This presentation premiered at WaterSmart Innovations

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Testing and Performance of Pressure Regulating Sprinkler Bodies

WaterSmart Innovations
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Agricultural & Biological Engineering

University of Florida/IFAS

UF/IFAS Center for Landscape Conservation and Ecology

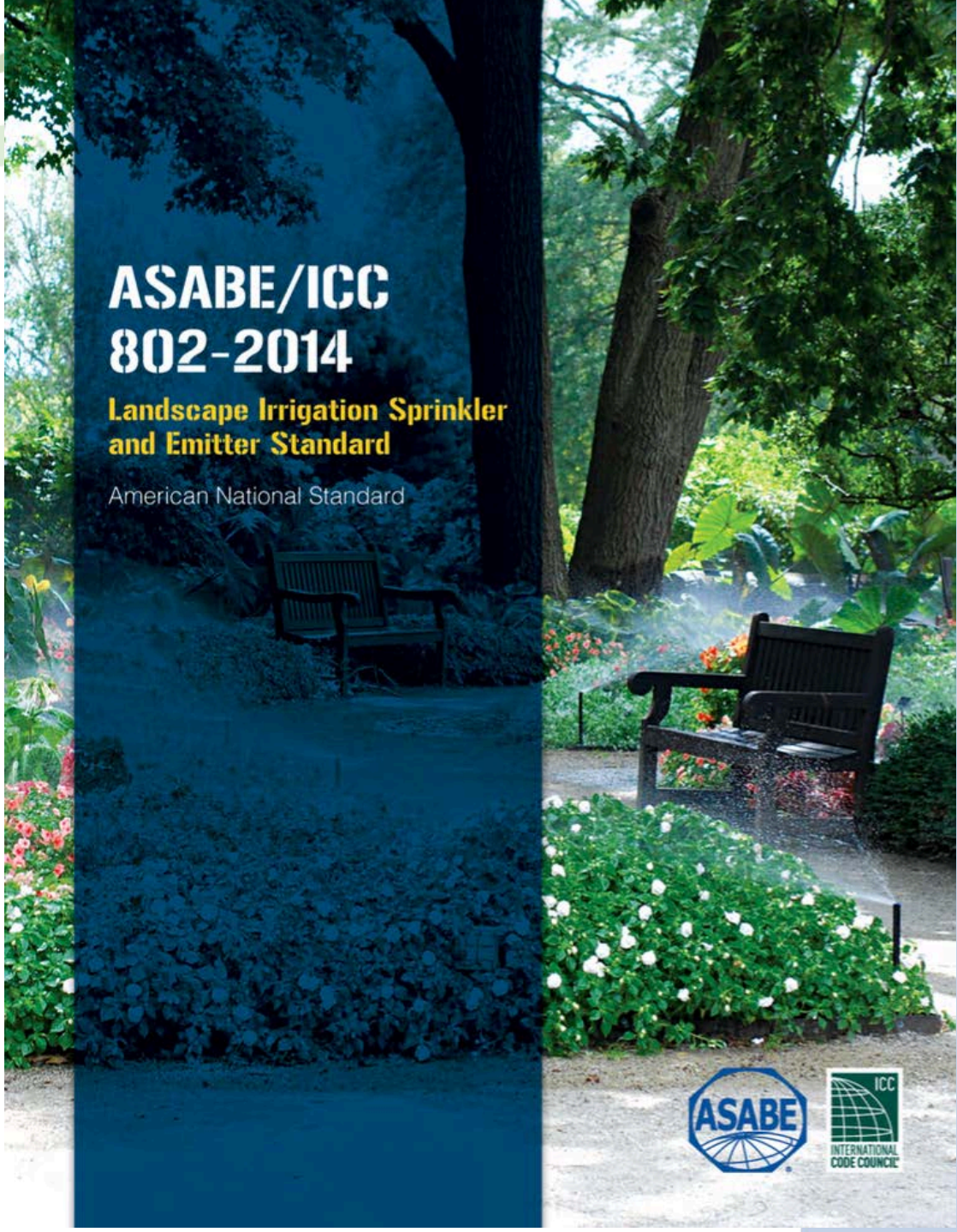
- Mission
  - To protect and conserve Florida's natural resources through research-based sustainable urban landscape practices.
- Vision
  - To be the leading source of science-based information on horticulture and the urban environment in Florida.

Background

- ASABE/ICC Sprinkler & Emitter Standard

Committee Composition

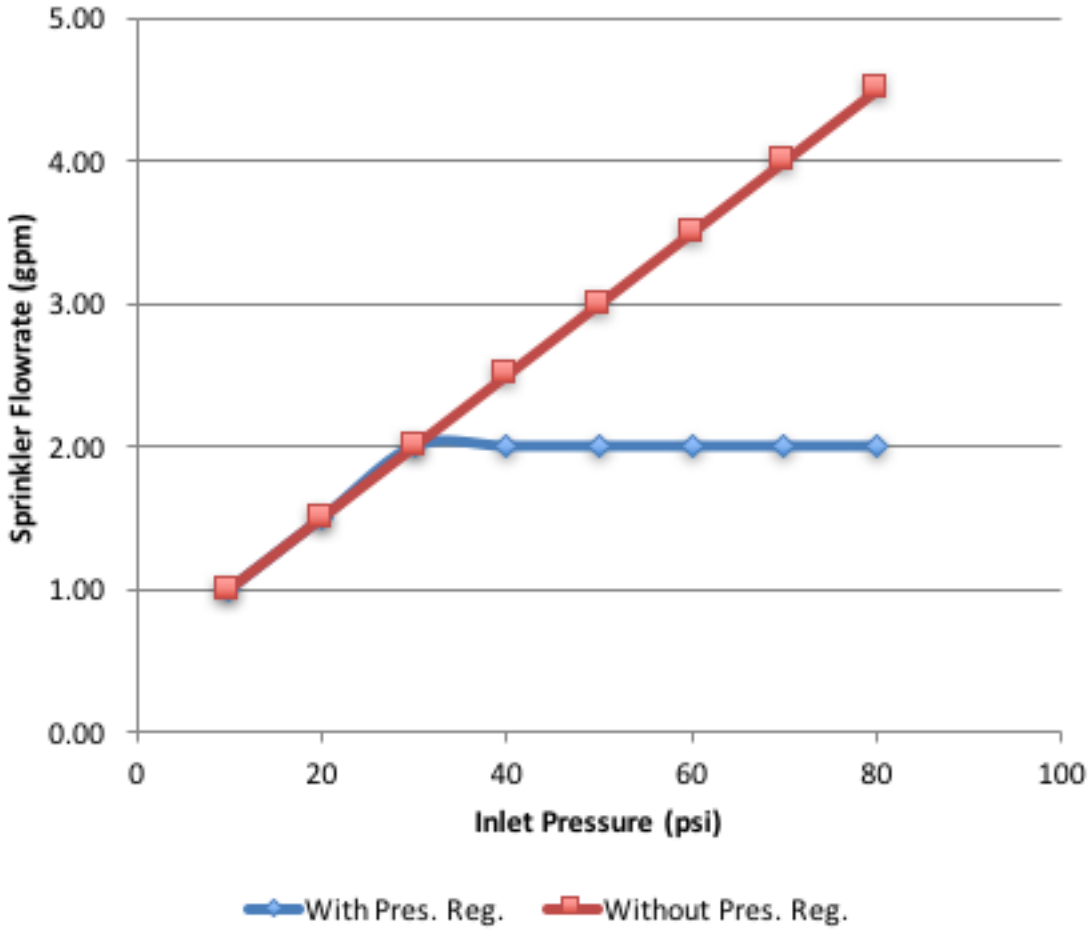
- Irrigation manufacturers
- Utilities
- Irrigation Association
- Irrigation contractors
- Researchers



Background

- ASABE/ICC Sprinkler & Emitter Standard
- Potential savings → flowrate reduction at elevated operating pressures

Theoretical Pressure Regulation Flowrate Reduction



Pressure and Flowrate

12' SERIES WITH 24° TRAJECTORY (BROWN)

Arc	Desc.	psi	gpm	Radius	Prec. Rate ▲	Prec. Rate ■
90°	12-Q	20	0.40	11	1.48	1.28
		30	0.50	12	1.55	1.35
		40	0.60	13	1.64	1.42
		50	0.63	13	1.67	1.44
	12-Q-PC	30-40	0.48	12	1.49	1.29
		40-75	0.53	12	1.65	1.43
120°	12-T	20	0.57	11	1.58	1.37
		30	0.72	12	1.68	1.45
		40	0.87	13	1.87	1.62
		50	0.97	13	1.93	1.67
	12-T-PC	30-40	0.64	12	1.49	1.29
		40-75	0.70	12	1.63	1.41
180°	12-H	20	0.95	11	1.76	1.52
		30	1.09	12	1.69	1.47
		40	1.30	13	1.72	1.49
		50	1.55	14	1.77	1.53
	12-H-PC	30-40	0.96	12	1.49	1.29
		40-75	1.05	12	1.63	1.41

12 Series MPR

30° Trajectory

Nozzle	Pressure psi	Radius ft.	Flow gpm	Precip ■ In/h	Precip ▲ In/h
12F	15	9	1.80	2.14	2.47
	20	10	2.10	2.02	2.34
	25	11	2.40	1.91	2.21
	30	12	2.60	1.74	2.01
12H	15	9	0.90	2.14	2.47
	20	10	1.05	2.02	2.34
	25	11	1.20	1.91	2.21
	30	12	1.30	1.74	2.01

12
● Green

12' radius
Fixed: ¼, ⅓, ½, ⅔, ¾, Full
Trajectory: 28°

Arc	Position	Pressure PSI	Radius ft.	Flow GPM	Precip in/hr ■	Precip in/hr ▲
90°	Q	20	11	0.54	1.71	1.98
		25	12	0.61	1.62	1.87
		30	**12**	**0.67**	**1.78**	**2.06**
		35	13	0.72	1.65	1.90
		40	13	0.78	1.77	2.04
120°	T	20	11	0.72	1.71	1.98
		25	12	0.81	1.62	1.87
		30	**12**	**0.89**	**1.78**	**2.06**
		35	13	0.97	1.65	1.90
		40	13	1.04	1.77	2.04
180°	H	20	11	1.05	1.67	1.93
		25	12	1.18	1.58	1.83
		30	**12**	**1.30**	**1.74**	**2.01**
		35	13	1.42	1.61	1.86
		40	13	1.52	1.73	2.00

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		50	0.63	13	1.67	1.44
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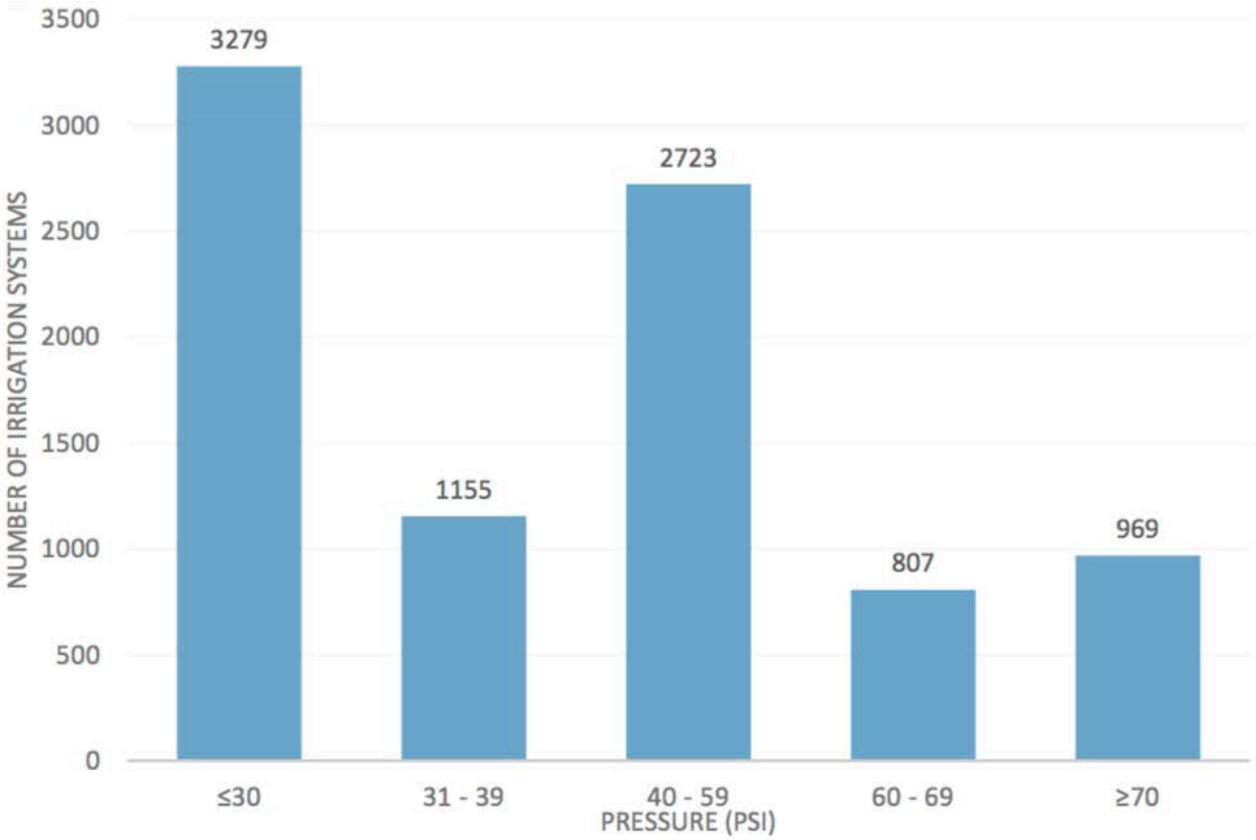
		35	13	1.42	1.61	1.86
		40	13	1.52	1.73	2.00

EPA Estimated Savings

- Avg. house using 50,500 gal/yr saves 5,600 gal/yr
- 2.3 yr ROI retrofit
- 1.5 yr ROI new install



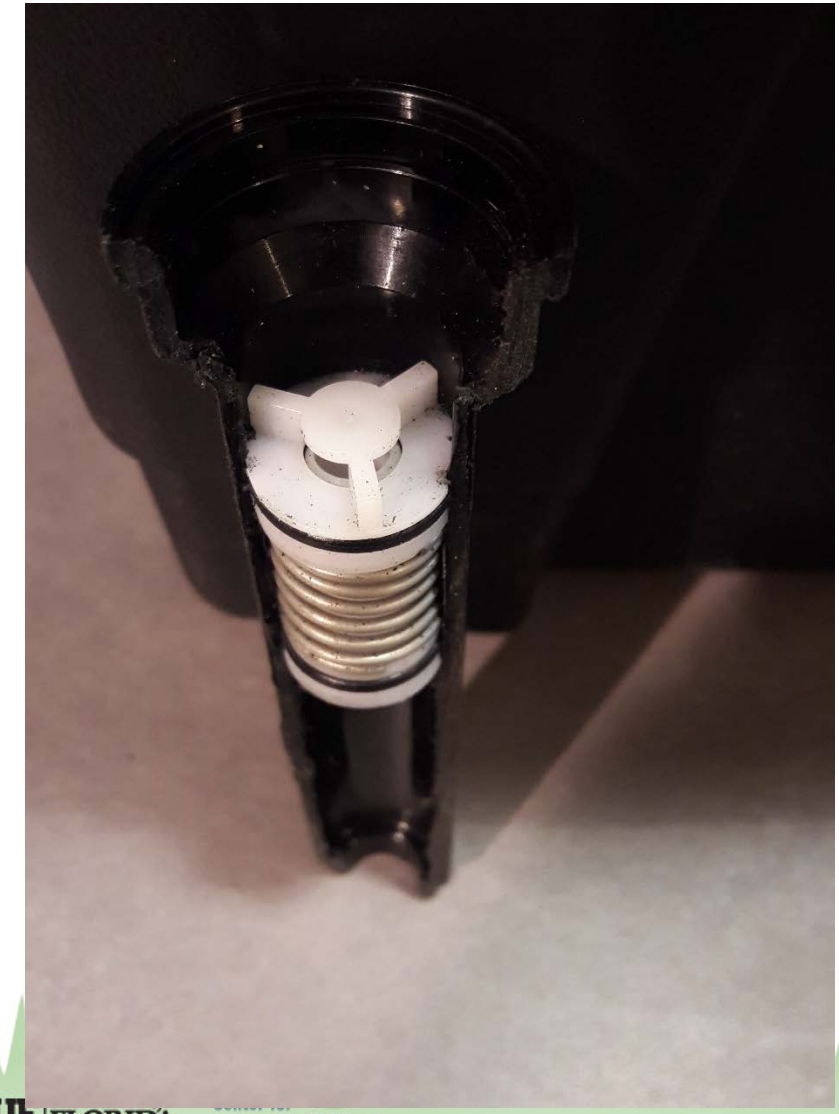
Irrigation System Pressure Data, Utah State University and Center for Resource Conservation

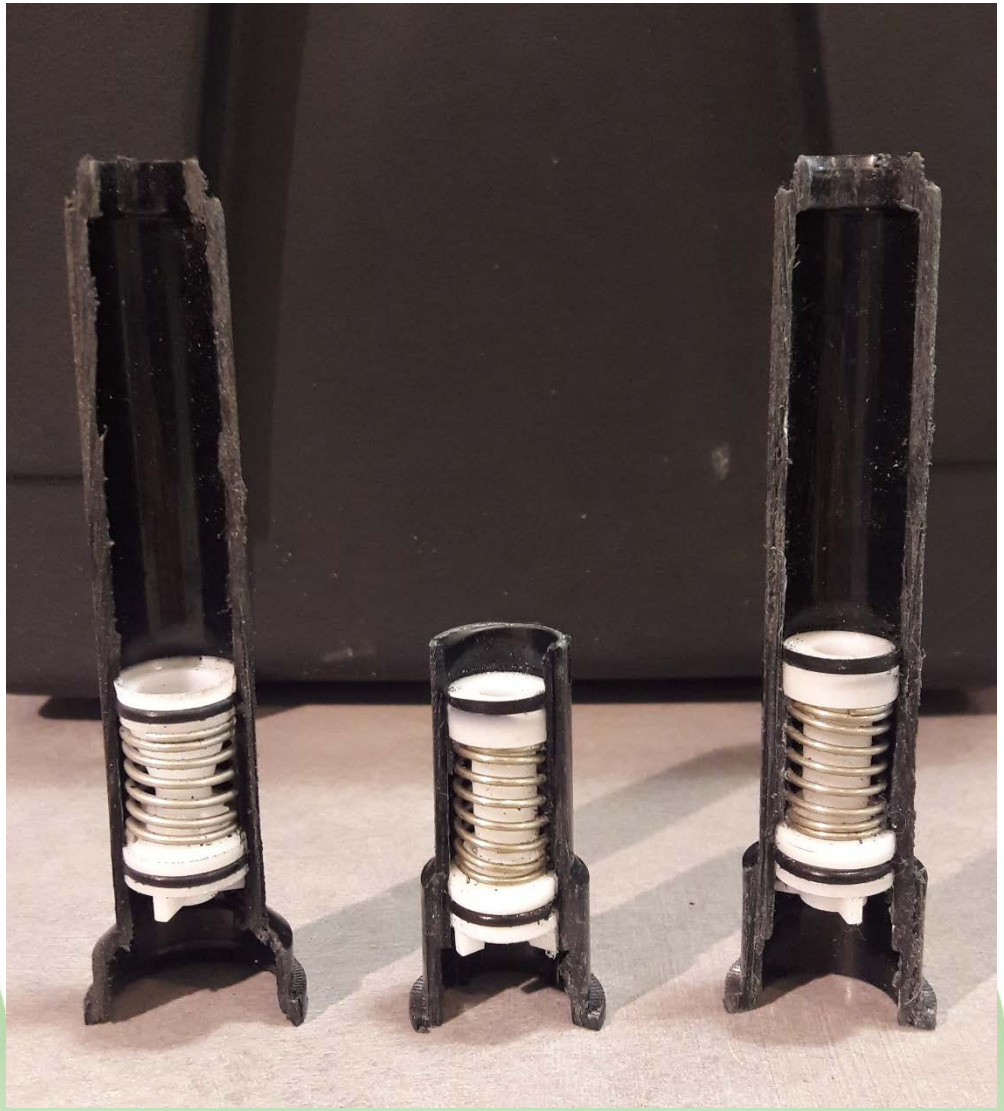
Misting and Drift

Pressure Regulation

No Pressure Regulation

How Do They Work?

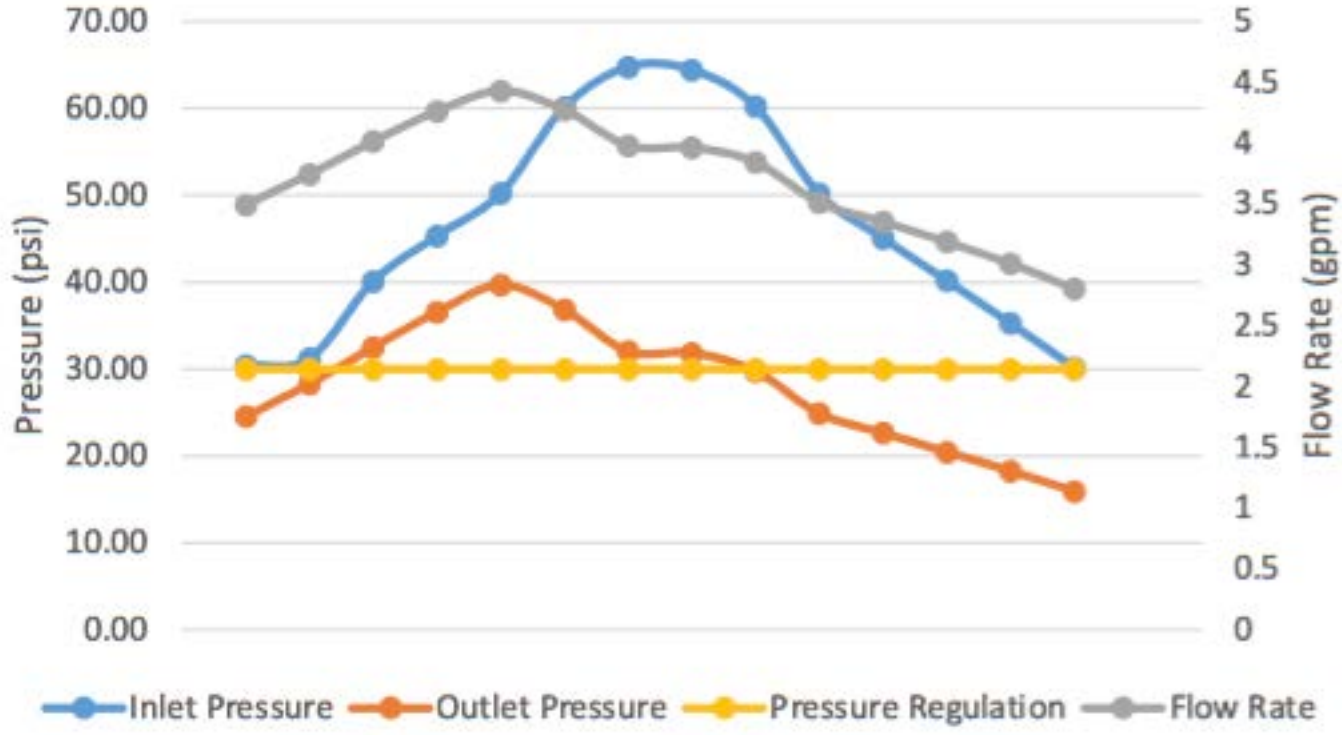




EPA WaterSense Initial Testing

- Three labs
- Outlet device
  - Standardized orifice in 802
  - Ball valve/gate valve
  - Variable arc nozzle
  - Needle valve
- Increasing pressure/decreasing pressure → hysteresis

