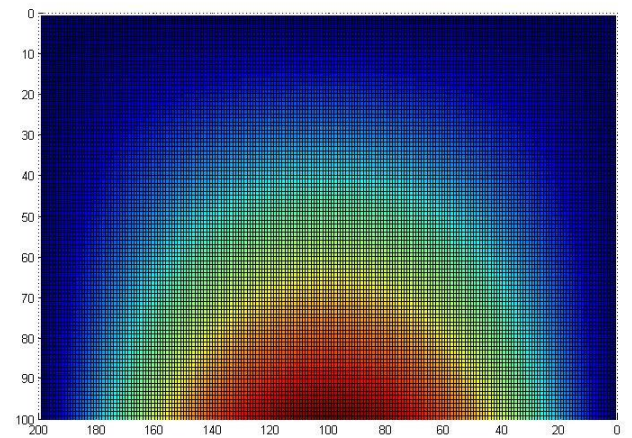


By Kurt Sassmannshausen (Product Development Manager)
 Bronze guide bands and bushings have been the traditional “go to” solution for guidance and load bearing solutions for decades. Applications include hydraulic cylinder guidance and shaft bearings. However, breakthroughs in materials, modeling, and experimentation have exposed the shortcomings of using metal bushings for such applications. At the same time, composite materials have been used successfully as replacements for their intrinsic advantages including better load distribution and carrying capacity, lower friction, self-lubrication, better wear resistance, and less corrosion.

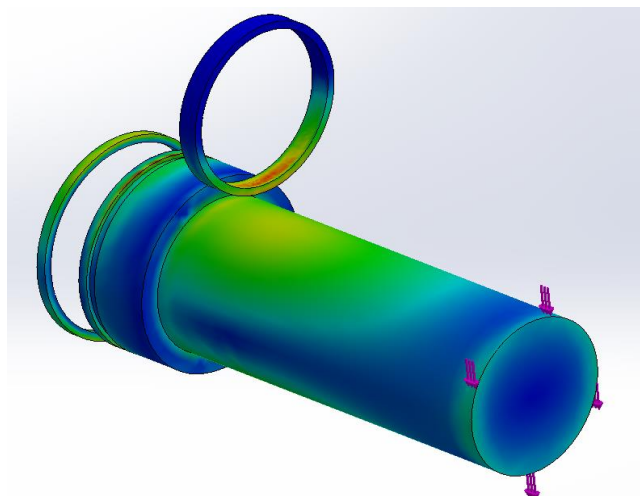
One common reason bronze bushings are recommended is their higher stress carrying capacity over composites. However, this concept ignores the load concentration created by stiffer materials such as bronze and other alloys. On the other hand, composites, due to their unique blend of stiffness and flexibility, provide contoured guidance and more even load distribution. Thus, for a given load, a composite material will conform more than the bronze, distributing the load more evenly over the band area, and thus reducing the maximum stress.

Models for stress and load distribution for a rigid bushing indicate that when a cylinder rod experiences side loading as a result of tolerances, bending, and torques, stresses on rigid bushings peak at the front loading edge and decrease radially and from front to rear.

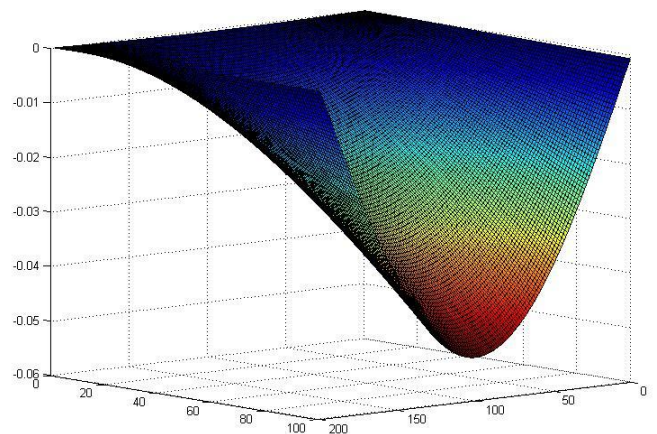
However, FEA analysis of stress distribution for bronze vs. composite materials indicates that the stresses in composite bushings distribute more evenly. This results in a lower stress peak, which in turn reduces the likelihood of failures due to high stress.



