HEPA Filter
High Temperature Test Unit (HTTU)

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Sponsored by:
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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” H₂O
• 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
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™ 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
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

Thermocouple

Pitot Static Tubes

Differential Pressure Gauge
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)

Time (Min)

Temperature of Heaters
Temperature at Filter
Testing

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

6.4 Inches of H₂O pressure drop

250 ACFM flow rate at test section
Future and Potential Project Expansion

• Completely automated test procedure
  – In progress with 2\textsuperscript{nd} 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?