

**National Personal Protective  
Technology Laboratory**

**Determination of Air Flow for  
CBRN Tight Fitting Powered Air-  
Purifying Respirators**

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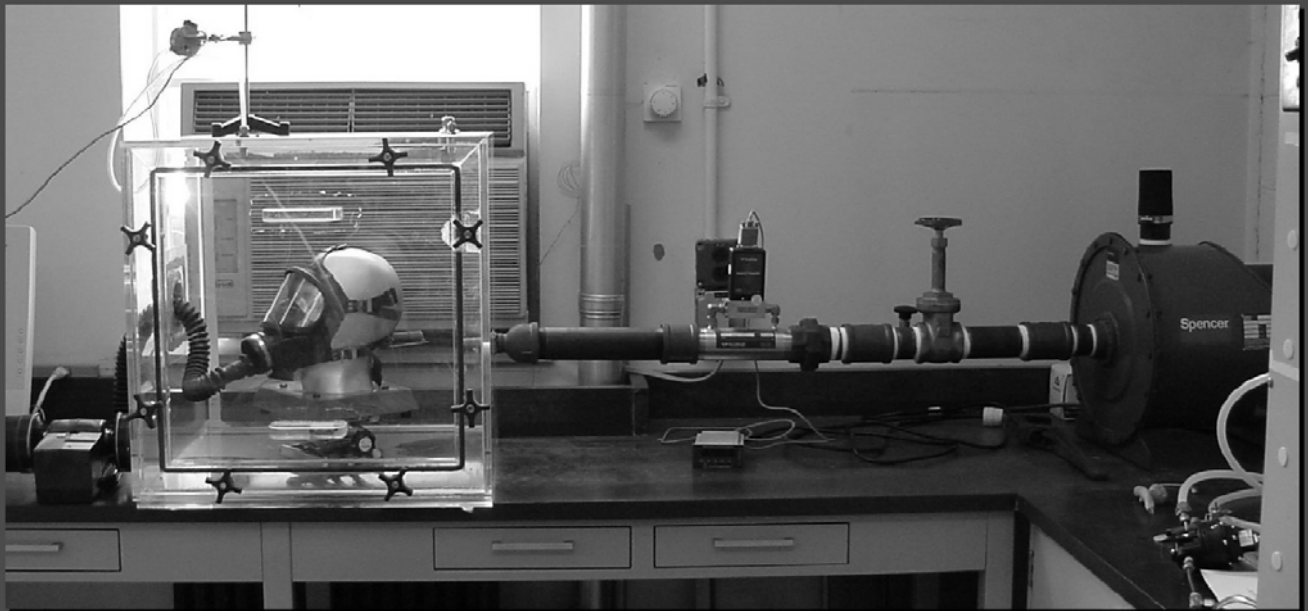
## Objective

- **Assess current PAPR flow measurement techniques**
- **Derive a new flow measurement method that will allow both constant flow and demand response flow PAPRs to be evaluated utilizing the same test method and equipment**

# Current Method for Measuring Flow Through Constant Flow PAPR

- The flow through a PAPR is measured using the following method
  - Mount the facepiece on a head form and leak test
  - Place the head form with the facepiece mounted in a sealed Lexan enclosure
  - Switch PAPR blower “On”
  - Apply a vacuum to the enclosure until zero inches of water column is reached
  - Record flow

# Evaluating the Current PAPR Flow



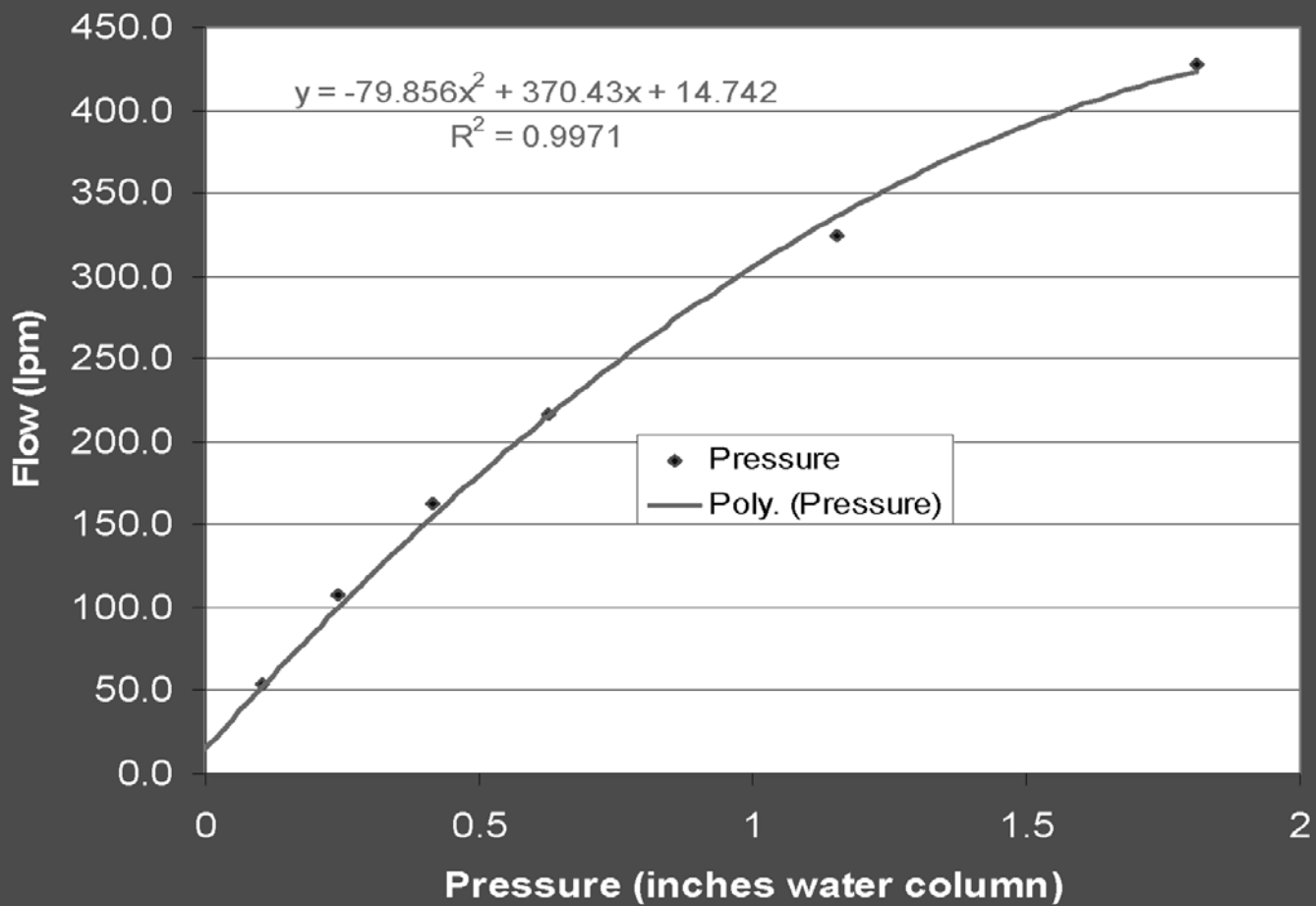
# Evaluating the Purposed PAPR Flow Measurement Method

- A flow curve was developed for each PAPR tested using the following method
  - Mount the facepiece on a head form and leak test
  - Install a pressure tap at the PAPR manifold outlet
  - Plug the pressure tap in the head form
  - Connect the head form breathing tube to a flowmeter and vacuum blower
  - PAPR switched “Off”

