



Canadian  
Electricity  
Association

Association  
canadienne  
de l'électricité

# CIRCUIT KILOMETER DEFINITION

## **About CEA**

Founded in 1891, the Canadian Electricity Association (CEA) is the national forum and voice for the evolving electricity industry in Canada.

CEA is the premier association for the electricity industry in Canada, whose membership includes not only world-class providers but electrical manufacturers and corporate consulting companies.

The association contributes to the regional, national and international success of its members through the delivery of quality value-added services.

## **About Service Continuity Committee**

The only source for national assessment on distribution system performance in Canada. The committee comprises utilities from across Canada and the globe who participate and contribute to the discussion of increasing distribution system performance through better resiliency and improved reliability, by addressing operational challenges and reducing commercial risk through shared practices, knowledge, innovation and data collection.

## Service Continuity Committee

### Definition of Circuit Kilometer

#### General

For clarity, circuit length is distinct from conductor length in that one or more conductors may be employed to create a circuit. CEA's intention is to report circuit length. The bet's analogy is to consider a single line diagram representation. For instance, a 1 km long three-phase grounded interconnection between two points which is built with one conductor per phase plus one neutral conductor has a total of 4 km of conductor; however, it is only a 1 km long circuit.

It is important to have a parallel between techniques used to calculate circuit length for overhead as compared to underground.

Multiple, independently-switched circuits (i.e., feeders) may be attached on the same structures or located in a common trench alignment along a route. In such instances, the length of each circuit will be compiled independently. A 1 km length of double circuit is reported as 2 km of circuit.

A three-phase circuit may have "single-phase" (or "two-phase") branch line taps. This terminology derives from the fact that only one (or two) of the phases of the three-phase circuit – plus (in most areas) a neutral conductor – are involved. Each single-phase (or two-phase) branch line tap will be treated as a separate length of circuit beginning at the point where it connects to the three-phase circuit.

#### Overhead Circuits

##### Overhead – Single Circuits of Multiple Phase

- Two or three individual phase wires each of a different phase that are carried on common structures and sourced from a common switching point<sup>1</sup> will be considered a single circuit.
- The presence or absence of neutral conductor will not affect the circuit designation.

##### Overhead – Individual Circuits

- If more than one multi-phase circuit exists on common structures they will be counted as separate circuits for determining circuit length.
- Separate wires of the same phase angle will be considered separate circuits even if in a common alignment, unless bundled and operated as one single phase conductor.
- Individual phase wires on separate structures will each be considered a separate circuit.
- Individual phase wires on common structures but not sourced from a common switching point will be considered separate circuits.

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<sup>1</sup> A common switching point may be a three-phase device or may be two or three single phase devices at the same location, arranged together on the same switching structure, and operated using common switch number designation. If the first two criteria are met but not the third then it is likely three separate circuits.

## Cable Circuits

### Cable – Single Circuits Multiple Phase

- Three phase cable<sup>2</sup>, or three individual cables each of a different phase in a common alignment that are sourced from a switching point will be considered a single circuit.
- Two or three separate cables each of a different phase sourced from a common switching point and in a common alignment will be considered a single circuit. This is true even if in some locations along the alignment one of the phases divert to feed a single-phase transformer and then immediately rejoins the other phase(s) in the common trench.

### Cable – Individual Circuits

- Two or more cables of the same phase will be considered separate circuits even if in a common alignment.
- Individual phases on separate alignments will each be considered a separate circuit.

### Low Voltage Circuits

- Low voltage circuit length (e.g. 120; 120/240; 120/208; 600/347; 600 V) will be measured analogous to primary circuit length. Although individual conductors may comprise a low voltage circuit, it is length of circuit that will be reported.
- Utilities may have varying definitions for which low voltage circuits are designated as “secondary” circuits versus which are designated as “service” circuits and they may or may not compile data for each of them. In addition, there may be varying policies governing ownership of circuits and this could affect the circuit length that would be reported by the utility. These definitions and policy differences add to the complexity of using any low voltage circuit data that may be reported by each utility.

