

## Reliable Grounding Methods in Busway Class 5600

Retain for future use.

### Introduction

Confusion about the purpose and performance of the various methods of providing a reliable, continuous ground path in busway systems can lead consultants and users to specify unnecessary product features. These features are costly and add no value to the installation. This paper is intended to provide a review of grounding methods used in the construction of busway and recommendations for specifying busway that provides a cost effective, robust, and reliable ground.

### Function of the Ground Path

The grounding conductor in the modern electrical system provides a low impedance current path to earth to facilitate the safety of the system. The grounding conductor does not normally carry current and is used to connect the housings and enclosures of all equipment or the grounded circuit of a wiring system to one or more electrodes at the point of service. Should an abnormal phase to ground fault occur, the grounding conductor is intended to provide a path of least resistance for current flow, allowing circuit protective devices to properly function.

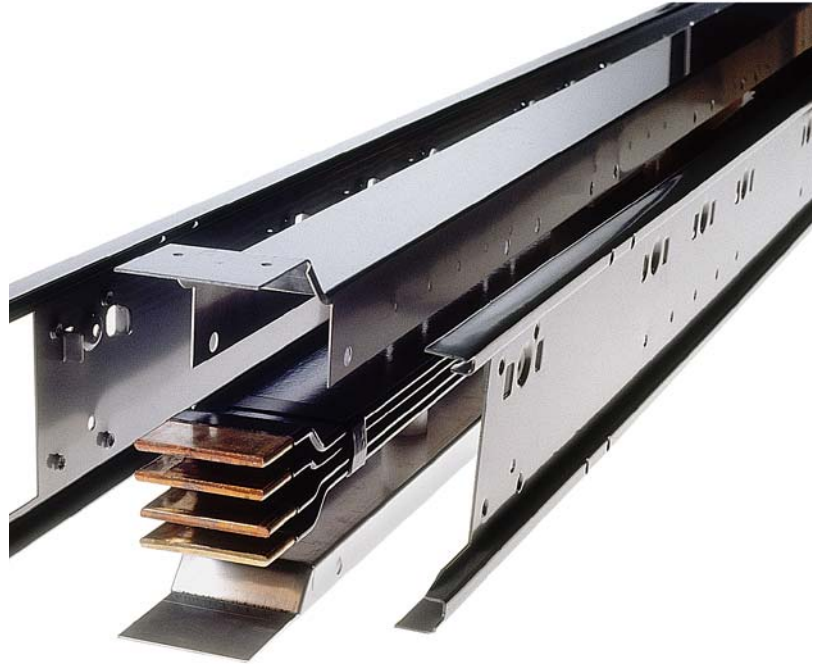
Article 250 of the National Electrical Code® NFPA 70 covers the requirements for grounding and bonding of electrical systems. NEC article 250.4(A)(2) requires non-current carrying conductive materials enclosing electrical conductors to be connected to earth to limit voltage to ground on the materials. As such, the enclosure of busway products must be connected to ground.

The Underwriters Laboratories (UL) standard UL 857 covers the construction and testing of busway. According to this standard, a busway is a grounded metal enclosure containing factory mounted conductors. The standard requires that busway provides grounding in one of two methods. The first method is to use the enclosure material as a ground path. The second method is to provide a ground bus within the enclosure. The standard further requires grounding of all exposed metal parts.

Since the standard requires that all housing components be grounded, the most effective construction for meeting the UL 857 requirements is to incorporate the ground bus within the housing of the busway. All four major North American Busway manufacturers have designed their most recent product offerings in this way. The ground bus has become "integral" to the housing of the busway. This is in itself causing some of the confusion. The difference between an "integral" or housing ground and an "internal" ground bus is commonly misunderstood. Subsequently, a costly decision can be made by requiring an internal ground in the specifications.

Figure 1 demonstrates the “integral” construction of the ground bus to the busway housing.

**Figure 1: Busway with Integral Ground Construction**



Specifying an “internal” ground bus requires an additional bar be added to the stack of conductors contained within the housing. So, is there a need to specify an internal ground bus?

