Abstract

Nuclear thermal rockets are a way to propel aircraft. Nuclear thermal rockets use a nuclear heating element, like uranium, to heat and pressurize hydrogen, resulting in thrust. Nuclear heating allows the fuel to last much longer than conventional fuel. This is useful for deep space exploration missions. This is an interest of the National Aeronautics and Space Administration. At the Marshall Space Flight Center, a lab simulates the interaction between hydrogen and uranium. Induction coils transfer heat to the hydrogen through metals that can withstand high temperatures. The current setup at the lab allows for heating of 20 inches of a 50-inch-long tube. This 50-inch-long tube is the size used in the rocket. A pre-heater is necessary to study the heating of locations past the 20 inches.

This project is the design and analysis of a tool that heats hydrogen to needed temperatures. It allows for easier experiments during testing of hydrogen heating. Our work is creating a new reference tool used by scientists at the lab. Customers come with various needed test conditions to study the effects of hydrogen heating. The lab does not have a way to change testing conditions like power or temperature levels before the hydrogen enters the testing chamber. Our tool allows users to select heating equipment based on these testing conditions. This will help choosing power levels of the heating tool and will give users a safe working range to test in. It also allows the design of a heat exchanging shape that encloses the flowing hydrogen and transfers heat into the hydrogen. The heat exchanging shape will also provide heat uniformly to the hydrogen. Users can choose the shape and material of the exchanger to fit their needs.