

Built-in-place Refuge Alternative Pressure Relief Valve Cracking Pressure and Flow Rate Versus Pressure Drop



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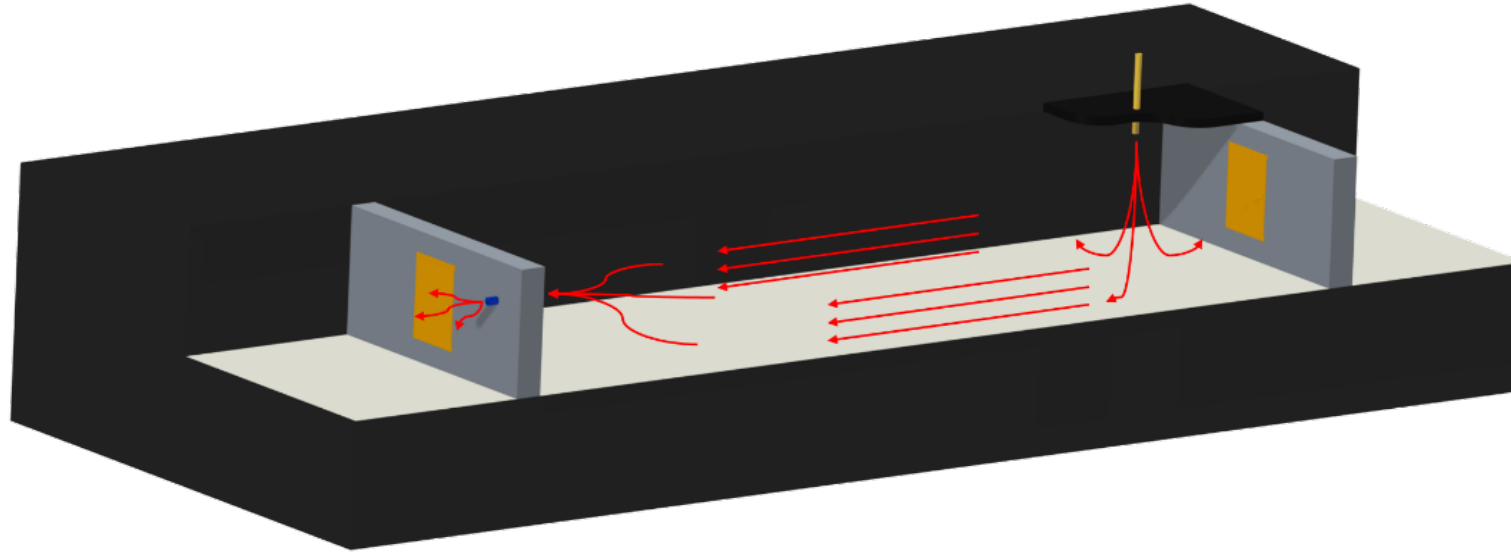
**Pittsburgh Mining Research Division
RA Partnership**

