303 333 1876
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4600 Holly Street
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EFI POLYMERS

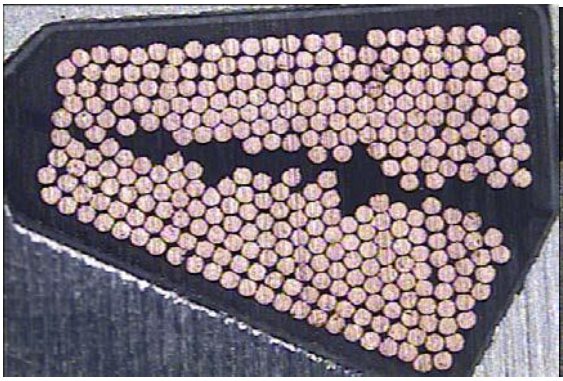
FORMULATED SOLUTIONS WORLDWIDE

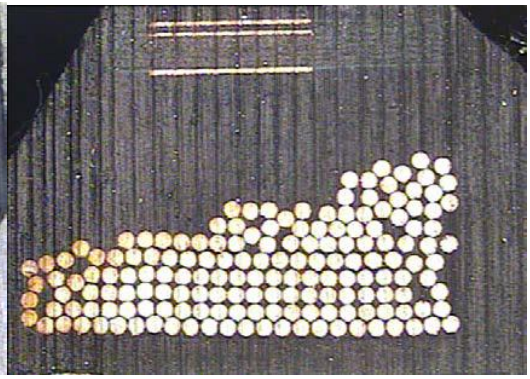
Motor Potting Explanations and Tips

Potting of motor stators is an increasingly popular option, especially when designers want to push more power in smaller spaces. EFI polymers is a world leader not only in formulating materials for this purpose, but in implementing the process.

Materials

EFI 20290 / 50021 – (see TDS) is a proven system with a thermal conductivity of 0.66 W/M*K that typically results in 20C -30C heat reduction vs a varnished stator. The material is applied in a single temp process, no multiple step cure required. It is readily available and widely used in the OEM motor market and is a UL 1446 Class H recognized potting system for insulating and protecting windings / end turns up to 180C. It ensures complete slot fill and impregnation at the recommended process temperatures.





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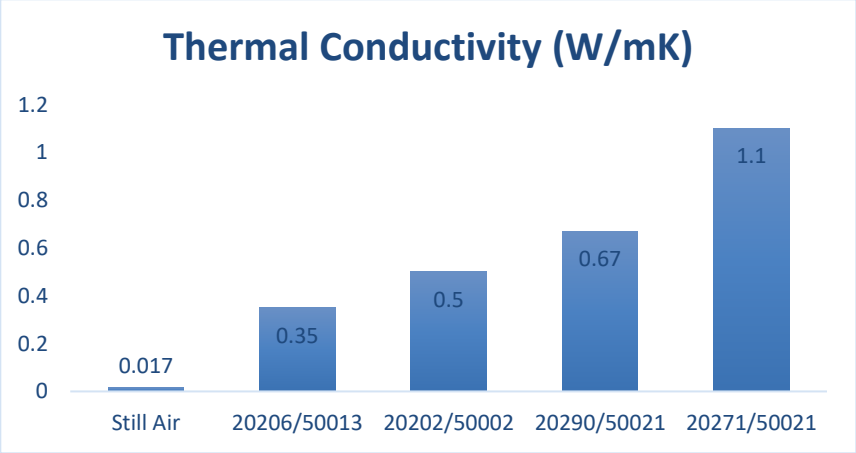
Thermal Conductivity:

Materials are available with much higher thermal conductivity, but it is strongly recommended to start with an easy to process material, as enormous benefits can be realized simply by displacing thermally insulative air. Benefits estimated to be up to 60X improvement in thermal conductivity. The table below shows some typical thermal conductivity values of air vs select EFI Polymers motor potting materials.



Problems with Varnish:

While varnish is a widely used method on motor stators, it has inherent problems that make it an inferior option for reliability.

1. Although wire and stacks are coated and sealed with varnish, a large amount of air remains in the stator/coil (especially around the end turns). Air acts as insulator, more and more power lost as heat, resulting in loss of motor efficiency.
2. When exposed to both elevated temp and high humidity, varnish has been shown to drop in electrical insulating properties that may never be regained even after drying.
3. Varnish is not as durable. In operation, when the motor is exposed to repeated thermal expansion and contraction, the thin varnish layer can wear away.

Manufacturing Process Tips:

Dispensing/Filling:

- Preheat resin, and stator assembly
- Machine internal tooling (stator plug) out of teflon, or similar material. Tooling will expand with heat, and give a very tight seal against the inner diameter
- Dispense material into stator immediately after mixing (ideally with a meter mix machine), to utilize the lowest mixed viscosity

Curing:

All EFI epoxy systems for motor encapsulation perform better with heat cure. Advantages of heat cure:

- Thorough crosslinking, yielding optimum performance
- Maximize Glass Transition Temperature (Tg)
- Improve thermal cycle performance

Tooling for repeatability:

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EFI Polymers commonly solves these types of issues:

- Voids/trapped air
- Cracking
- shrinkage, exotherm, and internal stress upon cure
- thermal shock
- Incomplete fill
- Hard & soft spots

Typical Failure Mode Analysis Tests

HALT Testing:

Typical OEM HALT chamber testing was performed on two motors. Motors were tested one at a time. The procedures are as follows:

a. Motor mounted horizontally to an 'L' shaped bracket.

b. An accelerometer was attached to the top of the 'L' bracket.

c. Ambient temperature reduced to -30C and stabilized for 4 hours.

d. Initiated vibration at 6g's in all axis for remainder of test.

e. 4 hours of vibration at -30C without motor running.

f. Increase ambient to -10C and allow temperature to stabilize at -10C.

g. Initiate motor no-load reversing operation. Operated motor at 8000 rpm reversing rpm direction every ten seconds as quickly as the motor and drivel would allow for 24 hours.

h. Increase ambient from -10C to 90C over 4 hour time span while continuing reversing operation.

i. Continue reversing at 90C for 24 hours

EFI ResultsNo signs of cracking or separation of EFI Polymer from the frame.

Corona (CIV) Testing;

EFI CIV Results: 3400 V & 3800 V

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More standard motor potting offered by EFI: