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National Personal Protective Technology Laboratory

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

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CBRN Respirator Standards

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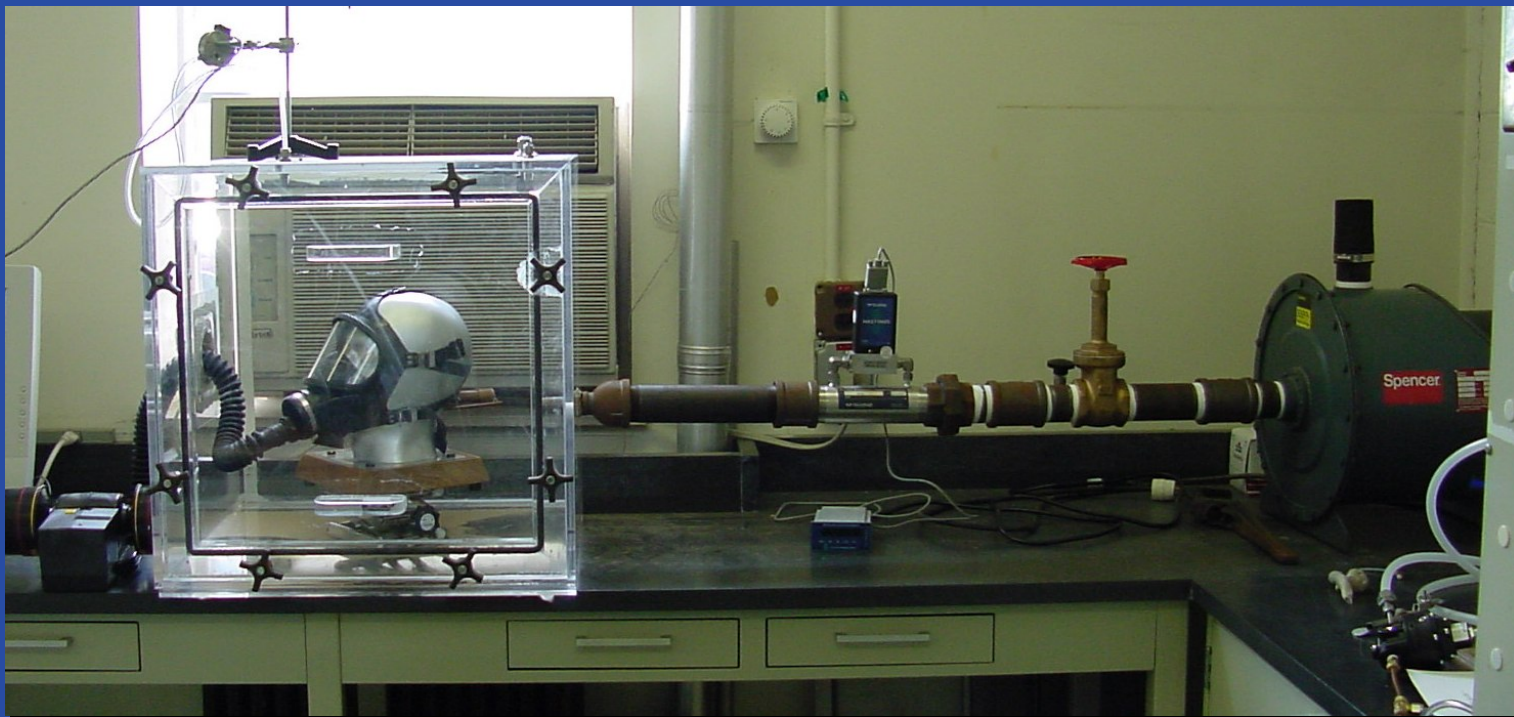
Objective

