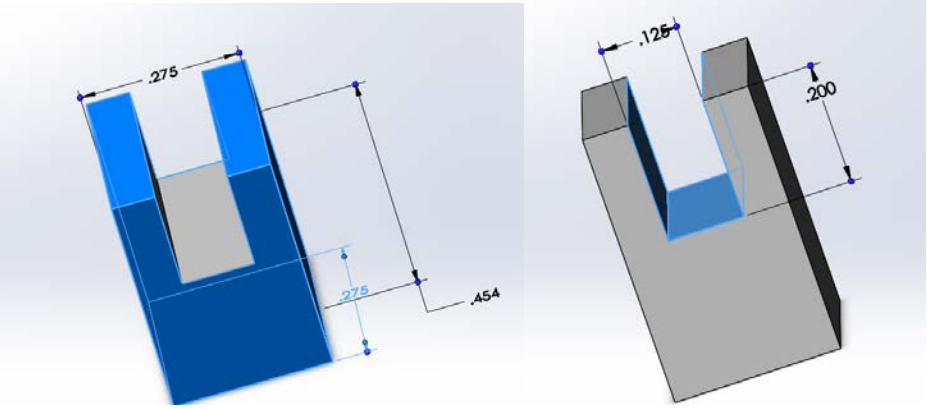
ITAR Inner Cylinder Simulation 3/8/16

The Model:

SWX file used “Inner Cylinder RF Heat Test.SLDPRT”

The model is a .275 x .275 section of the cylinder with one .125 x .200 coolant channel.

Material is 304L Stainless Steel.



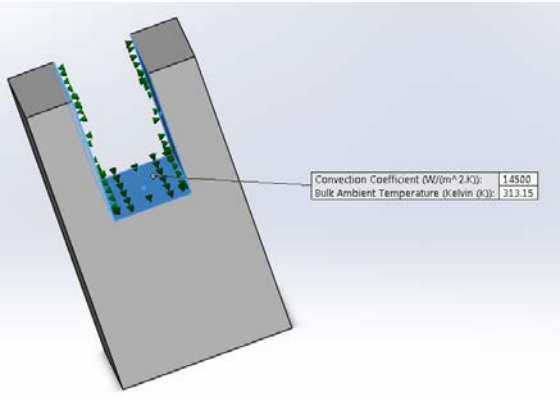
Thermal Simulation:

Initial temperature of the part is 25C.

Cooling Convection is 14500 W/(m^2k).

This number was calculated by Thuc based on 150 PSI

Ambient temperature of the coolant is assumed to be 40C



RF Power is defined in the simulation as Heat Flux.

Thuc calculated the flux to be 126000 W/m^2 based on a RF power of 3.5 kW/cm^2 and other factors.

Since the RF rotates around the cylinder at 30 RPM a time cure was developed for the heat flux.

