



Encapsulation Enables More Power in a Smaller Package

Lin Engineering wanted to take its proprietary stepper motors to the next level — a modular design with increased power density and reliability at the same or lower cost. The company also sought the capability of making motors of various stack heights, without increased capital costs. Lin prides itself on rapid deliveries and short lead times, and as it ventured into a new type of manufacturing it needed a development and manufacturing partner that could meet these requirements.

Based on Lin's needs and Encap's experience, Encap proposed to skip the normal time and cost of prototyping and proceed directly to a production mold. The proposed design encapsulated the wound stator, forming integral end caps and termination points. Integrating the end caps into a unitized structure eliminated the stack-up tolerances usually seen with aluminum or steel housings. The integral end caps also enabled reduced package size. The benefit to Lin Engineering's customers was the ability to either put more torque into the same package size, or to allow the motors into smaller applications than previously possible.

As alignment and position were especially critical on this particular motor, Encap recommended a thermoplastic with dimensional stability approaching that of metals. As an additional benefit, the encapsulant selected was thermally conductive and electrically insulative, enhancing the stator's heat dissipation.

With the high cost of stator inserts, critical in the encapsulation process was the ability to mold without causing electrical leakage or filling into the teeth found on each stator pole. Proprietary processing technology and tool design were used to insure the part was well packed without allowing resin to flash into the teeth. These same techniques were used to enable yield rates substantially better than prior designs or typical encapsulation applications. A modular tool design enabled the manufacturing of multiple lam stack heights in the same mold.

With Lin and Encap engineers working closely together throughout the process, the final motor was production-ready six months after concept. The new encapsulated stators achieved significant improvements in yield rates (over 99.5%) and production efficiencies. Lin Engineering now offers these 0.9 degree stepping motors in a variety of stack heights and housing configurations.

Benefits Achieved:

- Concept to production in six months
- Cost reduction – eliminated machining cost, additional components
- Reliability and lifetime performance
- Greater torque / smaller package size
- Multiple lam heights in the same tool
- Process capability improvement – from 2.5 sigma to 4.5 sigma on critical characteristics