



# THE GUND COMPANY

MANUFACTURERS & FABRICATORS OF ENGINEERED MATERIAL SOLUTIONS

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## Water Absorption

The Gund Company fabricates custom electrical insulating components for power systems equipment including generators, transformers, switchgear, power supplies, electric motors, and related equipment.

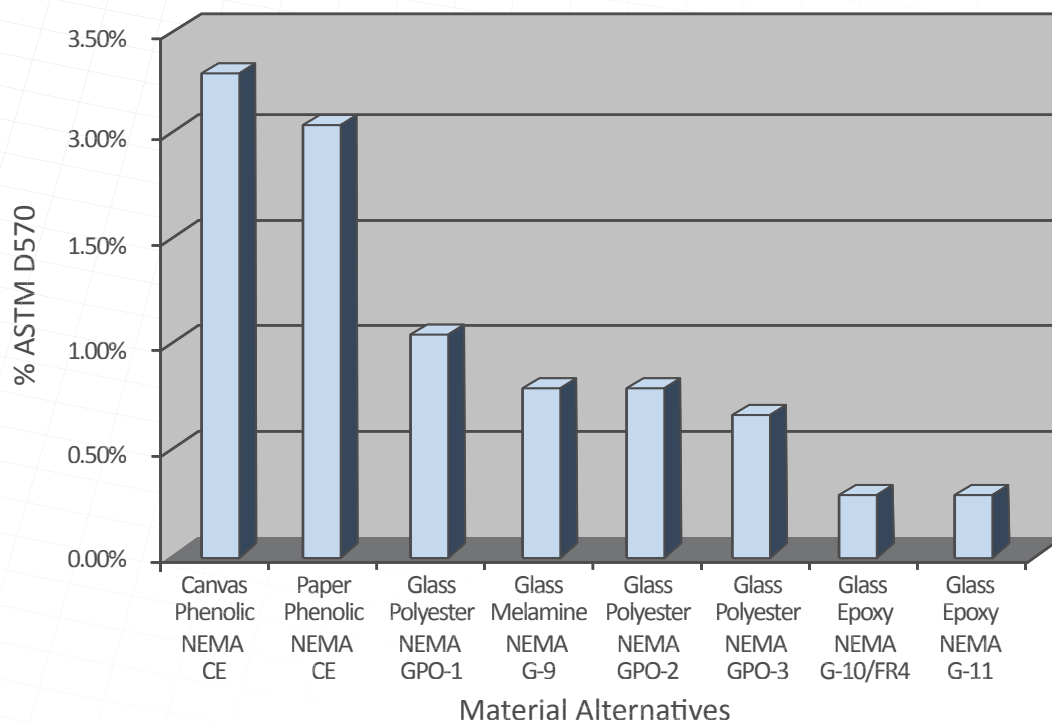
Insulation material selection can be quite a challenge due to the number of factors that influence insulation system engineering and insulation component design.

Moisture, especially when combined with aggressive gases and dust, causes atmospheric corrosion. This corrosion can result in the failure of components such as circuit breakers, bus bars, relays, integrated circuit boards, and transformers. The greatest danger lurks in conditions where electronic equipment is exposed to relatively high air humidity or extreme variations in temperature, such as day-and-night operation or outdoor installation. Failure of components in such cases is usually caused by changing contact resistances, flashovers, creepage currents, corona, or reduced insulation properties.

The moisture absorption of a material is a key property than is often overlooked. According to ASTM D570, the American Standard Test Method for determining the Water Absorption of Plastics, "the moisture content of a plastic is very intimately related to such properties as electrical insulation resistance, dielectric losses, mechanical strength, appearance, and dimensions." Of course, with insulation materials, the absorption of water from high humidity conditions can result in the originally design insulator becoming a conductor.

The chart below shows the water absorption properties for several common rigid insulation materials used in electrical and electronic equipment applications. Note that the values below are the maximum allowable water absorption percentages per the NEMA Standards for laminate insulation materials.

Water Absorption





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The ASTM D570 test for water absorption most commonly uses a 24 hour immersion test to determine the a material's water absorption property. "The conditioned specimens shall be placed in a container of distilled water maintained at a temperature of 23C +/- 1C and shall rest on edge and be entirely immersed. At the end of 24 hours, the specimens shall be removed from the water one at a time, all surface water wiped off with a dry cloth, and weighed to the nearest 0.001 gram immediately." The percentage change in weight is then determined.

According to W. Tillar Shugg, the author of the Handbook of Electrical and Electronic Insulating Materials:

"In selecting a material for a specific use, these steps are important:

1. All possible environmental conditions for which the material could be exposed should be determined, including (but not necessarily limited to) temperature, humidity, chemicals, and radiation."



Clearly, the effect of the environmental humidity on an insulation material's performance can be critical. A specific example may help illustrate the point.

The tremendous growth in the electronics industry driven partly by the proliferation of computers, servers, and network devices has resulted a large demand for power quality equipment such as power supplies. In large server farms, keeping this equipment cool can be quite a challenge. The higher the air temperature, the more invisible water vapor it can absorb. Even if the amount of water vapor remains the same, the air will become saturated as the temperature drops. When the air can no longer hold the water vapor it contains, it has reached the "dew point". Observers will note fine drops of water (condensation) forming on the surfaces. In everyday life, droplets form on window panes, eye glass lenses, and drinking glasses. Unfortunately, the simple physics of condensation can be very destructive inside electronic enclosures.

Up to a relative humidity of 65 percent, the probability of condensation and corrosion remain low. Above 65 percent the likelihood of condensation occurring increases significantly. These problems can be reduced substantially by keeping the environment inside an enclosure at a temperature as little as 5C higher than that of the ambient air temperature.

In electronic equipment applications such as power supplies, the industry is moving away from high water absorption materials such as Nomex and Vulcanized Fiber due to their high water absorption rates. Both of these materials and fiber based insulating papers in general tend to have water absorption rates higher than 15%.

Today's solution is the use of PolyPro FR™ material with a water absorption in the range of 0.01% to eliminate the potential negative effects of water absorption on insulation materials in this environment.