CAL POLY
ENGINEERING

HEPA Filter
High Temperature Test Unit (HTTU)

Presented by:

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Sponsored by:

Purpose

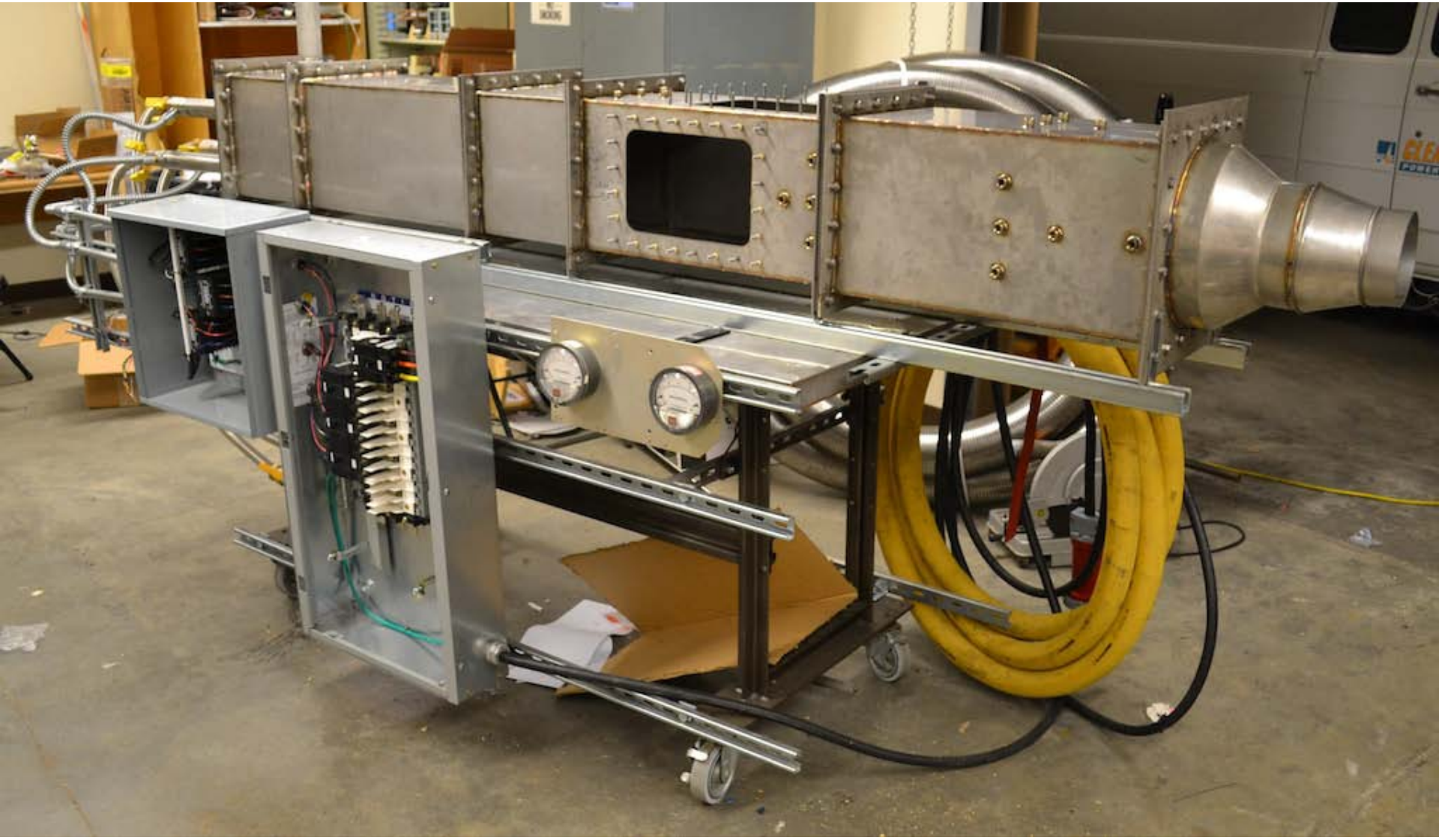
- To further improve nuclear air cleaning technology a next generation high temperature HEPA filter is needed

