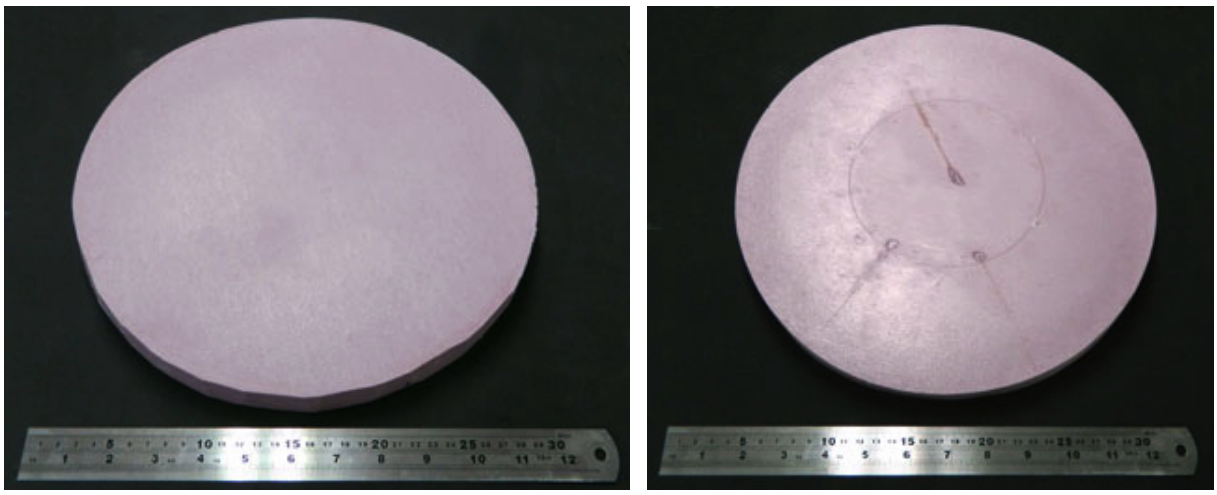
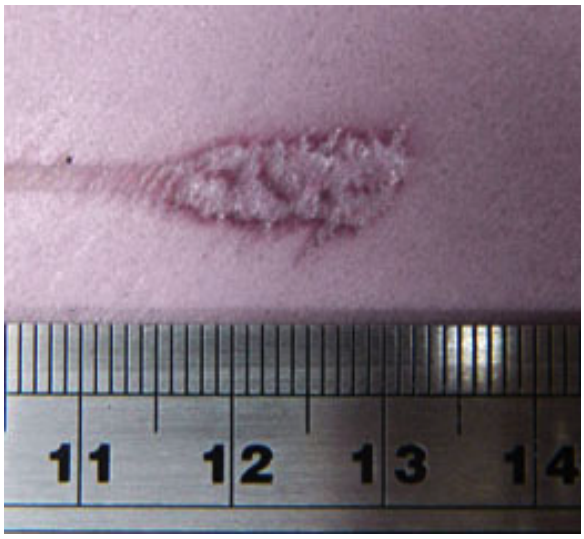
GE Varnish

GE varnish is a commonly used adhesive material in the field of cryogenics and vacuum science. This viscous dark brown liquid is a phenolic resin and was invented by General Electric in the middle of the last century. It sometimes goes by its product code GE-7031, and it has a number of properties that make it useful to the experimenter and engineer. It is basically an adhesive and has a number of properties that make it useful in cryogenics: it has a high thermal conductivity (1) over a wide temperature range, it is also a good electrical insulator (10^{15} to 10^{17} Wm^{-1}) when dry (2) and has a high dielectric strength of over 10^{8} Vm^{-1} (3).

It can be thinned by diluting it with a 50:50 mixture of methanol and toluene and can be brushed onto fabrics such as cotton or glassfibre to make laminated mechanically robust electrically insulating sturctures. The speed with which it dries can make handling it a little tricky – strands of the varnish rapidly dry given their large surface area/volume ratio and over time it's a good idea to add a little of the thinning solution to make handling the varnish easier.

However, there are a few drawbacks to the use of GE Varnish and the first problem is in procuring it. It is not available from many equipment stockists. Red Core Consulting's stock was bought from Datacomp in Canada, and it was made by Von Roll Isola USA. As it contains dangerous chemicals, it often is shipped in restricted quantities. Secondly, as it is a phenolic resin the fumes may be an irritant to some individuals. On this last point, note that care should be taken when using this varnish with certain polymers. The dried varnish, when heated, can degrade polystyrenes, presumably through the release of phenol from the cured varnish. This effect is under-reported in the literature, although the material has a suggested maximum working temperature of 150°C. In the following left-hand image a virgin piece of a polystyrene foam is shown, and on the right that same piece is shown after being in contact with a plate at 100°C for 1 hour. The groove eroded into the foam matches exactly a grooved channel for a thermocouple that is potted with GE varnish, with a close-up shown below the two paired images.





Showing the erosive capability of year-old dry GE varnish against polystyrene.

One further comment should be made. While the varnish is drying it is not to be treated as an insulator. When attaching thermocouples to metallic objects that have a significant potentials on them, a blob of GE Varnish can partially conduct electricity and cause your thermocouple to 'see' the potential of the thing it is attached to. With a Fluke 8442A the resistivity of liquid GE varnish has been measured to be around 4 kΩm. This is sufficiently small for a thermocouple circuit, which typically has a sensitivity of a few 10s of μV K^{-1}, to show anomalous ‘temperature’ readings till the varnish has dried thoroughly.

References

(1) Tsatis, D. E., 1987. Thermal diffusivity of GE-7031 varnish, *J. Appl. Phys.* **62** (1), 302-302

(2) Oxford Instruments' web site (http://www.oxinstdirect.com) - accessed July 2011.

(3) SCB shop web site (www.scbshop.de) - accessed July 2011.