

# Seat Cushion Test Method Update



Federal Aviation  
Administration

Presented to: IAMFTWG

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# 2.0 gph NexGen Burner Set-up

- **2.02 gph @ ~95 psi fuel pressure**
- **1/8” sheathed ceramic packed K type TCs**
- **Test using an air pressure of 45 psi**
  - Based on previous seat cushion test results using a 2.0 gph NexGen burner that were comparable to the Park Burner test results

# 2.0 gph NexGen Burner Setup Continued

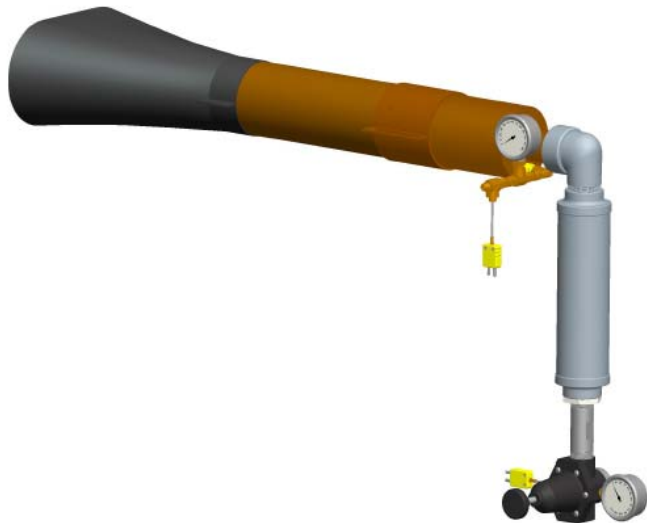
- **Stator Positioning: Results**
  - Rotational Location
    - Igniter centerline located 330 degrees clockwise from zero degrees (igniter vertical centerline)
  - Axial Location
    - Front face of stator located 3.375 inches from front face of turbulator

# 2.0 gph NexGen Burner Set-up Continued

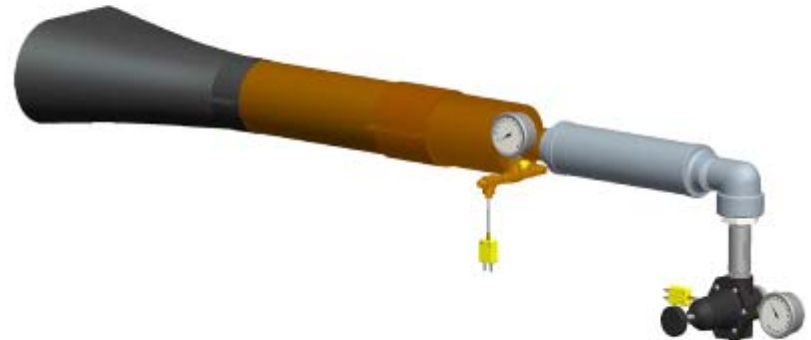
- **Configuration: Muffler and 90 degree elbow**
  - The burner was fitted with a 90 degree elbow at the rear of the draft tube to reduce the space needed to run the device. This seemed to have an impact on the operation of the burner, and resulted in reduced TC temperatures, and erratic results. The muffler on the burner was repositioned in between the elbow and the draft tube. The muffler acts to smooth out the flow which was being disrupted by the 90 degree elbow.

# Muffler and Elbow Configuration

**Before**



**After**



# Fuel Nozzle Adjustment

- **Flame temperature profile can further be refined by clocking fuel nozzle**
  - A non-uniform spray pattern can require nozzle adjustment to achieve a more uniform temperature profile
  - This setting would not necessarily be the same for each burner since each fuel nozzle may have slight variations in fuel spray pattern
  - Testing has shown even small changes (~5 degrees) can have an effect on the flame temperature profile

# Fuel Nozzle Adjustment

- **Fuel Nozzle Adjustment Continued**
  - Because fuel nozzle clocking is a lengthy process, it was determined that a better alternative would be to use a different brand of nozzle with tighter tolerances.
  - The FAA has recently acquired a set of Delevan fuel nozzles, which are in the process of being tested.

