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

Problem Statement

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.

Engineering Analysis

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.

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 Coandă Effect, which means that the flow stays close to the wall all the way through the apparatus and out the exit, minimizing turbulence.

Manufacturing

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

Acknowledgements

Team Ignite Innovation would like to express gratitude to Dr. Shaffar, Dr. Miller, Michael Lester, Paul Ahlers, Brayden Butler, Michael Berry, Nick Satterlee for their contribution and efforts to this project.

Spring 2022