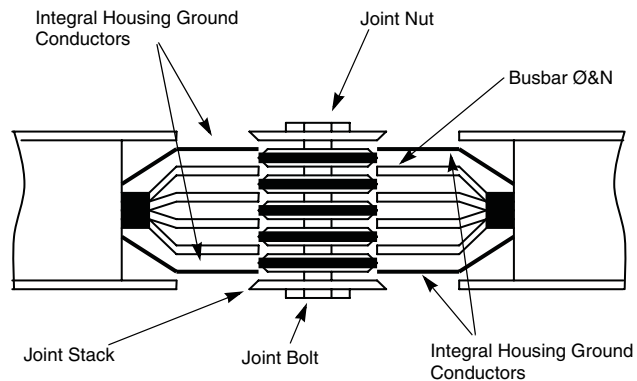
### **Busway Construction with Integral Top and Bottom Aluminum Housing Ground Bus**

The answer involves the critical need for the integrity of the ground path. The ground path must remain continuous throughout the run of busway. Each length of busway must be connected to another length and the means of joining must provide a secure path by which the continuity of the ground connection is made and maintained.

To better understand this, we'll look at the two methods used in busway construction today. Both methods utilize a component of the housing as the ground conductor. In one design the housing ground conductor is carried into the joint connection. In the other, the housing ground conductor terminates at the connection block adjacent to the joint and the joint cover plates are used to provide a continuous path across the joint.

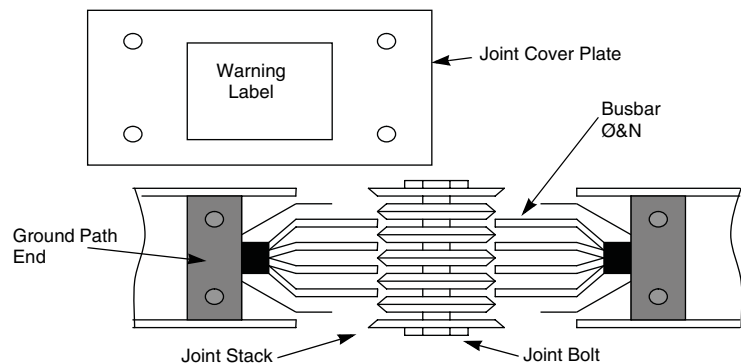
Figure 2 depicts a design that carries the housing ground conductor through the joint stack. This design insures that the integrity of the ground path is maintained by the same mechanical pressure used to maintain the continuity of the conductive path. A consistent pressure on the joint stack is maintained by one or more belleville (cupped spring) washers in the joint stack.

**Figure 2: Busway Design with Ground Path Running through Joint Stack**



In contrast, Figure 3 depicts a design that terminates the ground path at a connection block. In this design, the continuity of the ground path is maintained through the joint cover plates. The fasteners connecting the joint cover plates are subject to loosening resulting from movement of the busway and unless properly maintained may not provide a reliable ground connection. Labels are commonly attached to joint cover plates warning of the added maintenance requirement. In order to provide a more reliable ground path and overcome the risk associated with a joint cover ground path, an additional internal ground conductor is often recommended by the manufacturer.

**Figure 3: Busway Design with Ground Path Terminated at Joint**



Some have justified the cost associated with adding an internal ground conductor by saying that adding the internal ground conductor, which typically is sized at one half the cross sectional area of a phase conductor, enhances the system's ability to handle fault current. In reality, UL 857 requires the cross sectional area of the ground path used on all busway to provide an impedance value that is less than the requirements in NEC 250.122 for minimum ground conductors. An added internal ground bar offers no electrical advantage.

But what about those long bus runs that have higher impedance or a voltage drop issue? Will the overcurrent device open when there is a fault? Remember, if the bus size is increased due to voltage drop or other impedance issues the housing, and therefore the size of the integral ground conductor, will increase.

## Recommendation

Busway should be specified with a housing ground construction that ensures continuity of the ground path. The best way to accomplish this is by connection of the ground conductors within the joint connection assembly, the same method of connection employed for the phase and neutral conductors. The standard housing ground as specified above provides an effective and reliable ground for all building systems. An internal ground bus adds no benefit when the ground connection is made within the joint assembly. When this construction is used, an internal ground adds only unnecessary cost to busway installations.

Ground connections that can become loose are noted as requiring maintenance in excess of that required for the joint connection and should be considered highly suspect in the performance and safety of the electrical system. For this type of joint connection, an additional internal ground should be specified. This will typically add 12–15% to the cost of the busway.