Burnthrough and NexGen Burner Update

Federal Aviation Administration

IAMFTWG

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Robert I. Ochs

Genesis of the Next Generation Fire Test Burner

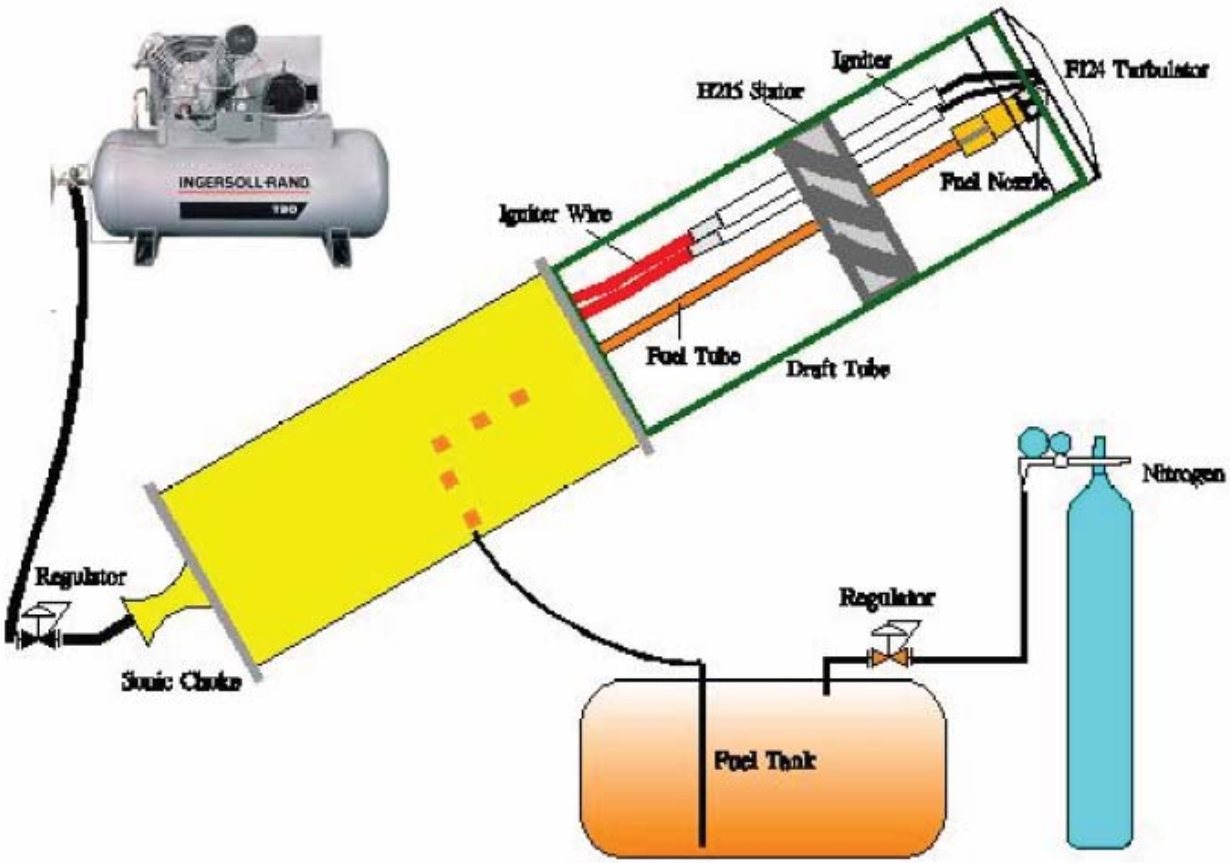
- **During development and implementation of the Thermal Acoustic Insulation Burnthrough Rule, it was discovered that the Park DPL 3400 was no longer in production**
- **Options**
  - Find another commercial off the shelf oil burner
  - Develop a new burner that will not suffer the same fate