## Definition

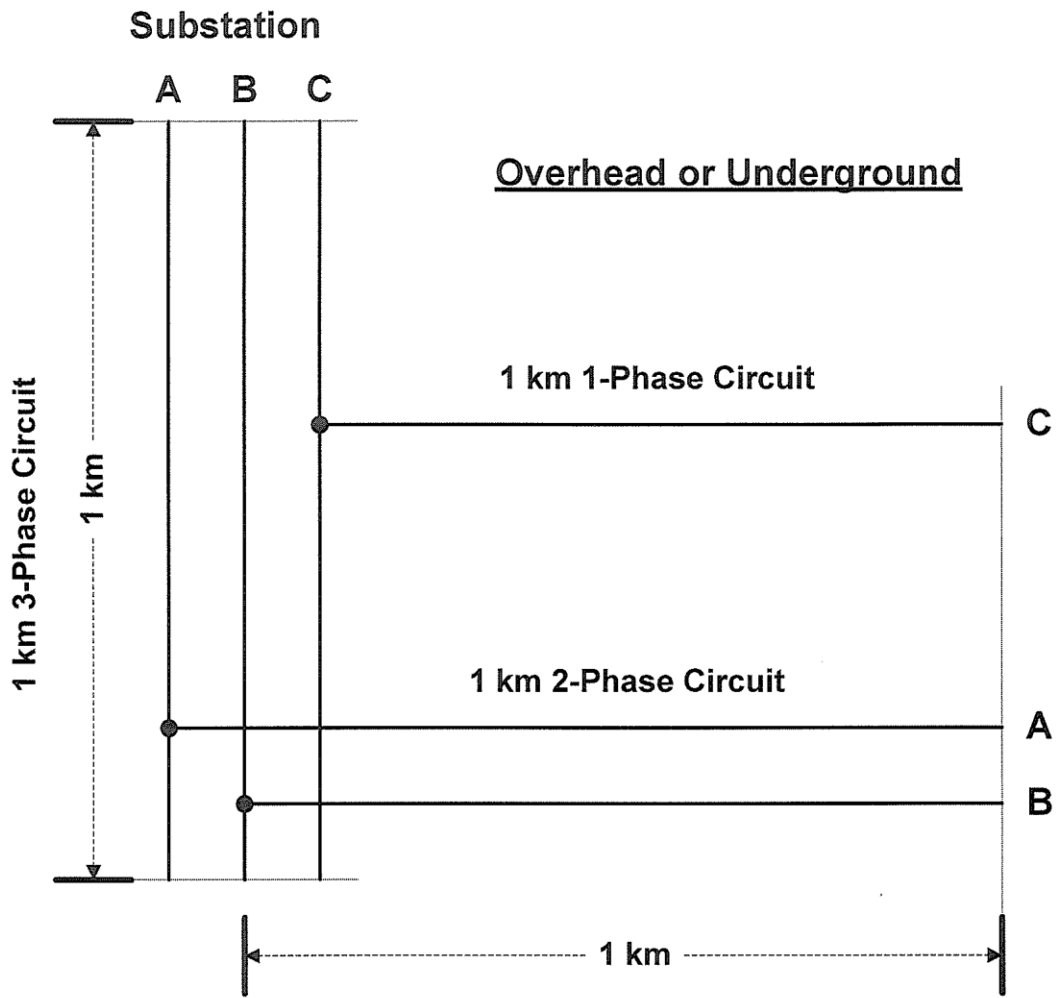
For reporting statistics for the distribution system, utilities will provide the total length of primary voltage circuit by designated voltage category. For those utilities who may provide it, circuit length data for low voltage ( $\leq 1,000$  Volts) secondary or service wire connections may also be reported.

Each circuit segment on the distribution system may be designated as “single-phase”, “two-phase” or “three-phase”. The total circuit km will be calculated as follows:

$$\text{Total Circuit km} = \text{Single-Phase Circuit km} + \text{Two-Phase Circuit km} + \text{Three-Phase Circuit km}$$

