is not certified).
- ▶ *Clarification note: on answer to a previous question, "equipment acceptance" variances can be taken in Alberta, but that is Not Approval, it is only Acceptance for use!*