Objectives

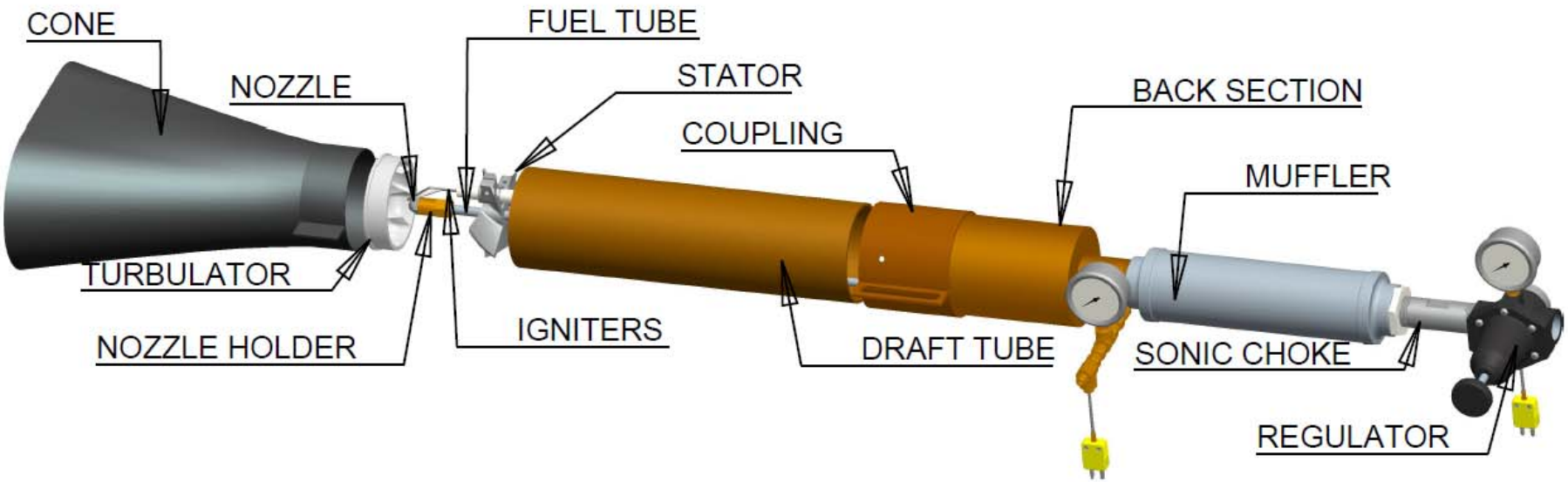
- **Design a fire test burner that can be constructed in-house with easily obtainable components**
  - Simple design
  - Simple operation
  - Simple maintenance
- **Burner output must be comparable to the Park DPL 3400**
- **Burner should achieve a higher level of repeatability and reproducibility**
- **Burner should be versatile and easily adaptable to any of the fire tests calling for a "modified gun-type burner"**

Initial Concept

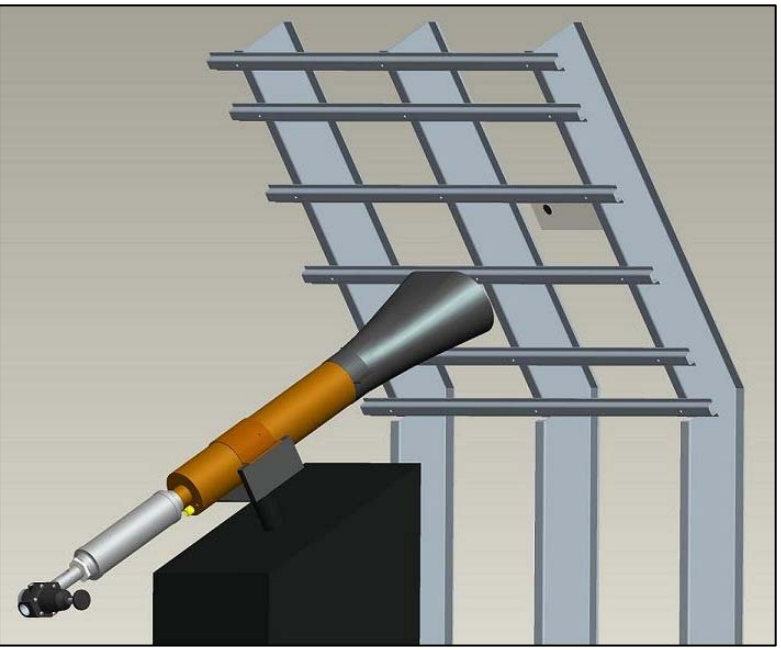
- **Compressed air metered with a sonic nozzle**
- **Fuel provided by a pressurized fuel tank**
- **Utilize original Park DPL 3400 components**