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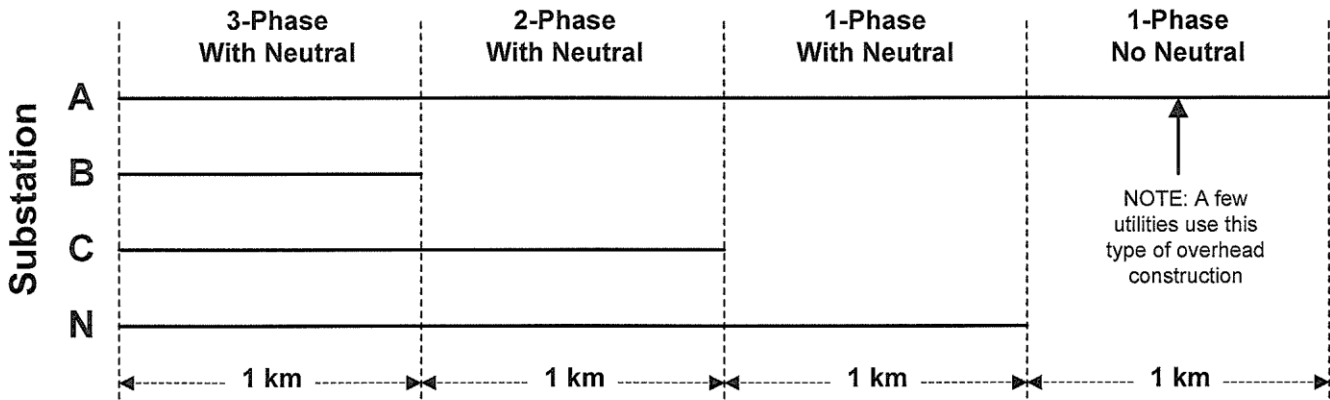
<sup>2</sup> Three Phase Cable contains all three phase conductors within one cable.



**Total Circuit Length = 3-Phase + 2-Phase + 1-Phase**  
**= 1 km + 1 km + 1 km**  
**= 3 km Circuit Length**

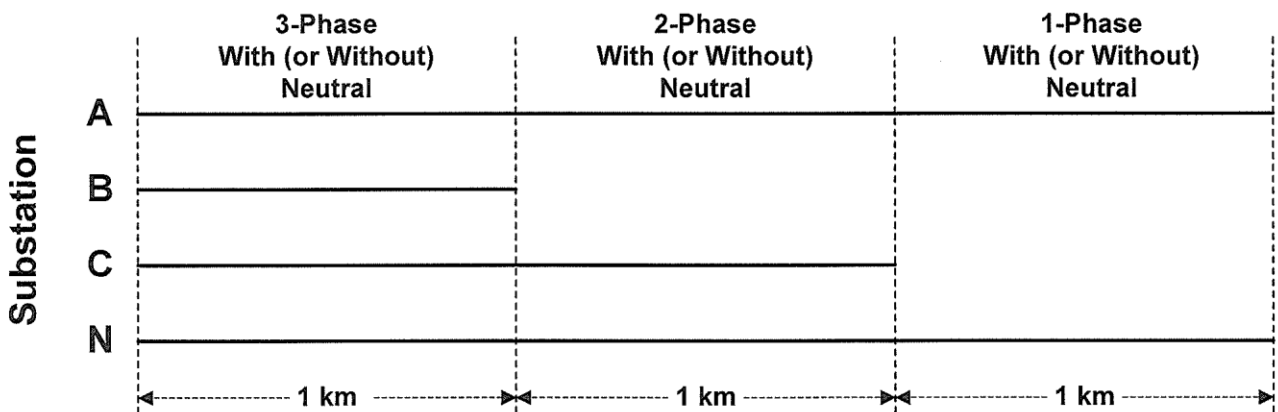
# Alternatives for Showing Overhead Circuit Length

## Overhead



$$\begin{aligned} \text{Total Circuit Length} &= 3-\emptyset + 2-\emptyset + 1-\emptyset \\ &= 1 \text{ km} + 1 \text{ km} + 2 \text{ km} \\ &= 4 \text{ km Circuit Length} \end{aligned}$$

## Overhead

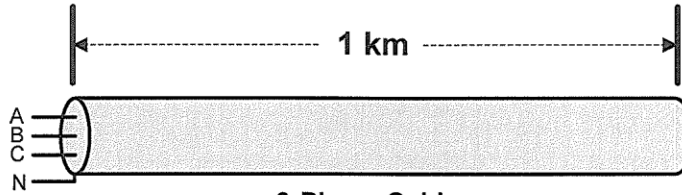


$$\begin{aligned} \text{Total Circuit Length} &= 3-\emptyset + 2-\emptyset + 1-\emptyset \\ &= 1 \text{ km} + 1 \text{ km} + 1 \text{ km} \\ &= 3 \text{ km Circuit Length} \end{aligned}$$