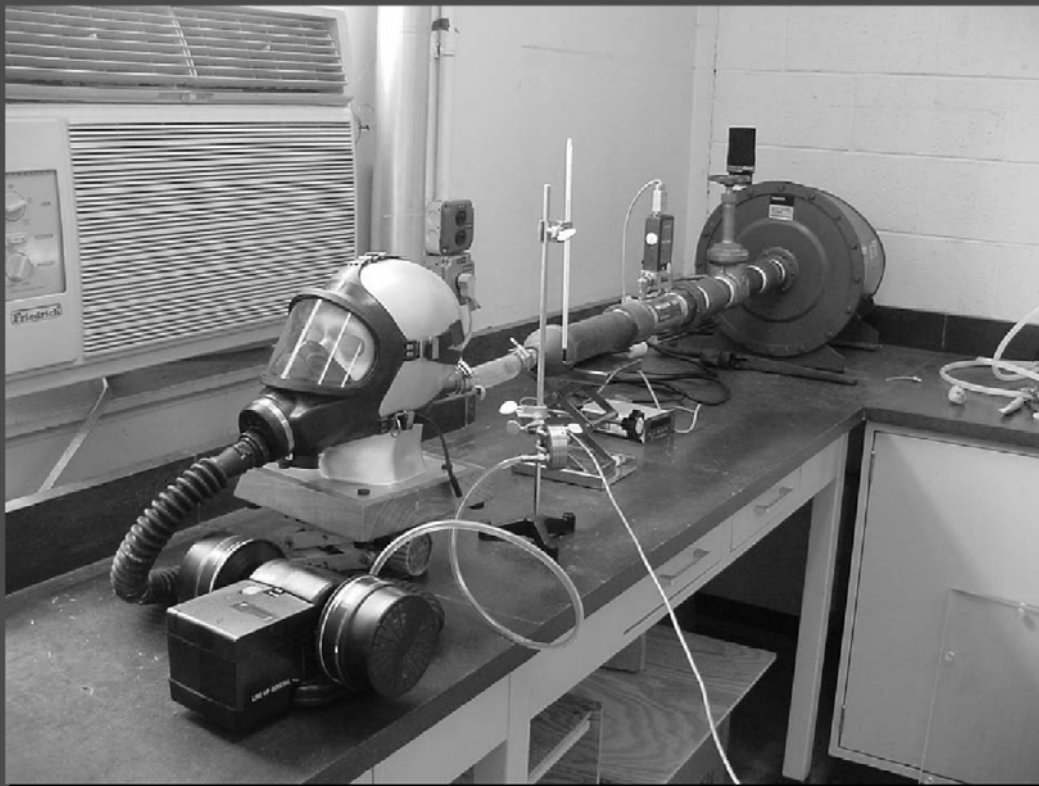
## Evaluating the Purposed PAPR Flow Measurement Method (Cont.)

- Incrementally increase the vacuum flow through the PAPR and record the corresponding manifold pressures
- Collect points from zero flow to 500 Lpm in increments of 50 Lpm
- Create a pressure vs. flow graph