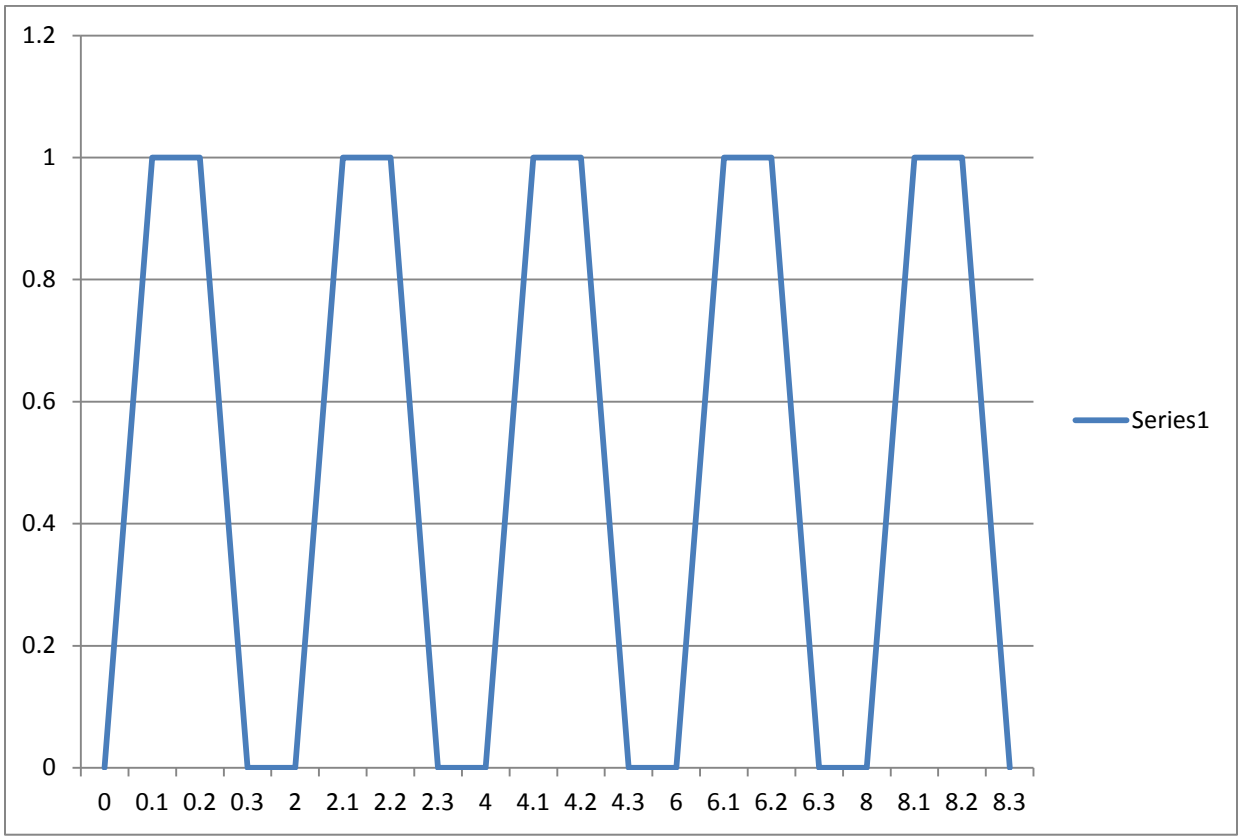
At 0 seconds the power turns on.

It ramps up to full power at .1 Seconds.

The power remains on at full for .1 second.

Then ramps down back to zero at time .3 seconds.

This repeats every 2 seconds.

