

Bulletin 10-10-9
Grounding of generators connected via transfer equipment
Rules 10-210 and 10-212

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1) Background

The use of standby and emergency generators has led to questions on the grounding of the neutral/grounded circuit conductor when connected to building loads via various connection arrangements. To increase understanding of the appropriate application of the Ontario Electrical Safety Code (OESC) the requirements for the grounding of alternating current systems, where more than one system exists at a facility, must be understood.

Rule 10-210 d), “Grounding connections for solidly grounded supply authority systems” states, that the grounded circuit conductor (neutral) cannot be connected to a non-current carrying conductive parts of electrical equipment on the supply or load side of the grounding connection.

Rule 10-212, “Grounding connections for separately derived ac systems” states that the conductor to be grounded is to be grounded at the source, at the first switch controlling the system, or at a tie point where two or more such systems terminate at a common tie point.

A generator is a separately derived system when it has no interconnection of circuit conductors with a supply authority system, except through bonding or grounding connections.

When one or more circuit conductors of a generator (or other separate source) are interconnected to a supply authority system, it is not a separately derived system and any grounding requirements are met by that interconnection. Rule 10-212 does not apply.

Bonding conductors are required to be installed throughout, with the circuit conductors between the service, transfer switch, generator and other non-current-carrying parts of the installation.

For generators, CSA Standard C22.2 No 100 requires information or marking on the status of the interconnection between neutral and ground. The generator is required to be marked as follows:

- NEUTRAL FLOATING; or
- NEUTRAL BONDED TO FRAME.

2) Generators connected using transfer equipment

In order to determine how a generator neutral is to be grounded, it requires an examination of the transfer equipment to be used.

a) Transfer equipment that switches the grounded (neutral) conductor

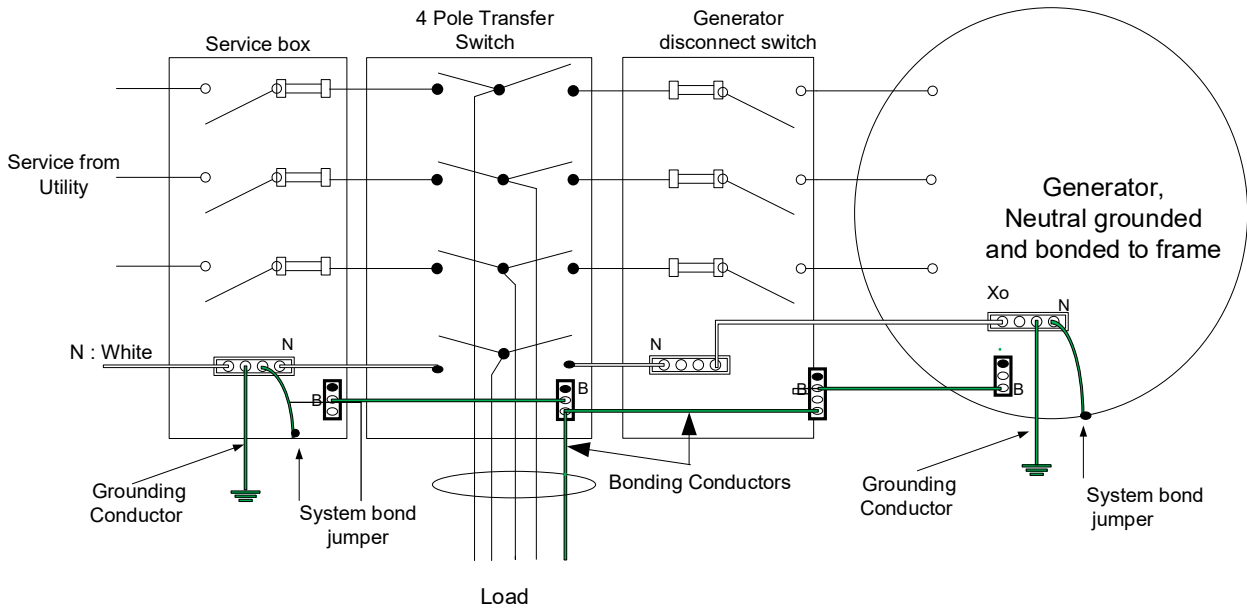
If the grounded conductor (neutral) is switched at the transfer switch, as in Figure B1, there would be no interconnection to the supply authority grounded conductor (neutral) and the generator would be a separately derived system.

For a solidly grounded system Rule 10-212 would require the neutral to be grounded by a system bonding jumper and connection to a grounding conductor at the source or the first switch controlling the system with no other connections to non-current carrying conductive parts on the line or load side of that connection.