## Example of a PAPR Flow Curve



# Evaluating the Purposed PAPR Flow Measurement Method





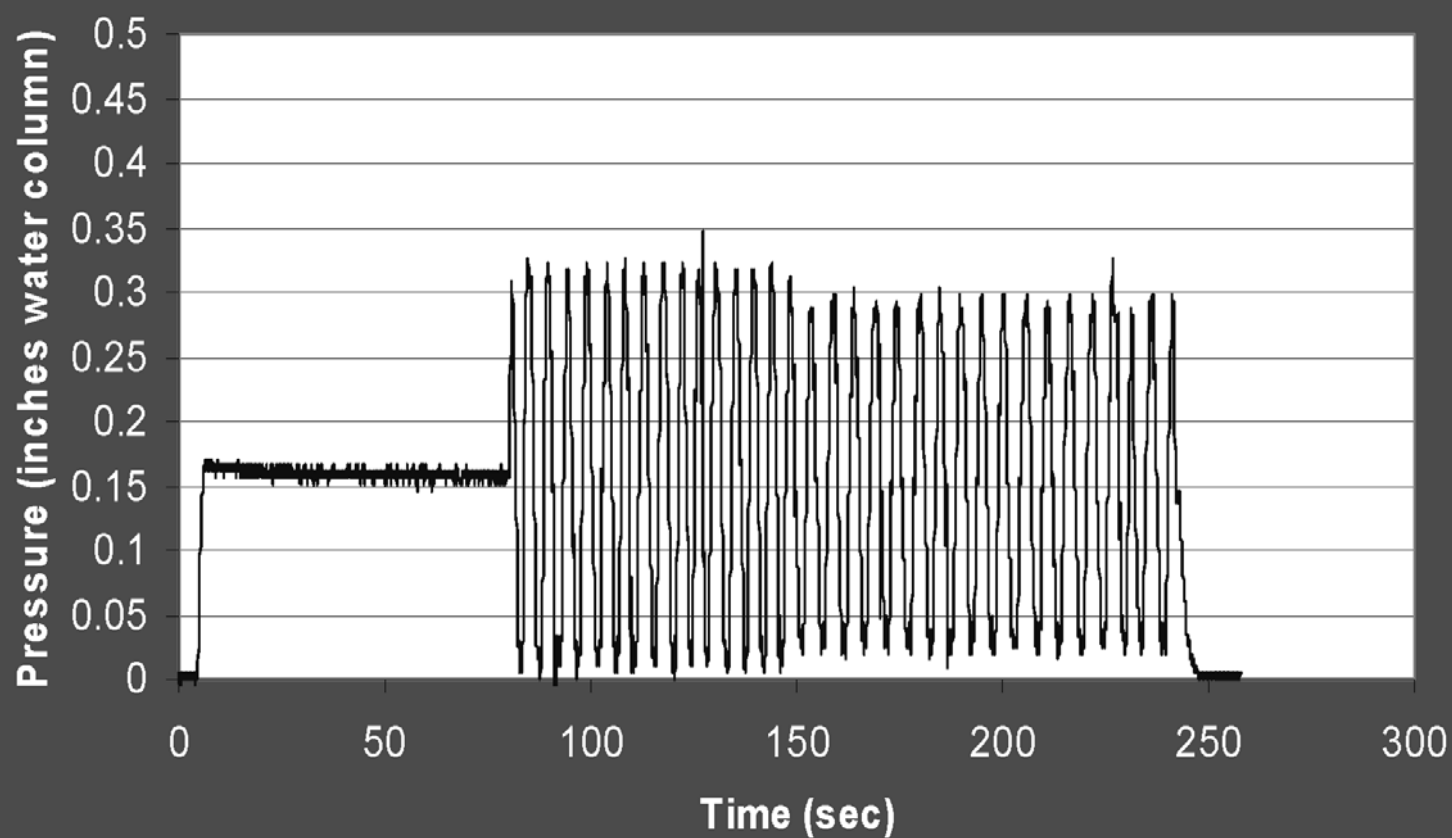
## **PAPR Evaluation Using a Breathing Machine**

- **Each PAPR was tested using the following procedure**
  - Mount the facepiece on a head form and leak test
  - Connect the breathing tube from the head form to the breathing machine
  - Monitor both the pressure at the PAPR manifold and facepiece
  - Increase the breathing rate until zero inches of water column is achieved in the facepiece during inhalation

