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Design and Prototype of Next Generation NASCAR Brake Caliper

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Design and Prototype of Next Generation NASCAR Brake Caliper

MNE503 | **Team members:** Jesse Crowder, John Knighton, Lenny Ports, Miranda Snyder | **Faculty adviser:** Dr. Charles Cartin
Sponsor: FDP Virginia Inc. | **Sponsor adviser:** Cody Boyd

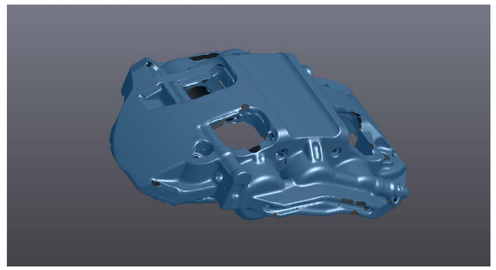
Objective

The objective was to reverse engineer a brake caliper capable of competitive performance under the extreme conditions of short track racing, while simultaneously reducing the weight of the caliper and maintaining its structural integrity.

Design Process

The reverse engineering process was accomplished by scanning the brake caliper in VX Elements using a Creaform Go!Scan 3D Scanner. The scanned data was then transferred into SolidWorks as contour geometry, which was used to effectively model and prototype the brake caliper.

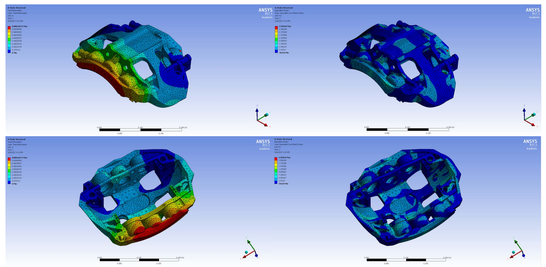
VX Elements



Initial scan into VX that was used to create contour geometry for SolidWorks.

Finite Element Analysis

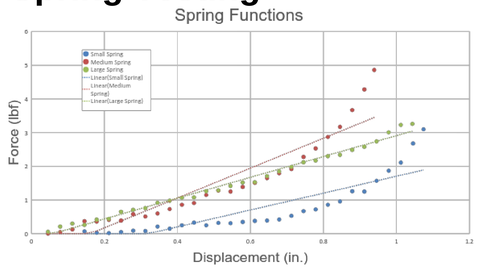
To ensure structural integrity, strain gauge testing, material testing, and a finite element analysis was performed. This testing was used to validate the model and justify structural modifications for weight reduction.



Static Structural Analysis	
Material	2099-T83 Alloy
Yield Strength	480 Mpa
Internal Loading	1,200 psi
Max Stress	220 Mpa
Max Displacement	0.017 inches
Safety Factor	2.2

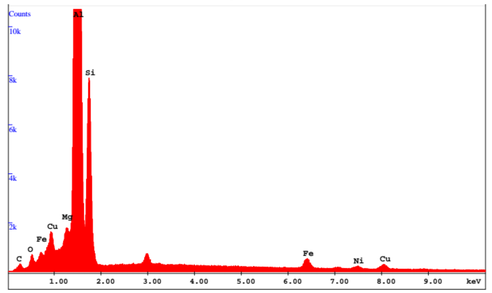
Results indicate that the chosen material's strength properties are adequate. In addition, the maximum displacement was 0.017", which is well within reason to maintain piston geometry.

Spring Testing



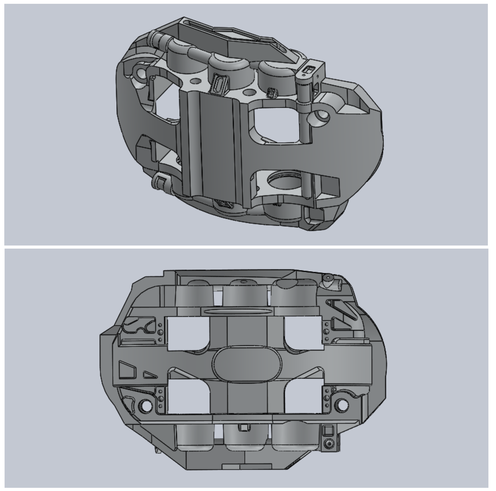
Compression MTS testing was performed on the anti-kickback springs to identify their functions, which will be used to select springs for use in the new design. This will ensure proper piston operation during braking.

Material Analysis

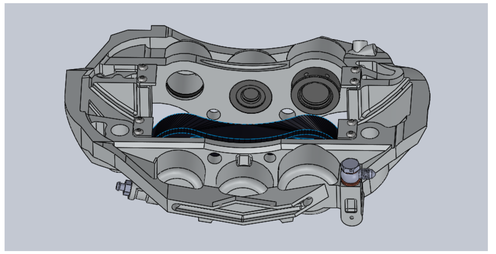


Material testing was completed using Energy-dispersive X-ray spectroscopy. The results indicate that the caliper was composed of a hypereutectic aluminum alloy with a nickel phosphorous coating.

Final Design and Prototype



The final material choice is a 2099-T83 alloy instead of the hypereutectic aluminum alloy from the original caliper. Along with the material choice and sufficient weight reduction, the caliper's weight has been decreased by approximately 5 percent.



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