November 17-18, 2021

Pressure Relief Valve Installed in PMRD BIP RA



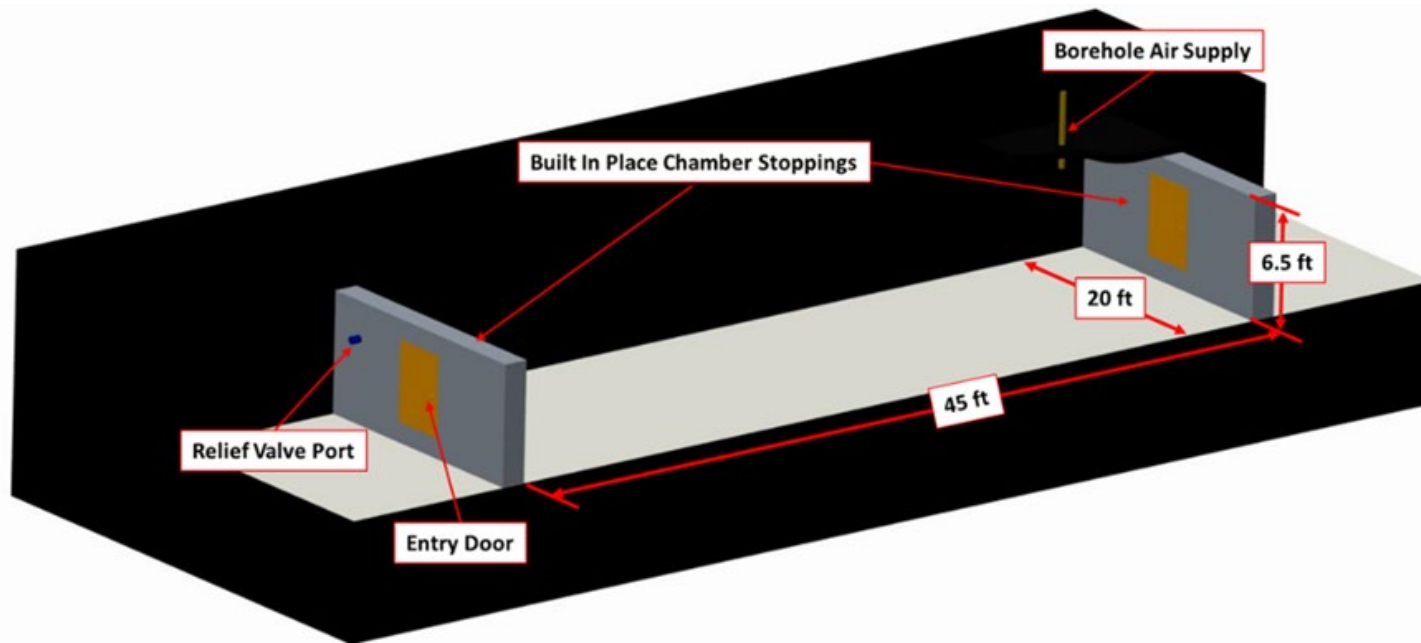
BIP RA Relief Valve



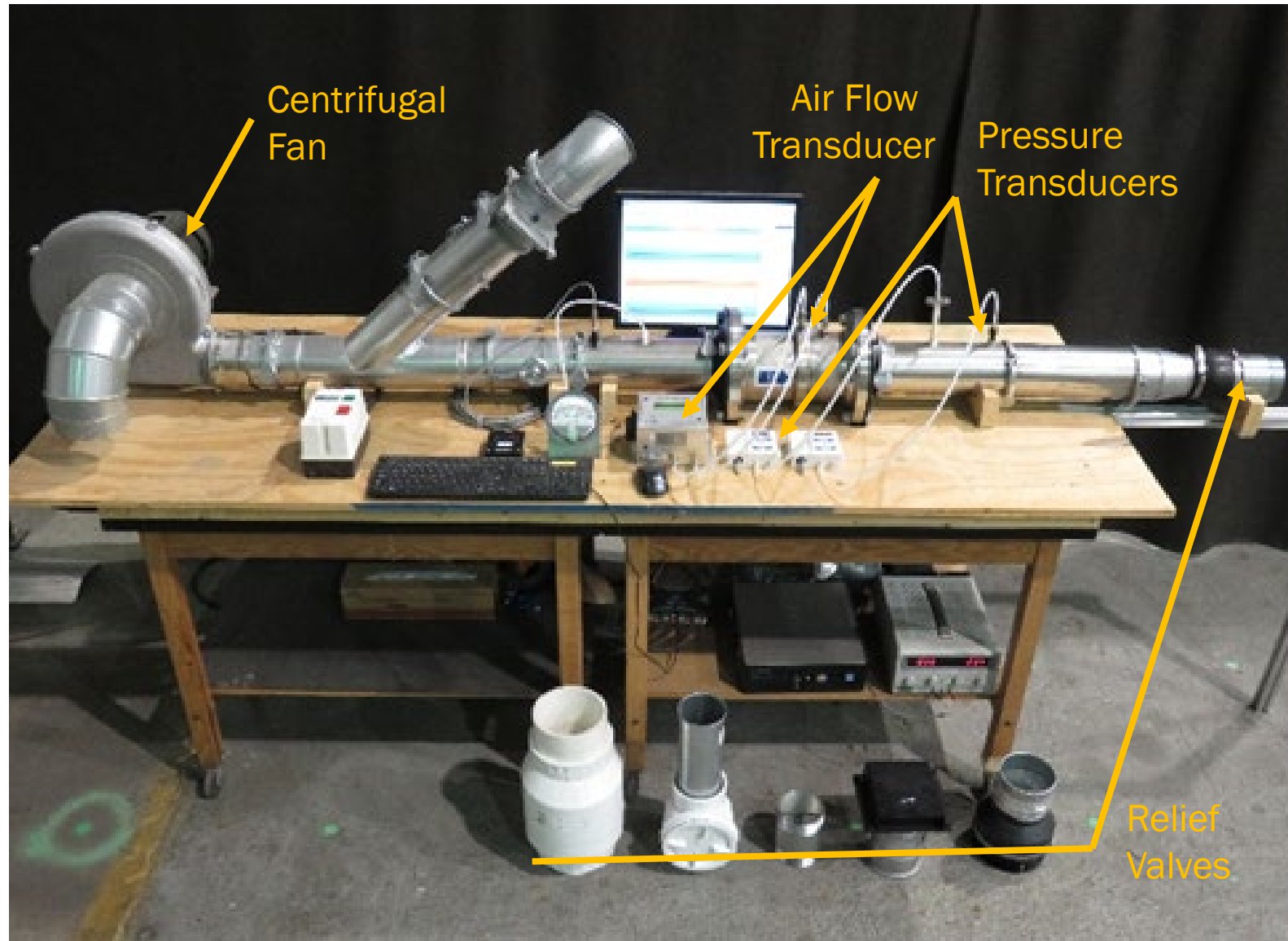
- Maintain positive pressure inside Refuge Alternative (RA) to prevent contaminant migration into RA via ribs, roof, and floor.
- Allow purging of contaminants out of RA and maintaining survivable/comfortable pressure inside RA.
- Keep airborne contaminants out of RA before, during and after disaster.
- Allow RA door opening and closing when positive pressure inside.