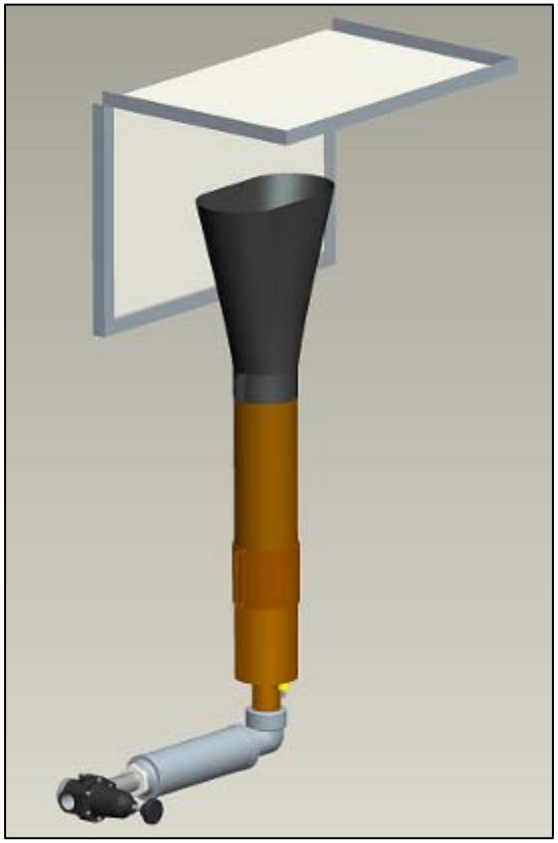
NexGen Burner Design



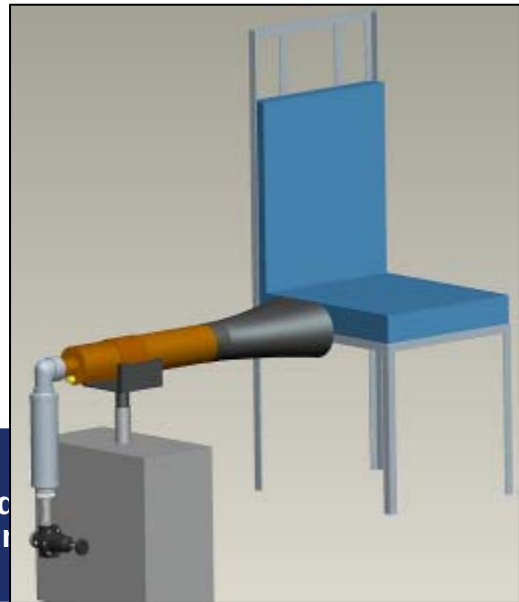
Thermal/Acoustic Insulation Burnthrough



Cargo Liner Burnthrough



Seat Cushion Flammability

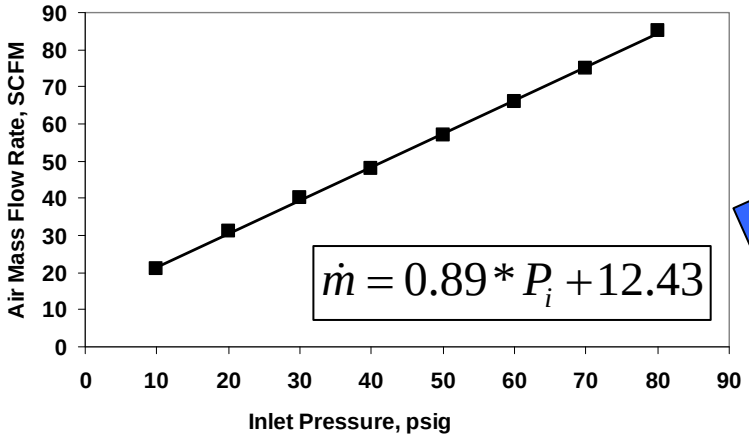


Burner Control

Air Flow

+

+