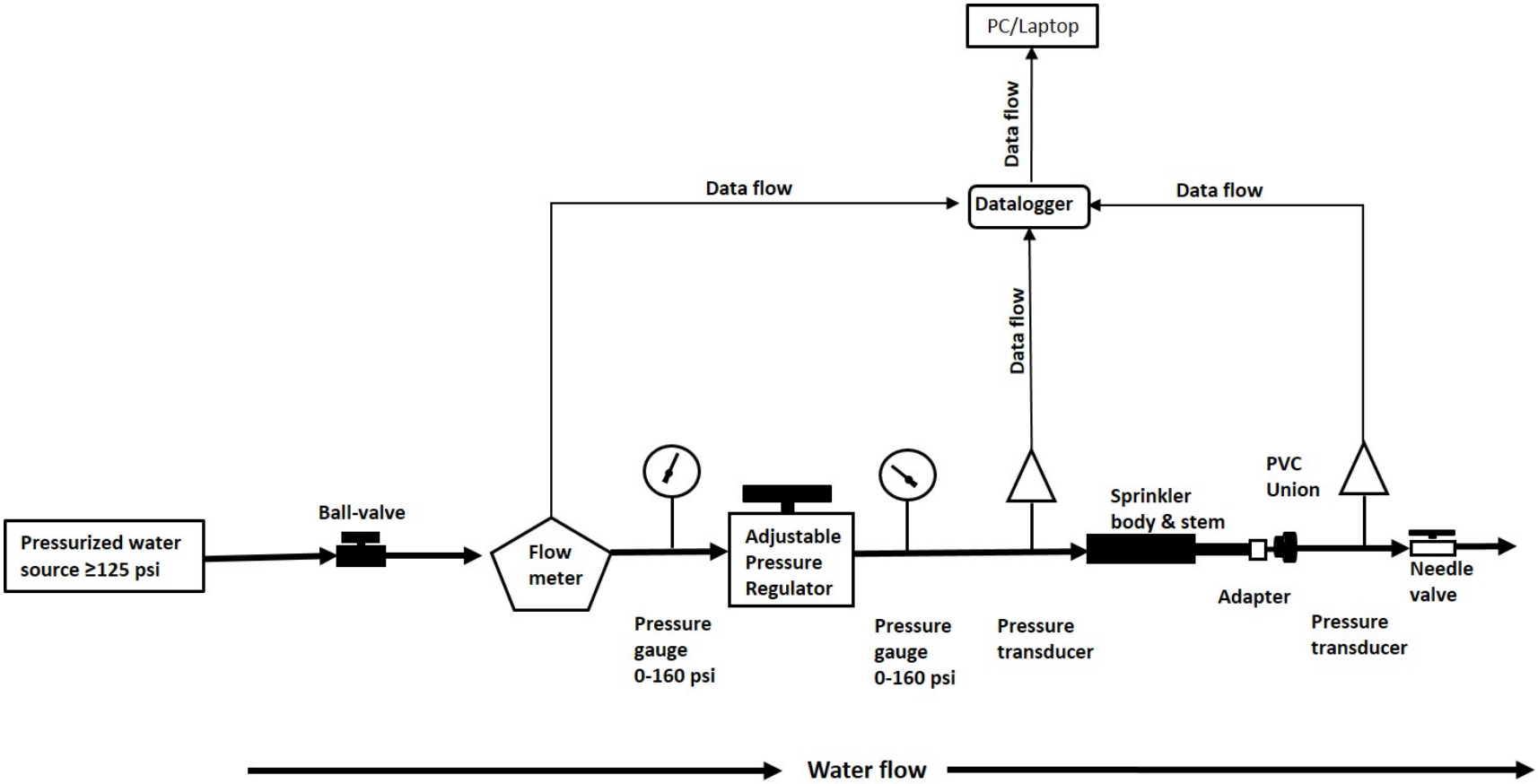
Initial Testing Observed Hysteresis



Outline

- Test equipment
- Test process
- Modifications
- Results
- Recommendations

Test Equipment



Test equipment


MARVARD
BAR
100xkPa
psi
PLASTI-FAB, INC


FLOW

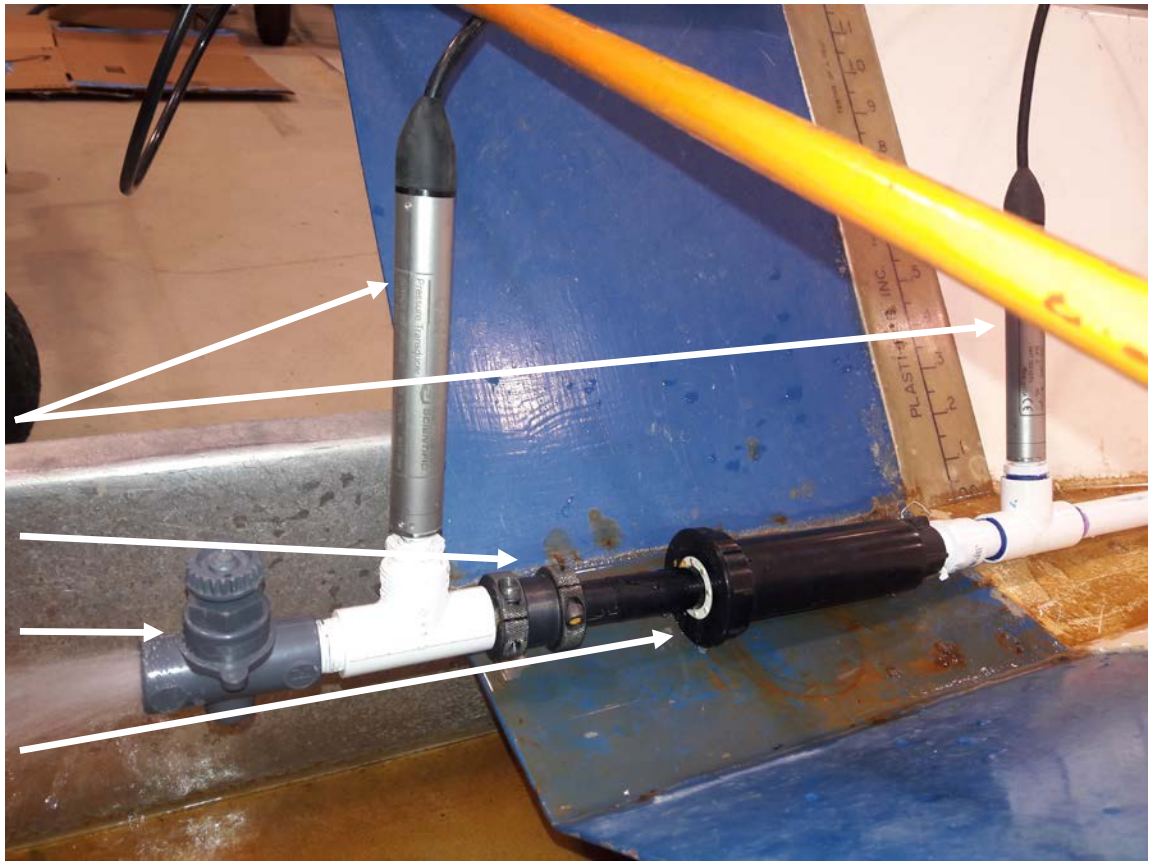
Test Sample, pressure transducers, needle valve

Pressure Transducers

Adapter

Needle Valve

Test Specimen



Test Process

- Verify flowrate at rated pressure (3 consecutive readings) 30 psi +/- 1 psi, 1.5 gpm +/- 0.1 gpm
- Reduce pressure to zero (for at least 1 min)
- Increase pressure to rated+10 psi (3-5 min test, 30 sec recording)
- Reduce pressure to zero
- Increase pressure to 60 psi
- Reduce pressure to zero
- Increase pressure to 70 psi
- Repeat for 60 psi, rated+10 psi

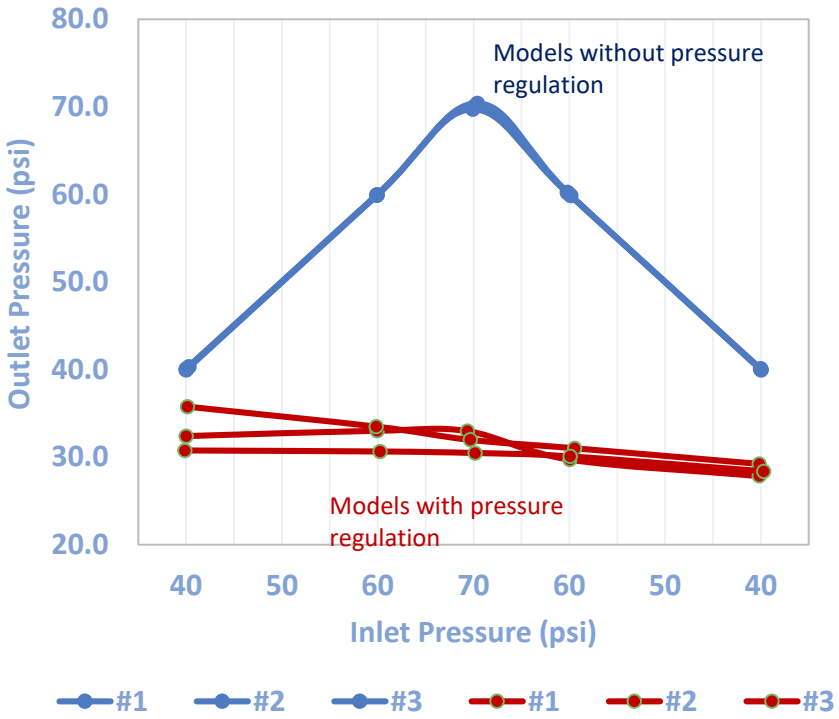
Test Modifications

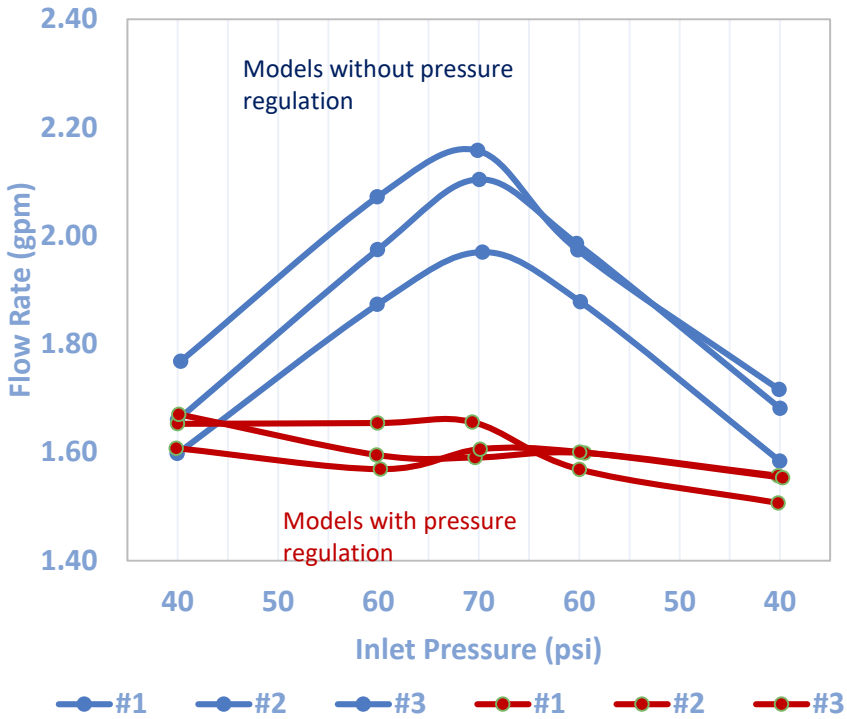
- All piping ½” SCH 40 PVC, not ¾”
- First test point at regulated pressure to verify test conditions
- Accepted a 0.2 gpm deviation at 3.5 gpm test point

Models Tested

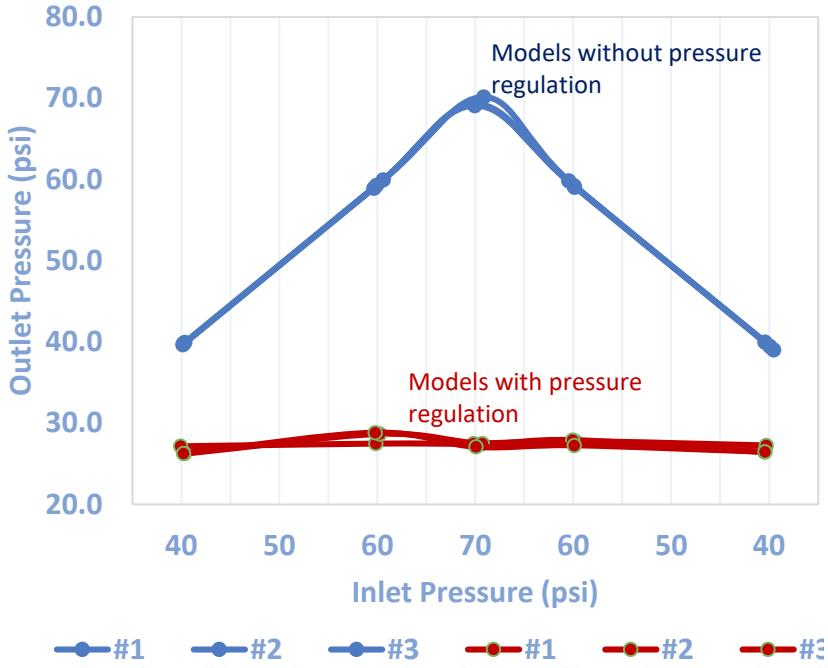
- 6 manufacturers
- 11 models tested, 3 samples each
- Brands A-C, PR and non-PR models tested
- One check valve model
- Two flow reduction models

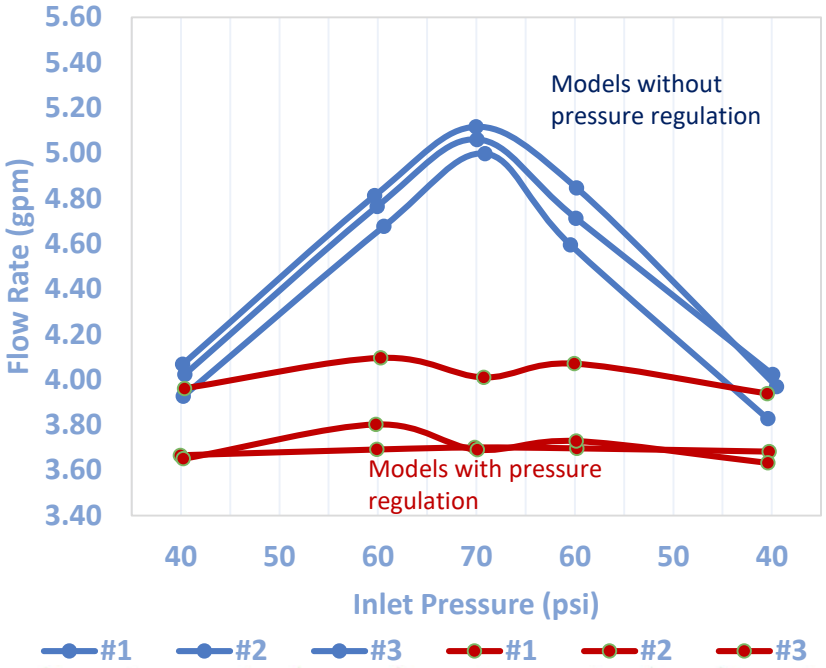
Brand A Pressure Regulated vs. Non-Pressure Regulated – 1.5 gpm Test