- A testing system is needed to develop this new type of filter

Project Requirements

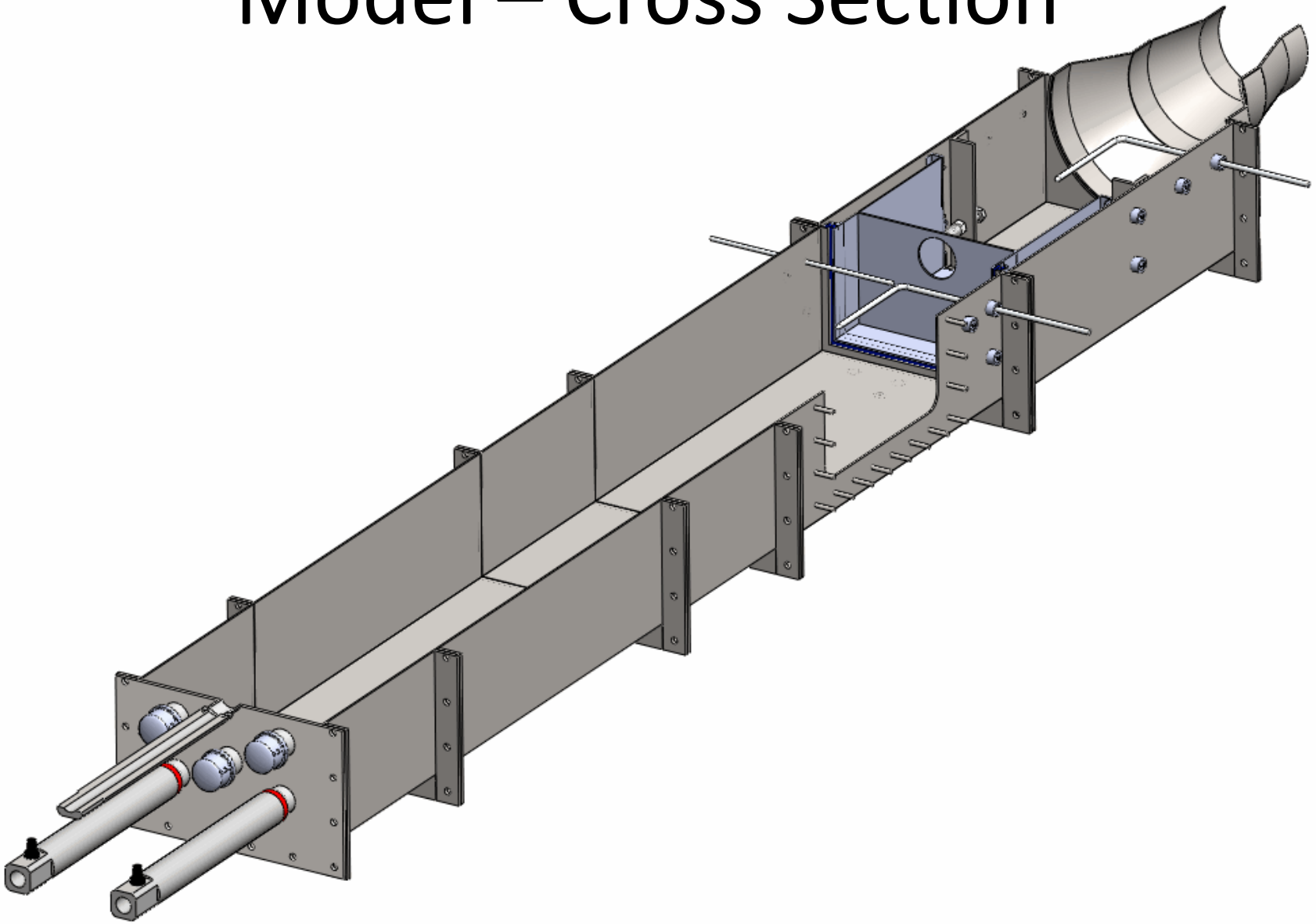
- Achieve at least 1000°F temperature
- Variable pressure drop across the filter from 1-6” H_20
- Inlet flow rate variable between 5 and 250 SCFM
- Measure temperature, airflow, and pressure
- Able to accommodate future improvements
- Complete requirements with $15,600 budget

HTTU Overview



HTTU Overview

Model – Cross Section



Previous Design Considerations

- Once Through Electrical System 1800°F
  - Required 180 kW of power
- Recirculating gas system at 1800°F
  - Blower is cost and temperature prohibitive
- Once through gas system at 1000°F
  - Back pressure too great for traditional burners

Major Components

- Air source
- Airflow control / measurement
- Heat source
- Ducting
- Insulation
- Filter interface / orifice plates
- Exhaust
- Instrumentation

Air Source and Flow Rate Control

- Compressor provides 330 SCFM at 120 psi
- Tanks alone can provide 250 SCFM for 45 minutes
- Needle valve to adjust flow rate
- Rotameter to measure flow rate

Heat Source

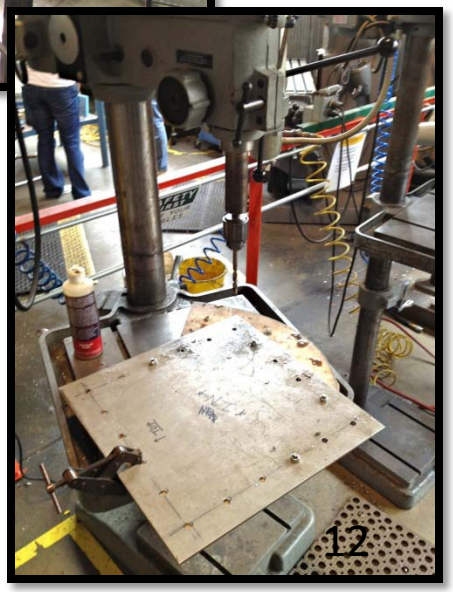
- 3 electric resistance heaters at 12.5 kW each
- Rated maximum temperature of 1300°F at 28.4 SCFM
- Power controlled with solid state relays
- Powered by 480 volts 3 phase
- Expandable to 8 heaters

Duct Material

- 12 gauge stainless steel ducting
- 3/8” Bolts 2 ¾” on center Through ¼” thick Flanges
- High Temperature Grafoil^{tm} gasket between sections