Fuel Flow

+

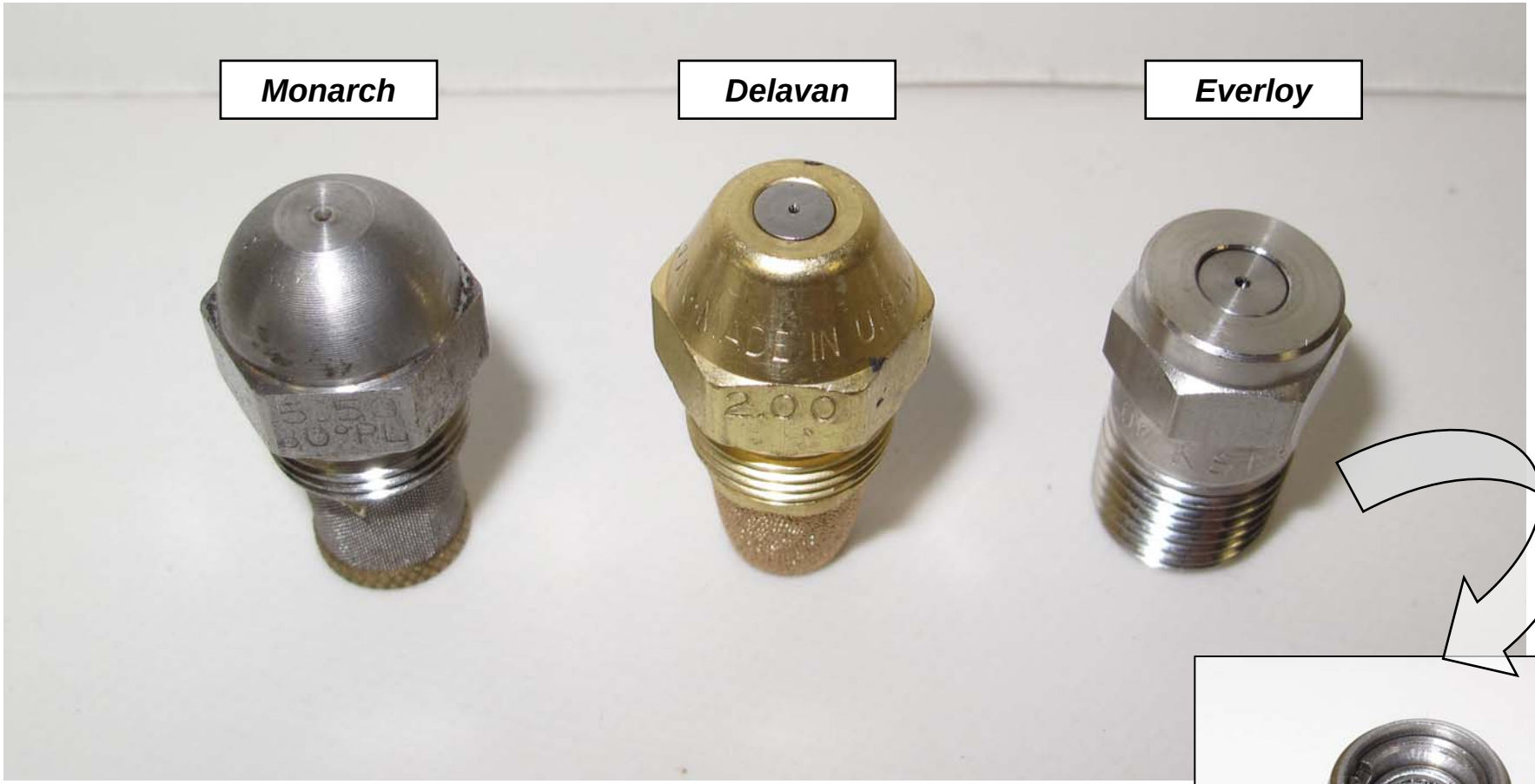
+

Regulated and conditioned air and fuel to burner

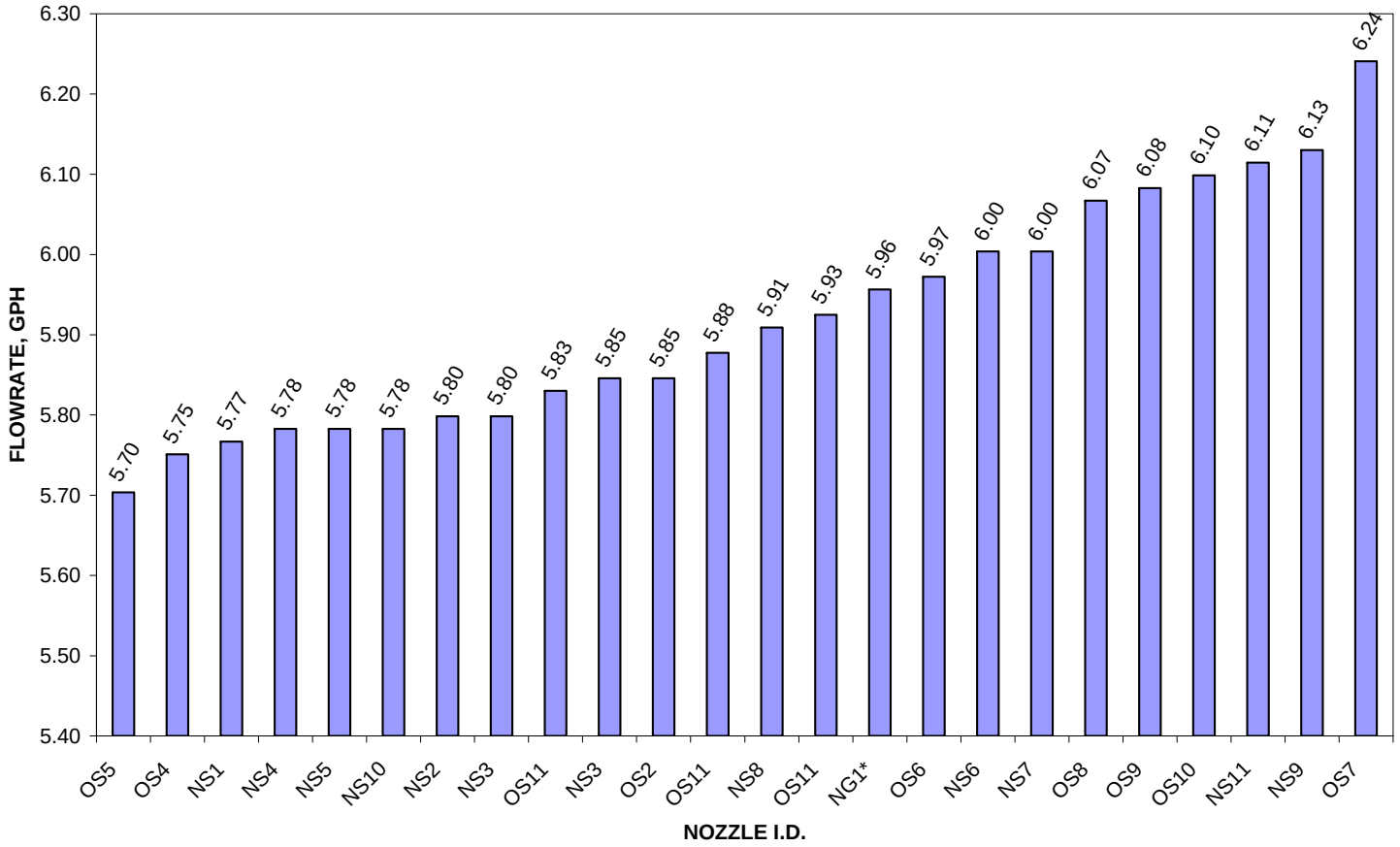
What's New

Spray Nozzles

- **Discussed with a spray industry expert / representative**
  - Industry standard on flowrate is about ±10%
    - 2.0 gph nozzles -> 1.8 - 2.2 gph
    - 6.0 gph nozzles -> 5.4 - 6.6 gph
  - Typical orders include thousands of nozzles, if FAA were to have a specially produced nozzle, price would be very high
- **Received 25 2.0 gph and 25 6.0 gph spray nozzles from Everloy (Japan)**