Relief Valve Requirements

- CFR Flow rate requirement: For RAs that use compressed air, “a minimum flow rate of 12.5 CFM of breathable air for each person” shall be provided.
- CFR Steady-state pressure: Require that “pressure is relieved at 0.18 psi, or as specified by the manufacturer...”

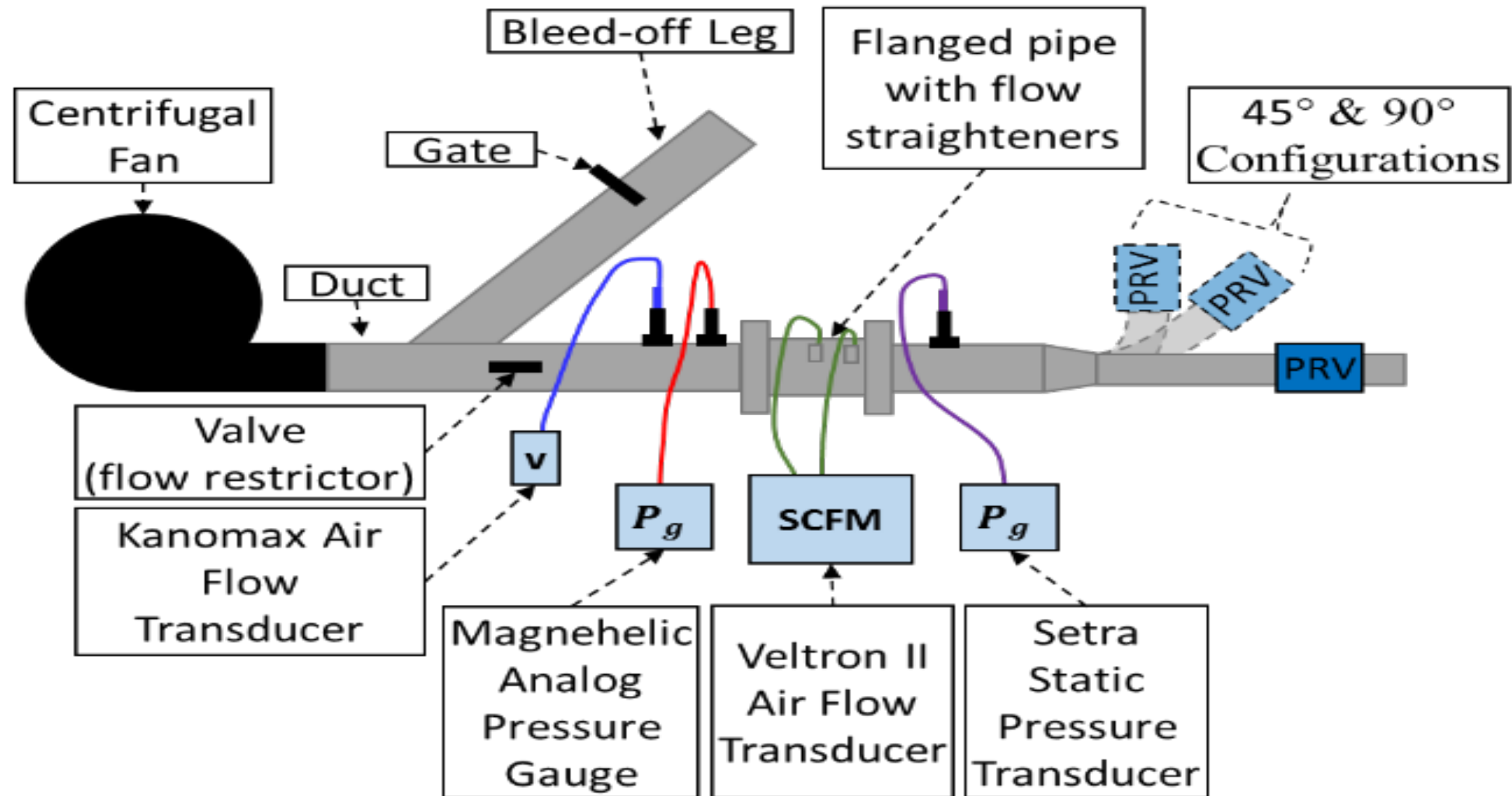


Pressure Relief Valve Test Stand Setup

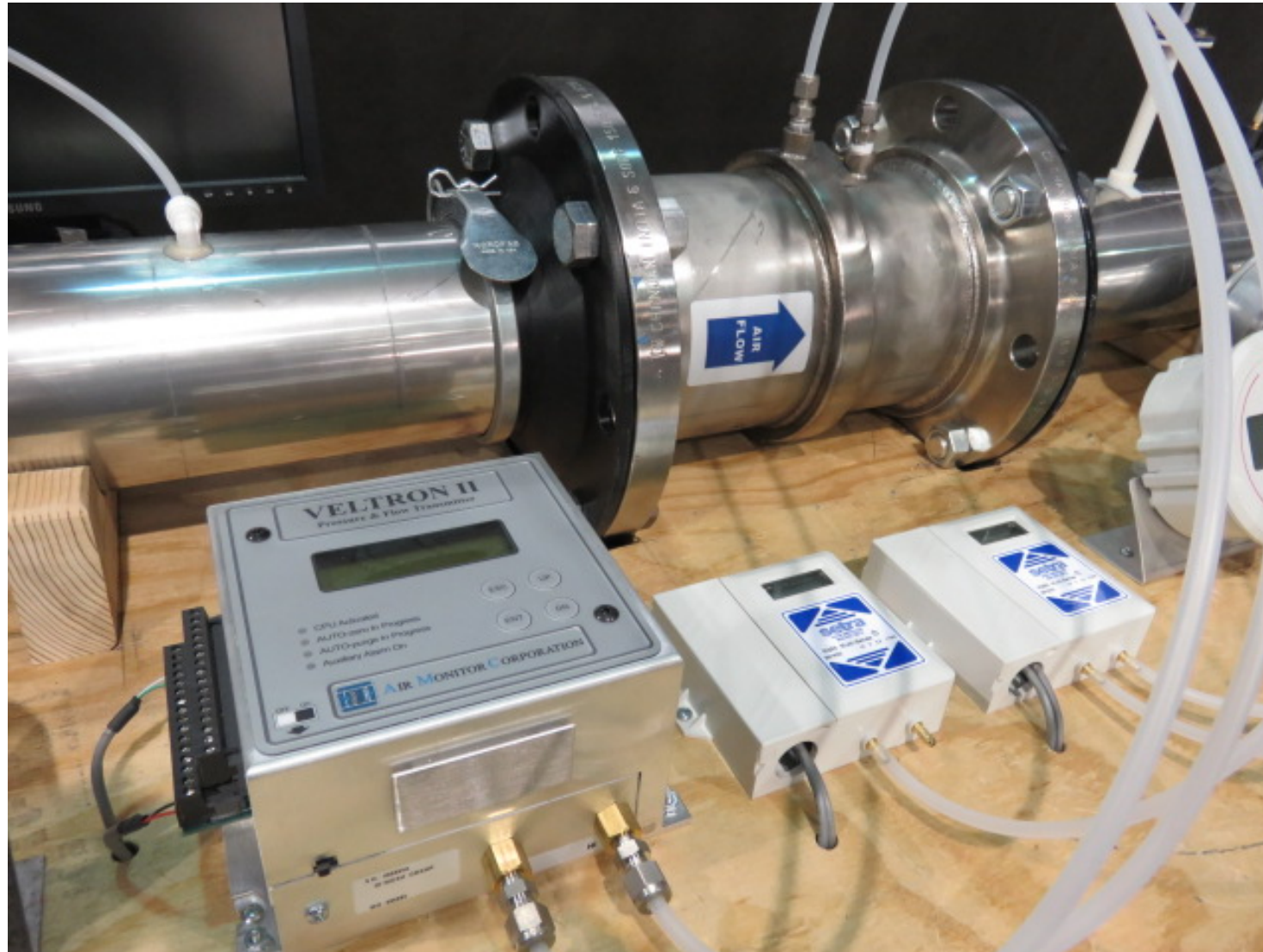


Pressure Relief Valve Test Stand Setup

(Not to scale)