- **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



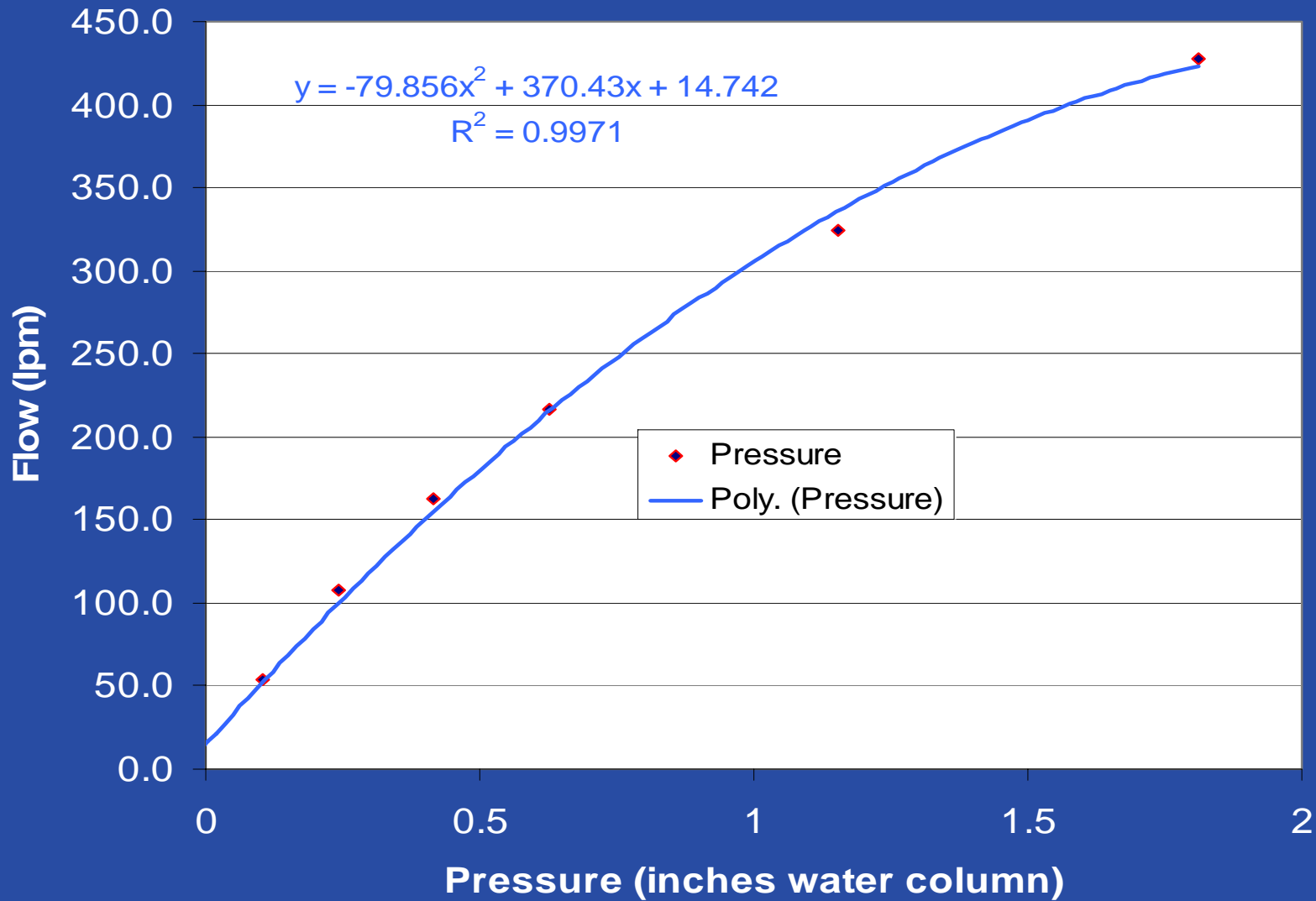
Evaluating the Purposed PAPR Flow Measurement Method

