Introduction

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

Q and A

What is Mylar?

Mylar is a polyester film made from polyethylene terephthalate, the polymer formed by the condensation reaction of ethylene glycol and terephthalic acid. The dielectric strength, moisture resistance, and physical toughness of Mylar make it a superior insulation material.

Mylar has an average dielectric strength of 7,000 volts for 1 mil film, a tensile strength of 23,000 psi, and an excellent resistance to most chemicals and moisture. Mylar also remains flexible throughout temperature extremes from –76 °F to 302 °F (–60 °C to 150 °C) and does not become brittle with age.

Does Mylar meet UL requirements?

To meet the 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). Mylar has a UL recognized thermal rating of 221 °F (105 °C), which exceeds the 203 °F (95 °C) maximum approved operating temperature of UL Listed busway.

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

• Flammability requirements
• Ignition requirements
• Arc tracking requirements

What about reliability?

Once Mylar-insulated I-Line II bus bar is assembled into busway, the busway must pass a 7,500 Vdc test before shipment from the factory. The factory test exceeds the UL dielectric strength requirement of 3,100 Vdc to ensure the highest quality insulation with every section of busway delivered.

Mylar has many electrical applications in addition to insulating bus bars. Many manufacturers use Mylar as insulation in transformers and electric motors. In fact, Mylar film is used in insulation systems that have been given Class B ratings (266 °F [130 °C]) by UL.
Electrical Properties of Mylar

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

Dielectric Strength

Mylar film offers high dielectric strength. The average dielectric strength for 1 mil film is 7,000 volts. As with most materials, the dielectric strength of Mylar film in volts/mil decreases as film thickness increases. For I-Line II Mylar insulation, the total dielectric strength is 20,000 volts.

The dielectric strength is determined by testing per ASTM D149 at a frequency of 60 Hz using a 500 V/sec rate of rise.

Effect of Temperature on Dielectric Strength

Mylar maintains its high dielectric strength over a wide temperature range. Its dielectric strength remains nearly constant from 77 °F up to 302 °F (25 °C up to 150 °C).

Effect of Humidity on Dielectric Strength

Humidity has a slight effect on the dielectric strength of Mylar. Varying the relative humidity from 20% to 80% causes less than a ±10% change in dielectric strength from the value obtained at 35% relative humidity.

Resistance to Arc Tracking

Arc tracking is the formation of a conducting path of localized deterioration on the surface of an insulating material. Arc tracks may form as the result of electric discharges on or close to the insulation surface.

Arc resistance tests (ASTM D495) showed that Mylar did not fail due to the formation of narrow tracks on the surface, but rather by melting with the subsequent formation of a conductive fluid. Mylar had an arc resistance time of 73 to 94 seconds.

The arc resistance tests indicate that Mylar should have an advantage over materials that track, because momentary overloads of a few seconds would be noncumulative in their effect on Mylar, provided that there was sufficient time for cooling between arcs.

Corona Resistance

Corona is an electrical discharge brought on by the ionization of a fluid surrounding a conductor that is electrically charged. Corona will occur when the strength of the electric field around a conductor is high enough to form a conductive region, but not high enough to cause electrical breakdown.

Corona in electrical systems can progressively damage electrical insulation leading to insulation failure. Having one of the highest resistances to corona of all plastic films, Mylar can withstand corona that may occur during the short surges of overvoltages common to many electrical systems.

Physical and Thermal Properties of Mylar

Mylar films are flexible, strong, and tough films with exceptional durability in high temperature environments. Mylar retains good physical properties over a wide temperature range from –76 °F to 302 °F (–60 °C to 150 °C).
Tensile Strength and Toughness

Tensile strength is the maximum stress that a material can withstand while being stretched or pulled before failing or breaking.

The tensile strength of Mylar is higher than most insulating materials. The tensile strength for I-Line II Mylar insulation is 25,000 psi.

Toughness is the ability of a material to absorb energy and deform without fracturing. Mylar has been proven through testing to be a tough material. For I-Line II Mylar, its elongation before breaking is 170%.

Creep

Mechanical creep is the tendency for material to slowly, permanently deform under mechanical stresses. Excessive creep can result in a reduction of insulation thickness over time. Testing done by DuPont™ has shown that Mylar is unusually resistant to creep. Two values measured at room temperature are 0.1% deformation after 260 hrs at 3,000 psi and 0.2% deformation after 1,000 hrs at 3,000 psi. After 4,000 hrs at 500 psi in a 212 °F (100 °C) oven, a creep of 0.9% was measured.

Thermal Aging

Mylar film has a UL recognized temperature index of 302 °F (105 °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 302 °F (105 °C), supporting a long service life.

Chemical Resistance of Mylar

Mylar polyester film exhibits good resistance to the action of many chemical reagents, solvents, varnishes, and other contaminants and is virtually impermeable to the liquid phase of most chemicals and reagents. Oils and greases such as penetrating oil, lard, cottonseed oil, and motor oil will not penetrate through 1 mil film even after two months of constant exposure at room temperature. Mylar is relatively insensitive to moisture absorption, absorbing less than 0.8% moisture when totally immersed in water over a 24-hour period.

Environmental

Mylar 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 Mylar 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 Mylar insulation, manufactured by Schneider Electric, has proven reliability in the industry.