For 3 Ø 4 W systems, a generator serving line to neutral loads, where the neutral is connected to the generator case (NEUTRAL BONDED TO FRAME), a four pole transfer switch that switches the neutral is required. This ensures that there are no connections between the grounding electrode and the grounded circuit conductor (neutral) beyond the service disconnect or beyond the generator, as per Rules 10-210 and 10-212 (see Figure B1). Generators with a connection between the neutral and the case (system bond jumper) shall be connected directly to the grounding electrode.

When a generator is connected to a grounding electrode at a location remote from the emergency source, a sign is recommended to be placed at the grounding location. The sign should identify that both emergency and normal sources are grounded at that location.

Figure B1- Neutral bonded to the frame
 (In this example the generator is a separately derived system)



b) Transfer equipment that does NOT switch the grounded (neutral) conductor

If the grounded conductor (neutral) is not switched, as in Figure B2, it will be interconnected to the supply authority system at the transfer equipment and the generator would **not** be a separately derived system.

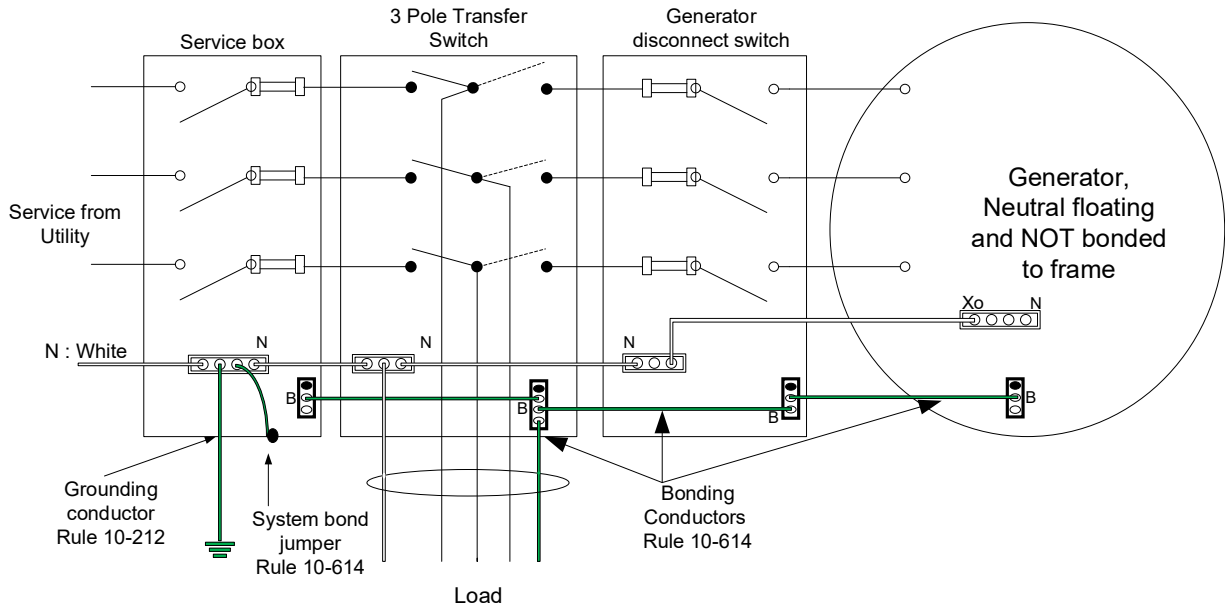
The generator neutral will be grounded by its interconnection to the supply authority system neutral. In this case the generator neutral cannot be bonded to the generator frame or connected to a ground electrode (NEUTRAL FLOATING).

Bonding connections are required throughout the installation.

Caution

Where three pole transfer switches are used with solid neutral connections, caution shall be exercised when working on the grounded circuit conductor (neutral), as it is common to both the normal power supply and stand-by (generator) systems and may be carrying current at any time. It is recommended that any neutral termination in the system be identified with proper signage, warning not to disconnect any system neutral when the stand-by system or normal system is operating.

Figure B2 - Neutral not bonded to the frame
 In this example the generator is **not** a separately derived system



c) Installations with undistributed generator neutral

Where neutral loads are not present in a system, as per Diagram B3, an alternate solution is available where the neutral conductor is not distributed. Under this circumstance, there is still a requirement to connect the neutral of the system to the grounding electrode, where required by Rule 10-214, for separately derived systems. Also, based on Rule 10-214, a system bond jumper and grounding conductor is required at the generator.

Three-phase, 208/120 V, 480/277 V and 600/347 V systems may be used, that do not require a distributed neutral conductor. In these installations, the system neutral would not be interconnected to the utility neutral conductor at a three pole transfer device and the generator would be a separately derived system, as per Figure B3.