Brand A Pressure Regulated vs. Non-Pressure Regulated – 3.5 gpm Test





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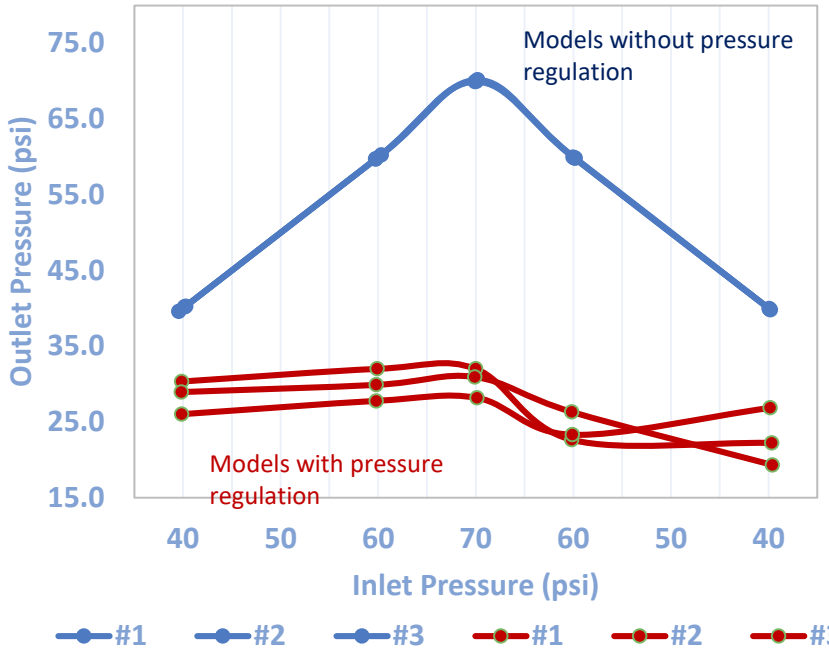
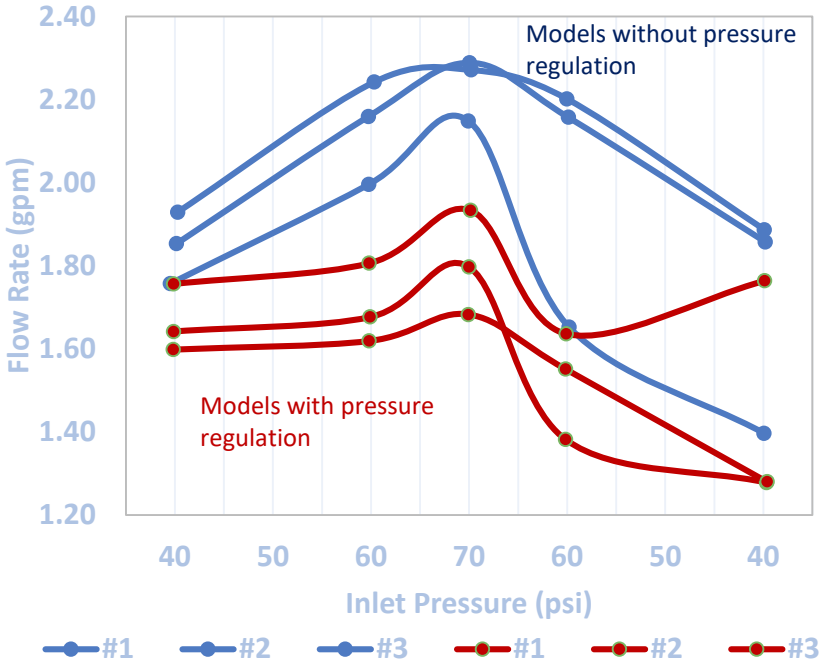
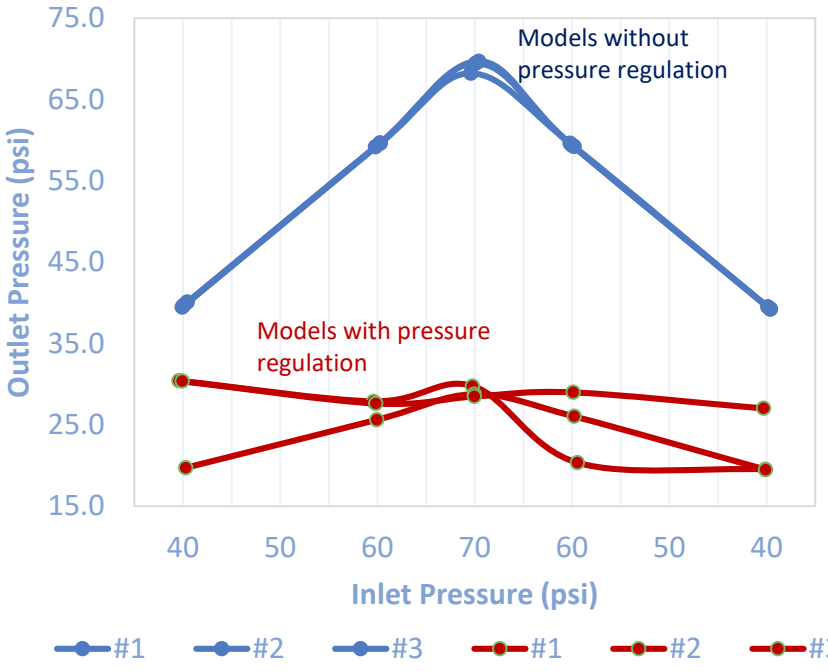
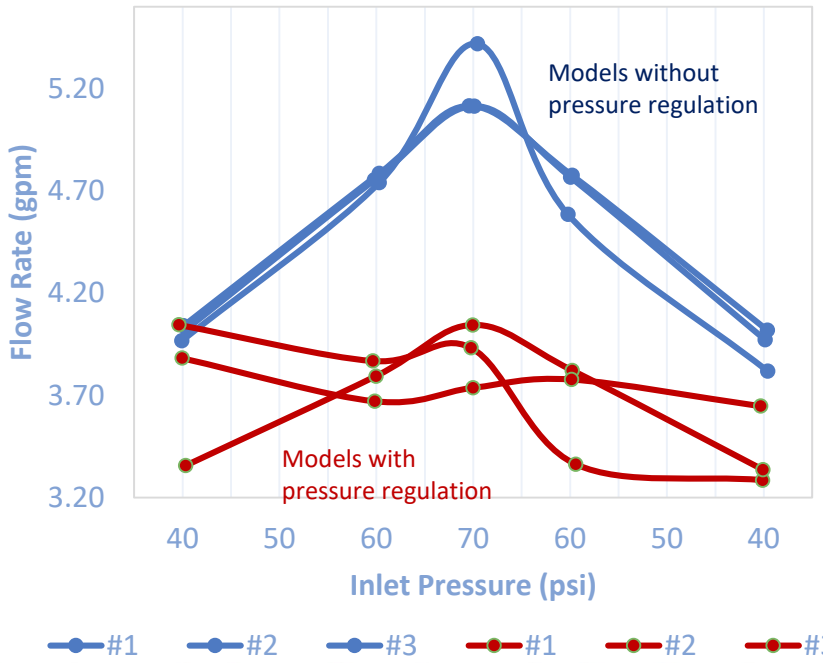
Brand B Pressure Regulated vs. Non-Pressure Regulated – 1.5 gpm Test