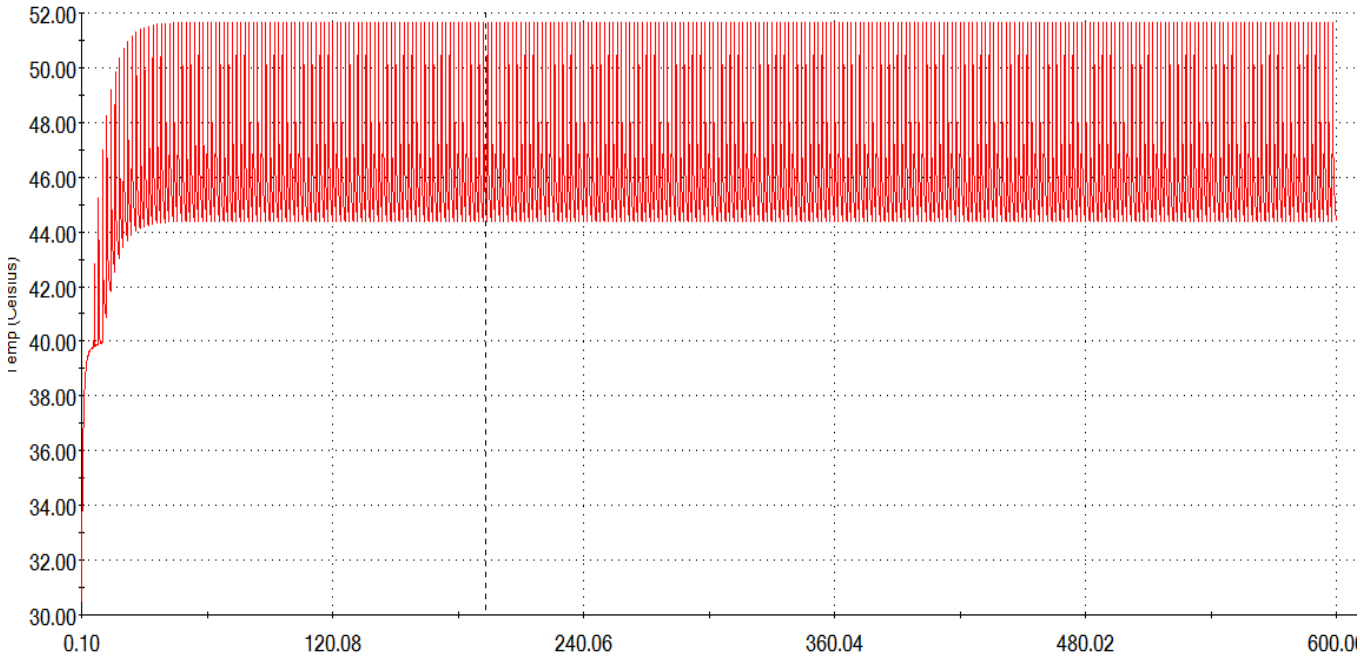


Partial Graph of time curve

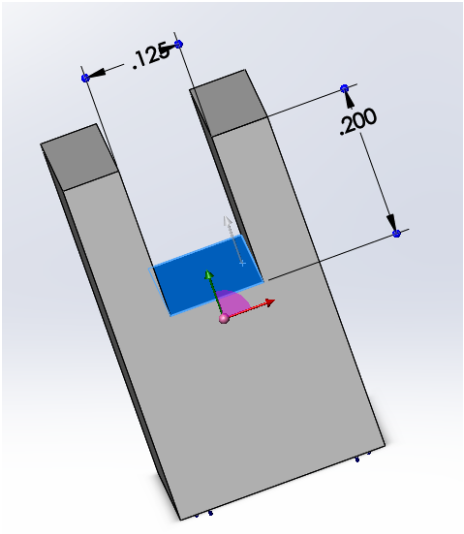
The simulation was run to simulate 10 minutes (600 seconds).

After about 25 seconds the system stabilizes where the max temp on the inner wall reaches 56.5C.

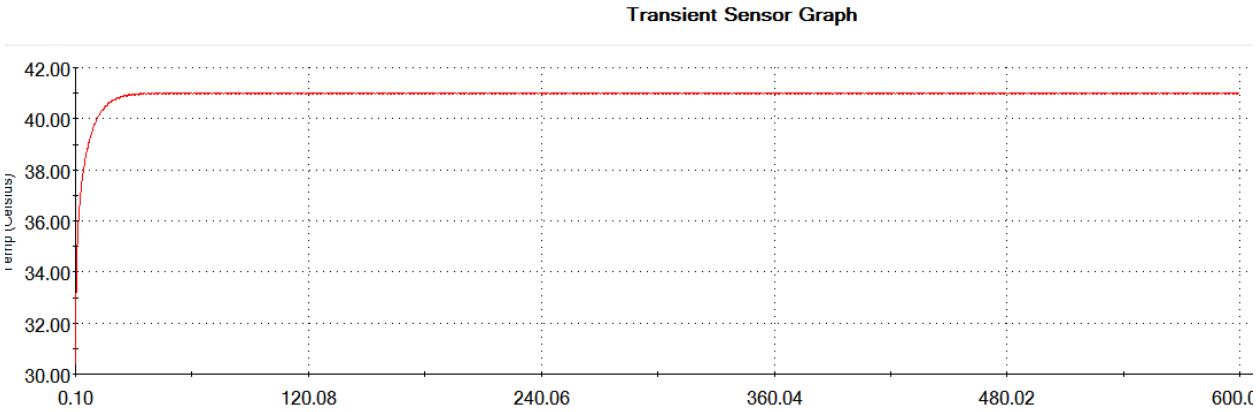
Then cools down to 44.4C, and repeats every 2 seconds.



The temperature of the bottom of the channel was also measured.



The coolant channel stays a steady temperature around 41C during the cycles.



Dynamic Stress Simulation:

A second simulation was done to evaluate the stress on the stainless steel cylinder during the cyclic heating. Since the temperature system stabilizes at around 25 seconds. The stress simulation only simulated 50 seconds to reduce simulation time.

Temperature data was input directly into the stress analysis from the temperature simulation.

The stainless steel has a yield point at 262 MPa. The stress simulation showed max stress at below 95 MPa.