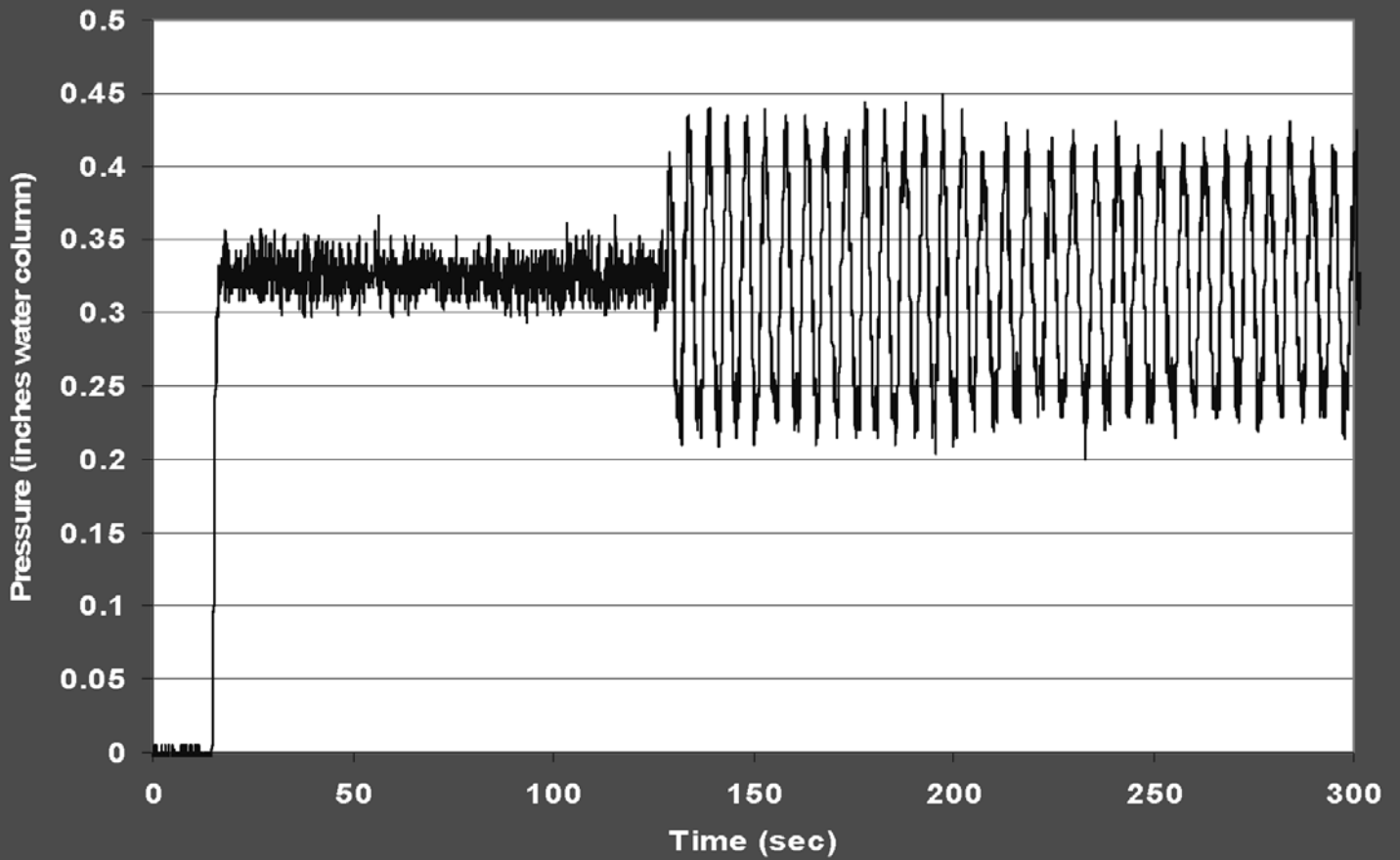
## **PAPR Evaluation Using a Breathing Machine (Cont.)**

- Record the maximum manifold pressure
- Based on the previously derived flow curve this pressure will correlate to a flow rate