Brand B Pressure Regulated vs. Non-Pressure Regulated – 3.5 gpm Test





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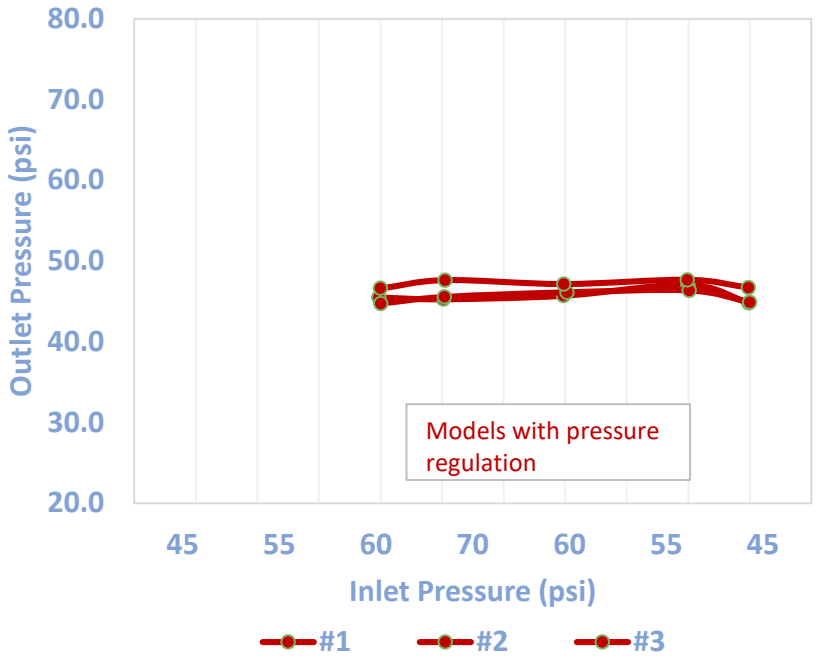
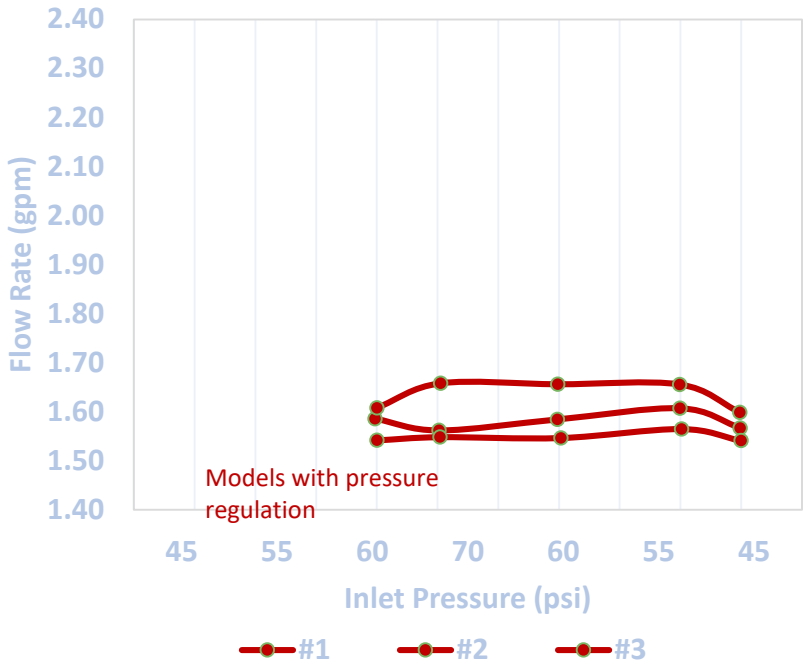
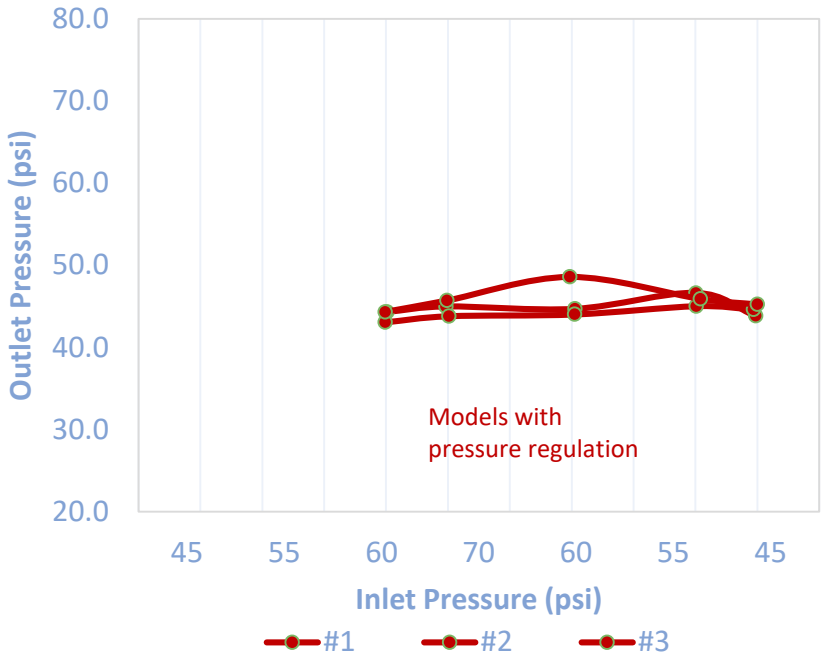
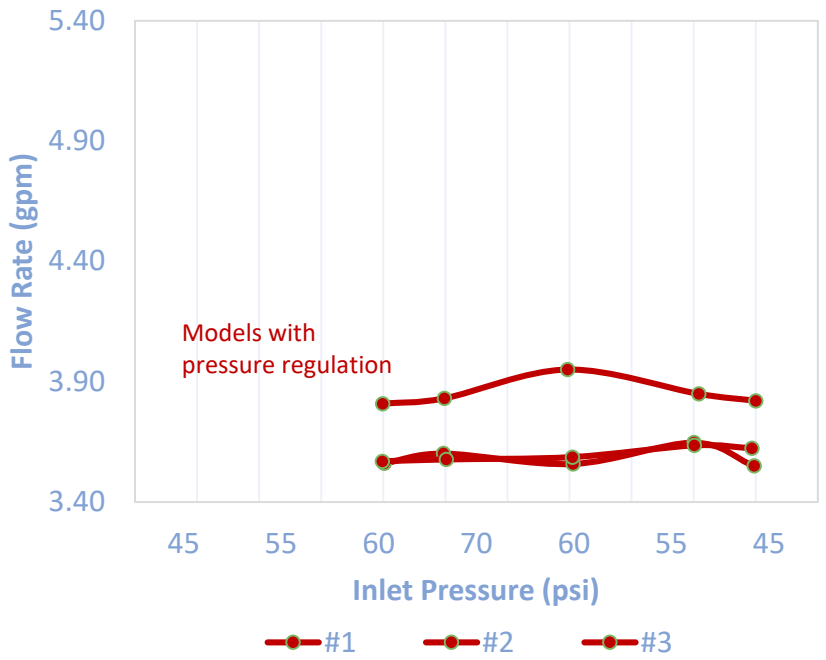
Brand E PRB & Check Valve – 1.5 gpm Test





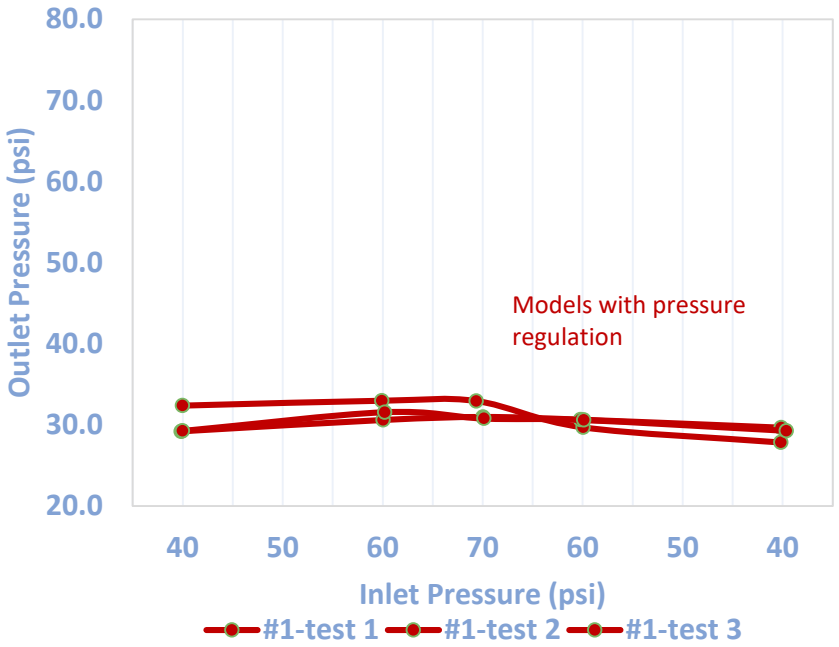
Brand E PRB & Check Valve – 3.5 gpm Test

