

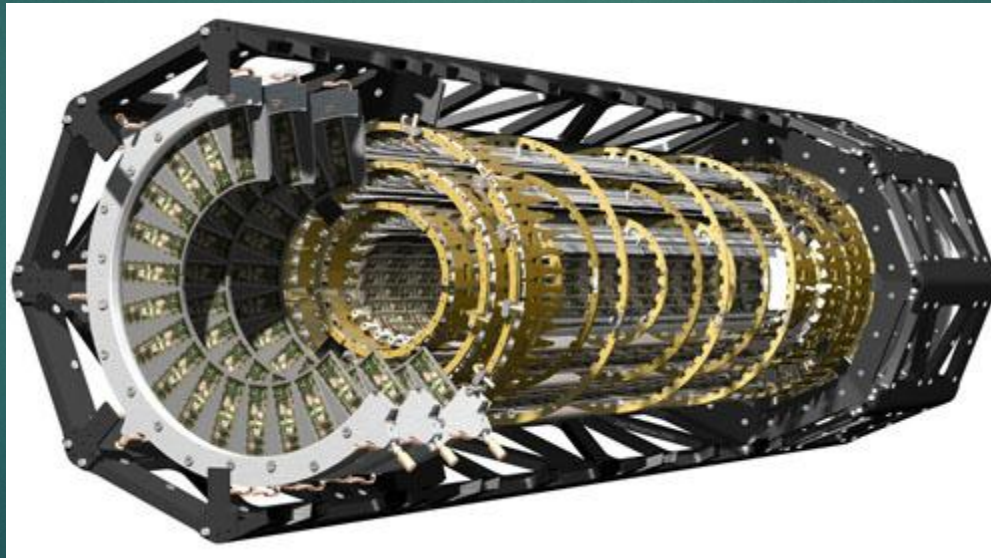


# Improving the HALT Procedure for ATLAS Pixel Detector Modules

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COLE LE MAHIEU

# Project Significance

- ▶ ATLAS, one of the LHC's detectors, is being upgraded
  - ▶ New Pixel Detector Layer
  - ▶ Vibrational table tests durability of pixel detector modules
- modules

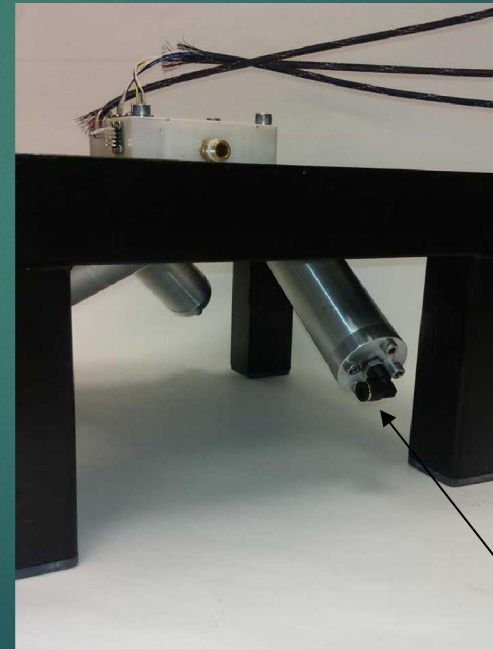
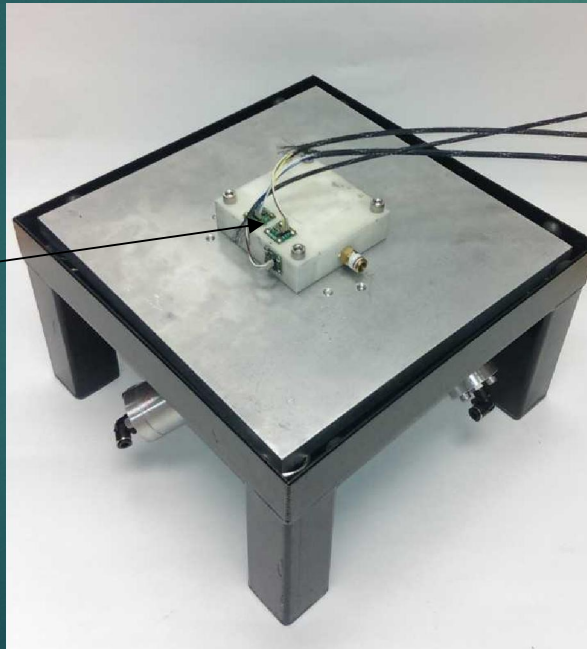




# Testing the Modules

- ▶ HALT – Highly Accelerated Lifetime Testing
- ▶ Find weakness in pixel detector chips
- ▶ The vibrational table:

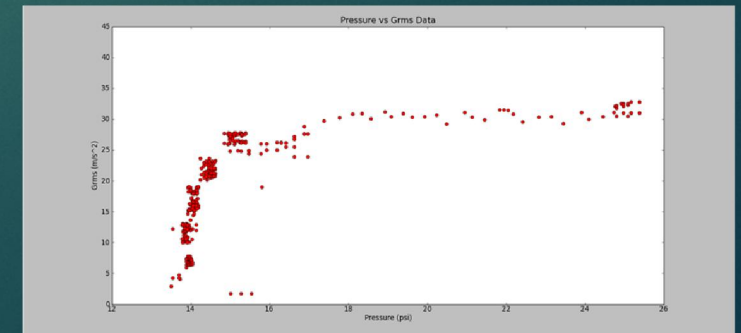
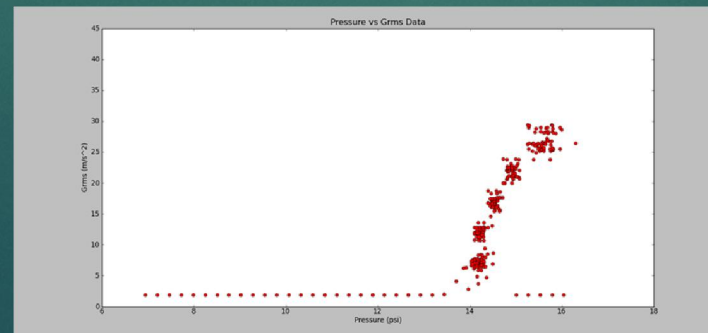
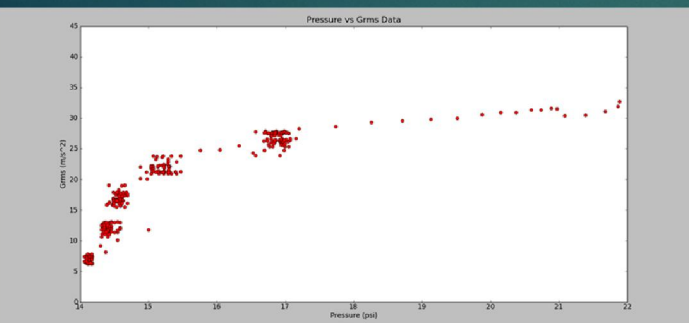
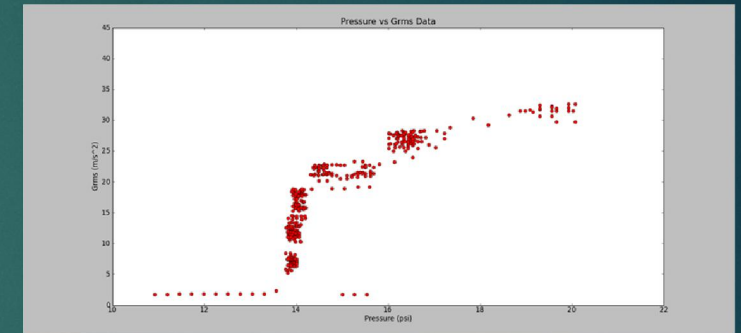
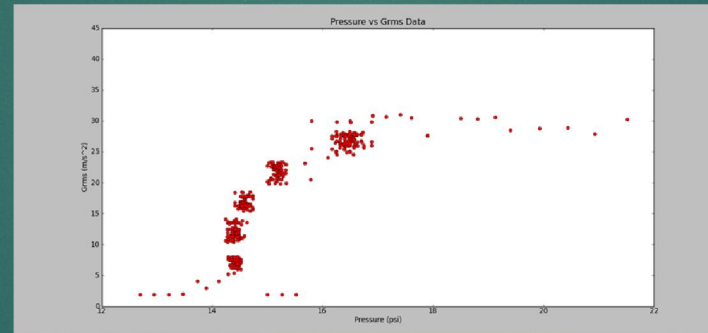
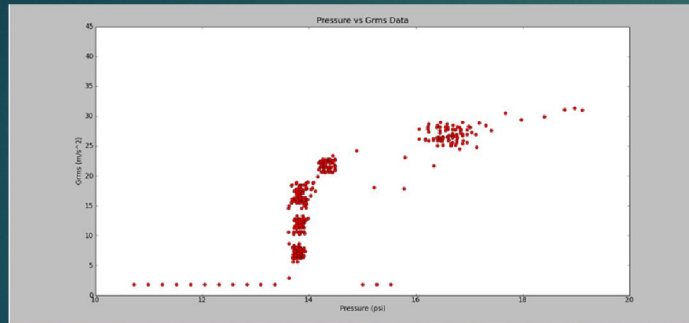
Accelerometers



3 pistons inside 3  
cylinders

# Do Pressure and Grms (acceleration) have a consistent correlation?

- ▶ Over the course of a week, I looked at grms vs pressure plots for various pressure valve positions.
- ▶ For example:

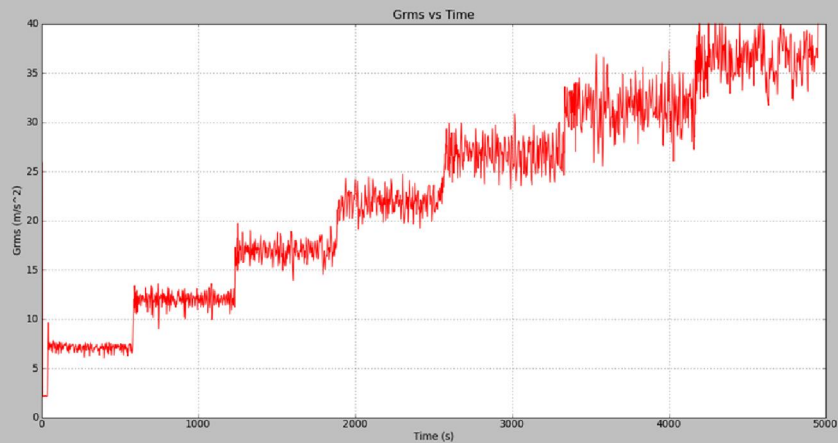
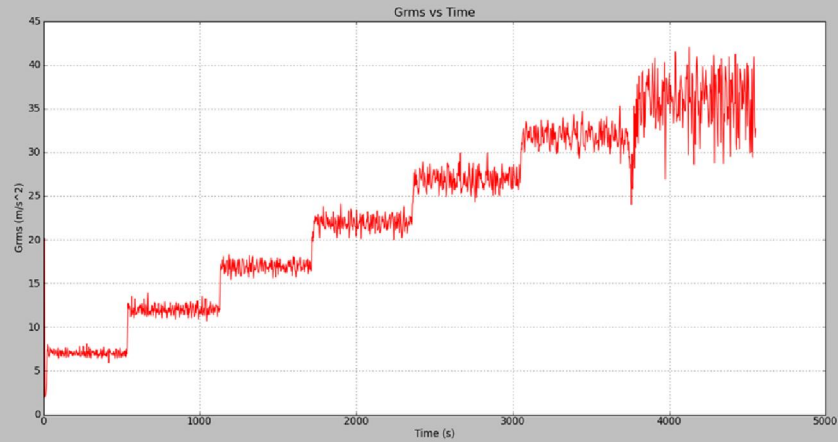




# Do Pressure and Grms (acceleration) have a consistent correlation?

- ▶ Yes, pressure has a generally reproducible effect on grms.