- **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



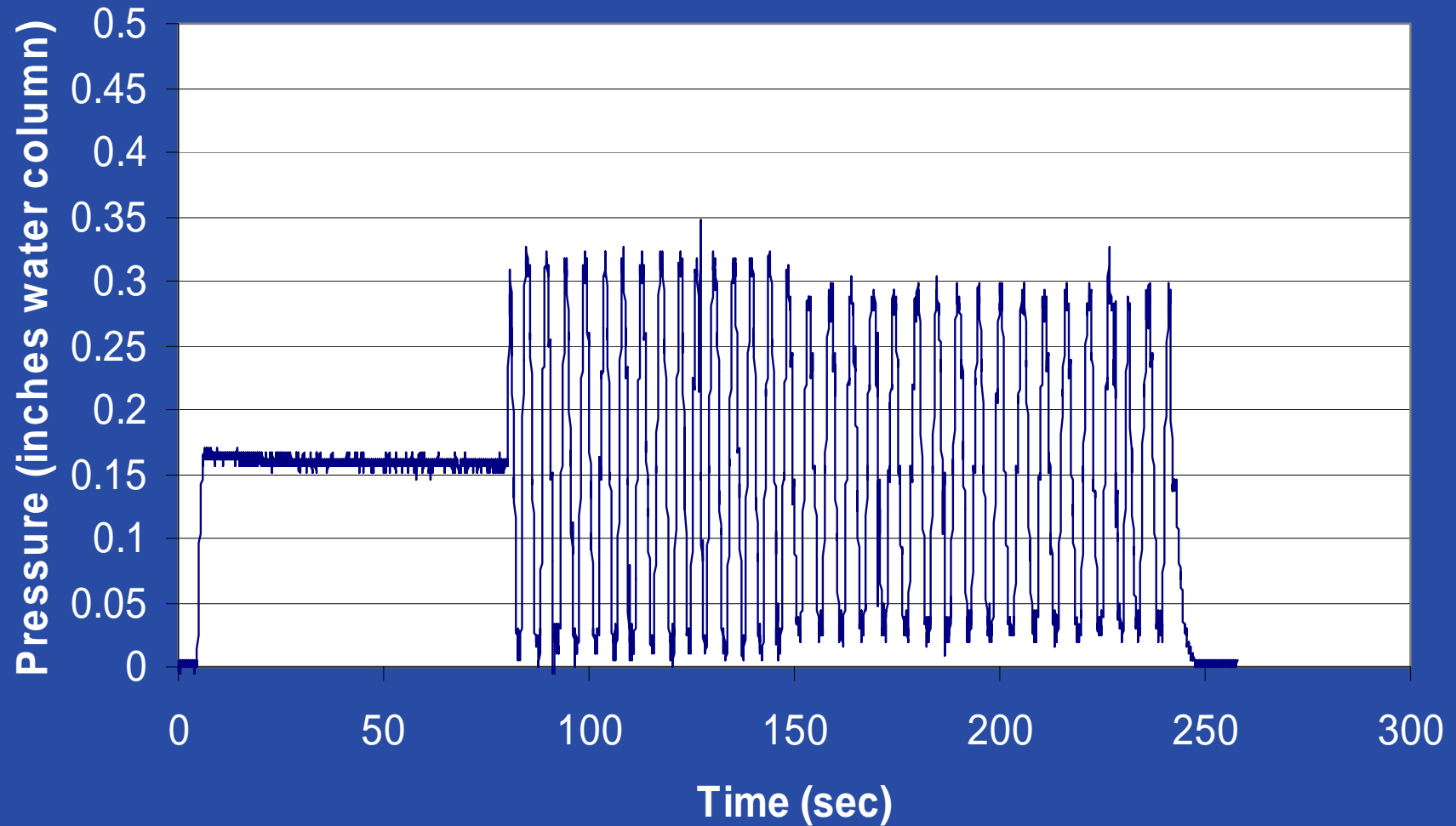
PAPR Evaluation Using a Breathing Machine