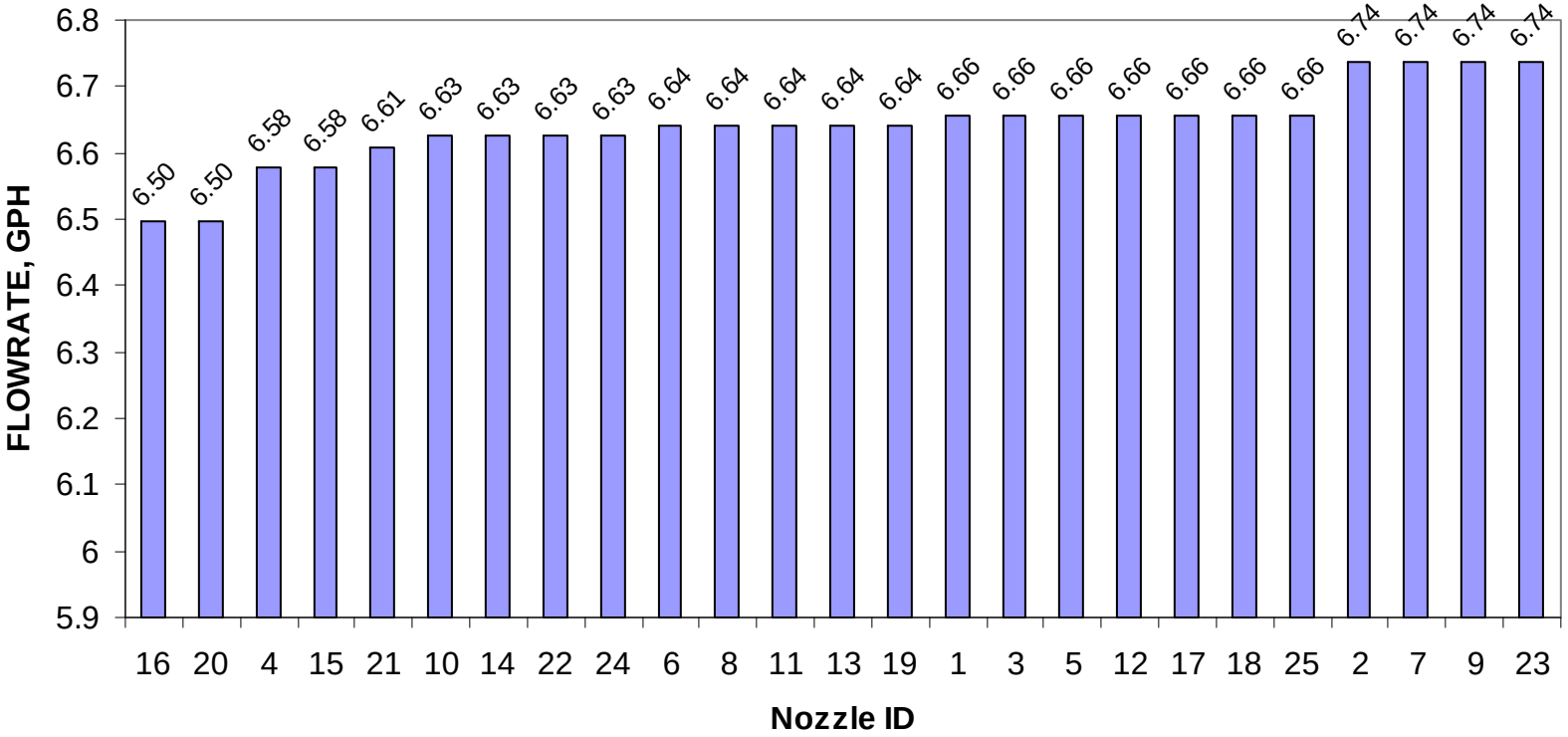

Monarch
Delavan
Everloy
200

Monarch Spray Nozzles



- **Average: 5.92 @ 120 psig**
- **%SD: 2.46%**

Everloy Spray Nozzles



- **Average: 6.64GPH @ 100psig**
- **%SD: 0.91%**

Everloy Nozzle

$$F_2 = F_1 * \left(\frac{P_2}{P_1}\right)^{.5} \Longrightarrow P_2 = P_1 * \left(\frac{F_2}{F_1}\right)^2$$

F_1 = calibrated flow rate at P_1 (6.6 gph)

F_2 = desired flow rate at P_2 (6.0 gph)

