

## 2018 CANADIAN ELECTRICAL CODE

**SUBJECT: Section 4 - Conductors**

**Rule 4-004 Ampacity of wire and cables**

### Underground Installations

The Appendix B note on this item makes reference to “defined assumptions”...

*It is the intent of this Rule that where ampacities of underground installations of cable size 1/0 and larger are based on conditions of use other than those set out in the foregoing notes or the defined assumptions preceding them, they should be justified by precise calculation based on IEEE 835.*

...but nowhere are those assumptions apparent. However, if we refer to the 1994 (seventeenth edition), the Appendix B note does provide the assumptions as follows:

### **Assumptions used in the Calculation of Cable Ampacity Rating for Direct Buried and Underground Conduit Installations**

#### General

Load factor	– 100%
Ambient Soil Temperature	– 20°C
Conductor Temperature	– 90°C
Soil Thermal Resistivity	– <u>90°C - CM</u> Watt
Insulation/Jacket Thermal Resistivity	– <u>400°C - CM</u> Watt
Shield or Sheath Operation	– Open Circuit
Voltage Rating	– 0 to 5 kV

#### Direct Buried Installation

Cable Depth of Burial	– 915 mm (36")
Cable Types	– RWU90 – RA90 – TECK90 – ACWU90

#### Conduit Installation

Diameter of Conduit	– 127 mm (5")
Depth of Concrete from Surface	– 760 mm (30")
Concrete Thermal Resistivity	– <u>85°C - CM</u> Watt
Cable Type	– RW90

Issue of this STANDATA is authorized by  
the Provincial Electrical Administrator

*[Original Signed]*

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In determining the maximum current which copper or aluminum conductors may carry in underground runs, paragraphs 1) d) (*for copper*) and 2) d) (*for aluminum*) of Rule 4-004 requires that, for conductors 1/0 AWG and larger, diagrams D8 to D11 and tables D8A to D11B assist the code user in determining the maximum conductor ampacity. The results arrived at when using diagrams D8 to D11 and tables D8A to D11B are based on the foregoing assumptions.

Otherwise, to determine precise maximum ampacities, for conductors 1/0 AWG and larger, the detailed calculations in IEEE Standard 835 should be applied as advised in the Appendix B note to Rule 4-004.

#### Cable Arrangements

The Appendix B note to Rule 4-004 indicates where tables D8A to D11B may be used to determine ampacities of conductors for the cable arrangements shown in diagrams D8 to D11. Where other cable configurations are used, you should consult the cable manufacturer or a registered engineering professional to verify the cable ampacities.

#### Metallic vs. Non-metallic Raceway

Note (1) of Tables D9A and D9B refers to non-metallic underground raceways. These tables apply to an installation configuration of a single conductor per raceway. The values in the table do not take into consideration heating effects of circulating currents that would be imposed on metallic conduit, hence the reference to only non-metallic raceways.

### **Rule 4-012 Uses of flexible cord**

#### Portable multi-outlet assemblies

Approved indoor power poles of the portable type are available with a flexible supply cord. The installation of receptacle outlets above suspended ceilings for the connection of cord connected portable indoor power poles is considered acceptable. The installation however, is normally concealed in the ceiling space resulting in a potential for proper maintenance to be overlooked. Therefore, the use of extension cords or "cube" taps are discouraged and the power pole flexible supply cord should be plugged directly into the receptacle outlet.

### **Rule 4-018 Size of neutral conductor**

#### Reduced neutral conductor size for single family dwellings

For a single family dwelling with provision for a 120/240 V electric range, or a 120/240 V electric dryer, the neutral conductor of the consumer's service, or feeder, may be reduced to a size having not less than 70% of the ampacity of the ungrounded conductors.

This concept may be equally applied to a feeder or service supplying more than one unit of row housing or similar installations.

As explained in Rule 4-004 4), the common conductor of a consumer's service or feeder connected to 2-phase wires and the neutral of a 4-wire, 3-phase system carries approximately the same current as the other conductors and therefore shall not be reduced.

#### Neutral overload from the effect of harmonics on a system

When designing an installation that will incorporate a number of electronic devices, a registered engineering professional should review the design to ensure that conductors will not be subject to an overload condition due to harmonic effect.

**Note:** The standard averaging type clamp-on ammeter cannot measure the overload imposed on a system from the effect of harmonics accurately. A "true RMS" type must be used.

**Rule 4-022 Installation of identified conductor**Identified conductor

An identified conductor is a conductor that has either a white or grey covering (or other effective means), or, in the case of certain flexible cords, a raised longitudinal ridge. In either case, the identified conductor is the grounded circuit conductor or a neutral.

Pigtailing of identified conductor

Where a device, such as a receptacle or lampholder, is fed from a 2-wire circuit employing an identified conductor, pigtailing the identified conductor is not required. Where a device is fed from a multi-wire branch circuit employing an identified conductor, pigtailing of the identified conductor is required as per Rule 4-030 4).

**Rule 4-024 Identification of insulated neutral conductors up to and including No. 2 AWG copper or aluminum**Conductors suitable for exposed wiring where exposed to weather

When exposed conductors are installed outdoors, such as service entrance installations, they are required to be suitable for exposure to weather in accordance with Rule 2-024, 4-008 and 12-100. Note #30 of Table 19 reinforces this requirement.

Because of the cold weather we experience in Alberta, the common choice for service entrance conductors is usually a thermoset conductor manufactured in accordance with CSA C22.2 No. 38-18. Clause 4.8 of this standard requires that conductors used where exposed to weather have a minimum of 2.5% by weight of suitable carbon black, well dispersed. Because of the high carbon content, this requirement essentially eliminates the ability of the manufacturer to introduce coloured insulations that would be suitable for exposure to weather.

Rule 4-024 1) requires that the neutral conductor of consumer services up to and including No. 2 AWG copper and aluminum be identified with a white or natural grey covering or by three continuous white stripes along the entire length of the conductor. When only black conductors are available, the identified (neutral) conductor should be permanently marked as outlined in Subrule 4) of Rule 4.