Duct Manufacturing

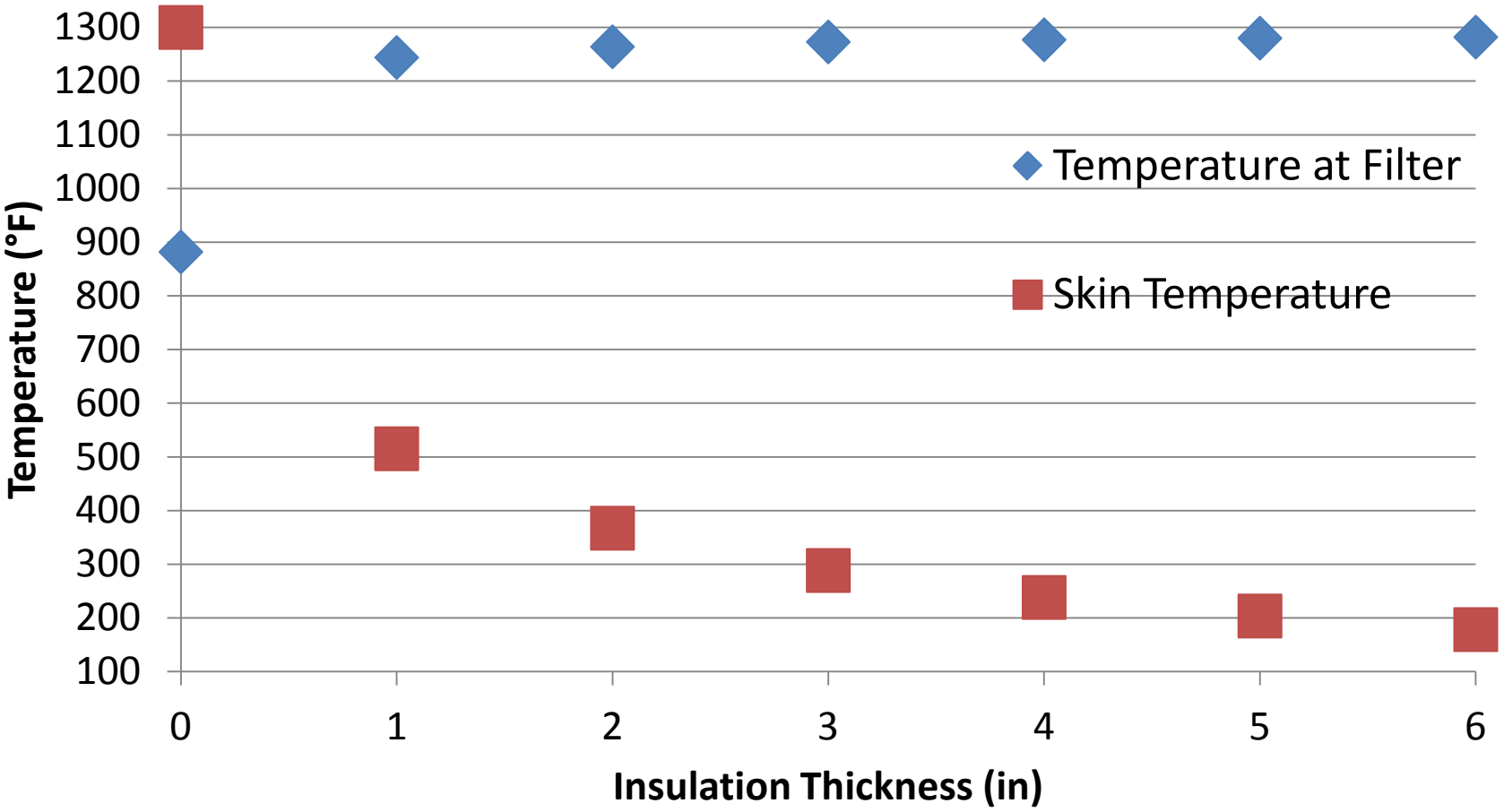
- Over 90’ of welds
- Over 380 holes drilled
- Total length of holes drilled through stainless steel: 6’-3”