# Fuel Nozzle Flow Test Rig

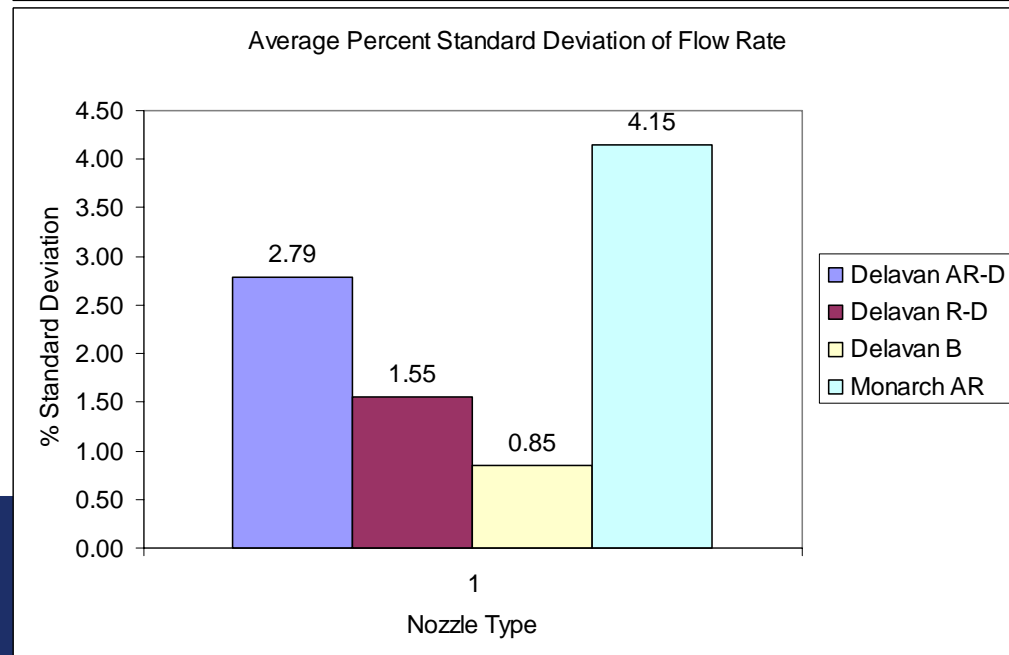
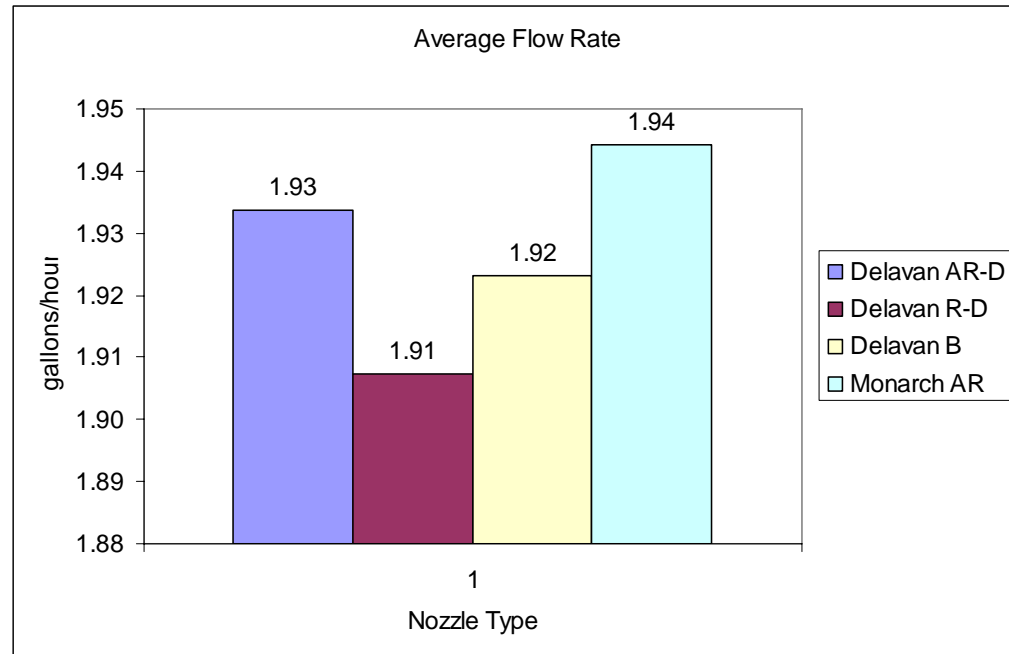