- **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

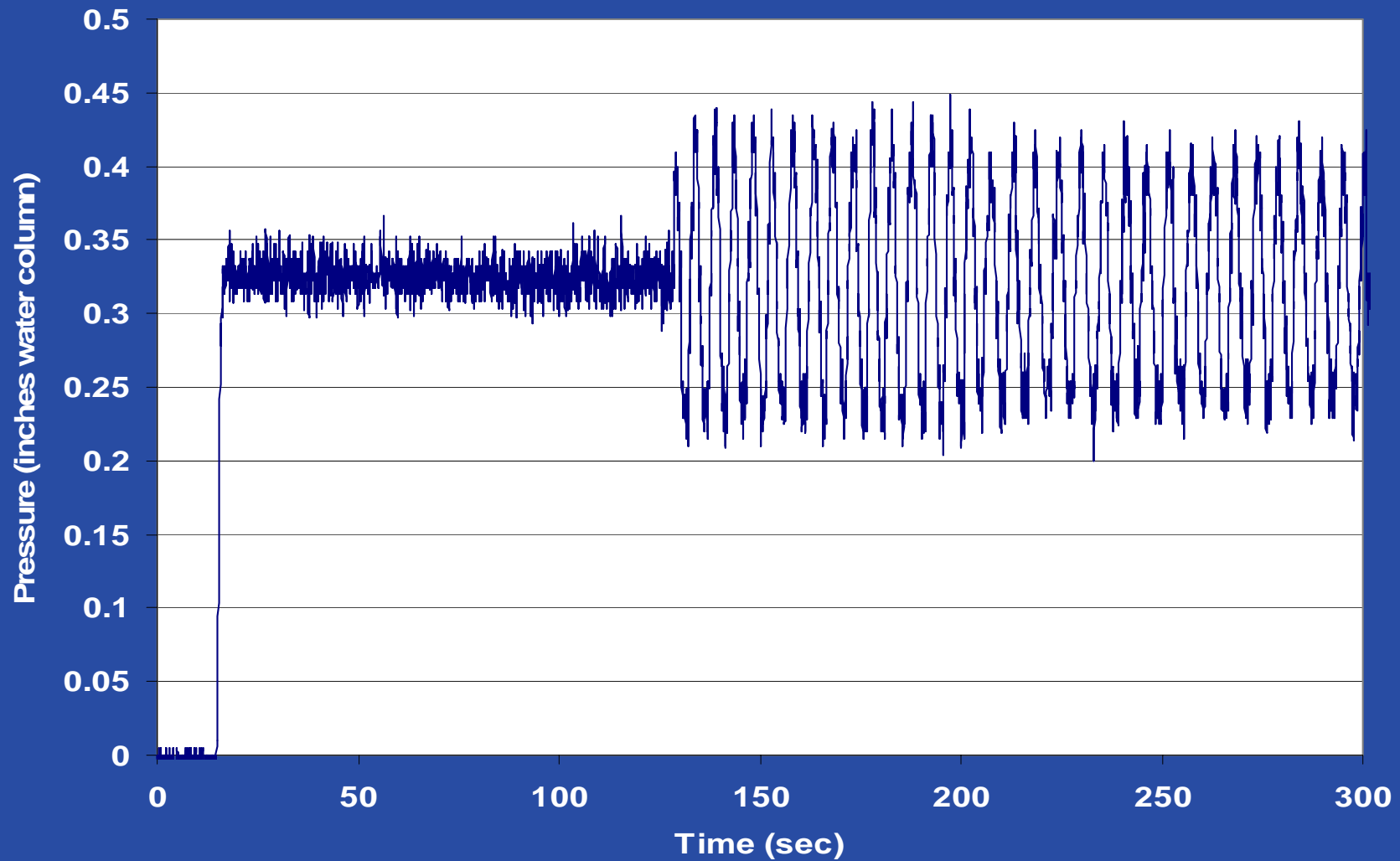
PAPR Evaluation Using a Breathing Machine (Cont.)

