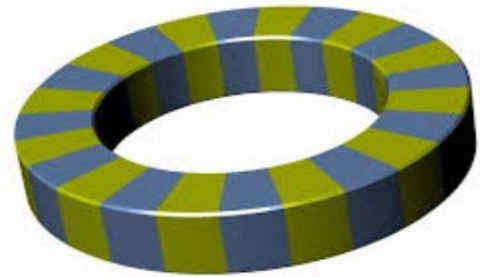


November 20th 2020**Investigation of Thermal Expansion Properties of Rare Earth Magnets in Servo Motors****Robert Gaus¹, Stephen M. Fields², and William T. Reynolds¹**

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Abstract

As time continues to move forward, the demand for smaller electronic devices continues to increase. In terms of motor design and development this has come in the form of higher torque density requirements, which is to say make a smaller motor that is capable of moving a given load. As a company Kollmorgen specializes in high torque density motors. Currently Kollmorgen is in the process of developing a new line of frameless motors that will use a single sintered rare earth ring magnet in place of the more traditional multiple loaf magnet stator designs in order to save on space. This new design comes with new challenges, this presentation will describe the work that I have done to solve the problem of thermal induced magnet fracturing. Specifically, this presentation will report the experiments that I done to determine the coefficients of thermal expansion for the sintered ring magnets of three potential suppliers in terms of length, outer diameter, and inner diameter. As the sintered magnets are grain refined rare earths, their microstructures are multiphased and differences in the manufacturing processes of the suppliers is expected to result in differing thermal expansion properties. The goal of these experiments is to determine the amount of thermal stress that will be placed on the magnets when they bonded onto a steel shaft at maximum rated operating temperature. Once the maximum thermal stress is known, it is hoped that a suitable bonding adhesive with enough flex can be found to provide space for enough expansion to bring the stress levels on the magnets down to where they will not fracture.



Visualization of a ring magnet with multiple north and south poles on the same magnet

Biography

Robert Gaus is a masters of engineering student in the Materials Science and Engineering program at Virginia Tech with an expected graduation date of December 17th,2020. He completed his Bachelors of Science in Materials Science and Engineering in 2017 at Virginia Tech and went to work for Kollmorgen starting in the summer of 2017. While working full-time at Kollmorgen he began work on his masters in the fall of 2018. He is currently working as a Product Environmental Compliance Engineer within the Kollmorgen corporation where he specializes in both EU Reach and RoHS environmental regulations as the primary function of his work. In addition to these regulations, he also handles quality certifications, material validations, handling and disposal of dangerous goods, and engineering support for the electro plating department. His graduate level work and research has focused on high energy product grain refined rare earth magnets.