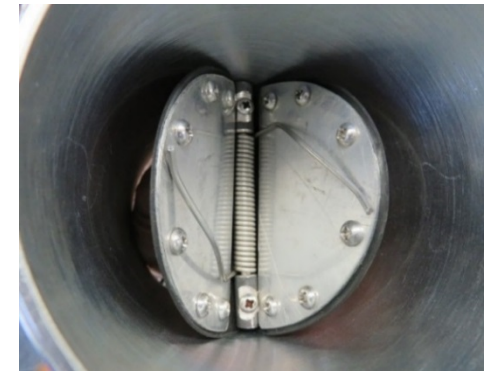
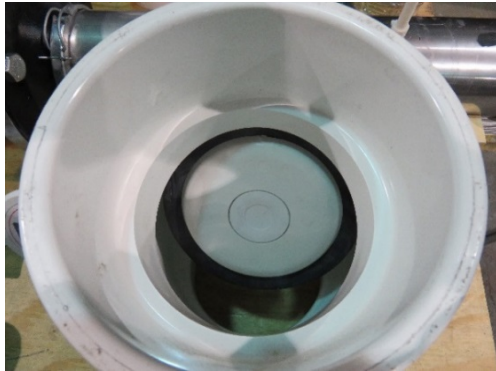
Airflow Meter and Digital Pressure Meters



Capabilities of Test Stand Setup

- **Characterization of flow/pressure**
 - **Flow versus pressure**
 - **Steady state static pressure**
 - **Cracking pressure**
 - **Pressure differential**
- **Digitally recorded data**
- **Graphical outputs**
- **Aid designers of air supply systems**

Relief Valves Tested

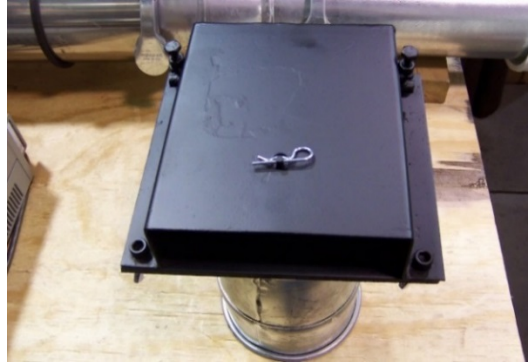


PVC Check Valve 6"