Insulation

- Gemcowool mineral wool insulation
- Rated to 2100°F

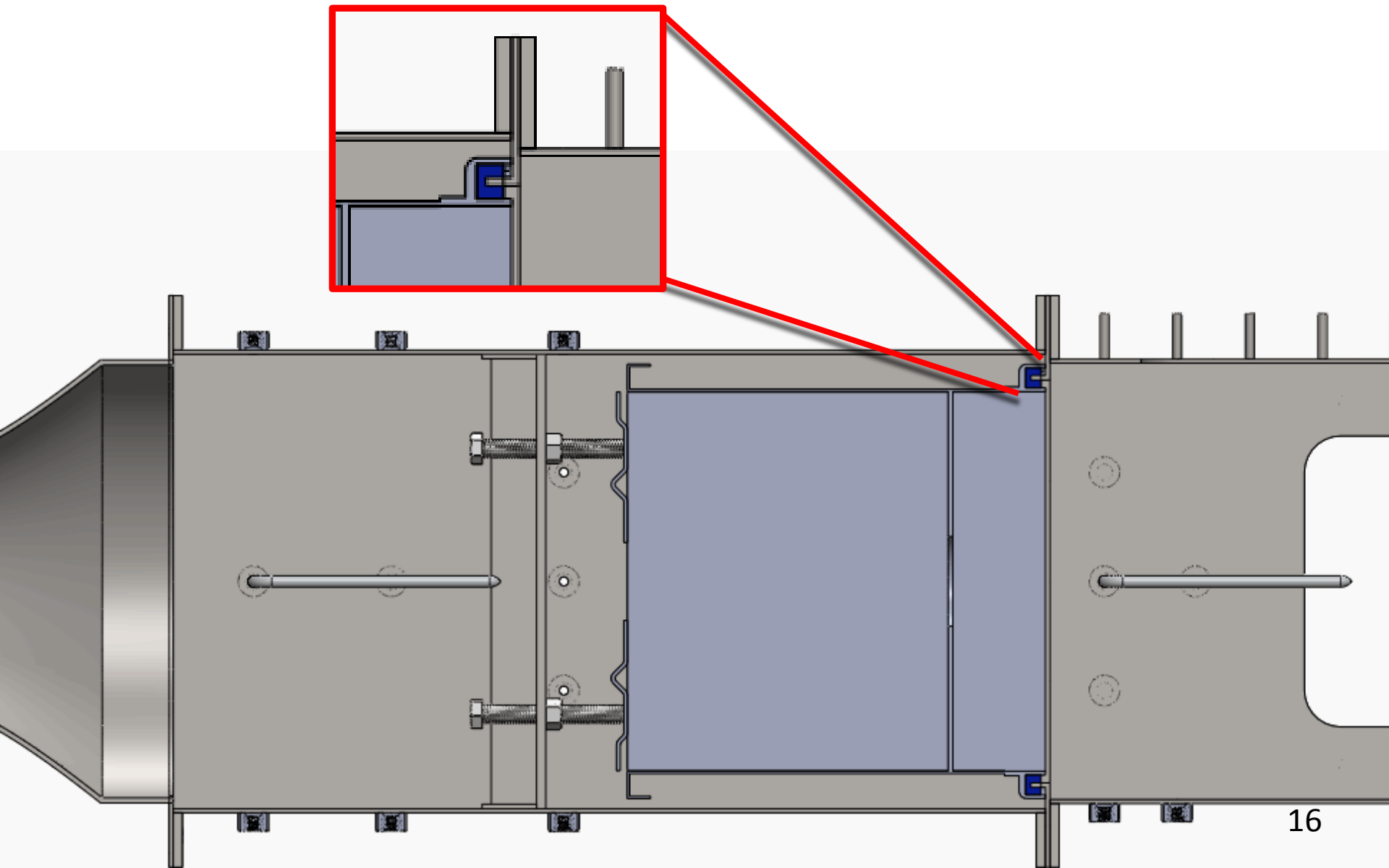
Insulation Thickness



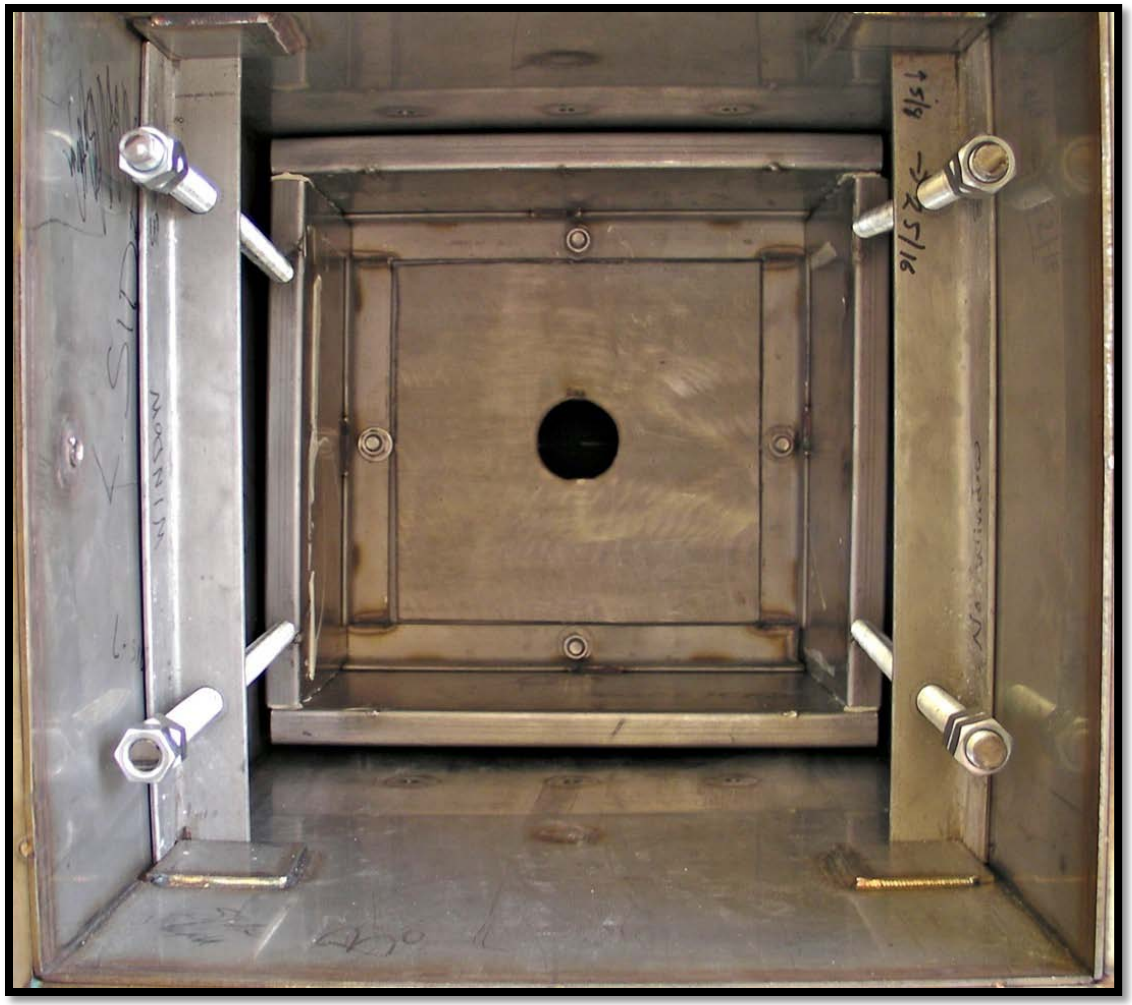
Filters

- HTTU interfaces with both Gasket Seal and Gel Seal filters

