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 to enable a transformer that has been designed with conventional meta-aramid to run cooler, or if the transformer is redesigned, to potentially reduce size, utilizing less conductor, resulting in a lower total transformer cost.

For a 75 kVA coil that was designed with conventional cooling, the coil fabricated with a combination of ThermaVolt insulating paper and 3M ThermaVolt Calendered Inorganic Insulating Paper had a maximum temperature rise that was 11% lower than the same coil fabricated with calendered meta-aramid. In this case, the 3M calendered coil was cooler, which results in the insulating materials having more overall capability and longer life.

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

- Reduction in conductor size needed area
  - An increase in the conductor size, decreases electrical insulation in-cane, which increases the heat generated.
- Designs with reduced conductor size and high thermal conductivity insulation may achieve temperatures that exceed designs with larger conductor and lower thermal conductivity insulation.
- Reducing or eliminating air gaps
  - Decreases conductor total length
  - Decreased circumstance occurs in shorter conductor length.

Example: 75 kVA Transformer Coil
  - (Total cost savings: 8%)
    - 72% conductor size reduction
    - 22% core and outer wrap size reduction
    - 22% ground and layer insulation size reduction

Inorganic-based materials can enable:
- Long-term voltage endurance
- Resists partial discharge/corona
- Greater electrical insulation reliability

ThermaVolt Insulating Paper is a calendered, meta-aramid insulation. The calendering process reduces thickness and enhances the product’s performance. It was developed through a process developed through a variable-frequency design. With a voltage of 180 v/mil per turn to ensure corona, a 20-kHz square wave and a temperature of 150ºC, the test was more severe than a typical 60-Hz frequency test. This is due to the voltage cycling being more than 300 times faster than the sine wave and the increased temperature decreasing insulation life.

The average time to failure for the three calibrated three-, 22-mil thick insulation samples was less than an hour. Three samples of ThermaVolt insulating paper were tested for more than two months without failure, at which time the test was stopped.

Inorganic-based materials can enable:
- Decreased circumference results in shorter conductor length
- As conductor size decreases, electrical resistance increases, which increases the heat generated.
- Increased temperature decreasing insulation life.

To understand the level of performance, ThermaVolt insulating paper and laminated meta-aramid insulation were tested through a procedure developed for voltage endurance. With a voltage of 180 v/mil per turn to ensure corona, a 20-kHz square wave and a temperature of 150ºC, the test was more severe than a typical 60-Hz frequency test. This is due to the voltage cycling being more than 300 times faster than the sine wave and the increased temperature decreasing insulation life.

Inorganic-based materials can enable:
- Increased temperature decreasing insulation life.

High Performance for High Expectations

3M ThermaVolt Calendered Inorganic Insulating Paper

3M ThermaVolt Insulating Paper meets high performance requirements for high-temperatures, dry transformors as air-gap grounding insulation in electrical systems rated through Class 220(R). ThermaVolt paper offers good dielectric characteristics, excellent partial discharge resistance and high thermal conductivity – making it especially suitable for use as an insulating insulation in strip-coil record coils.

ThermaVolt paper also is available bonded with polyester (PET) film for applications that require enhanced stiffness and formability, such as core and layer insulation.

ThermaVolt insulating paper, made with inorganic material, has lower thermal conductivity than meta-aramid fiber insulation and can enable coil performance improvement. As an example, an existing coil design may have a lower temperature rise at the same power level or the coil load may be increased while the temperature rise is held constant. If the coil design is optimized for higher thermal conductivity, this may result in smaller conductor size and lower overall material cost, and probably higher efficiency, depending upon the coil design.

ThermaVolt insulating paper and laminates are RoHS & REACH Compliant.

ThermaVolt insulating paper and laminates were tested for more than two months without failure, at which time the test was stopped.

Warranty; Limited Remedy; Limited Liability

If this product is defective within the warranty period stated above, your exclusive remedy shall be, at 3M’s option, to replace or repair the 3M product or refund the purchase price of the 3M product.

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**3M™ ThermaVolt Calendered Inorganic Insulating Paper**

**Typical Mechanical and Electrical Properties**

- **Flame Rating**: UL File E65069
- **ThermaVolt Calendered Inorganic Insulating Paper**

### Typical Mechanical and Electrical Properties

- **Thick**: 3 mil, 5 mil, 7 mil, 10 mil, 15 mil
- **Width**: 36 inches (914 mm)
- **Availability**: Available in rolls or sheets.

#### Mechanical Properties

- **Elongation to Break, CD**: 1.1% (D-689)
- **Tensile Strength, CD**: 103 kN/m (D-645)
- **Knee Weight**: 0.03 g/cm² (D-645)
- **Density**: 1.1 g/cm³ (D-202)

#### Electrical Properties

- **kV/mm (D-728)**: 0.264
- **N/cm (D-149)**: 150
- **V/mil (D-828)**: 1300

#### Moisture Absorption

- 50% RH, 50 Hz

**3M™ ThermaVolt Calendered Inorganic Insulating Paper and TVF Laminates**

- **Typical Mechanical and Electrical Properties**
- **Thermavolt Calendered Inorganic Insulating Paper**

#### Mechanical Properties

- **Elongation to Break, CD**: 0.9% (D-689)
- **Tensile Strength, CD**: 170 kN/m (D-645)
- **Knee Weight**: 0.07 g/cm² (D-645)
- **Density**: 0.7 g/cm³ (D-202)

#### Electrical Properties

- **kV/mm (D-728)**: 0.47
- **N/cm (D-149)**: 464
- **V/mil (D-828)**: 1400

#### Moisture Absorption

- 50% RH, 50 Hz

### Notes

- Roll width: 36 inches (914 mm).
- Roll thickness, size and weight are for guideline purposes only, as they can vary by +/- 15%.
- Product is also available in 0.75” x 24”, 0.30” x 30” or 0.31” sheets.

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