# Generating Step Functions





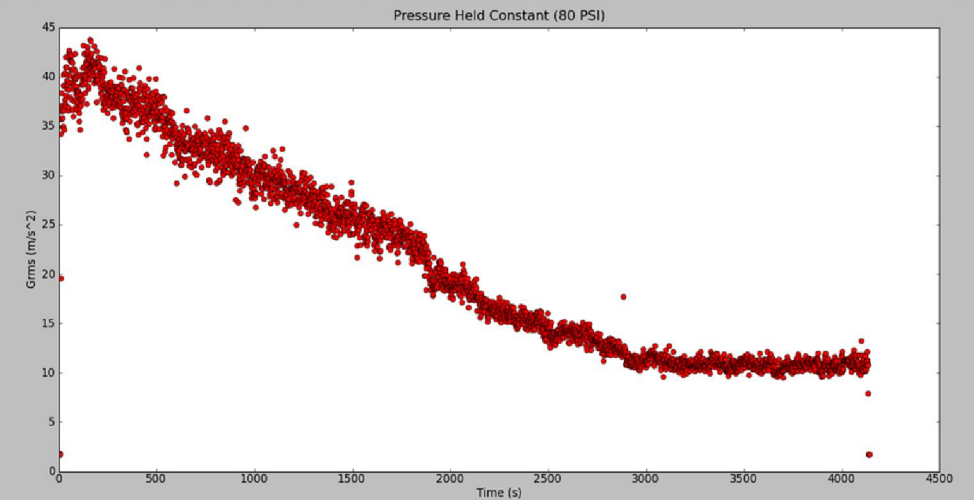
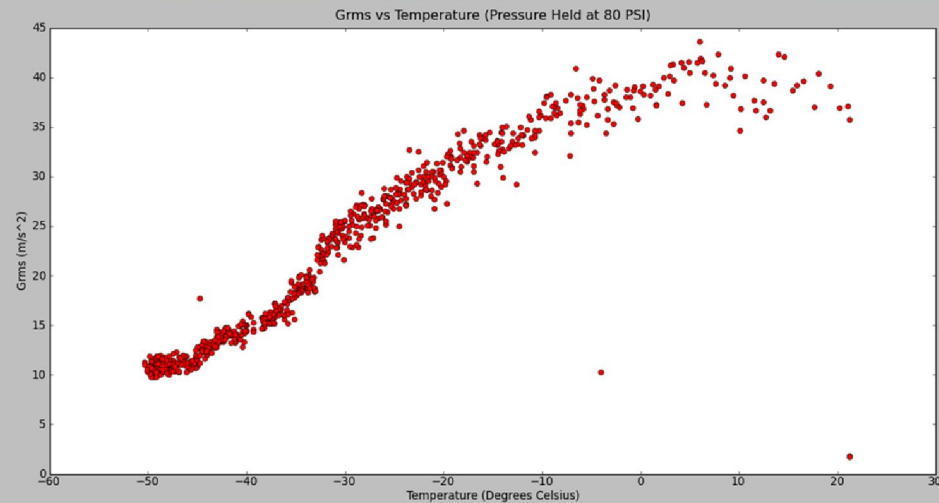
# Effects of Temperature on Grms and Pressure

- Holding pressure constant, the grms of the table would gradually drop to 10 or less.



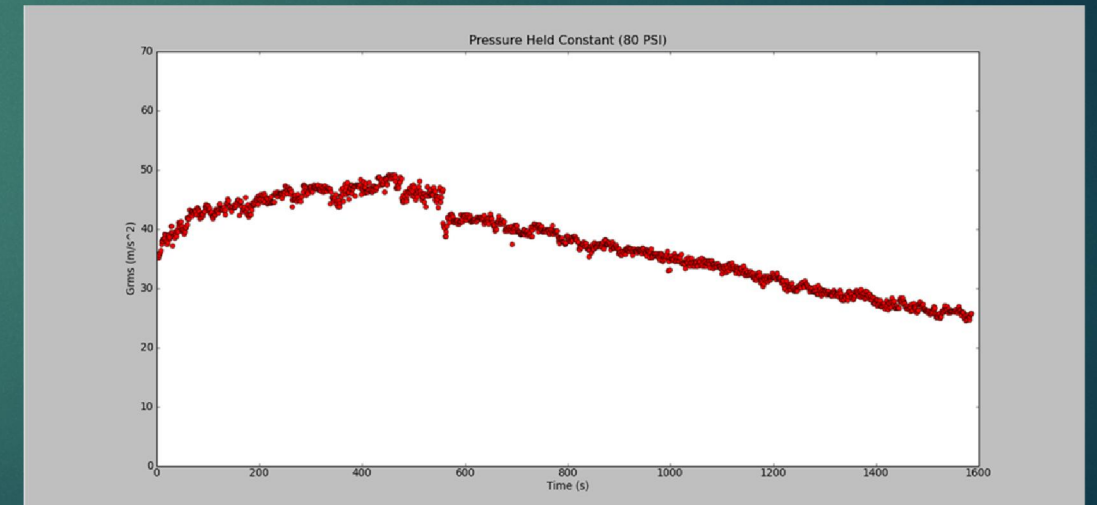
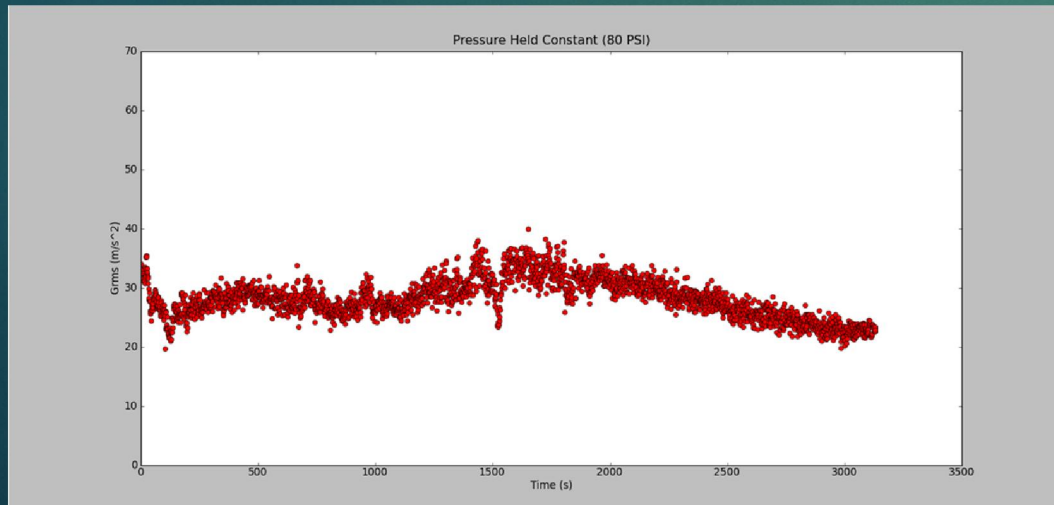
Grms vs Temperature