Filter Interface



Orifice Plate and Filter Retaining System

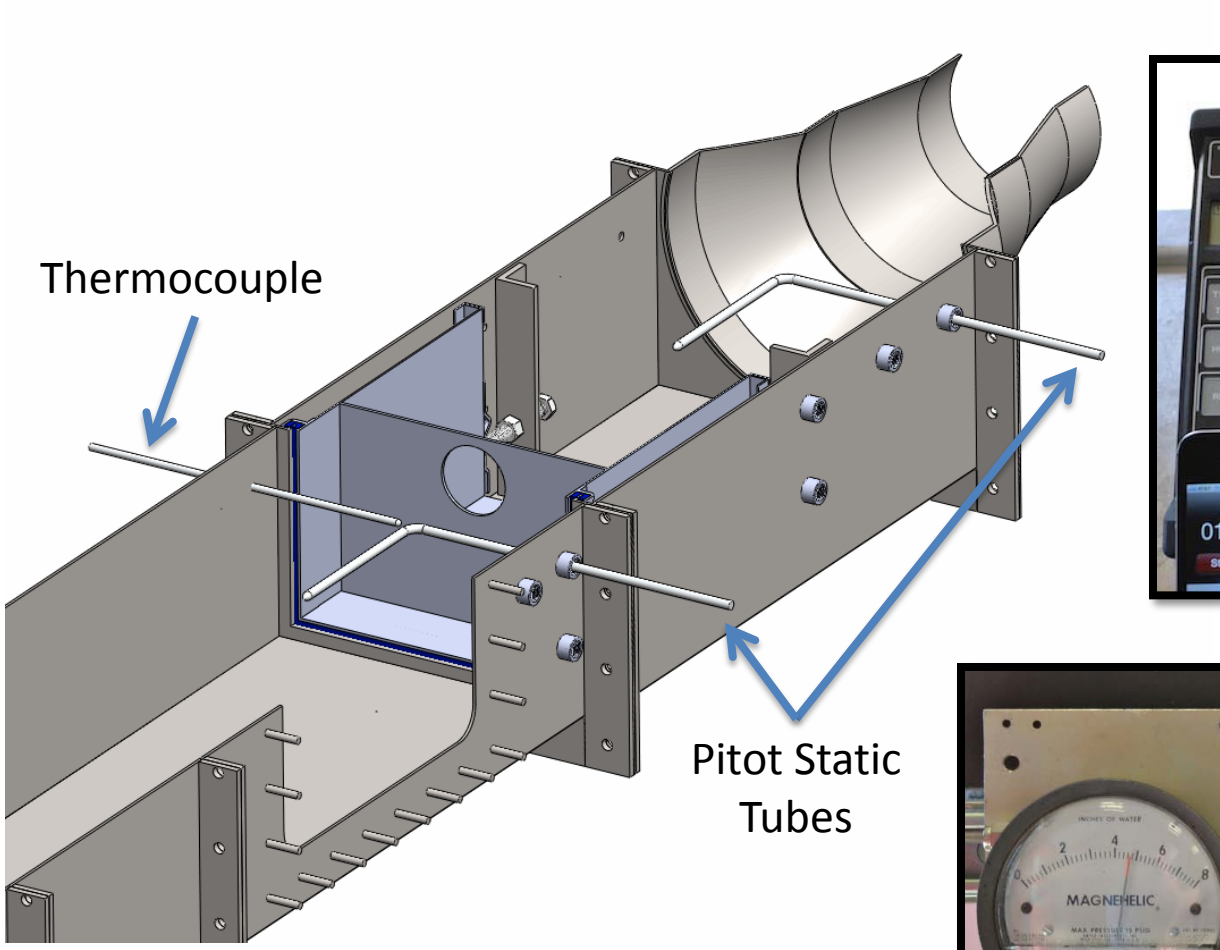


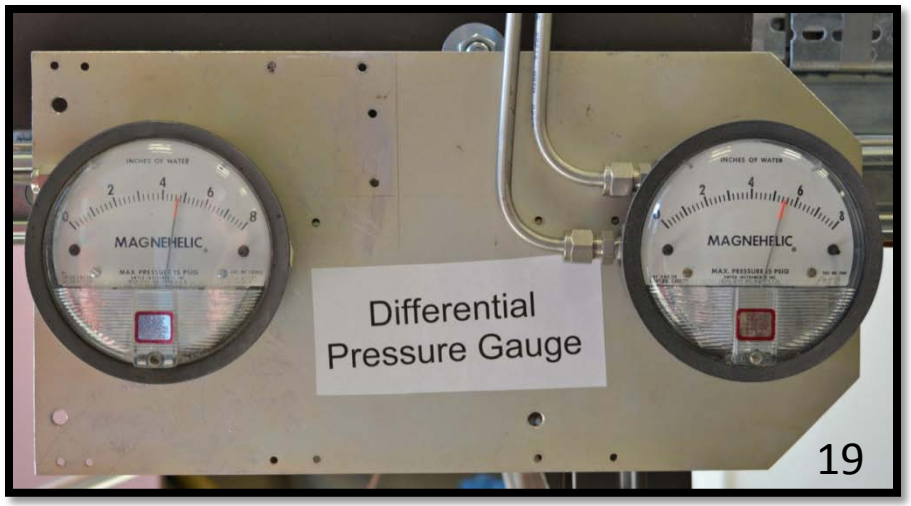
- Use of orifice plates to simulate clogged filters
- Filter retainer design puts no holes in ducting