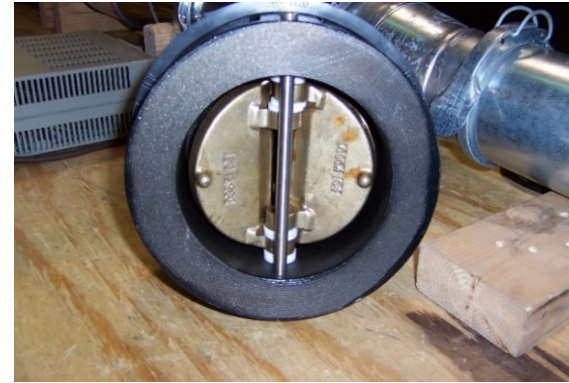
PVC Check Valve 4" (modified)

Steel Check Valve 4"

Relief Valves Tested



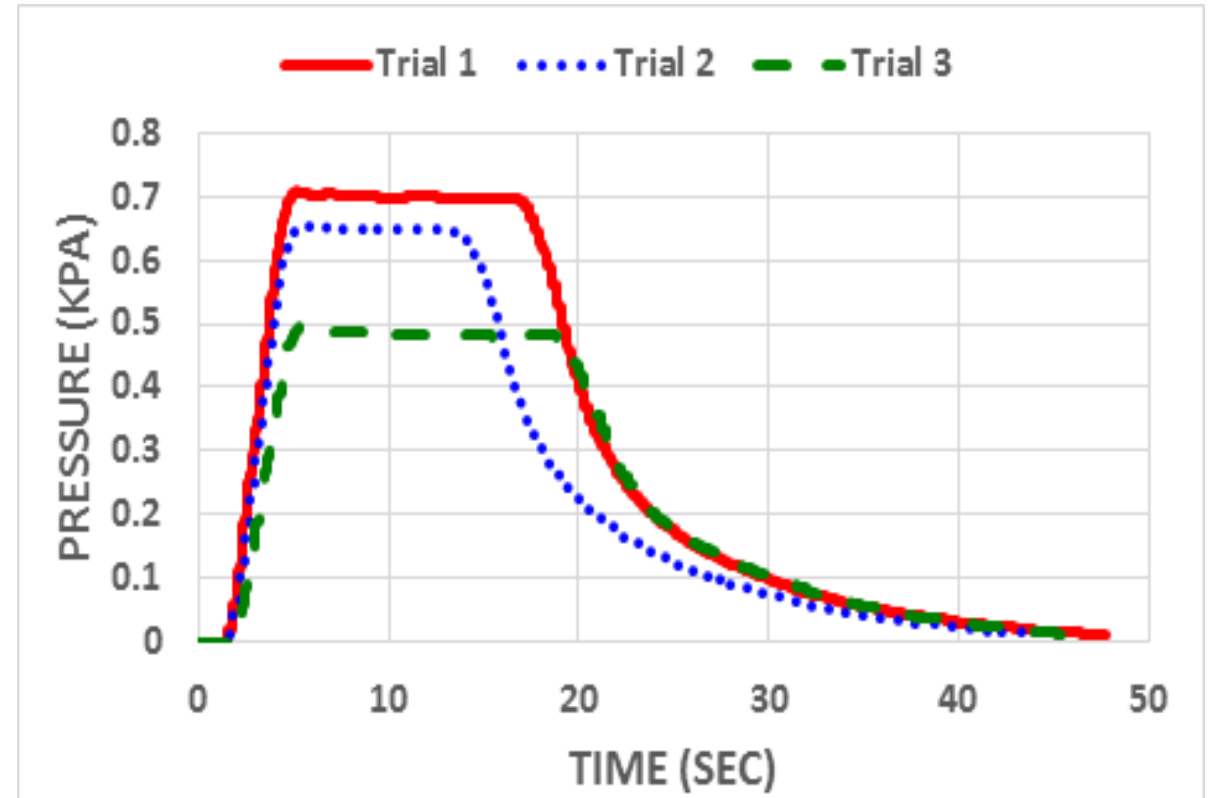
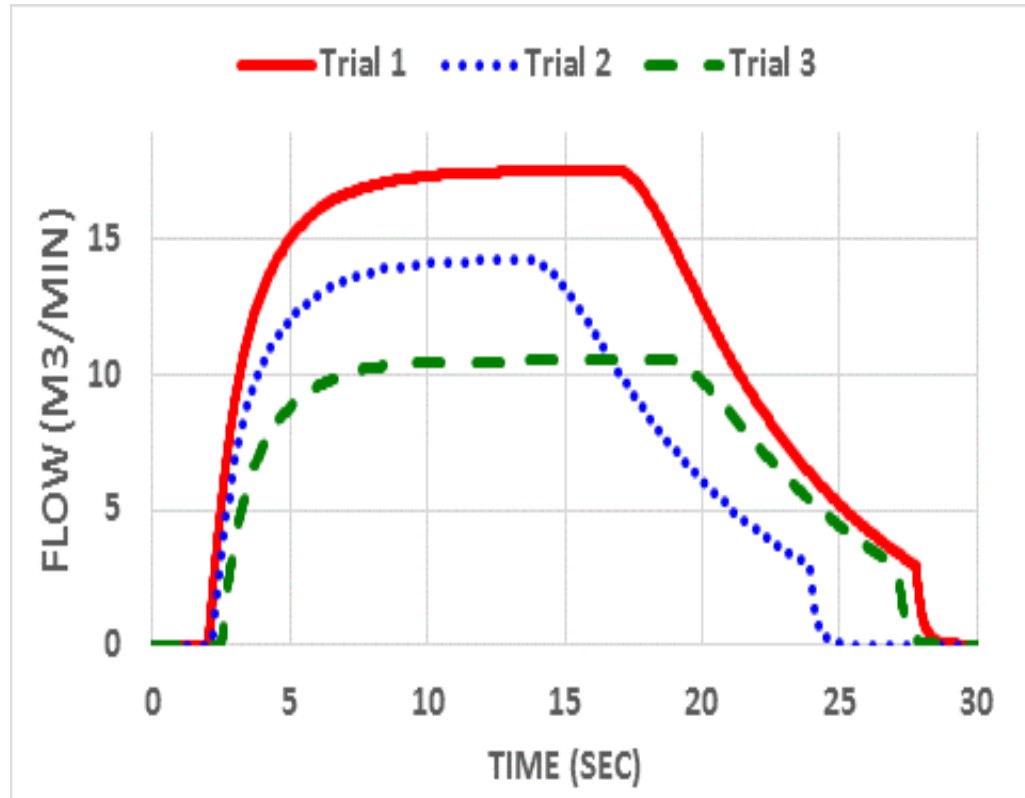
RA Manufacturer Relief Valve