Grms vs Time



# Effects of Temperature on Grms

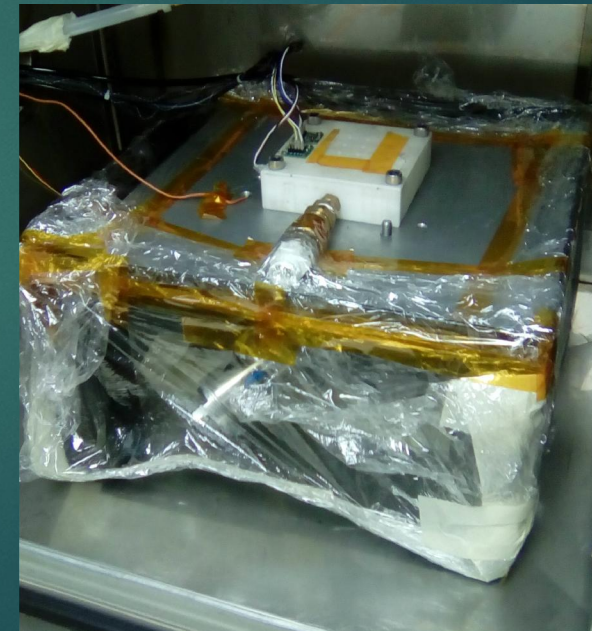
- Switched out the double mass for a longer single mass and the effects became less extreme.



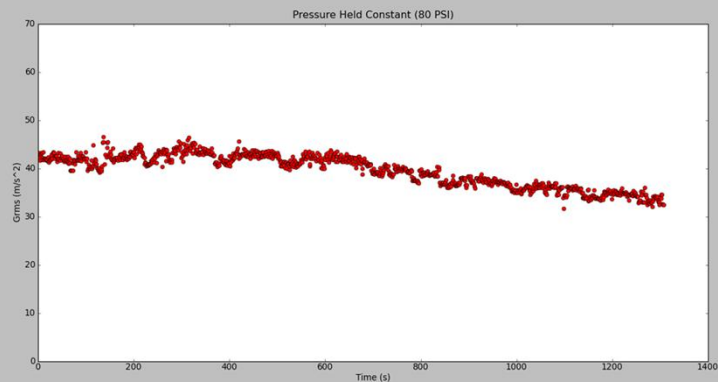


# Attempts to Keep Grms from Dropping

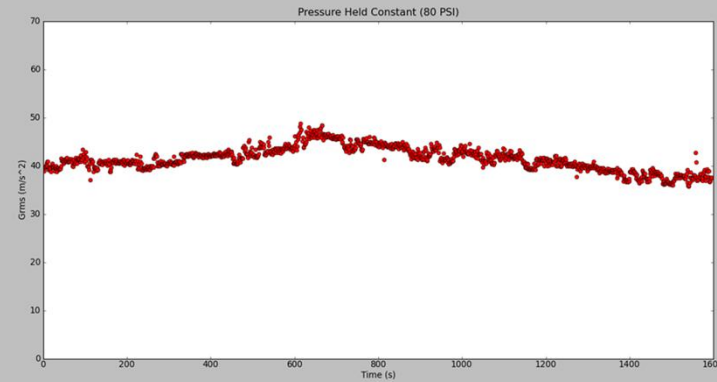
1. Saran wrap insulation
2. Heat tape coiled around cylinder
3. Heat tape attached to pressure tubing