- 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



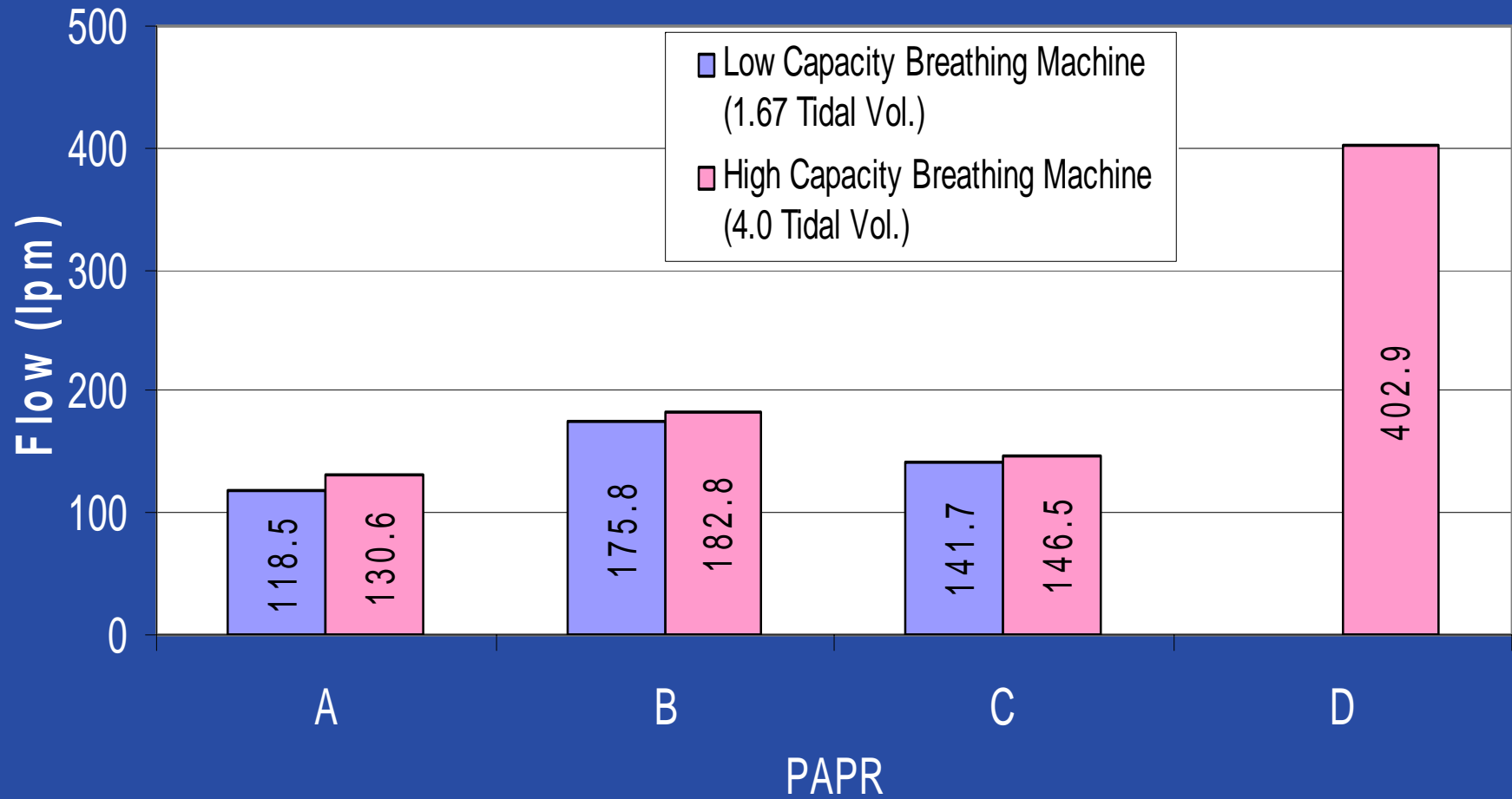
(Example) Manifold Pressure During a Breathing Machine Test



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?



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