- Fuel is pressurized to 100 psi, and fuel is collected for one minute then stopped. The reading on the graduated cylinder shows the number of milliliters that flow in one minute. This is then converted to gallons per hour. The actual fuel flow rate can then be compared to the rated flow rate of the nozzle. A higher quality nozzle will show a lower difference between actual and rated flow rates.

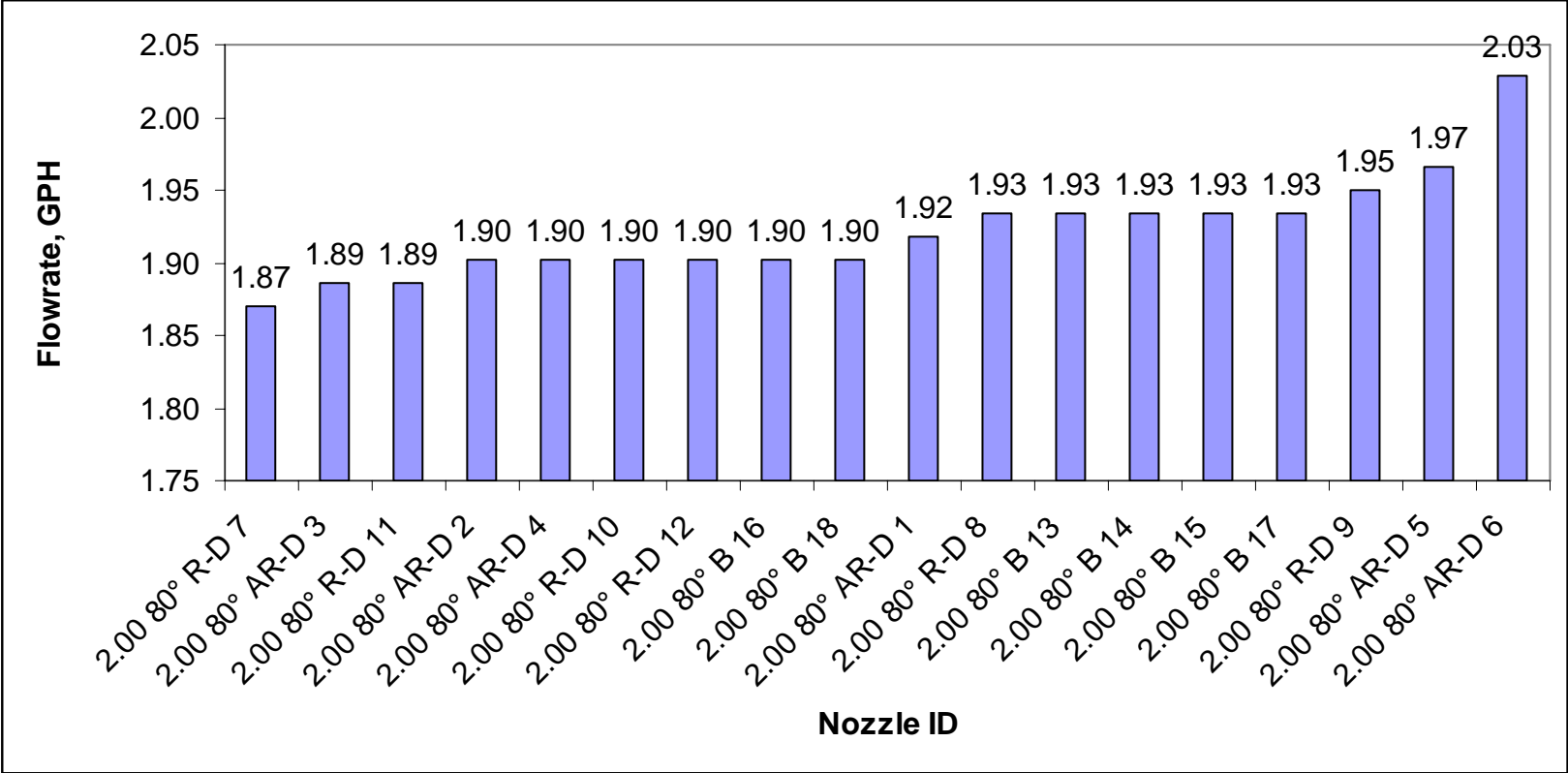


# Fuel Nozzle Flow Rate

- **Delevan Nozzle Flow Check**
  - The Delevan nozzles were checked on a bench top flow testing rig. The results show, that compared to the typical Monarch nozzles, the Delevan nozzles have a much lower percent error.
  - **Delevan error: 4.09%**
  - **Monarch error: 13.59%**
  - Further testing with different nozzles is ongoing.
- **25 Everloy 2.0 gph-rated hollow cone nozzles have been purchased and are being flow tested now**



# Delavan Nozzle Flow Test Results



- **Average = 1.92**
- **Std Dev = 0.04**
- **%SD = 1.89%**



# Monarch Nozzle Clocking Tests

Monarch 2.25 PLP



# Delavan Nozzle Clocking Tests

Delavan AR-D-6



# Nozzle Clocking Summary

- **Monarch nozzles are not uniform around the spray cone periphery**
- **Delavan nozzles seem to provide more uniform spray pattern through 360° nozzle rotation**
  - Magnitude of temperature is significantly lower (~1550°F) than Monarch (~1770°F)
  - Could be due to old thermocouples, will be replaced and Delavan nozzles will be re-checked

# Ceramic Fiberboard Seat cushion

- **To reduce the number of seat samples burned, and to gain a better understanding of the surface temperature of the seat, a seat cushion made of kaowool was constructed and outfitted with 40 thermocouples.**
- **Seat samples testing will also continue to help develop the Nexgen Burner settings.**