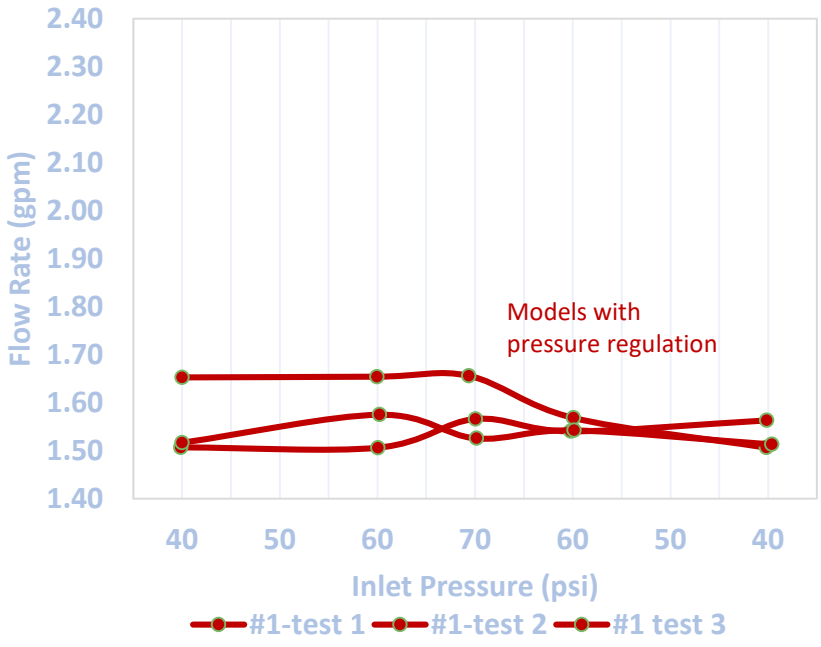




PRB Replicate Tests– Brand A Sample #1

1.5 gpm





PRB Replicate Tests– Brand A Sample #1

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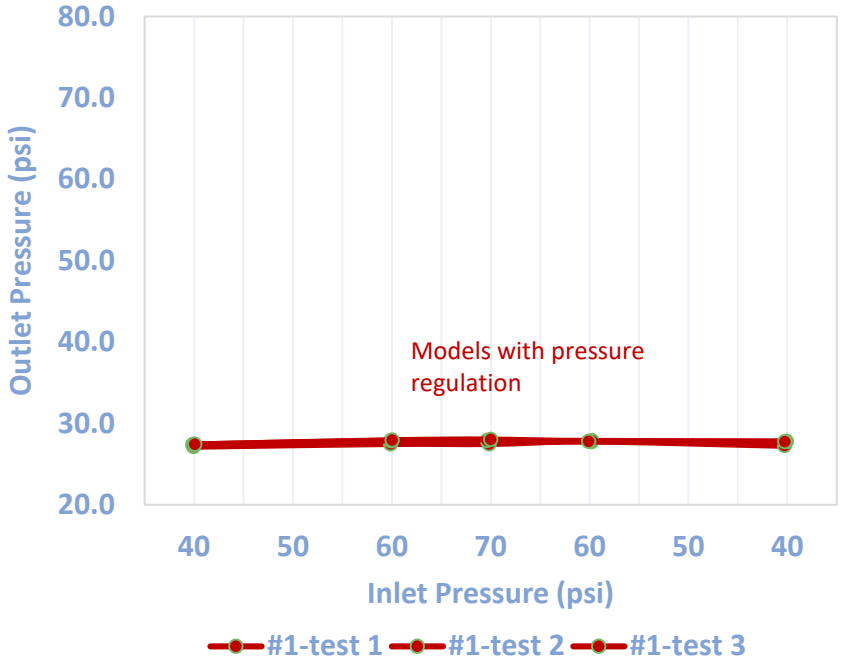
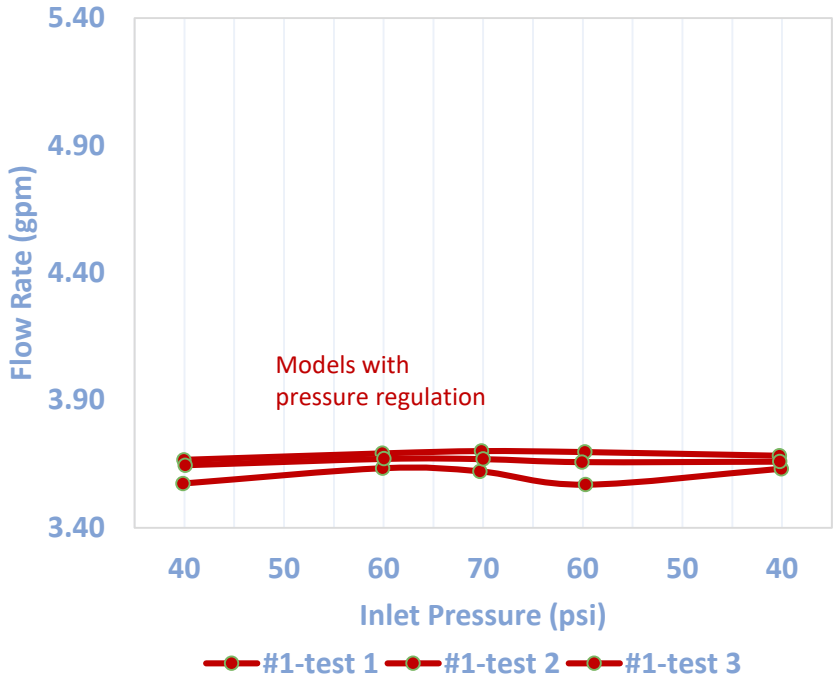
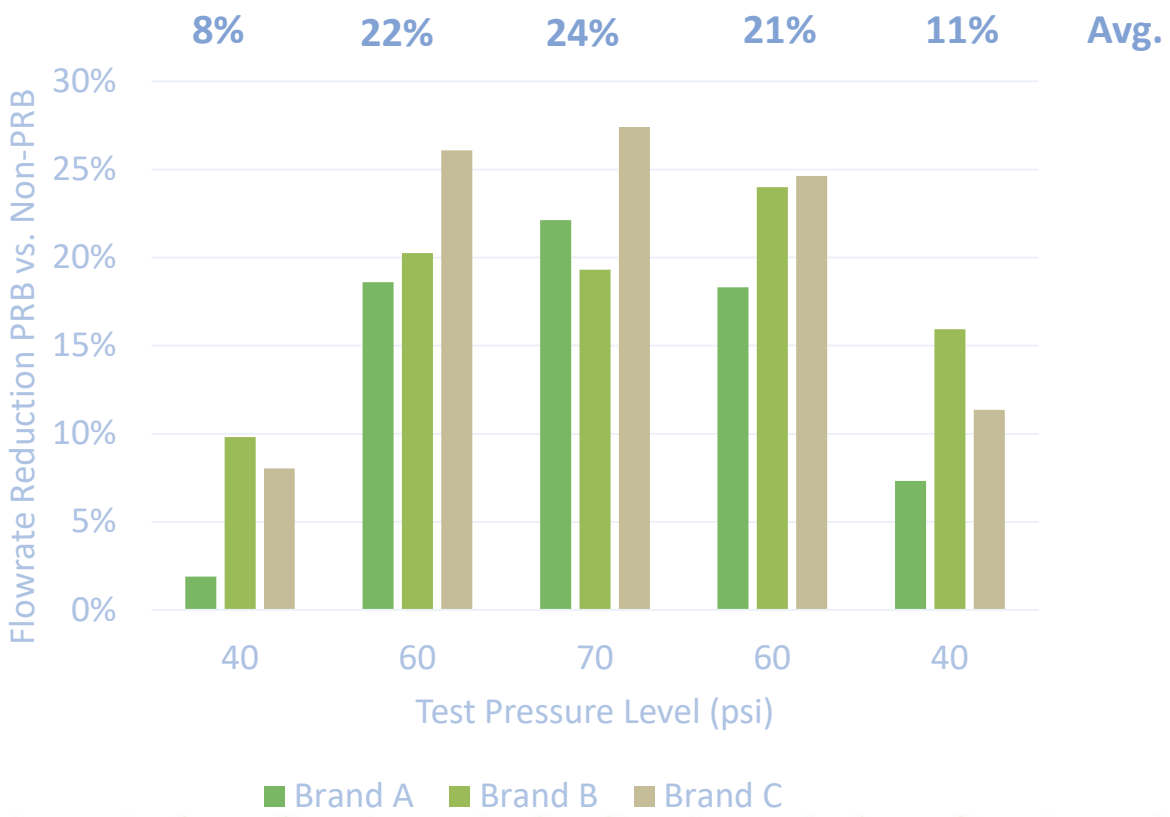