Exhaust

- 6 inch stainless steel flexible tubing
- 1900 CFM roof mounted exhaust fan

Instrumentation



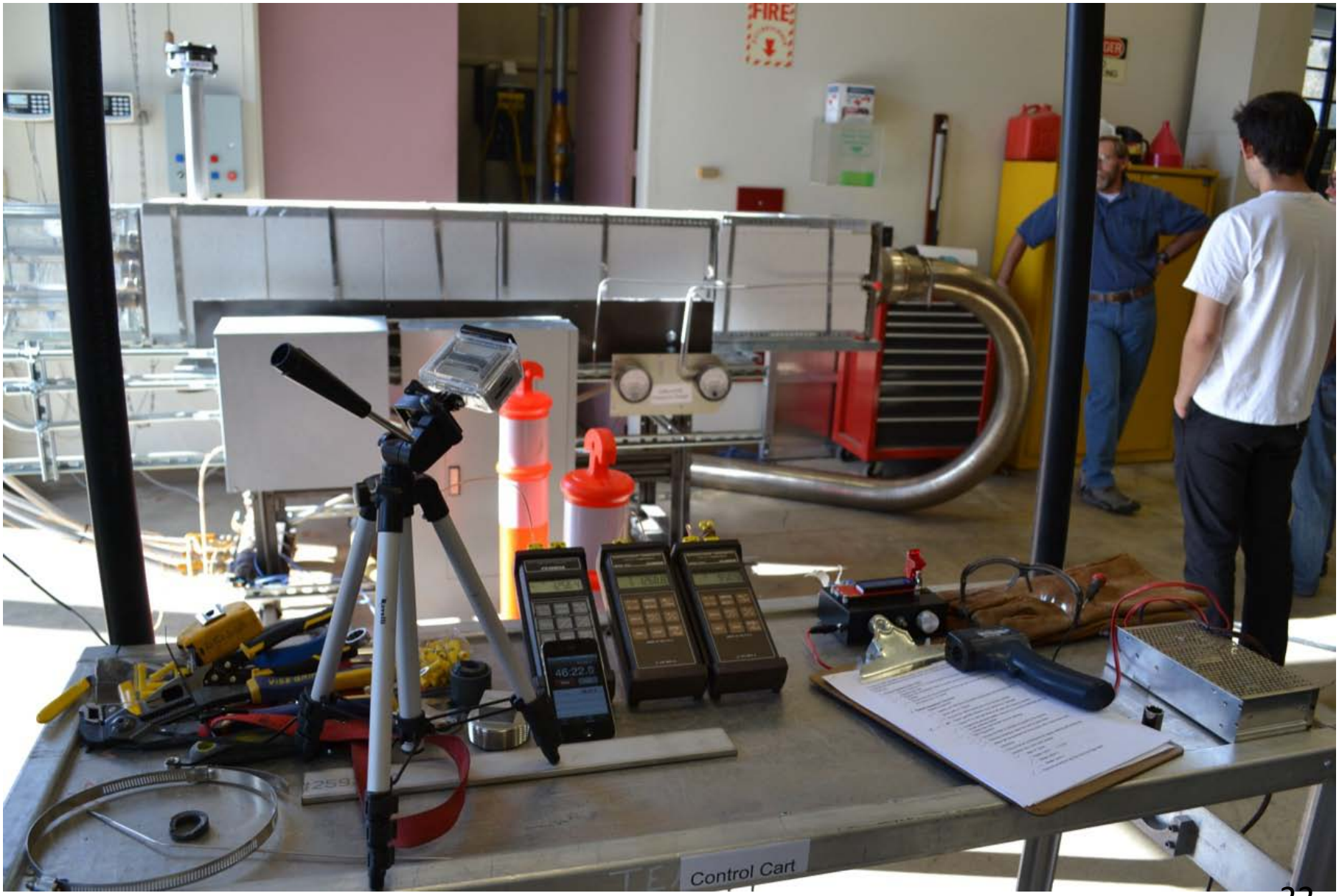


Key Design Features

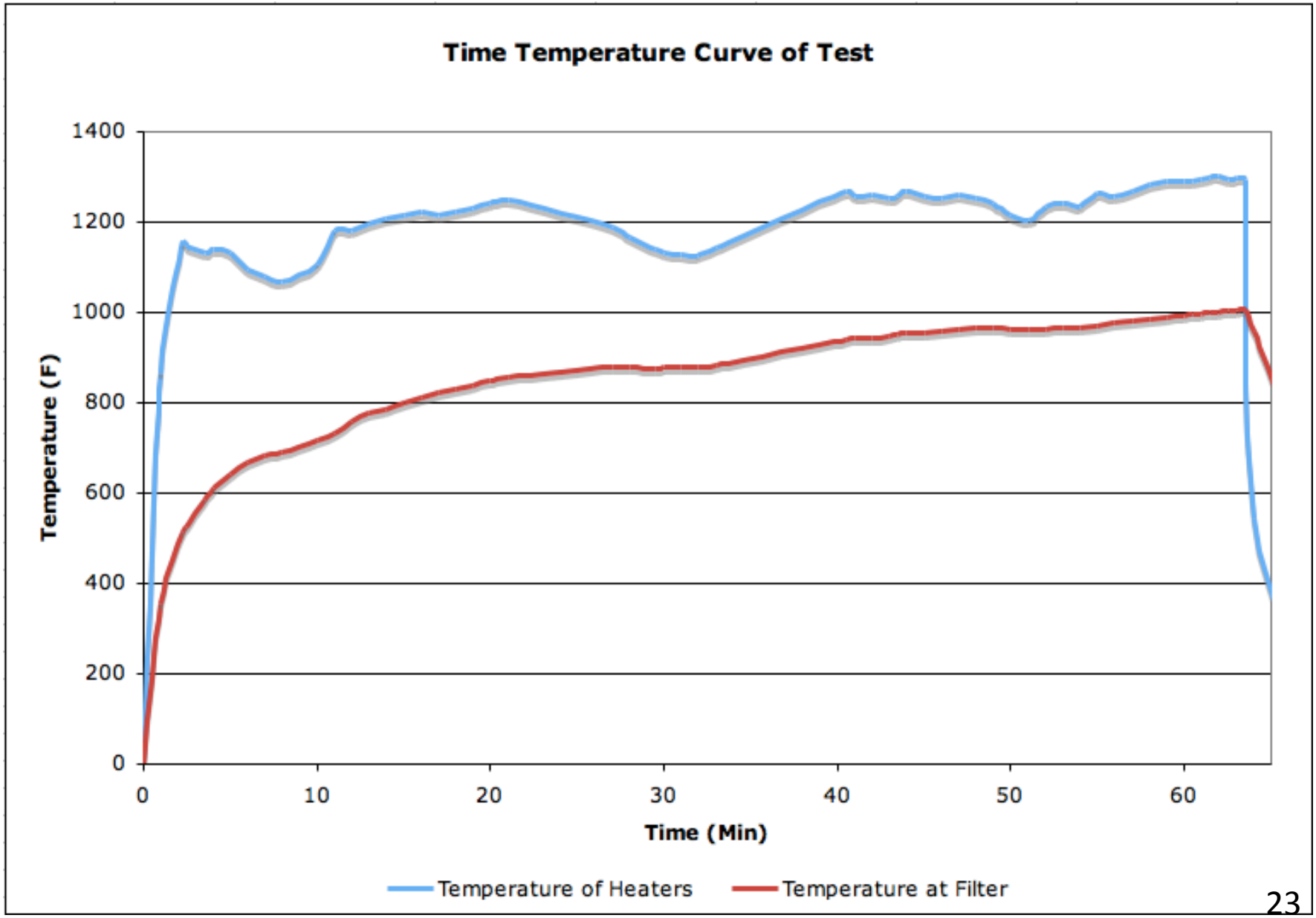
- Modular design
  - Expandable
    - Additional heaters & sensors via extra receptacles
  - Easily Reconfigured
    - Interchangeable duct sections
  - Accommodates future systems
    - Blanks for viewing windows