# Ceramic Fiberboard Seat cushion

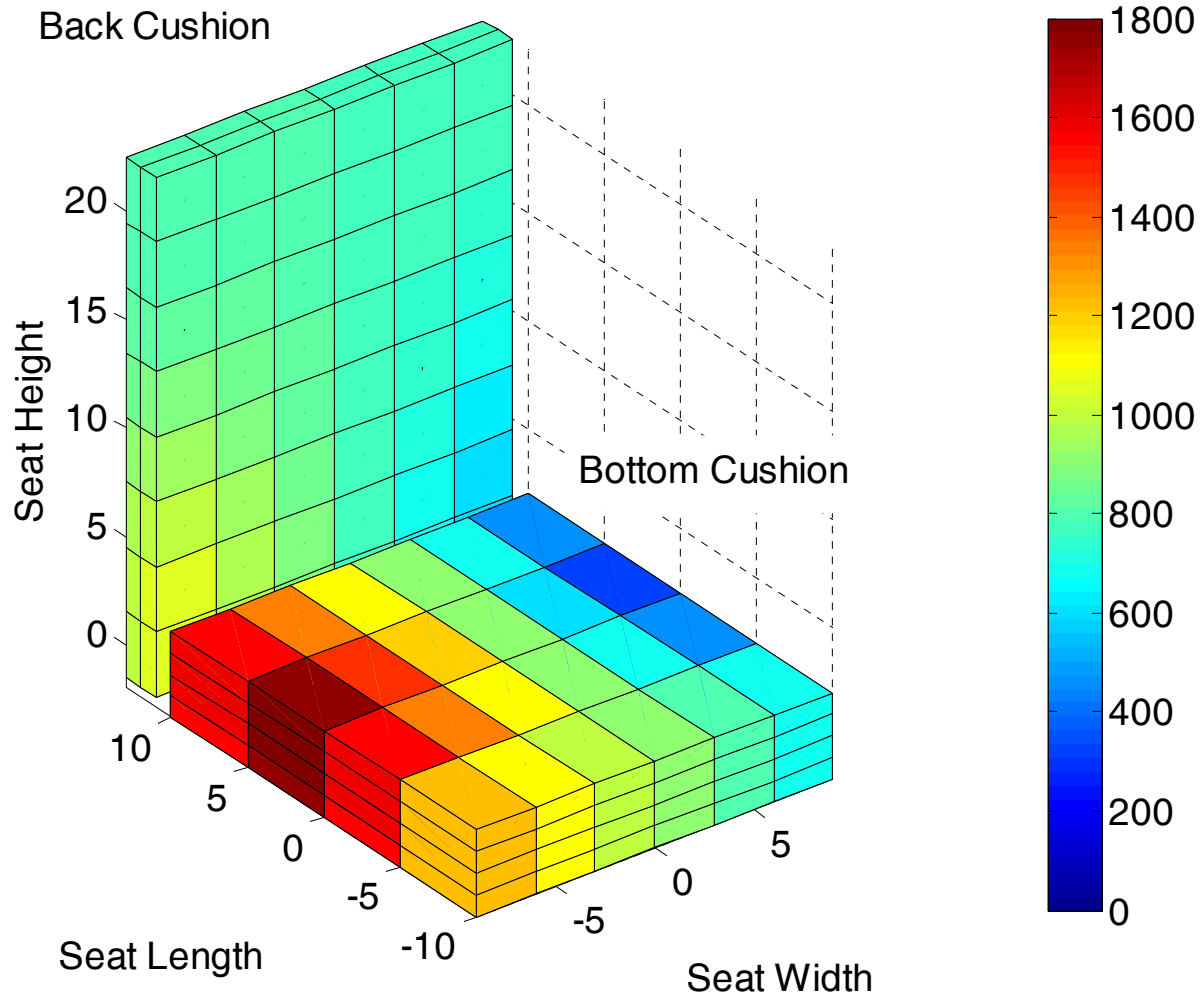
- **The arrangement of the muffler and elbow on the Nexgen burner, as well as the fuel nozzle and other parts, can have an effect on the flame. Improper setup can cause the flame to become skewed and lead to faulty test results. The kaowool cushion will show the temperature profile of seat surface, and enable the technician to adjust the burner such that the flame is centered on the cushion.**

# Ceramic Fiberboard Seat cushion





# Ceramic Fiberboard Seat Cushion



# Summary

- **Testing of various aspects of seat cushion test still underway**
  - Back end of burner (muffler, sonic choke, etc.) configuration has an impact on test results for the seat cushion test
  - New fuel nozzles have been obtained and flow checked, results are more consistent than original nozzles
  - New fuel nozzles have more consistent temperature profile through full rotation of spray nozzle
  - Seat testing will verify if new nozzles can be used
  - A new tool is being developed to determine if changes in burner settings can be detected without burning of many seat cushions