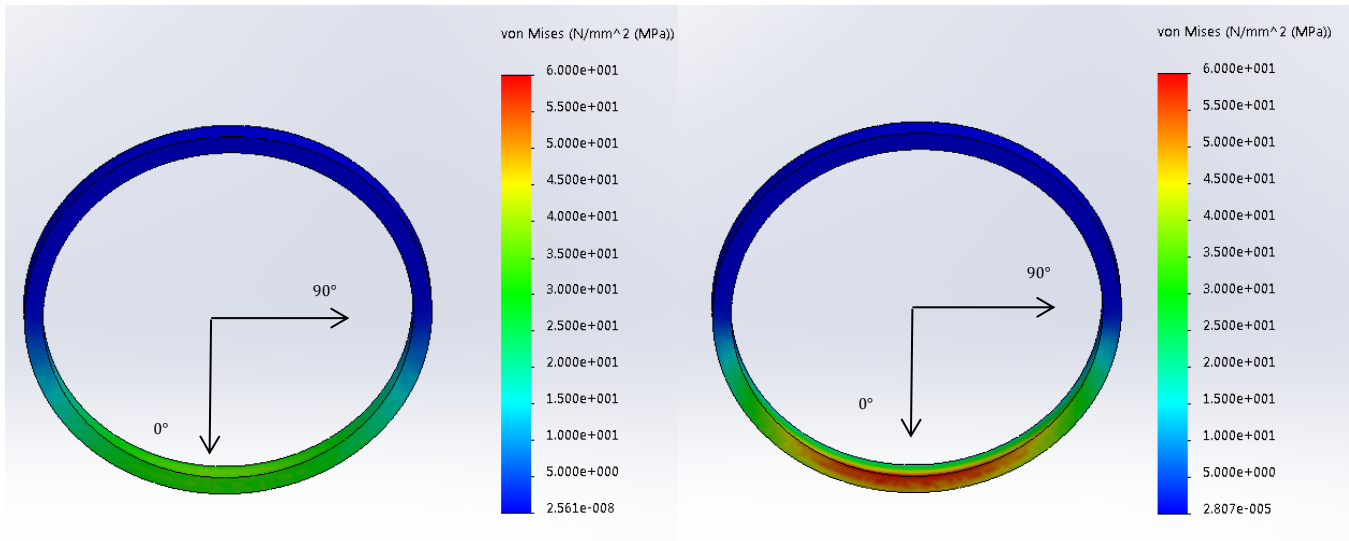
2D model of stresses in rigid bushings - high edge stress



FEA model of composite bushing

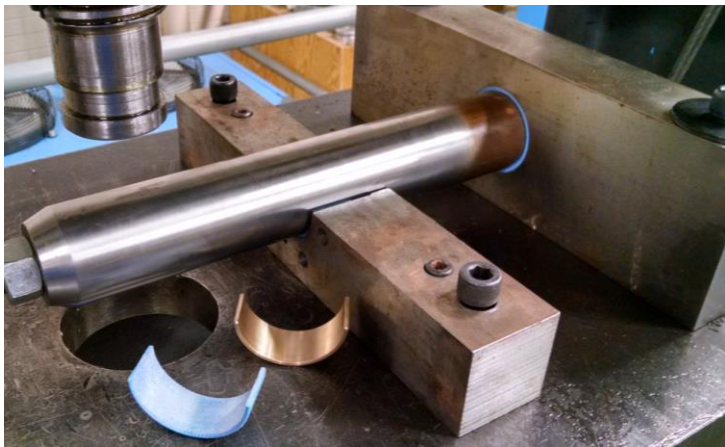


3D model of stresses in rigid bushings - high edge stress

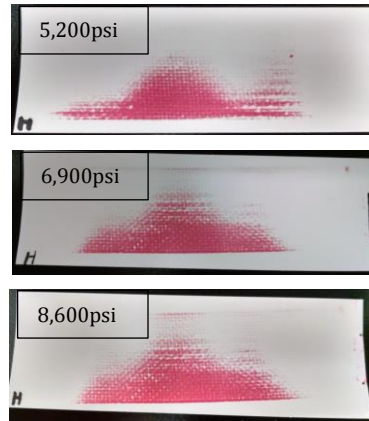


FEA results show lower stresses in the composite (left) vs. the bronze (right).

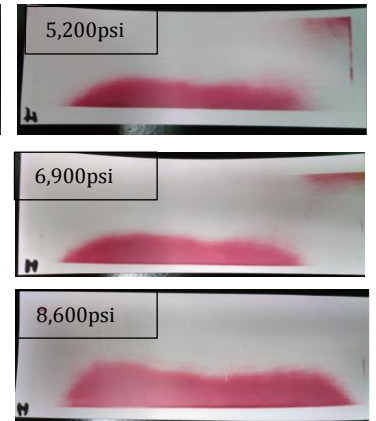
Experimental Confirmation: In order to confirm computer simulated models, an experiment was conducted in which both bronze and composite bushings of 25mm were subjected to a bending load, similar to what would be encountered in applications. Calculated projected contacted stresses were 5,200psi, 6,900psi, and 8,600psi. Pressure contact film was placed between the rod and sample. As the results below demonstrate, the pressure distribution was more even on the composite, whereas the bronze shows evidence of stress concentrated near the front of the loading surface.



Test stand



Composite



Bronze

Conclusion: Composite bushings are superior to bronze bushings due to their ability to conform to the bending deflections that occur as a result of side loading. This results in lower peak stresses and better load distribution, preventing damage that can occur as a result of higher stresses from bronze bushings.