NOTE: A few utilities construct overhead circuits without a Neutral

# Underground

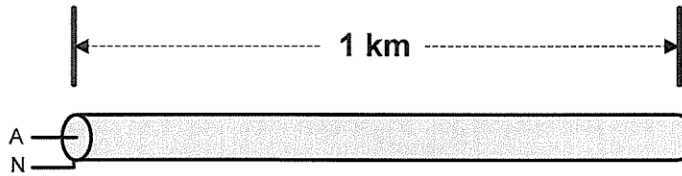
Source:  
Common  
Switching  
Point<sup>2</sup>



Supplying Single or  
Three Phase  
Loads

3-Phase Cable  
With Concentric Neutral  
1 km Circuit Length

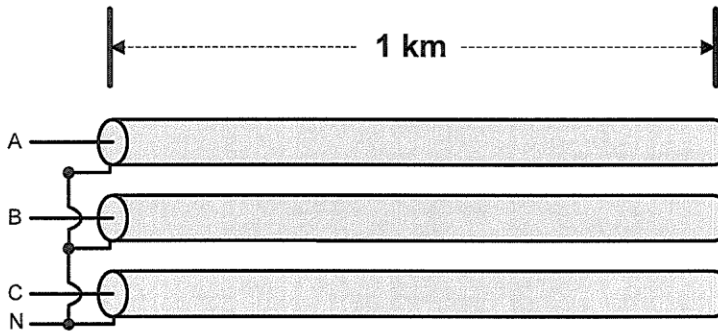
Source:  
Common  
Switching  
Point<sup>2</sup>



Supplying Single  
Phase Loads

1-Phase Cable  
With Concentric Neutral  
1 km Circuit Length

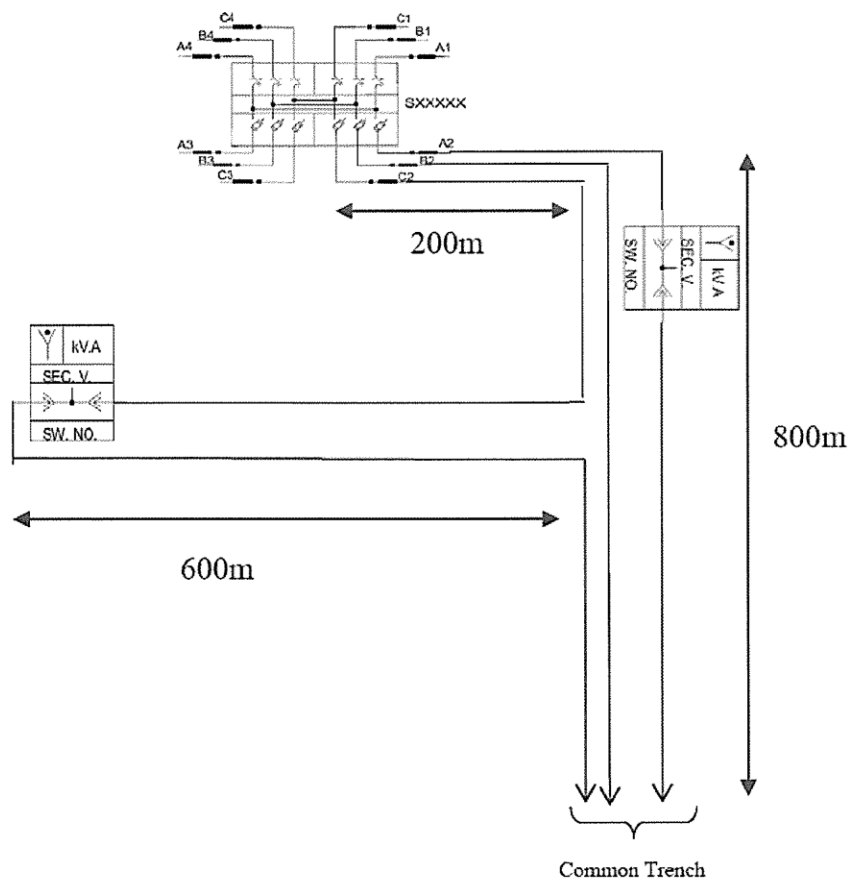
Source:  
Common  
Switching  
Point<sup>2</sup>



Supplying Single  
or Three Phase  
Loads

Three 1-Phase Cables, each  
With Concentric Neutral,  
comprising a 3- $\emptyset$  Circuit  
1 km Circuit Length

NOTE: Cables comprising the 3- $\emptyset$  Circuit may or may not occupy the same conduit but will generally be in the same trench.



**Total Circuit Length**

$$200 + (2 * 600) + 800m = 2200m$$