

## Epoxy Bus Bar Insulation—Benefits of Thermosetting Dielectric Material

### Class 5600

Retain for future use.

### Introduction

Schneider Electric uses epoxy dielectric material to insulate bus bars in I-Line II busway. The purpose of this paper is to provide information on how and why epoxy is both a proven and reliable insulation system.

### Q and A

#### What is Epoxy?

Epoxy is an thermosetting dielectric material that is applied as a dry powder resin. The resin is applied to each bar in a fluidized bed process as follows:

1. The bars, which have been fabricated and formed, are deburred and masked.
2. The bars are cleaned; then preheated in an oven.
3. The heated bars are dipped into the fluidized bed to coat them. The fluidized bed is created by releasing compressed air through a porous plate located in the bottom of the bed. The epoxy powder “floats” in the bed in a fluidized state. The bars are coated with a smooth, continuous epoxy coating as they are “dipped.”
4. Bars are sent to an oven for curing.

Epoxy has outstanding heat transfer characteristics and is ideally suited for sandwich-bus applications. Epoxy gives the bus bars a uniform thickness and smooth surface, allowing excellent heat conduction from bar to bar. The adhesive bond between the epoxy and bus bars results in a lower thermal resistance, improving heat conduction and resulting in a lower overall operating temperature.

#### Does Epoxy meet UL requirements?

To meet Underwriters Laboratory (UL) thermal requirements, UL Listed busway cannot exceed a total operating temperature of 203°F (95°C) in an ambient temperature of 104°F (40°C) at full load. This requirement applies to the complete busway system, not just a single busway component. At loads up to and including the full load rating and at 104°F (40°C) ambient temperature, I-Line II busway *will not* exceed a total operating temperature of 203°F (95°C).

The epoxy insulation used on I-Line II Busway has a UL recognized thermal rating of 266°F (130°C), which exceeds the 203°F (95°C) maximum approved operating temperature of UL Listed busway.

Epoxy also meets or exceeds the following UL requirements for busway insulation:

- Flammability requirements
- Ignition requirements
- Arc tracking requirements

### What about reliability?

I-Line II bus bars are insulated with 32 mil of epoxy and each **bar** is individually tested at 7500 Vdc. Daily adhesion and impact tests are conducted on production test samples.

Once assembled, every busway length and fitting must pass an additional 7500 Vdc test before shipment from the factory. The factory test exceeds the UL dielectric strength requirement of 3100 Vdc to ensure the highest quality insulation with every section of busway delivered.

## Electrical Properties of Epoxy

With an excellent balance of chemical, thermal, and physical properties, the electrical properties of epoxy insulation offer unique design capabilities to the electrical industry.

### Dielectric Strength

Epoxy offers high dielectric strength. The dielectric strength of the epoxy exceeds 800 volts for a 1 mil thickness. Each bar in I-Line II busway is insulated with a 32 mil thickness. This results in a total dielectric strength that exceeds 25,000 volts.

### Resistance to Arc Tracking

Arc tracking is an electrical breakdown on the surface of an insulating material. A large voltage difference gradually creates a conductive leakage path across the surface of the material by forming a carbonized track.

The epoxy was tested for tracking per UL 746c, "Polymeric Materials—Use in Electrical Equipment Evaluations." The test resulted in a Comparative Tracking Index Rating of 2, which exceeds the UL requirement.

### Flammability and Ignition

The epoxy was tested for flammability per UL94, "Test for Flammability of Plastic Materials for Parts in Devices and Appliances," and was rated as self extinguishing.

The epoxy has been tested for Hot-Wire Ignition, per UL746c. Test specimens were wrapped with resistance wire that dissipates a specified level of energy. The time it took to either ignite or burn through the test specimen was measured. The epoxy was assigned a performance level category of 0 (highest rating achievable).

The epoxy has also been tested for High Amperage Arc Ignition, per UL746c. In this test, the number of arc rupture exposures were measured that were necessary to ignite the material when applied on the surface of the material. The epoxy was assigned a performance level category of 0 (highest rating achievable).

## Physical and Thermal Properties of Epoxy

### Impact Resistance

Epoxy is a tough, durable material, and its impact strength on coated bar exceeds 150 in-lbs (17 N•m) (Closed Anvil Impact Test).

### Thermal Aging

The epoxy insulation material used has a UL recognized temperature index of 266°F (130°C). The temperature index defines a maximum service temperature at which material properties will not significantly degrade over the life of the product.

*UL Listed busways are designed not to exceed a total operating temperature of 203°F (95°C).*

The maximum operating temperature of the busway is significantly below the rated temperature of 266°F (130°C), supporting a long service life.

## Environmental

Epoxy is Halogen-free and RoHS compliant.

## Summary

UL listed busway systems are designed not to exceed a total operating temperature of 203°F (95°C), which falls into *Class A limits*. The epoxy insulation used in the high-quality design of I-Line busway provides improved thermal and electrical characteristics over the UL requirements.

Test data for insulation systems is generated in *laboratory* conditions. Historical data generated from actual applications is the most relevant and valuable data available. Square D™ brand busway with epoxy insulation, manufactured by Schneider Electric, has proven reliability in the industry.