Upward Facing Cone Calorimeter for Material Flamability Testing in a Simulated Microgravity Environment

Team Ignite Innovation

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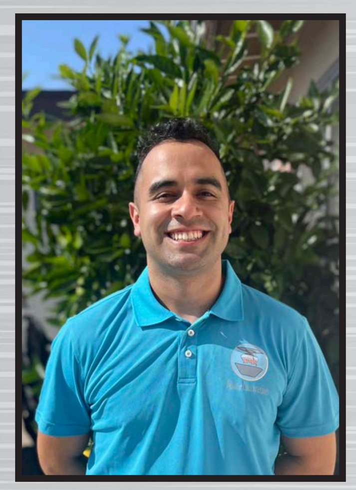
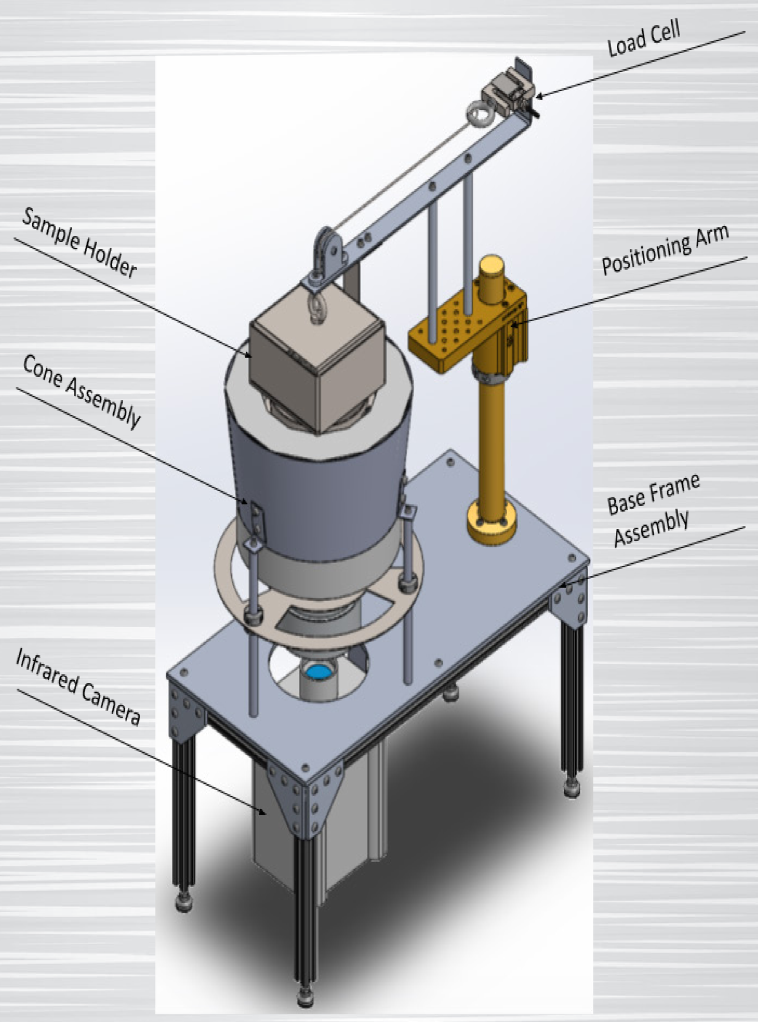
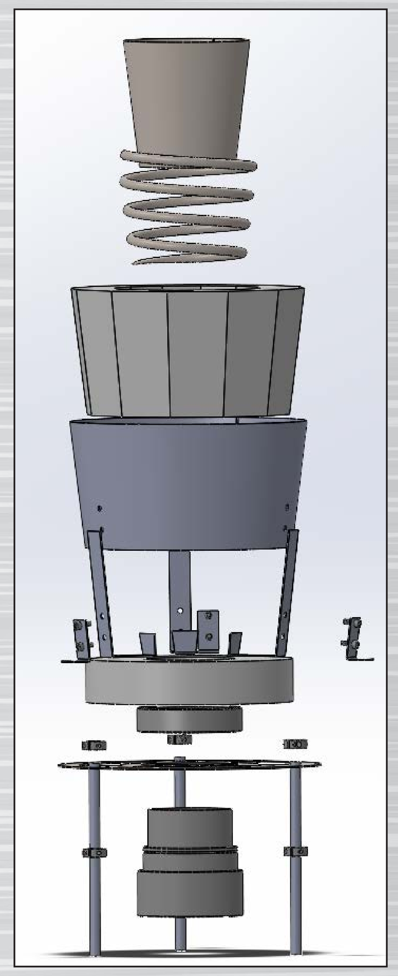
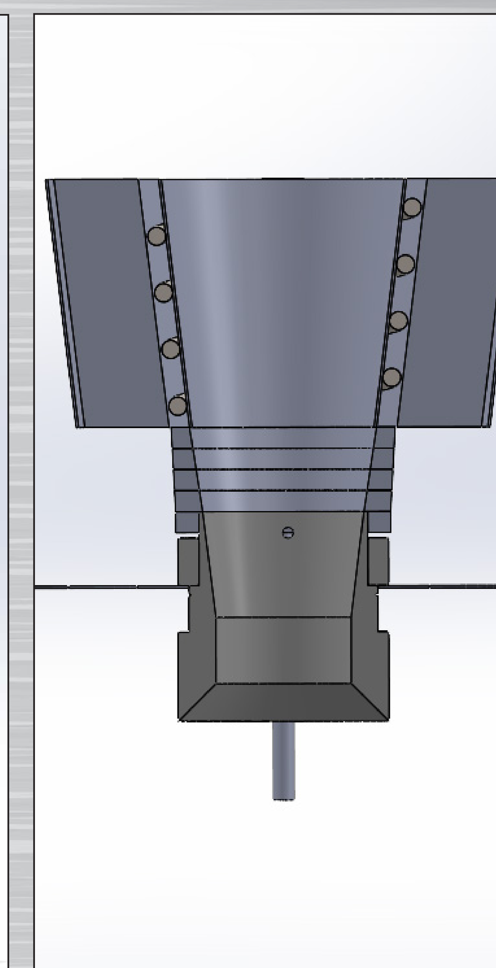