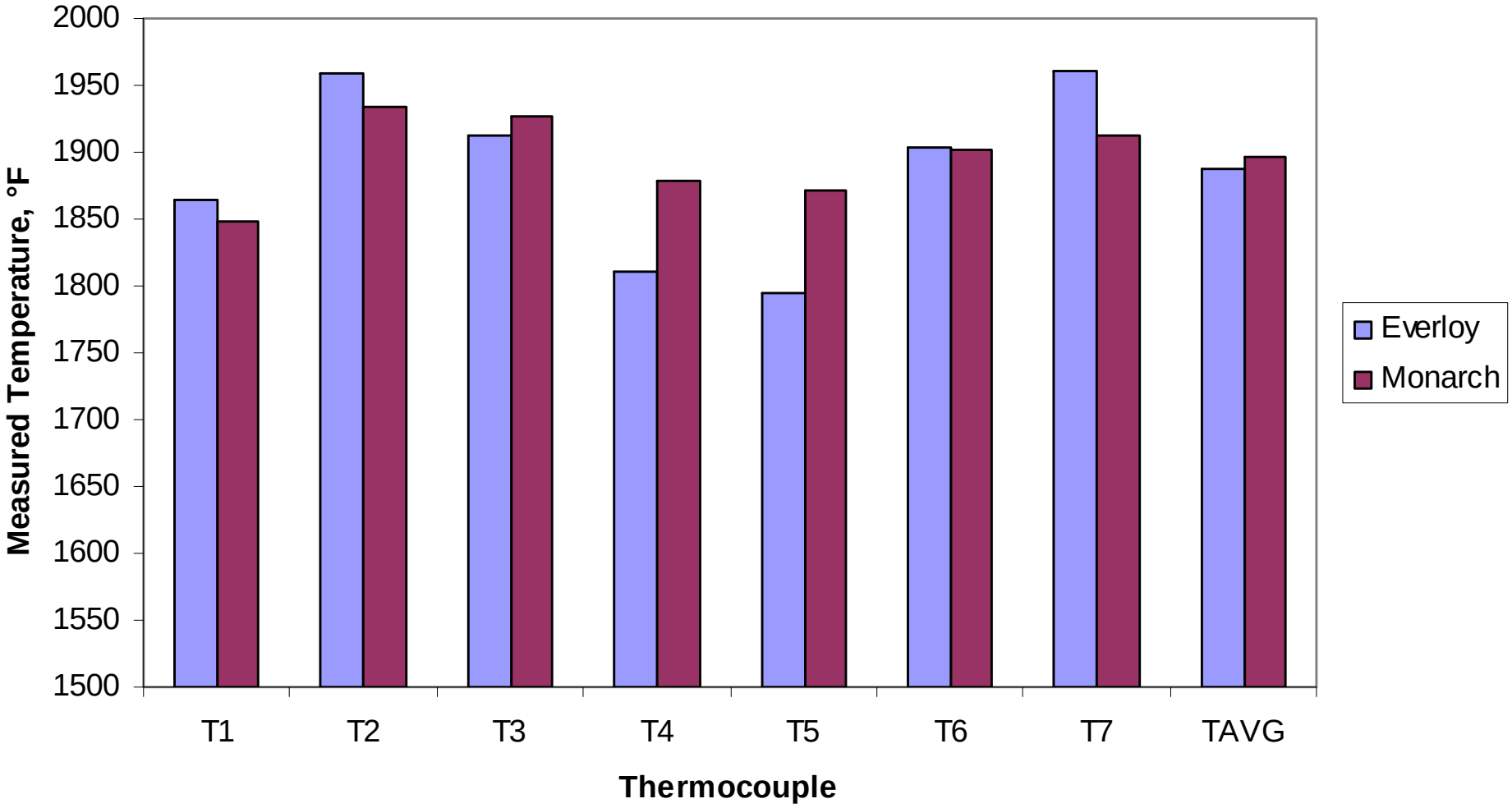
P_1 = calibrated nozzle pressure (100 psig)

P_2 = pressure to deliver F_2 (unknown)

