Advantages

- Resists partial discharge damage
- Can improve dimensional stability
- Reduced human and environmental impact
- Ensures resistance to ignition and flame spread

Benefits

- Material cost savings 8%
- Reduction in conductor material x11%
- Conductor % of material cost 73%
- 4% insulation
- 73% conductor
- 23% core

Example: 75 kVA Transformer Coil

- \( \frac{93}{100} \) material
- \( \frac{7}{100} \) winding
- \( \frac{1}{100} \) tank

Result: 8% decrease in total material cost

Resistance to Partial Discharge

Most equipment is designed to avoid partial discharge or Corona attack that may prematurely fail. However, there are cases where it is not practical to do so or where external factors that substantially increase the discharge stress so materially it must be used that a resistant to damage caused by partial discharge.

Made with inorganic materials, 3M® ThermaVolt Calendered Inorganic Insulating Paper is used in partial discharge resistant and can withstand the very high voltages with ease.

To understand the level of performance, ThermaVolt insulating paper and calendered meta-aramid insulation tested through a procedure developed for variable-frequency stress. With a voltage of 180 volts per mil to ensure corona, a 20-kilohertz square wave and a temperature of 150°C, the test was more severe than expected center-to-focus failure related to traditional 50-Hertz testing. This is due to the voltage cycle being more than 100 times faster, the square wave having more destruction than a sine wave and the increased temperature decreasing insulation life.

The average three to failure for the three calendered, meta-aramid 7-mil thick insulators sample was close to an hour. Three sets of 7-mil ThermaVolt insulating paper were tested for more than two months without failure, which is three times the life tested.

Inorganic based materials can enable:

- Long-term Voltage Endurance
- Reduces partial discharge/corona
- Greater electrical insulation reliability
- Inorganic-based materials can enable:
- Reduced dielectric strength
- Enhanced dielectric life
- Increased dielectric stress to voltage ratio
- Inorganic-based materials can enable:
- Long-term Voltage Endurance
- Reduces partial discharge/corona
- Greater electrical insulation reliability
- Inorganic-based materials can enable:
- Reduced dielectric strength
- Enhanced dielectric life
- Increased dielectric stress to voltage ratio

Thermal Conductivity

3M® ThermaVolt Calendered Inorganic Insulating Products have excellent thermal conductivity performance, which can increase the heat dissipation required in today’s high-efficiency electrical apparatus. The high thermal conductivity helps enable a transformer that has been designed with cost-effective metal and plastic cooler, at the transformer is re-designed, to potentially reduce costs, using 2-mil conductor, in a lower total transformer cost.

For a 75 kVA coil that was designed with minimal cooling, the coil fabricated with a combination of ThermaVolt insulating paper and 3M® ThermaVolt AR Electrical Insulating Paper had a maximum temperature rise that was 11% lower than the same coil equipped with calendered meta-aramid. In this case, the 2.4 mil coil was non-cooler, which results in the inductor having even more over-current capability and longer life.

Another option to optimize the coil design for smaller size and lower cost using ThermaVolt insulating paper:

- Reduces inductor core stress eccentric area
- A conductor size decrease, dielectric stress increases, which increases the heat generated. Designs with reduced conductor area and higher thermal conductivity insulation may achieve temperature rise equal to designs with larger conductor and lower thermal conductivity insulation.
- Reducing in thickness in gap
- Decreases wind thickness for coil
- Decreased circumstance results in smaller conductor length

Example: 75 kVA Transformer Coil

- \( \frac{93}{100} \) material
- \( \frac{7}{100} \) winding
- \( \frac{1}{100} \) tank

Result: 8% decrease in total material cost

3M® ThermaVolt Calendered Inorganic Insulating Paper

Thermaveau® ThermaVolt Insulating Paper is a high performance complement for high temperature, dry ground insulation systems where the electrical, thermal, and mechanical properties of the existing insulation do not meet the demands of the application. There are no electrical or physical limitations on the application. It is directly comparable to other similarly-oriented products, and can be used in a broad range of applications, including high-temperature, dry-type transformers.
### Typical Mechanical and Electrical Properties

<table>
<thead>
<tr>
<th>Property</th>
<th>ThermaVolt Calendered Inorganic Insulating Paper</th>
<th>ThermaVolt TvFTv Laminates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dissipation Factor</td>
<td>23ºC, 20 kHz</td>
<td>23ºC, 20 kHz</td>
</tr>
<tr>
<td>Dielectric Constant</td>
<td>23ºC, 20 kHz</td>
<td>23ºC, 20 kHz</td>
</tr>
<tr>
<td>Dielectric Breakdown</td>
<td>kV/mm</td>
<td>kV/mm</td>
</tr>
<tr>
<td>Tensile Strength, CD</td>
<td>lb/inch</td>
<td>lb/inch</td>
</tr>
<tr>
<td>Tensile Strength, MD</td>
<td>lb/inch</td>
<td>lb/inch</td>
</tr>
<tr>
<td>Density</td>
<td>lb/yd</td>
<td>lb/yd</td>
</tr>
<tr>
<td>Basis Weight</td>
<td>lb/yd</td>
<td>lb/yd</td>
</tr>
<tr>
<td>Nominal Thickness</td>
<td>mil</td>
<td>mil</td>
</tr>
<tr>
<td>Nominal Strength</td>
<td>%</td>
<td>%</td>
</tr>
</tbody>
</table>

### Available Roll Sizes*

<table>
<thead>
<tr>
<th>Size/Thickness</th>
<th>width</th>
<th>length</th>
<th>thickness</th>
<th>weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 mil</td>
<td>36 in (914 mm)</td>
<td>144 ft (44 m)</td>
<td>0.003 in (0.076 mm)</td>
<td>0.6 lb</td>
</tr>
<tr>
<td>5 mil</td>
<td>36 in (914 mm)</td>
<td>144 ft (44 m)</td>
<td>0.005 in (0.127 mm)</td>
<td>1.5 lb</td>
</tr>
<tr>
<td>8 mil</td>
<td>36 in (914 mm)</td>
<td>144 ft (44 m)</td>
<td>0.008 in (0.203 mm)</td>
<td>2 lb</td>
</tr>
</tbody>
</table>

*Roll width: 36 inches (914 mm). Roll thickness, size and weight are for guideline purposes only, as they can vary by +/- 15%.