## (Example) Mask Pressure During a Breathing Machine Test



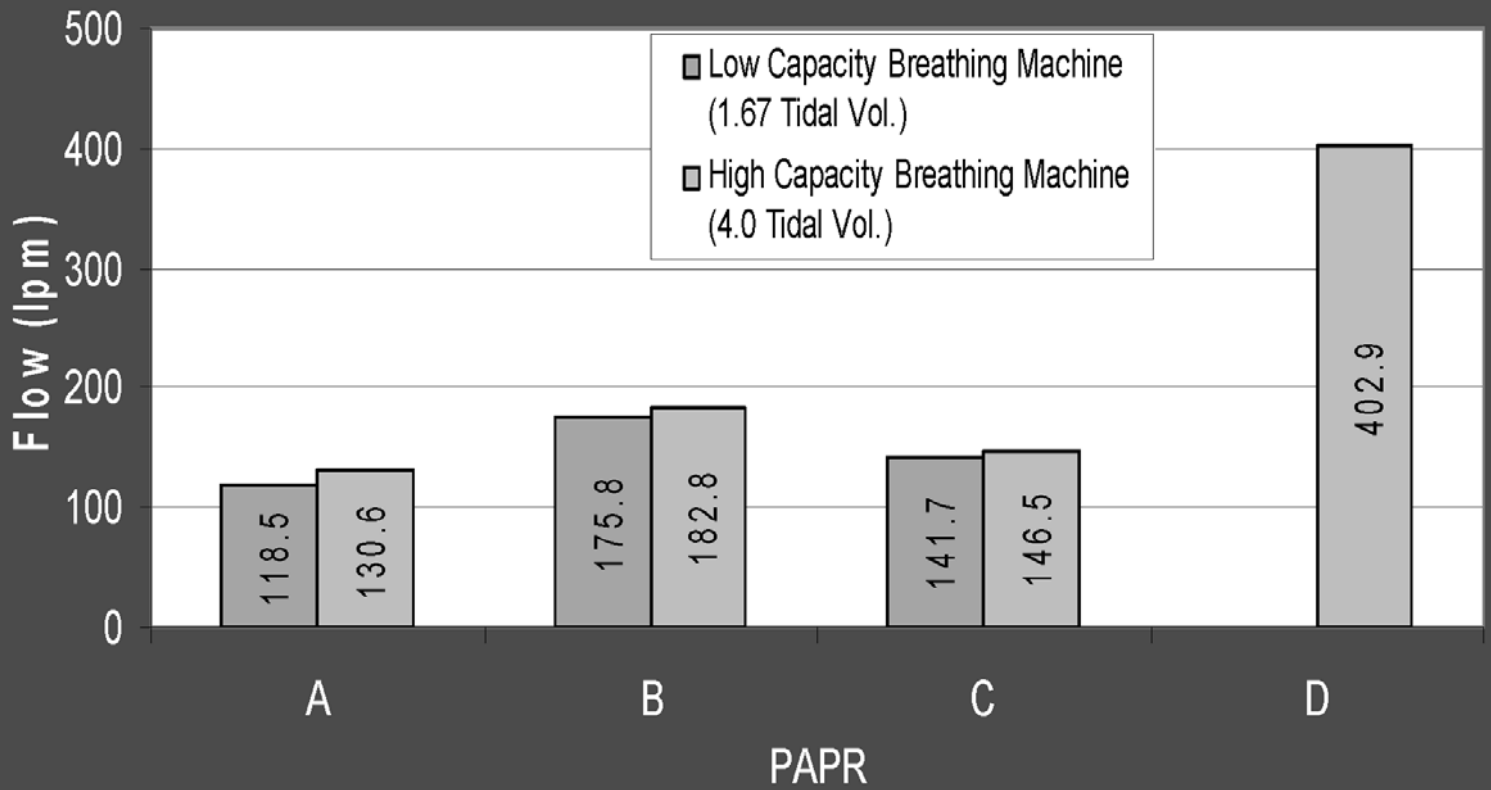
# (Example) Manifold Pressure During a Breathing Machine Test



# Evaluating the Purposed PAPR Flow Measurement Method



# Flow Comparison



## Conclusion

- Model D was unable to be tested using the low capacity breathing machine due to the higher flows required by this PAPR
- The high capacity breathing machine can be used to measure flow in both constant flow and demand response flow PAPRs
- Constant flow and demand response flow PAPRs will be tested using the same test method and equipment

# **PAPR Flow Measurement**

## **Remaining Work**

- **Evaluation of the purposed PAPR flow measurement method using the new variable tidal volume and respirations per minute breathing machine**



# PAPR Flow Measurement

Questions?