Brass/Cast-Iron Butterfly Check Valve



Graphical Results of Airflow and Static Pressure



Trial 1: Airflow for 50 person RA
Trial 2: Airflow for 40 person RA
Trial 3: Airflow for 30 person RA

Airflow and Static Pressure Test Results

PRV	Configuration	Trial 1		Trial 2		Trial 3	
		Q (SCFM)	P (psi)	Q (SCFM)	P (psi)	Q (SCFM)	P (psi)
<i>A</i>	<i>PVC (6 in)</i>	628	0.10	510	0.09	379	0.07
<i>B.1</i>	<i>PVC (4 in) (no weights)</i>	683	0.07	505	0.05	378	0.03
<i>B.2</i>	<i>PVC (4 in) (one weight, 0.95 lb)</i>	642	0.09	506	0.05	376	0.05
<i>B.3</i>	<i>PVC (4 in) (two weights, 1.9 lb)</i>	605	0.11	497	0.10	383	0.08
<i>C.1</i>	<i>Steel check valve (4 in) (original spring)</i>	0.0	0.25	--	--	--	--
<i>C.2</i>	<i>Steel check valve (4 in) (modified spring)</i>	558	0.15	555	0.15	369	0.13
<i>D</i>	<i>Purpose-built RA relief valve (4 in) (modified spring)</i>	361	0.22	--	--	--	--
<i>E.1</i>	<i>Brass/cast iron butterfly (4.5 in) (no spring) 45 degree</i>	444	0.18	--	--	--	--
<i>E.2</i>	<i>Brass/cast iron butterfly (4.5 in) (no spring) 90 degree</i>	414	0.20	--	--	--	--

Conclusions

- Relief valve concepts can meet the MSHA-specified requirements for relief pressure and flow as purchased and with modifications.
- Modifications may include reducing mass of valve flaps, spring stiffness, or installation angle to reduce opening (relief) pressure

Thank you!

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