Testing

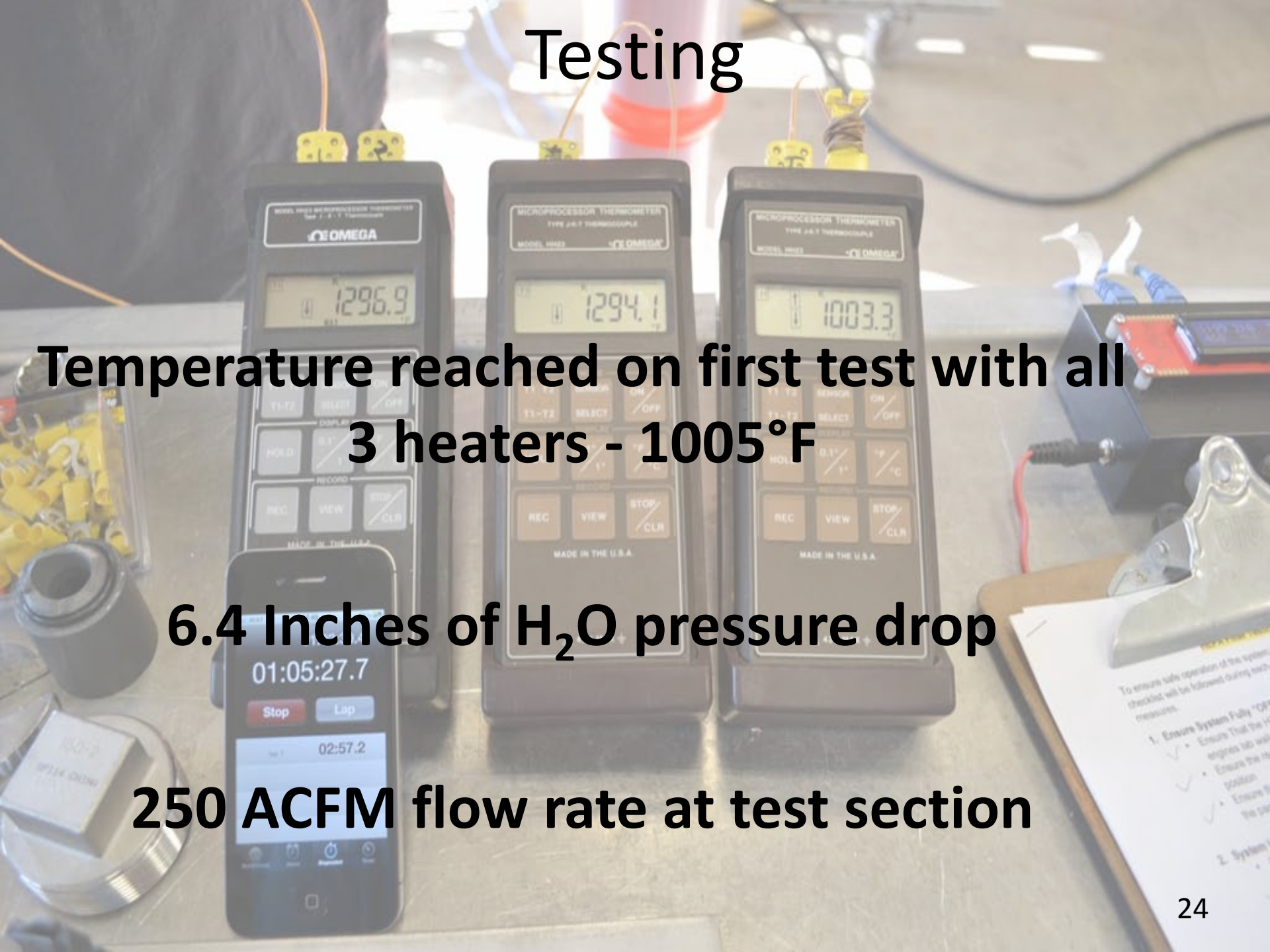
Testing



Testing


Time Temperature Curve of Test
Temperature (F)
1400
1200
1000
800
600
400
200
0
0
10
20
30
40
50
60
Time (Min)
Temperature of Heaters
Temperature at Filter

