Comparing T-LAM™ (Segmented Lamination) Stator Technology to Traditional Brushless Motors

Last Printed DEC 2002

T-LAM™ stators provide higher slot fill, >20-30% more slot fill in equal size traditional brushless motor stators which directly results in higher current rating, HP and torque.

The T-LAM™ stator technology provides substantially reduced end turns in comparison to traditional brushless motors. End turns are the most susceptible area on a traditional brushless motor to heat and voltage damage because they are surrounded by air, without a good thermal path for generated heat to escape.

The end turns of a brushless motor do not provide additional power or torque; they only produce inefficiency and unnecessary heat. Therefore, reducing the percentage of the stator that is comprised of end turns increases the motor's thermal efficiency and reduces it susceptibility to heat or voltage damage in the end turns.

The end turns of a traditional brushless motor unnecessarily increase the length of the motor stator. Forming (compressing) of the end turns reduces this length, but results in significant strain on the wire leading to insulation breakdown.

The T-LAM™ technology reduces end turns to less than 10% of a traditional brushless motor end turns.

The end turns that are present in the T-LAM™ stator are completely encapsulated in a heat conductive epoxy further increasing the thermal efficiency of the motor and protecting the end turns.

The combination of higher slot fill, thermally conductive epoxy potting and minimized end turns results in a motor that is >40% more thermally efficient than a traditional brushless motor of the same size. The result is a motor that can be rated for higher power, or for the same power production run much cooler.

In a traditional brushless motor all of the phase wires from one phase lay in contact with the phase wires from the other two phases within the end turns. This leads to massive voltage potential (peak to peak drive bus voltage) differences in the adjacent phase end turns, high stress on the insulation and potential for motor failure.

In a T-LAM™ stator only one wire passes from phase to phase, resulting in negligible voltage potential differences between these wires. The wire used to wind the T-LAM™ stators is heavy build, inverter grade wire which provides the most robust solution for operating on today's IGBT based servo amplifiers.

A UL recognized thermally conductive epoxy complete encapsulation of the TLAM™ stator, Rynite lamination caps and Nomex slot insulation result in Class 180(H) 460 Vrms (700 VDC bus) ratings of all T-LAM™ motor stators (180 degree C motor temperature rating.) Most traditional brushless motor stators are limited to 155 degree C temperature rating

The winding of the wire in a T-LAM™ motor is external winding, on a straight stack of laminations, and is performed directly on the laminations resulting in the least amount of stress to the wires. Exlar also winds complete phases on a single contiguous wires removing any current carrying solder joints from the stator winding for maximum robustness and reliability.

Traditional brushless motors require that the phase windings be done external to the stator and inserted after the coil is wound, resulting in high stress to the wires.

The straight winding, minimized end turns and eliminating the need for compressing or forming the end turns of the T-LAM™ winding allow for the most effective insulation of the phases, and eliminates many of the difficulties associated with insulating inserted coil type brushless motors that can lead to voltage related failures.

In addition, this winding method allows for maximum flexibility in windings, allowing for custom windings to be designed and manufactured in matter of a few hours without the need for special tooling, involved winding equipment programming or special equipment.

Traditional brushless motors often require that the lamination stack be skewed the width of one slot of the motor stator to reduce cogging torque, further stressing the wires. The straight coil designs of the T-LAM™ stators eliminate this need and accommodate low cogging torque through the design of the magnet and lamination geometry.

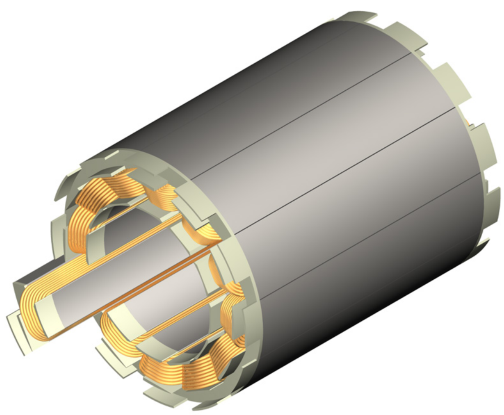


Figure 1. T-LAM™ Stator Prior to epoxy encapsulation

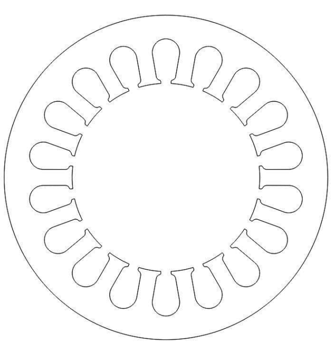
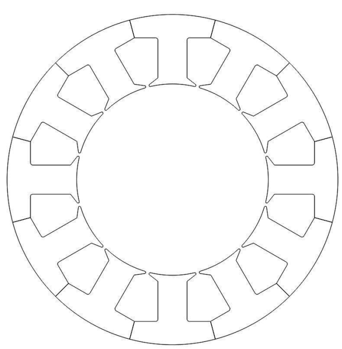


Figure 2: Traditional one piece lamination



T-LAM™ Segmented Lamination

Figure 3: Minimized, non-overlapping end turns

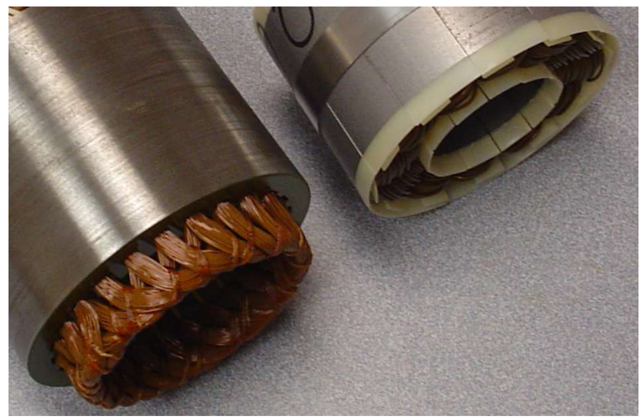
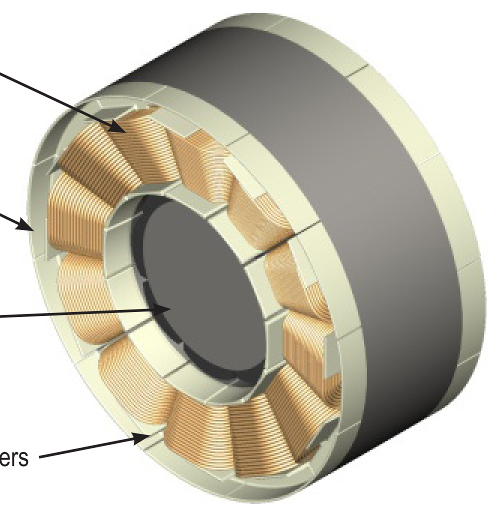


Figure 4: End turn length comparison



Thermally Conductive Epoxy Potting (not shown)

Figure 5: Insulation System. UL Class 180 H