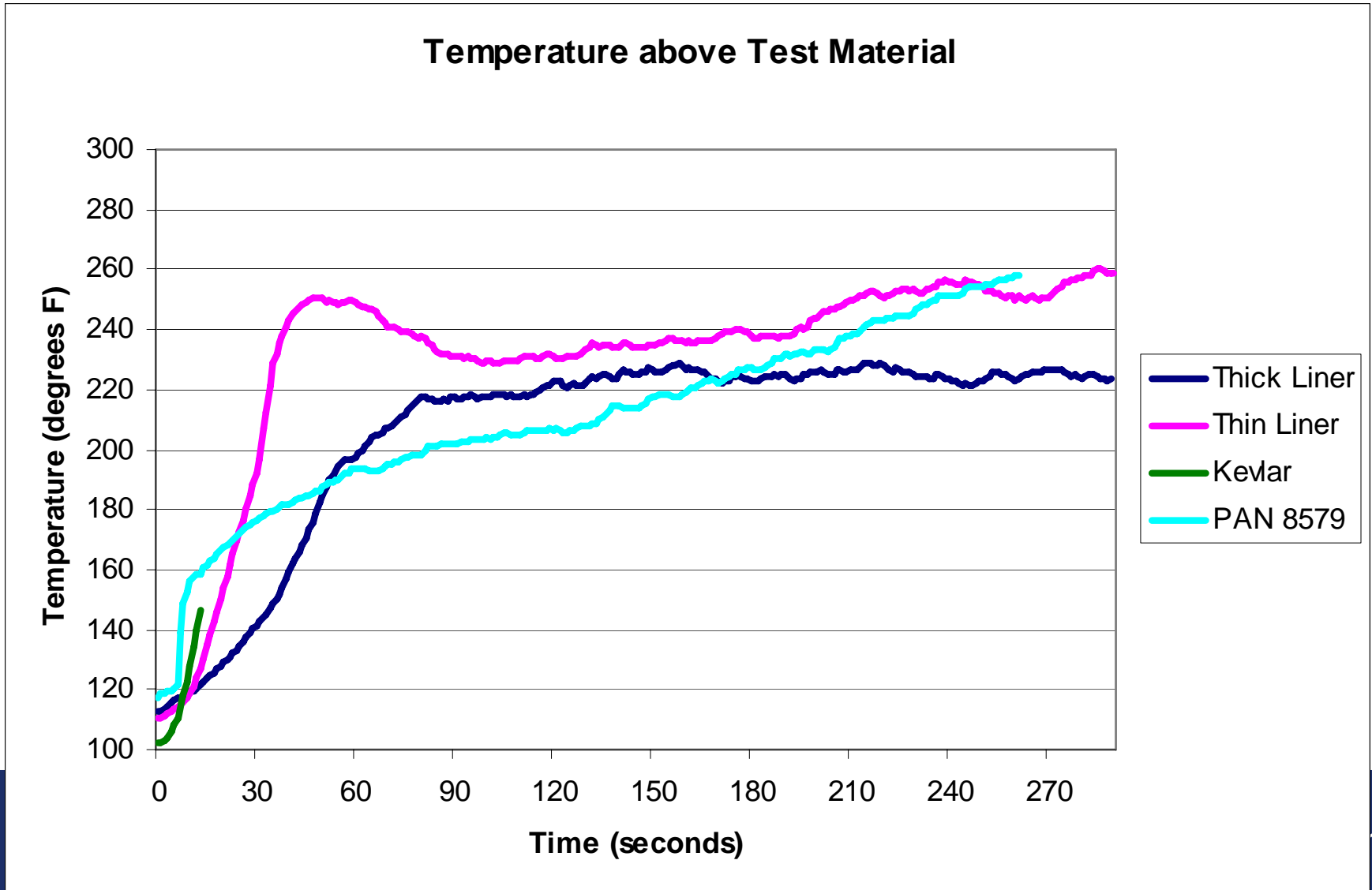
# Questions?



# Cargo Liner Burner

- **Park Burner has been reinstalled and calibrated for the purpose of running a number of tests on different materials.**
- **This data will then be the basis for calibrating the Nexgen Burner.**
- **Burn through times as well as the temperature 4 inches above the material were recorded.**

# Park Burner Test Results



# Park Cargo Liner Burn Rig



- **When testing is completed, the Park burner will be removed, and the Nexgen burner will replace it. Testing will then begin with the Nexgen so that test results match those of the Park burner.**

# Further Testing

- **Wrap-up testing cargo liner with Park burner, and begin to test specimens with Nexgen burner. Calibrate Nexgen burner to match Park results.**
  - Arrangement of 90 degree elbow and muffler has an effect on flame temperature and shape
  - Test cargo liner using new nozzles
  - Confirm Nexgen calibration settings