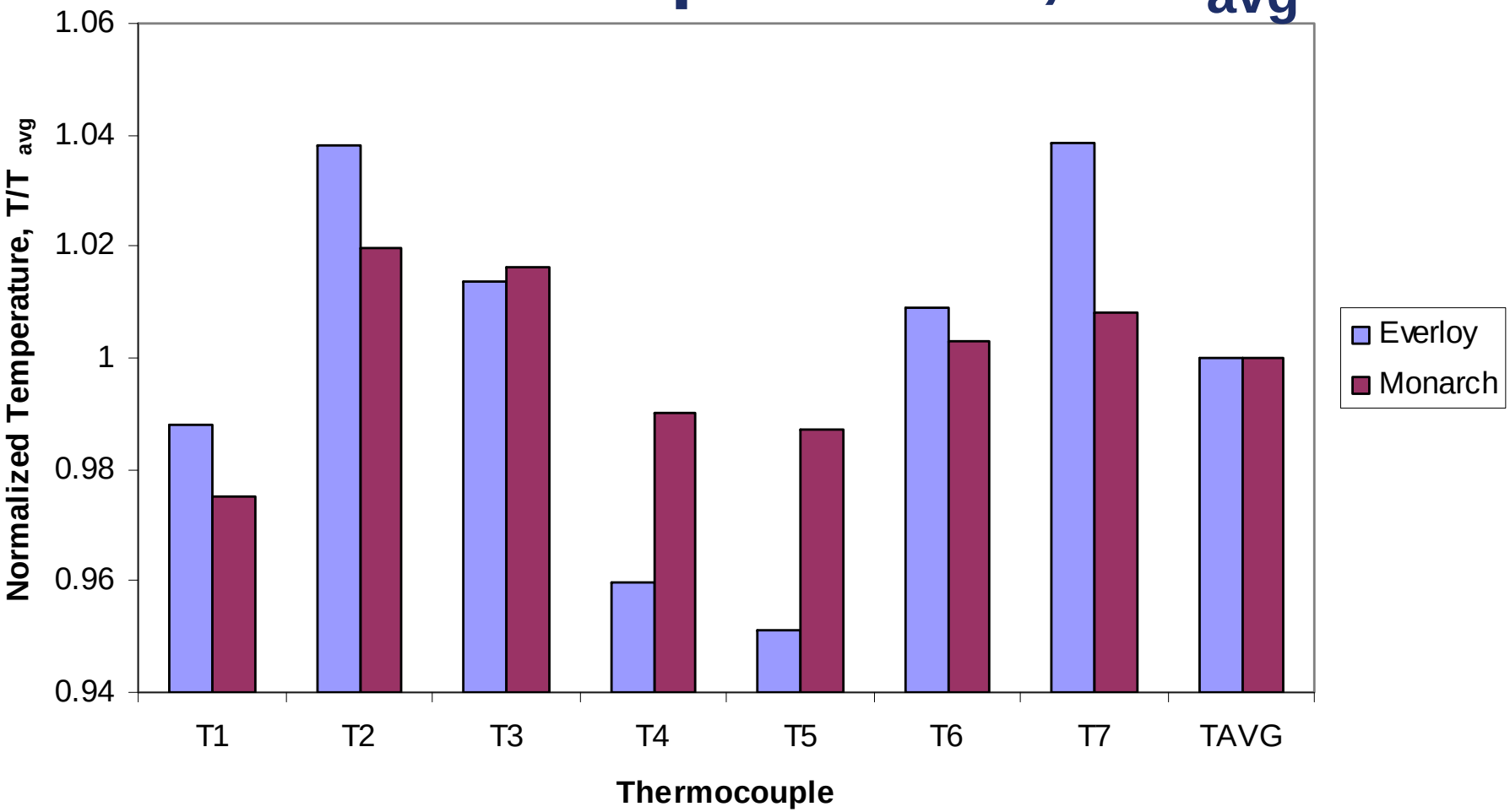
$$P_2 = 82 \text{ psig}$$

Nozzle ID	*Pressure, psig*	*T Start*	*T Final*	*mL/min*	*GPH*
1	100	51	44	420	6.66
1	82	51	44	385	6.10

Everloy vs Monarch: Flame Temperature



Normalized Temperatures, T/T_{avg}



Summary

- **Everloy nozzles have more consistent flow rates than Monarch nozzles**
- **Everloy nozzle spray produces similar average measured flame temperature to Monarch nozzle spray**
- **Everloy nozzle spray seems to be more hollow than Monarch spray, but also seems to be very symmetric**

Planned Work

- **A large quantity of TexTech PAN material (8579 and 8611) has been ordered for comparative testing at FAATC and round robin tests for interested NexGen-Burnthrough labs**

- **A variety of Delavan spray nozzles will be ordered in the near future for comparison**

- **Comparative burnthrough testing will be performed to determine equivalence of alternative spray nozzles for burnthrough testing**

Planned Work (cont.)

- **New batch of TexTech will also be used for comparative burnthrough testing with different sonic chokes to determine the effect of mass flow rate / exit velocity**