Christopher Tapia

CAD Model



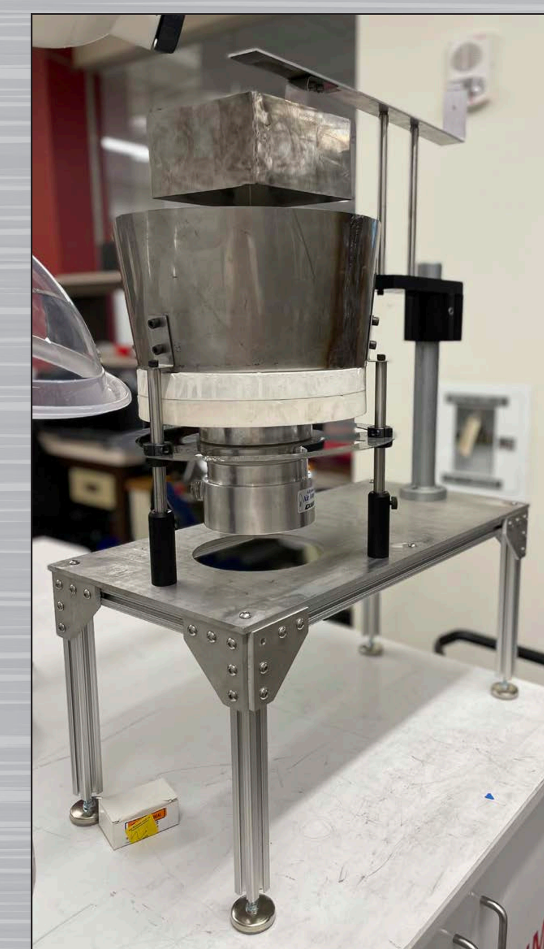
Isometeric View


Exploded View


Cross Sectional View

Final Product

Initial Assembly Figures:



Problem Statement

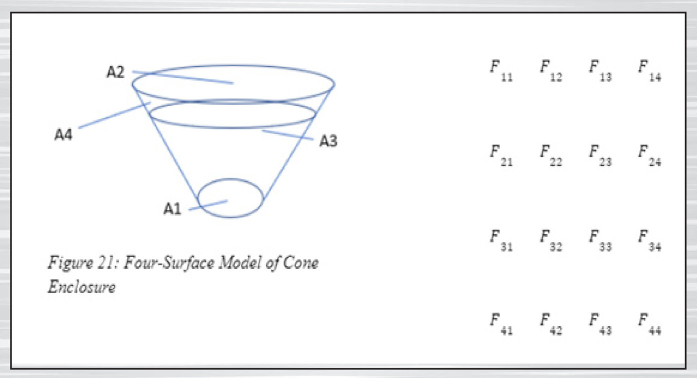
A cone calorimeter is a standard test that evaluates a material's flammability properties. The test has shortcomings in providing ignition properties in a low gravitational setting. Ignite Innovation designed an inverted cone calorimeter that simulates conditions consistent with a microgravity environment. Unlike the standard cone calorimeter, this apparatus will impose a slow laminar flow on the sample while reducing the effects of natural convection cooling. The inverted cone calorimeter has potential applications to study materials used in space or low gravitational environments.