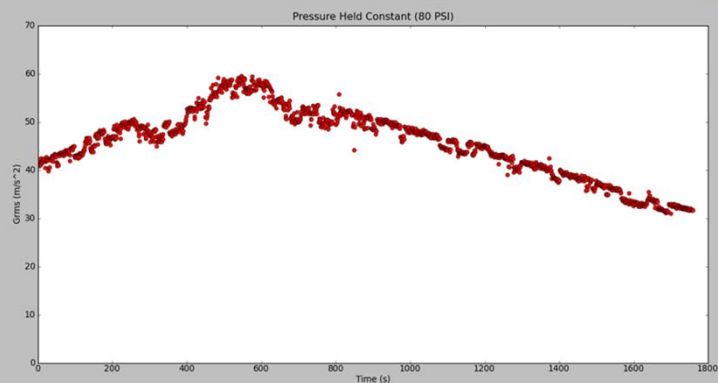
# Attempts to Keep Grms from Dropping



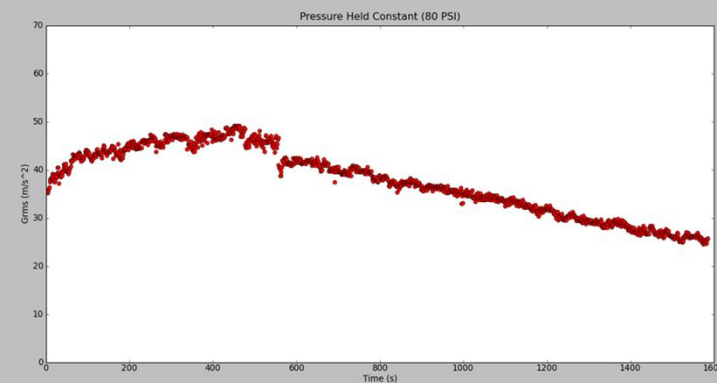
Saran wrap insulation



Saran wrap insulation plus heat tape  
around cylinder



Heat tape around pressure tubing

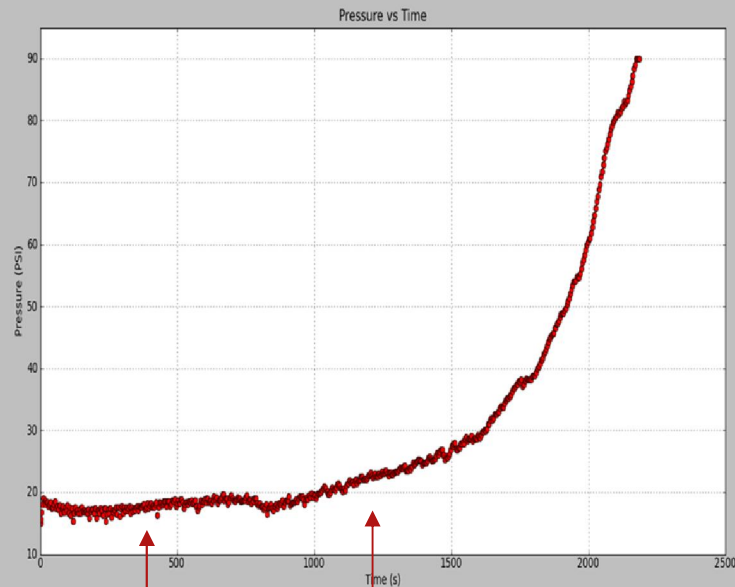


Control run