Testing



Temperature reached on first test with all 3 heaters - 1005°F

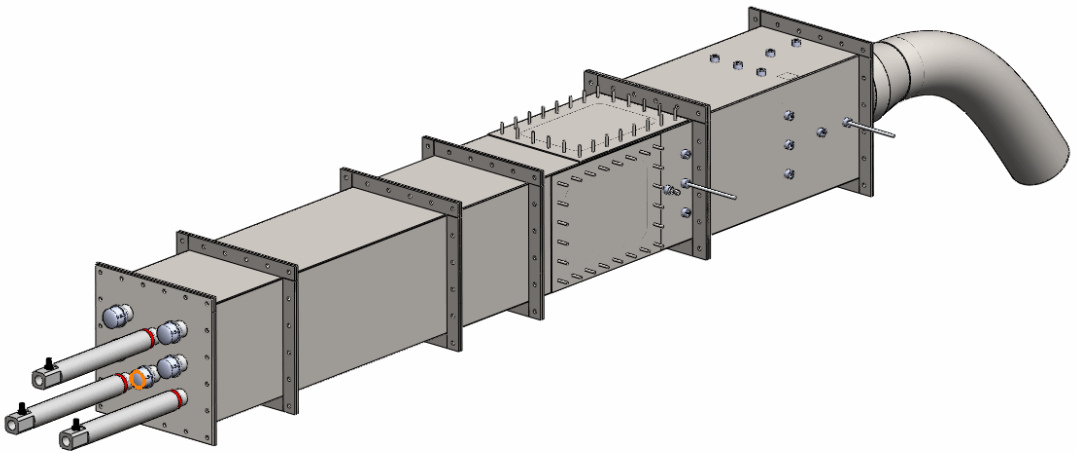
6.4 Inches of H_2O pressure drop

250 ACFM flow rate at test section

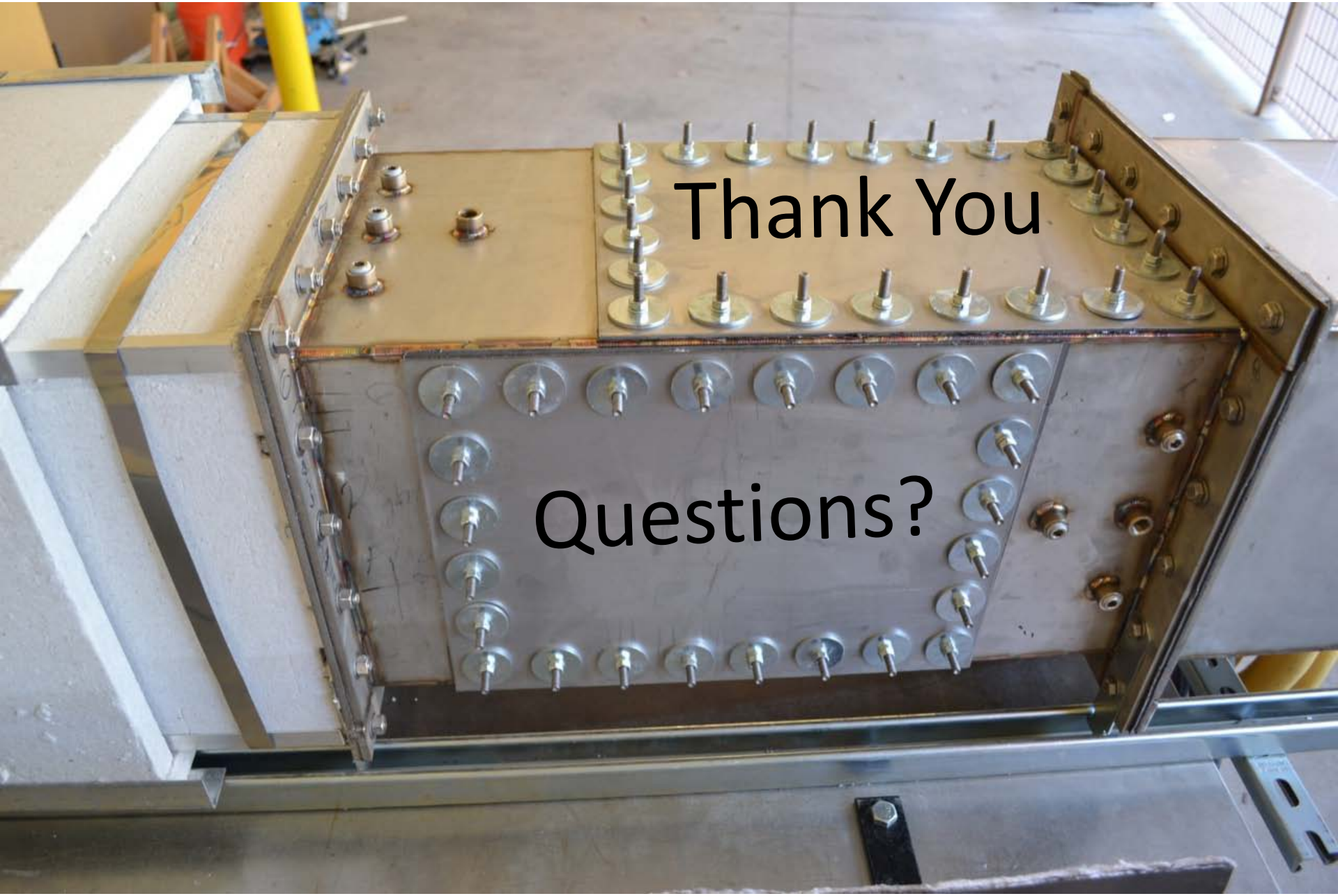
Future and Potential Project Expansion

- Completely automated test procedure
  - In progress with 2nd senior project team
- Higher flow rates from additional heaters
- Direct flame impingement
- Soot loading test
- Additional data acquisition
  - Filter seal leak detection
  - CCTV recording of test through viewing windows
  - Duct surface temperature

Conclusion



- All project requirements were met, including budget constraints
- The HTTU adds to Cal Poly testing capabilities which includes a shake table
- Cal Poly students are available to modify the HTTU and work on your sponsored projects


Thank You
Questions?