Laminated Bus Bar Insulation

Everything you need to know...
Ready, Right, Sure.

We are right, ready, and sure. Team Storm is on your side, day and night, to help keep you up and running, so you can get the job done.
Laminated Bus Bar Insulation

Manufacturing services are performed by experienced individuals that are dedicated to maintaining the highest-quality standards for your product.

This attention to detail helps minimize errors within the production cycle. Storm continually refines their production methods associated with laminated bus assemblies. If a laminated bus structure fails in an unexpected short lifecycle, the client can return the component. Storm's engineering team will review the defective material and conduct root cause analysis to determine the reason for the failure. If the cause of failure is found to be due to Storm's process or workmanship, the assembly will be promptly repaired or replaced.

What Lamination Can Do

Lamination insulation eliminates important critical design problems, high-voltage arcing, and current-induced magnetic fields that affect the surrounding area of the electrical bus bar. This allows for closer component location, giving the electrical network design additional space for other components or allow for smaller scale design.

Circuit performance is the main purpose of laminated bus bars. Laminated bus bars are compact and structurally integrated when compared to conventional electrical connectors using cables or cable assemblies. A more efficient alternative to traditional bus systems, Storm's laminated bus bar consists of flat, plated or un-plated copper conductors bonded over and between thin layers of insulating dielectric film or paper.

Applications of Laminated Bus Bars

Since lamination reduces induction, common applications include custom power distribution assemblies, multi-layered laminated copper connectors, multi-layered bus bars. Specific uses include components with high efficiencies, such as solar cells and IGBT structures.

Storm also goes the extra mile to meet the laminated bus bar needs of OEM customers from industries, including: Telecom, Power Generation, Electromechanical Motor Controls, as well as Aerospace and Military.
Lamination is composed of a dielectric material, when placed in an electric field, the electron charges do not flow through the material. Dielectric polarization causes the electrons to flow within the copper bus bar, improving conductivity and decreasing stray inductance as a result.

Bus bar laminations reduce inductance by alternating the positive and negative bus bar layers amid layers of thin dielectric insulation. Lamination allows for the position of these positive and negative conductors to be as close to each other as possible. By laminating the conductors together, separated by only a thin insulator, conductors can be positioned as close as .005" apart, maximizing the mating surfaces of the conductors. By reducing the thickness and increasing the width of the conductors, mating surface geometry can be increased. This significantly reduces inductance and increases capacitance.

Laminated bus bars come in many types of dielectric coating. Each coating has unique characteristics that can be utilized for specific applications. The table below can help you decide what is required for your design. This is key to maximizing the high-efficiency demands of today’s power conversion products.

**Material Characteristics**

**How It Works**

**Impression Materials Table**

<table>
<thead>
<tr>
<th>Material Characteristics</th>
<th>Continuous Use Temp. C°</th>
<th>Dielectric Constant ASTM D150</th>
<th>Dielectric Strength ASTM D149 (volts per mi)</th>
<th>Flammability Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Epoxy Glass (FR4)</td>
<td>140</td>
<td>4.3</td>
<td>1250</td>
<td>UL 94 V-0</td>
</tr>
<tr>
<td>Superior mechanical and dimensional stability</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mylar (PET)</td>
<td>105</td>
<td>3.3</td>
<td>7500</td>
<td>UL 94 VTM-0</td>
</tr>
<tr>
<td>Cost effective, tear, chemical, and moisture resistant</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tedlar (PVF)</td>
<td>105</td>
<td>11.0</td>
<td>3500</td>
<td>UL 94 HB</td>
</tr>
<tr>
<td>Chemical/solvent resistant; good mechanical properties</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Teonex (PEN)</td>
<td>140</td>
<td>3.4</td>
<td>5000</td>
<td>UL 94 VTM-0</td>
</tr>
<tr>
<td>Higher deflection strength and continuous use temp.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nomex</td>
<td>220</td>
<td>1.6</td>
<td>430-845</td>
<td>UL 94 V-0</td>
</tr>
<tr>
<td>Flame resistant, durable</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kapton</td>
<td>400</td>
<td>3.7</td>
<td>5000</td>
<td>UL 94 VTM-0</td>
</tr>
<tr>
<td>High temperature rating and range stability</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Epoxy Powder Coating</td>
<td>130</td>
<td>4.0</td>
<td>800</td>
<td>UL 94 V-0</td>
</tr>
<tr>
<td>Flame, moisture resistant; ideal for multiple shapes</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The Lamination Process

Lamination by definition is the technique of manufacturing a material in multiple layers, so that the composite material achieves improved strength, stability, sound insulation, appearance, or other properties from the use of differing materials. Laminated bus bars and connectors are coated by the heated dielectric material and then compressed once all the layers have been set. Quality control then executes all the necessary adjustments to provide a clean, even, and effective insulation for your device.

There are three specific geometric edge features that Storm uses individually, or in combination with one another, to achieve creepage and clearance distances, maximize space requirements, meet environmental demands, and maintain cost targets.

- **Open Edge**: Each layer edge is left isolated for further machining or component additions.
- **Pinch Seal**: Each layer has common edge for common electrical point or grounding.
- **Epoxy Edge Fill**: The edges are isolated and insulated for efficiency and space.

Design Considerations

Engineers are tasked to design a lamination that locates, shapes, and routes conducting points in ways to ensure that the multi-layered current can flow in opposite directions and in equal strength. The key aspect of this design is to generate opposing voltages proportional to the rate of current change in a circuit, which in turn enables the opposing magnetic fields to cancel each other’s vector fields, eliminating stray inductances in the device.

With the guidance of a competent fabricator, designers and engineers are able to make the right choice in insulating material and conductor (raw or plated copper) thickness. Generally, the rule of thumb is to make sure the copper conductor and dielectric materials are as thin as possible, but this isn’t always the case due to environmental demands.

Testing Criteria

A Hi-Pot test is performed to make sure the finished coating has no defects, such as pin holes, voids, and thin areas near sharp corners or edges. All surfaces will be scanned at twice the operating voltage plus 1,000 volts as standard procedure, unless otherwise specified. For example, if the operating voltage is 700v, Storm will test at 2400v (700+700+100=2400). Storm currently has the ability to Hi-Pot test laminations at voltages up to 14,000 volts.
Lead Time Considerations

First article orders can be shipped as quickly as four weeks, while production orders routinely ship within two weeks.

Part surface preparation and dielectric finish application times vary with regard to order size and the complexity of the finish.

Part preparation usually takes a day prior to the dielectric coating being applied.
About Storm Power Components

Storm Power Components is a fabricator of custom copper components. From back-up power systems, cell towers, and sub stations, to earth-moving equipment, motive power, and alternative energy applications, our industrial-strength parts are trusted by original equipment manufacturers around the world to power, connect, and protect their products.

As an industry veteran for more than 20 years, the company is squarely focused on delivering improved responsiveness, price advantage and shorter distribution channels. The result is its ability to manufacture superior-quality parts with speed and accuracy, while providing customers a delightfully uncommon experience. Storm Power Components, a privately held company, and is an ISO 9001-2008 certified organization headquartered in Decatur, Tennessee. For more information, please visit www.stormpowercomponents.com.
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