# A Closer Look at Pressure

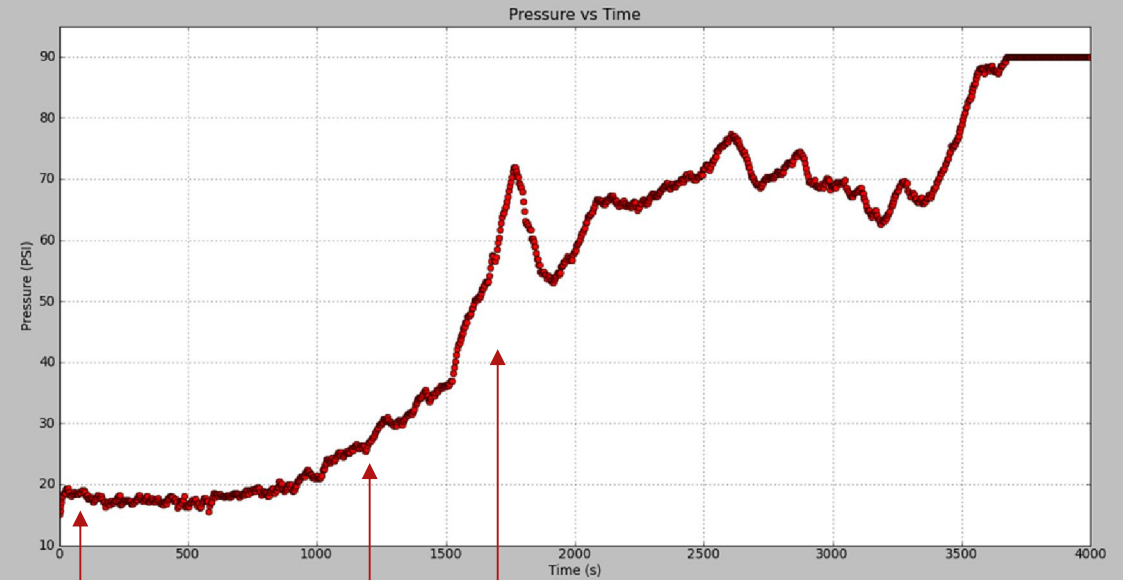
*No heat tape*



-20 C

-40 C

*Heat tape*



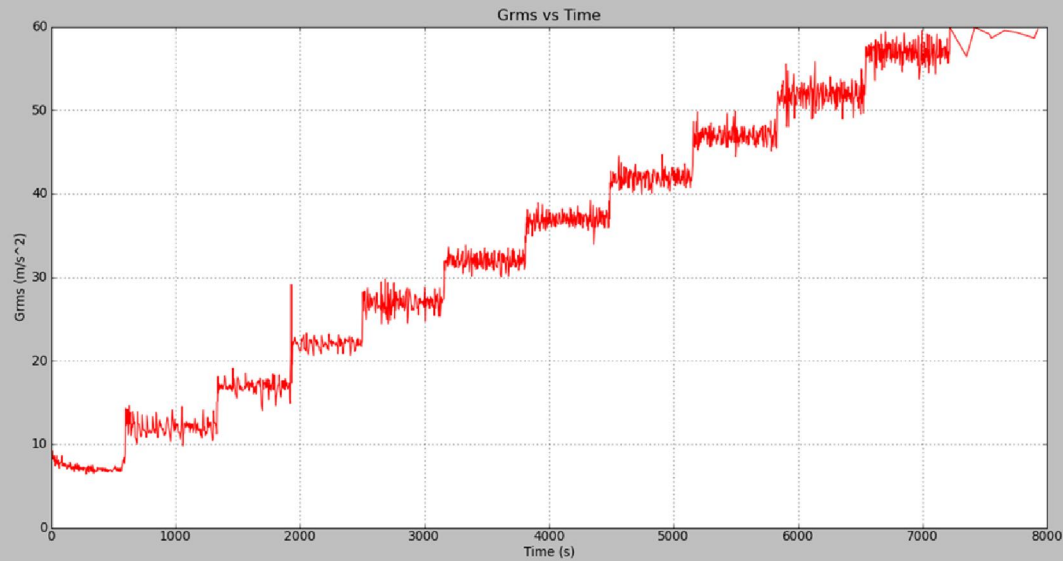
20 C

-40 C

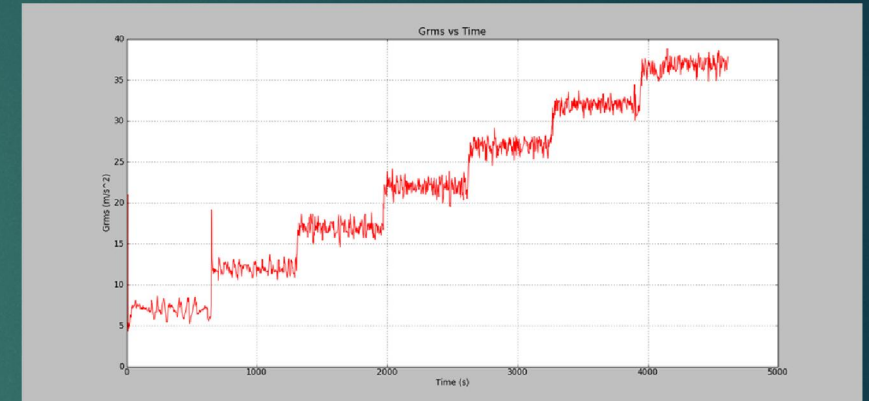
-50 C

# Testing 3 Cylinders at Once

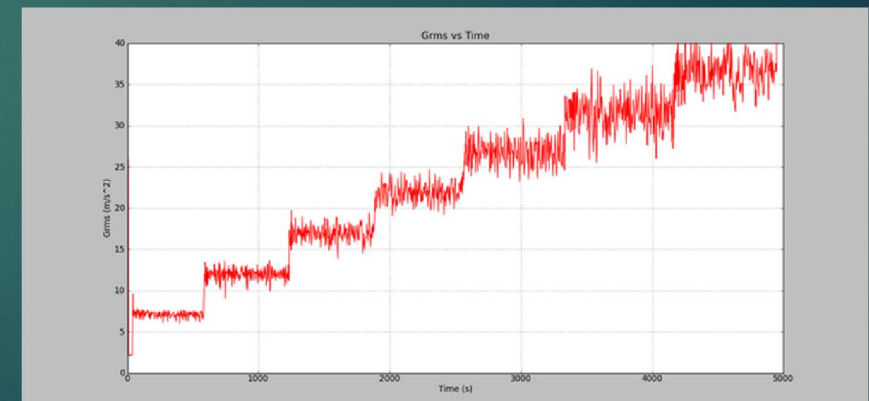
- Able to generate higher and more precise step functions:



