Elevated Ambient Temperature De-rating of Brushless Motors

Each brushless motor manufacturer selects the ambient temperature at which they rate their motors. The same is true for Exlar. A very common question that we receive is: “What percentage do I need to de-rate the motor (or actuator) if my ambient temperature is X degrees?”

There is a de-rating equation that can be used to de-rate any brushless motor. This equation takes the difference between the maximum temperature rating of the motor and the ambient temperature in which the motor will be used, and divides it by the difference between the maximum temperature rating of the motor and the rated ambient temperature of the motor. The square root of the result when multiplied by 100% gives the allowable percentage of the normal ratings at which the motor can operate in the elevated temperature environment.

$$\sqrt{\frac{\text{(Maximum Temperature Rating – Environmental Temperature)}}{\text{(Maximum Temperature Rating - Rated Ambient Temperature)}}} \text{ X } 100\%$$

What this equation is calculating is the ‘left over’ allowable temperature rise that the motor can produce when starting from an ambient temperature higher than that at which the motor is rated. The standard operating temperature of the stator to which Exlar limits its brushless motor is 130°C. (This is a common standard amongst brushless motor manufacturers.) Assuming a catalog rated ambient temperature of 25°C, and an example operating ambient temperature of 55°C, the results of this equation would be:

SQRT[(130-55)/(130-25)] x 100% = 84.5%

So, in this example, the given motor would have a de-rating to 84.5% of its catalog rated current, and thus of its output torque as well.