



# Microspheres

## Thermal Conductivity Report



June, 1998

### Increasing or decreasing thermal conductivity

The addition of 3M™ Microspheres to a resin system can increase or decrease thermal conductivity in parts and films. The change depends on the type and amount of microspheres used. This thermal control is in combination with other possible enhancements such as lighter weight.

Potential microsphere applications for thermal conductivity include the following:

- Potting compounds – protecting components from environmental heat.
- Floor tiles with feeling of warmth.
- Insulative pipe wrap to decrease heat loss.
- Refractory brick in furnaces for heat retention.
- Syntactic foam insulation.
- Cast polyester products with the warm feel of wood.

### Test Parameters

The following report compares 3M™ Scotchlite™ Glass Bubbles K1 and K46, Z-light Spheres™ Ceramic Microspheres W1300, Zeeospheres™ Ceramic Microspheres G400 and W410 and calcium carbonate.

**K1** – 0.125 g/cc true density with 30-120 micron size range.

**K46** – 0.46 g/cc true density with 15-80 micron size range.

**W1300** – 0.7 g/cc true density with 70-350 micron size range.

**G400** – 2.4 g/cc true density with 1-24 micron size range.

**W410** – 2.4 g/cc true density with 1-24 micron size range.

**CaCO<sub>3</sub>** – 2.7 g/cc true density with 2-48 micron size range.

RTV silicone and epoxy resins were used for commonality and workability.

General Electric's RTV silicone resin 615A cured with RTV 615B was mixed as follows:

1. Prescribed amount of resin and curing agent weighed and mixed in a 50 ml plastic beaker.
2. Proper amount of filler added and slowly mixed to reduce the air entrained.
3. Mixed material poured to the top of a round dish, 2" dia. x 1/4" deep. Cured overnight before removal.

Shell EPON™ 813 epoxy resin cured with 3072 was prepared in a similar manner to the silicone, but the epoxy/curing agent mix was allowed to thicken before pouring into the dish.

All samples were analyzed with an Anter Corporation Model 2021 Thermal Conductivity apparatus following ASTM-518 protocol.

### Results

Test results in the charts on the back page show a linear trend when fillers are added to the resins.

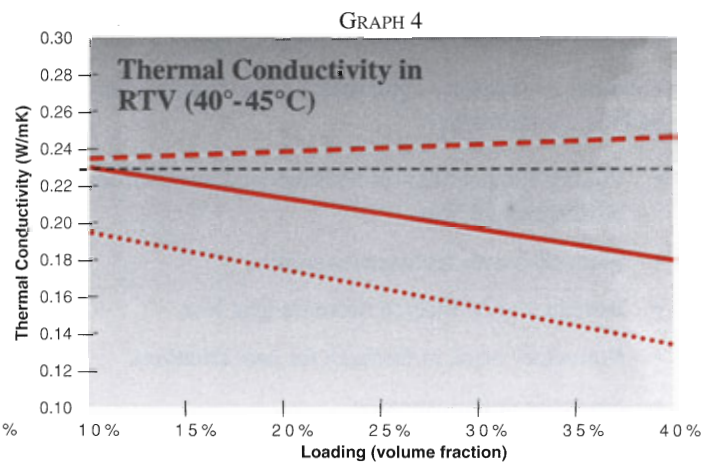
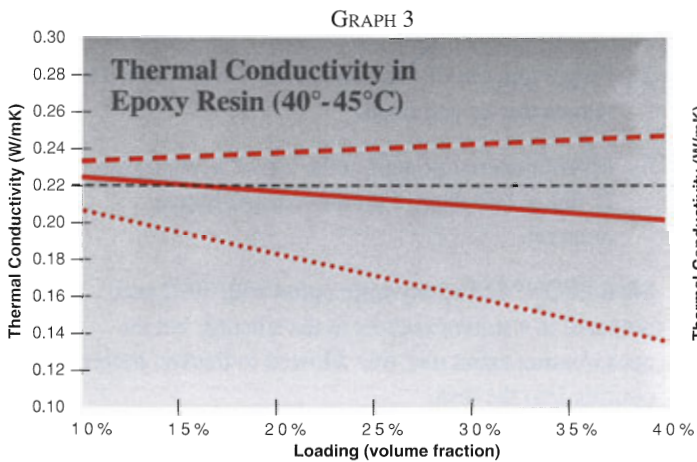
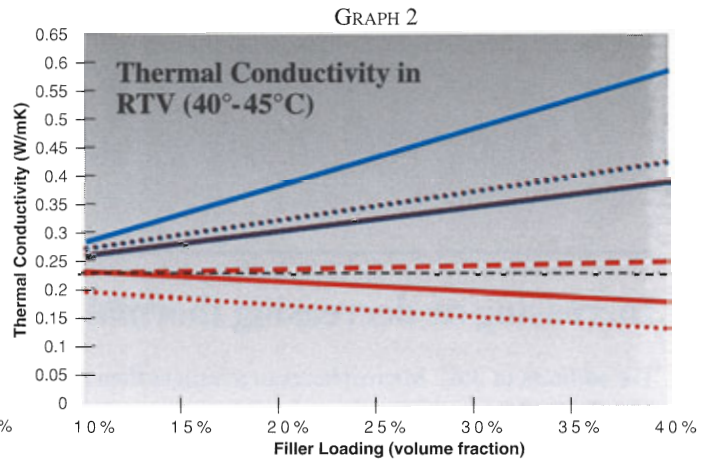
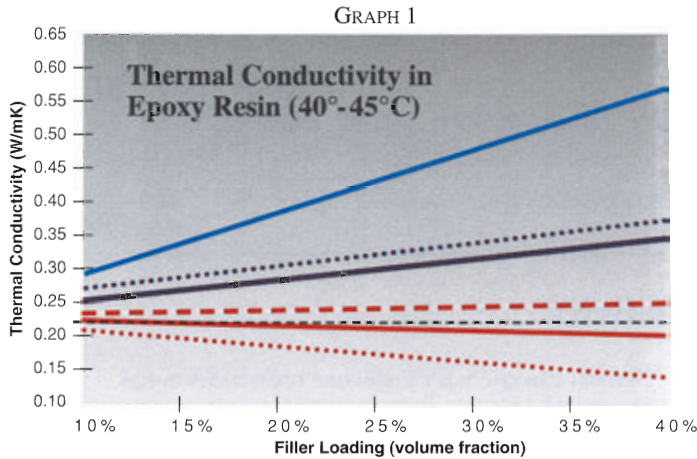
Scotchlite Glass Bubbles reduced the thermal conductivity of both resins. This would be important, for example, in syntactic foam insulation. With Z-Light Spheres Microspheres thermal conductivity increased slightly, but is less than mineral fillers, a characteristic to consider for refractory brick. Zeeospheres Microspheres provide higher thermal conductivity when enhanced heat transfer is preferred.

## Results

Graphs one and two illustrate thermal conductivity trends for all materials. Graphs three and four present 3M™ Scotchlite™ Glass Bubbles and Z-light Spheres™ Ceramic Microspheres in greater detail.

## Legend

- ..... K1
- K46
- - - W1300
- ..... G400
- W410
- CaCO<sub>3</sub>
- - - Control (unfilled resin)



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