7 – 57 grms



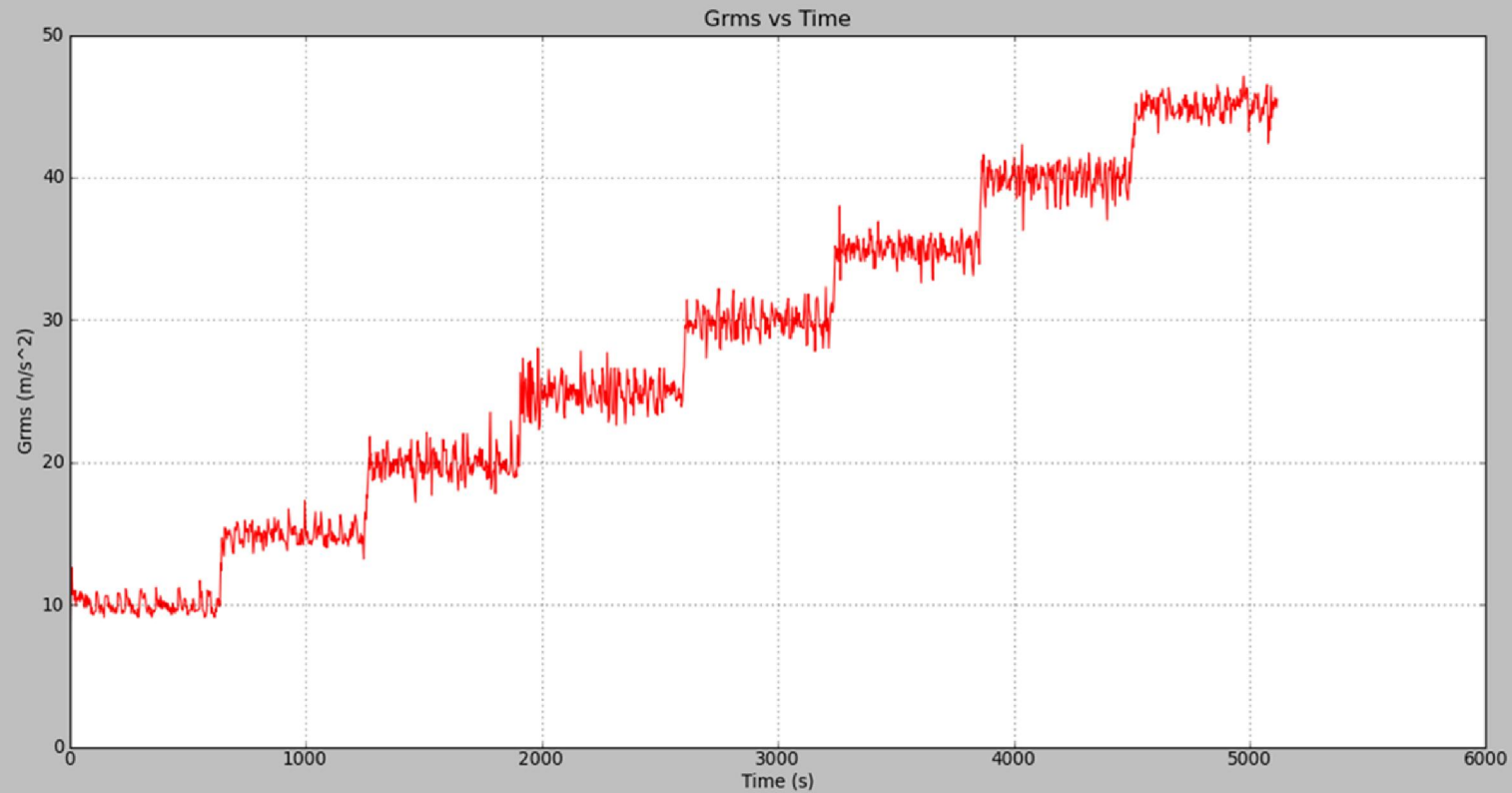
3 Cylinders



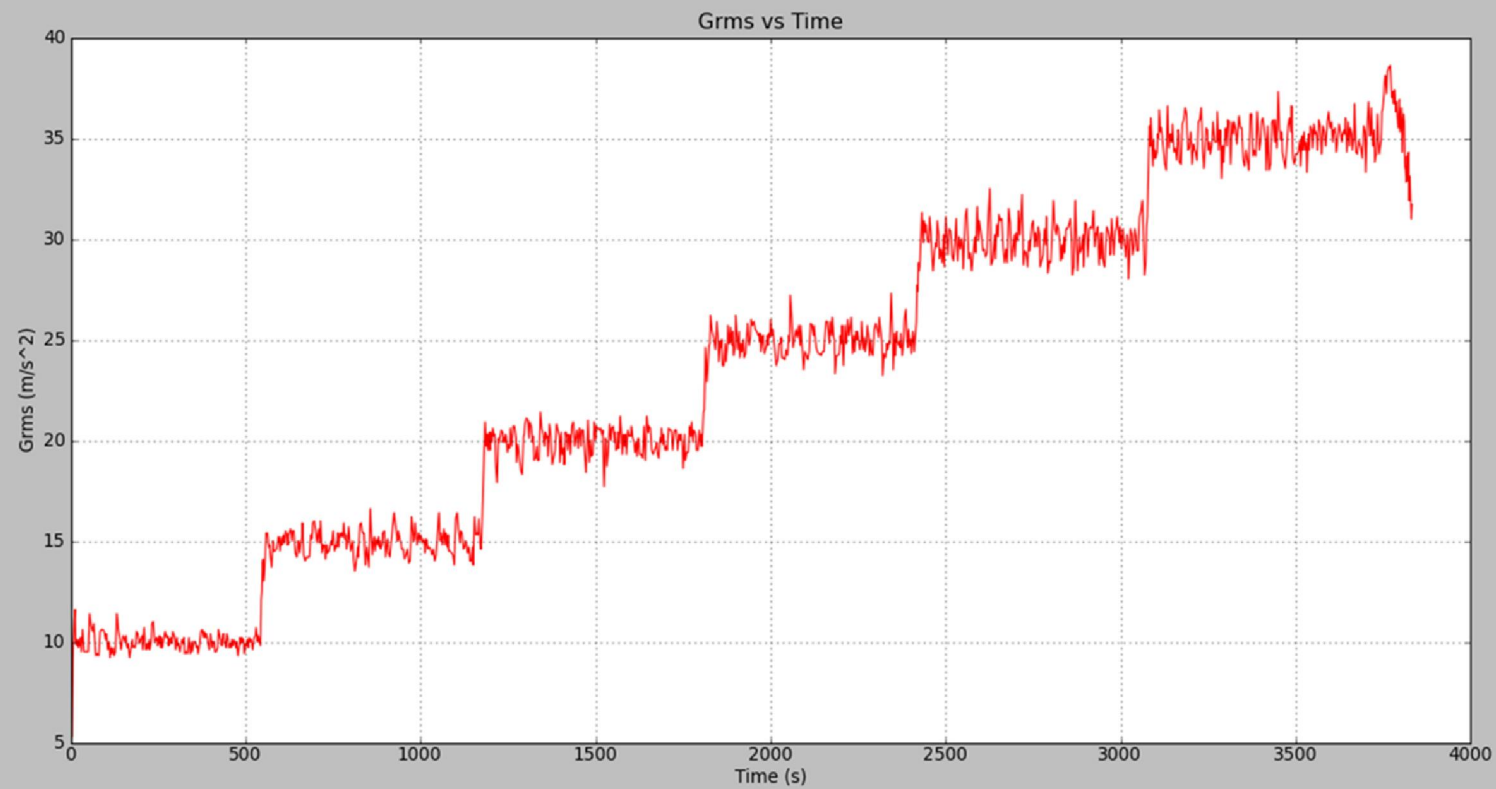
1 Cylinder



# Vibration Cycles at Various Temperatures

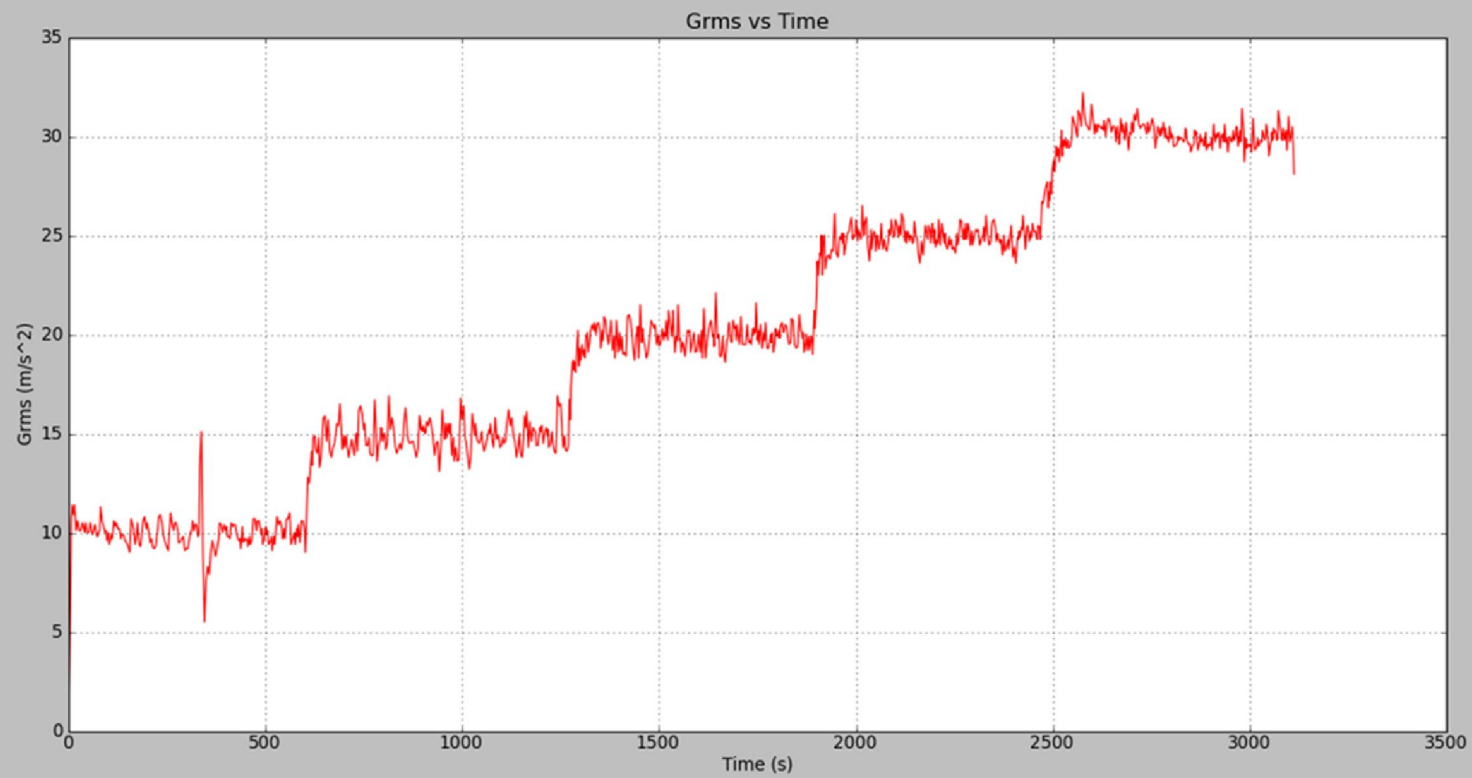


20 degrees Celsius

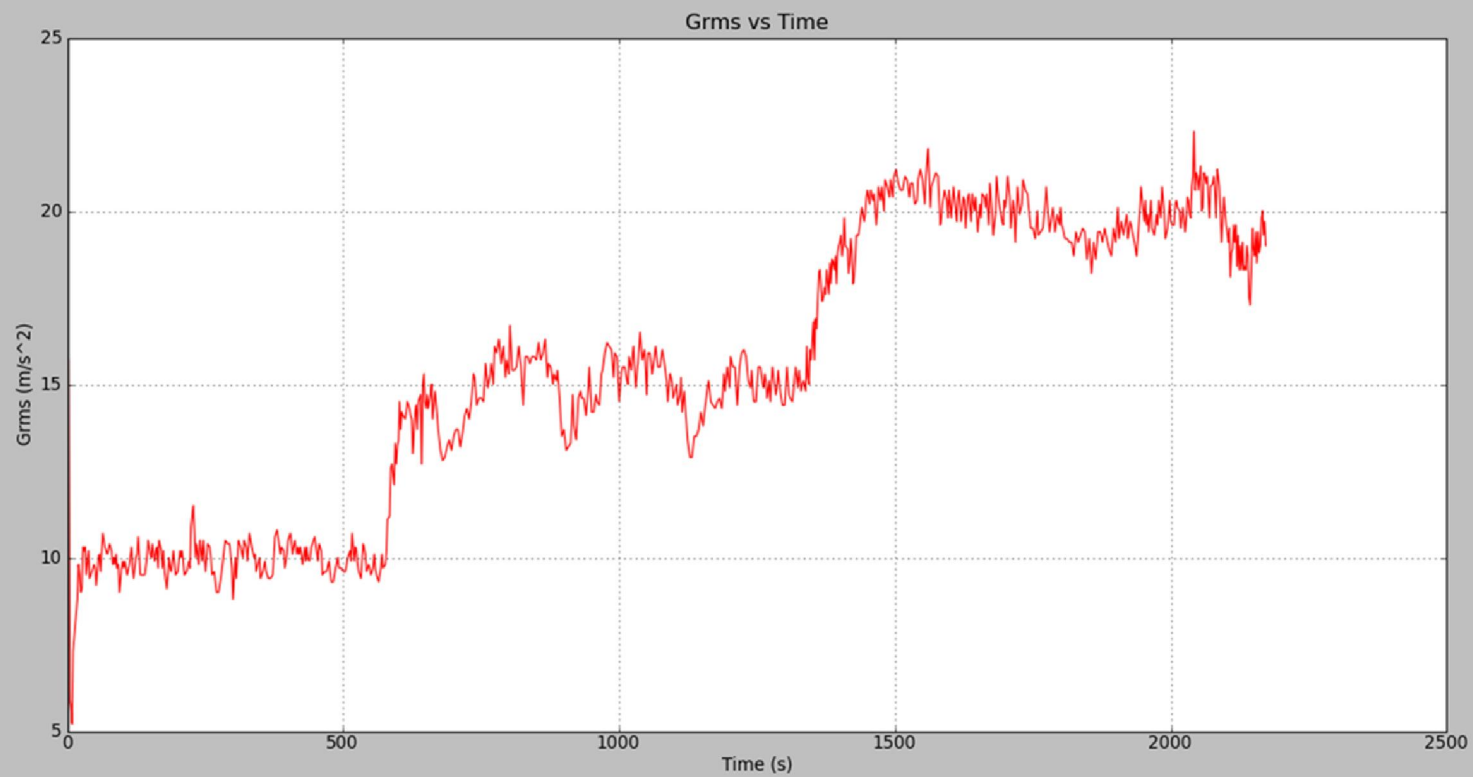


0 degrees Celsius





- 20 degrees Celsius



-40 degrees Celsius



# Future Work

- ▶ Table temperature does not cool or heat at same rate as thermal chamber. Program could be made to lower table temperature more quickly.
- ▶ Why does one cylinder behave differently from the other 2?
- ▶ Decide on best way to prevent pressure from skyrocketing at lower temperatures when trying to achieve a constant grms.
- ▶ Continue to look at alternate methods for vibration.