Figure B3 - Generator does not supply phase to neutral loads
 (In this example the generator is a separately derived system)

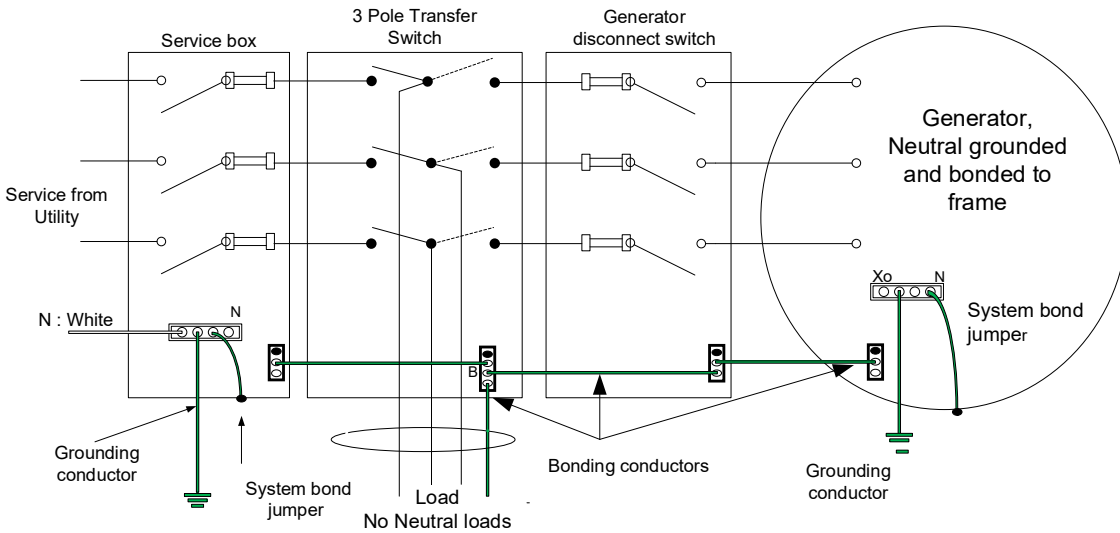


Figure B4 - Transformation added between generator and transfer switch
 (In this example the generator is a separately derived system, the transformer is not)

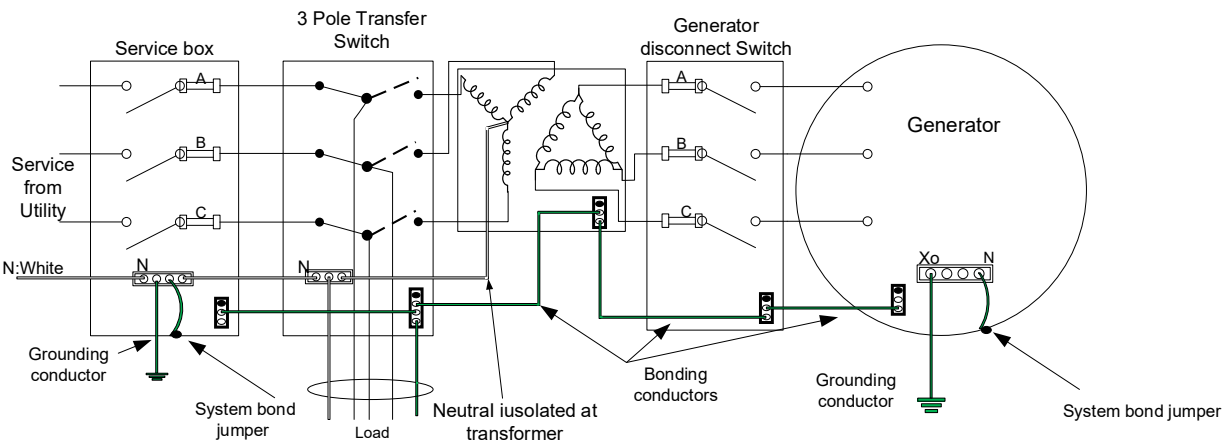


Figure B4 represents an installation where a transformer is added between a generator and a transfer switch and a generator neutral conductor is not distributed. The transformer neutral is.

3) Generators connected using interlocked breakers

A temporary connected generator that feeds a portion of the existing distribution may be connected through interlocked, kirk keyed breakers used as a transfer device, as per Figure B5. When using 3 pole interlocked breakers as a transfer device, they are equivalent to using a 3 pole transfer switch on a 4 wire system. It is important that the

generator is not bonded to ground (NEUTRAL BONDED TO FRAME). Failure to remove the generator bonding jumper creates an additional neutral bond downstream of the main service which can create objectionable current flow. During fault conditions, this may reduce the effectiveness of the ground fault protection and/or fuse coordination.

Figure B5 - Generator connected using interlocked 3-pole breakers
 Generator system grounding would be as per Figures B2 and B3