Senior Design Instructor: Dr. Scott Shaffar
Sponsor: Dr. Fletcher Miller

Manufacturing

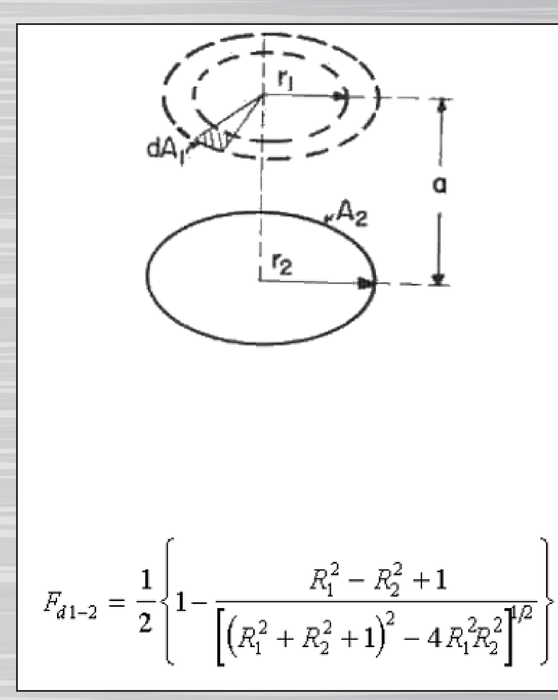
Manufacturing methods used: Milling, Slip Roll , Bandsaw, Waterjet, Press Brake , TIG Welding

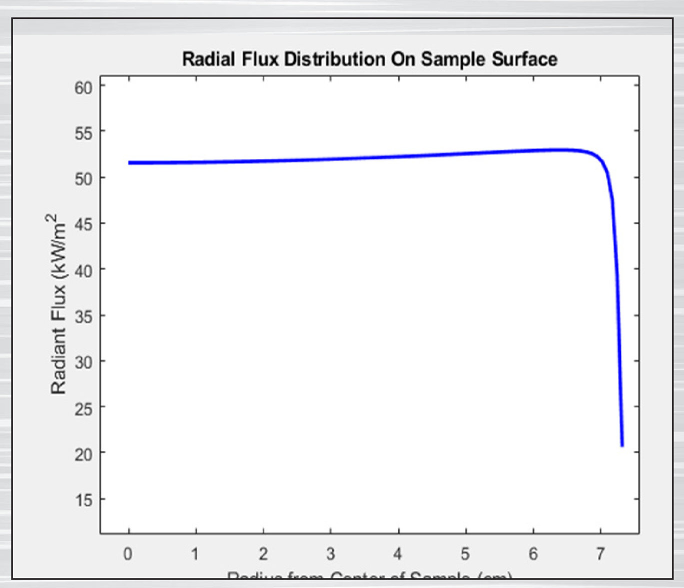
Enigneering Analysis



To estimate the amount of heat flux at the sample surface as a function of cone geometry and cone temperature, the cone had to be modeled as an enclosure, and the radiation view factors had to be found.

To determine if the given cone geometry will provide a constant heat flux across all points of the sample, the sample surface had to be modeled as differential rings

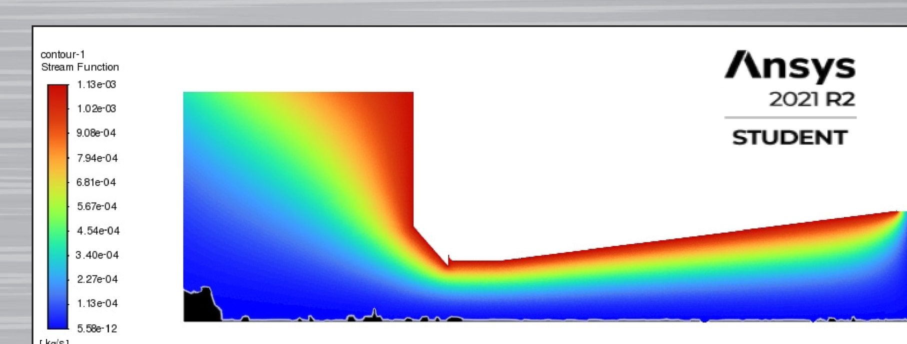




MATLAB graph displaying constant heat flux across all points of the sample

Results

It is very important that the flow does not separate from the wall during operation because as it diverges from the wall it creates turbulence. To achieve a laminar flow, the apparatus was modeled in Ansys Fluent and studied. The air amplifier used in the design was first suggested because it allows the IR camera to see through the apparatus while testing; however, it provides another benefit. Air amplifiers work based on the Coandá Effect, which means that the flow stays close to the wall all the way through the apparatus and out the exit, minimizing turbulence.



Fluent Model of Mass Flow Rate

Acknowledgements

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