Flowrate Reduction – PRB vs. Non-PRB @ 1.5 gpm



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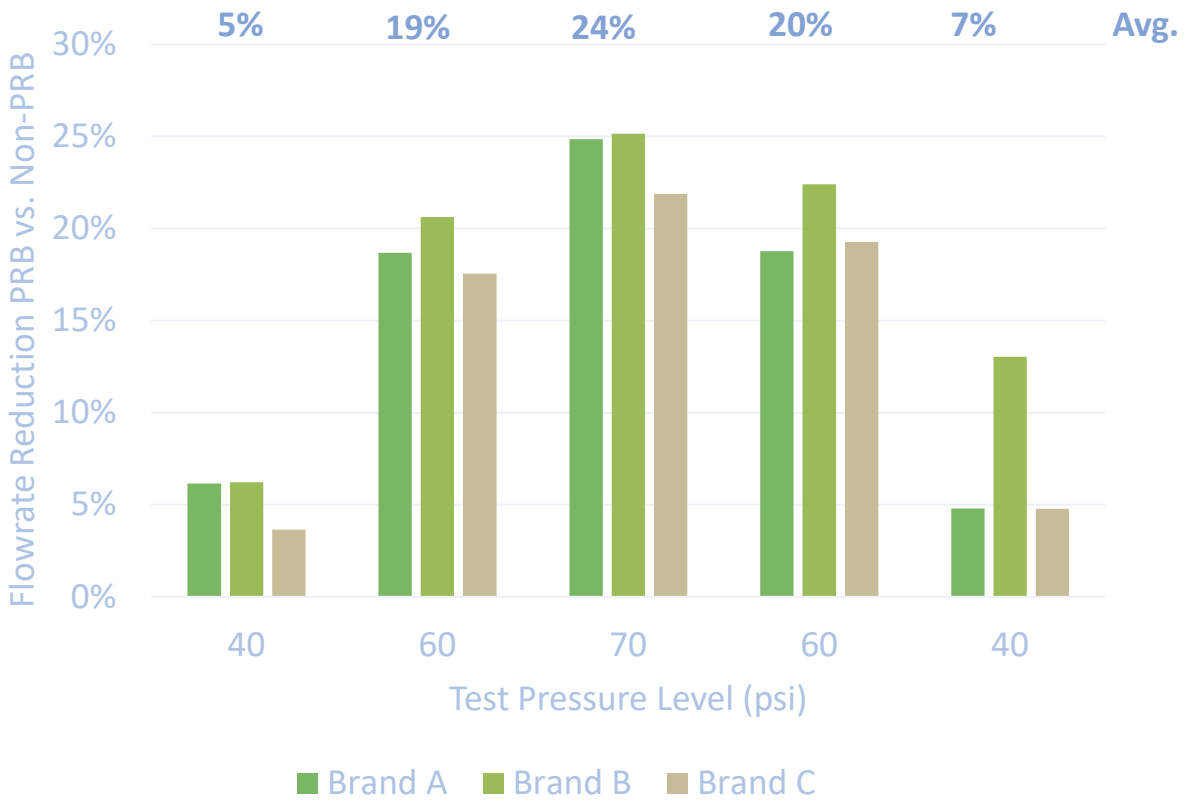
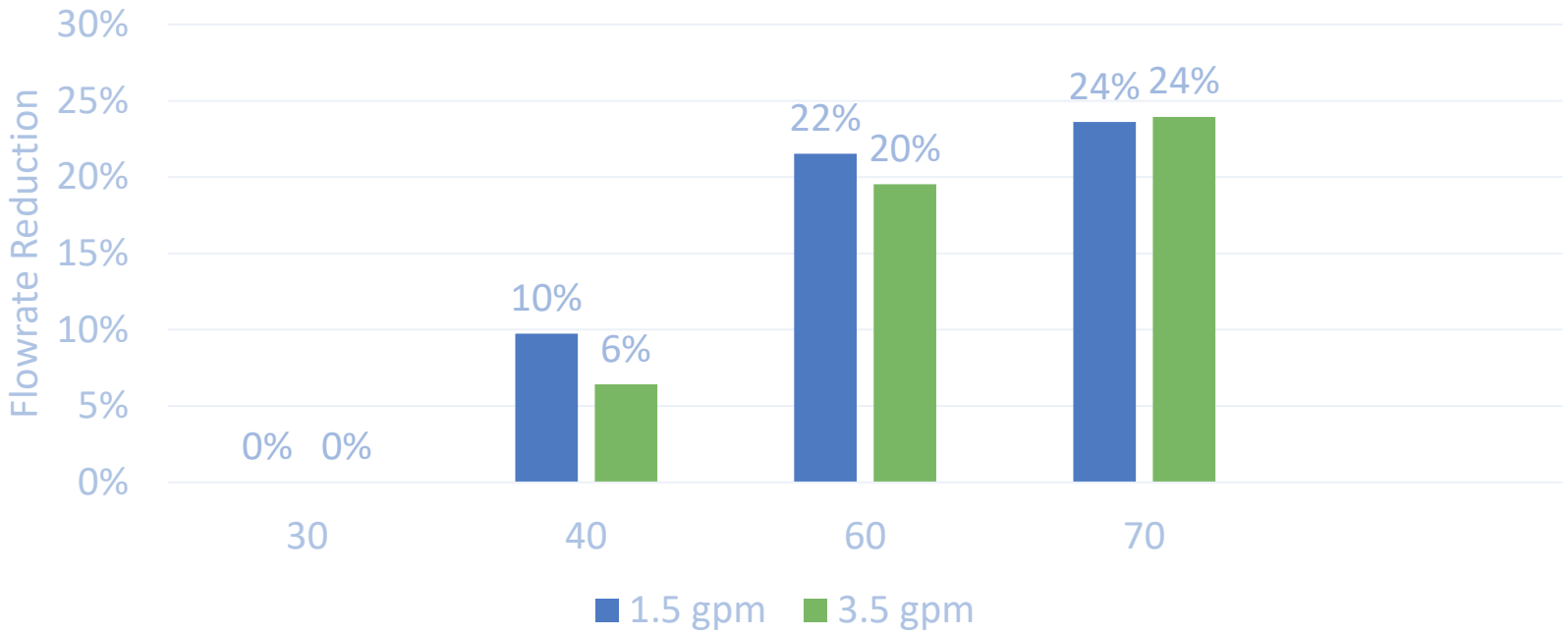
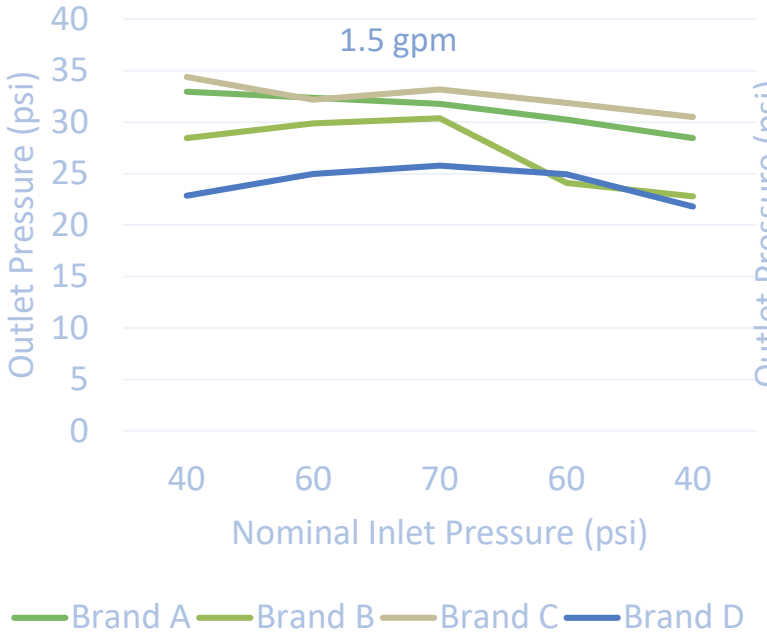
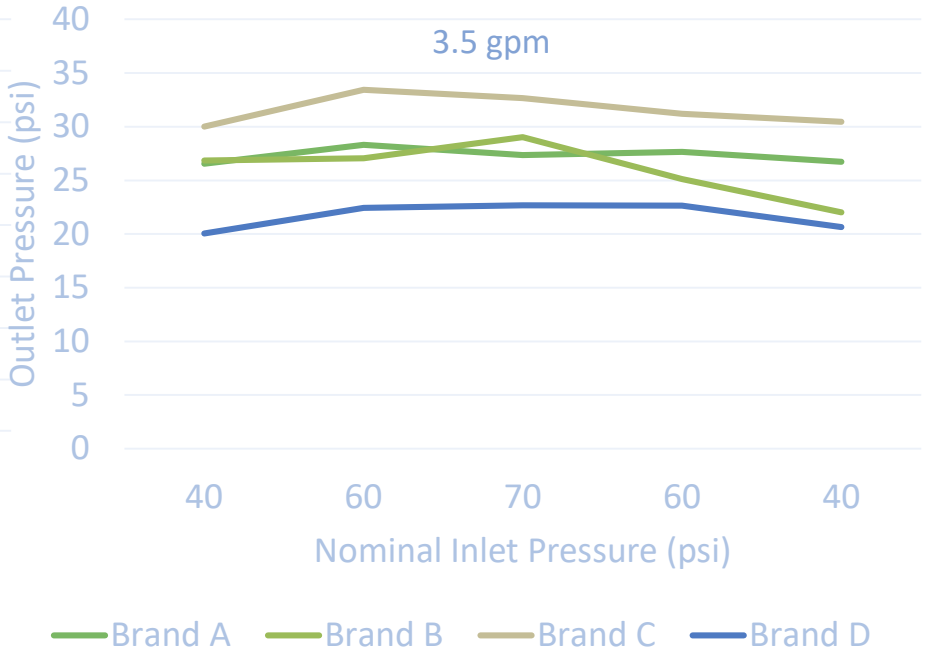


Average Flowrate Reduction – PRB vs. Non-PRB

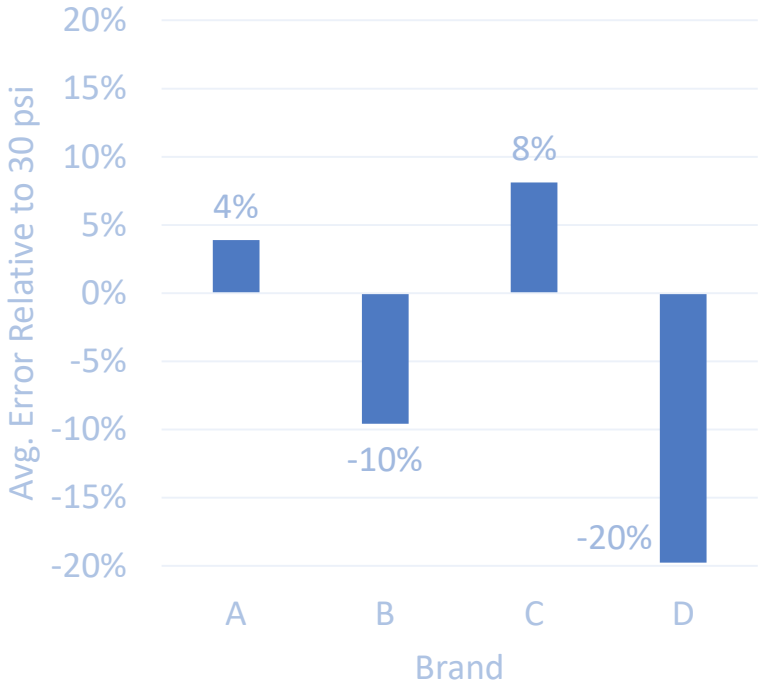


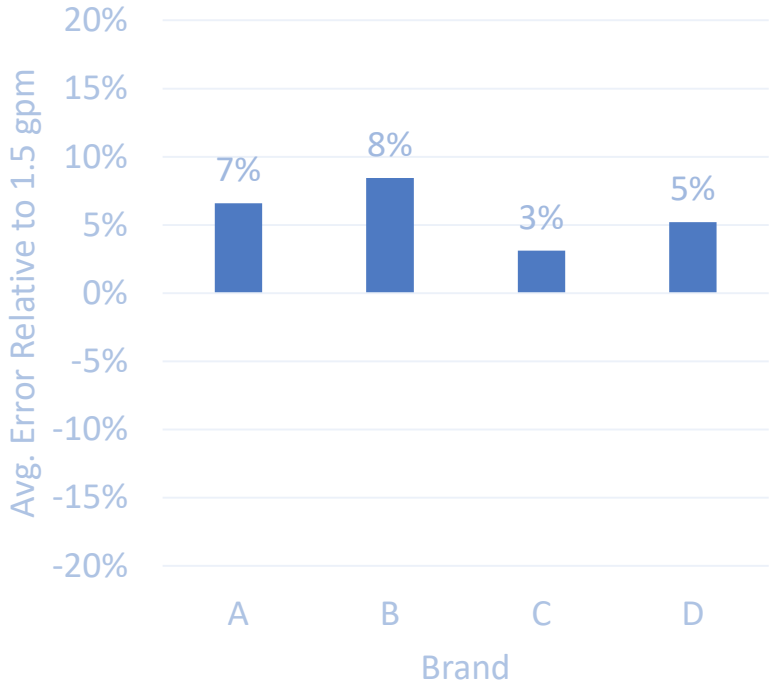
PRB Outlet Pressure





Average Pressure & Flowrate Error – 1.5 gpm





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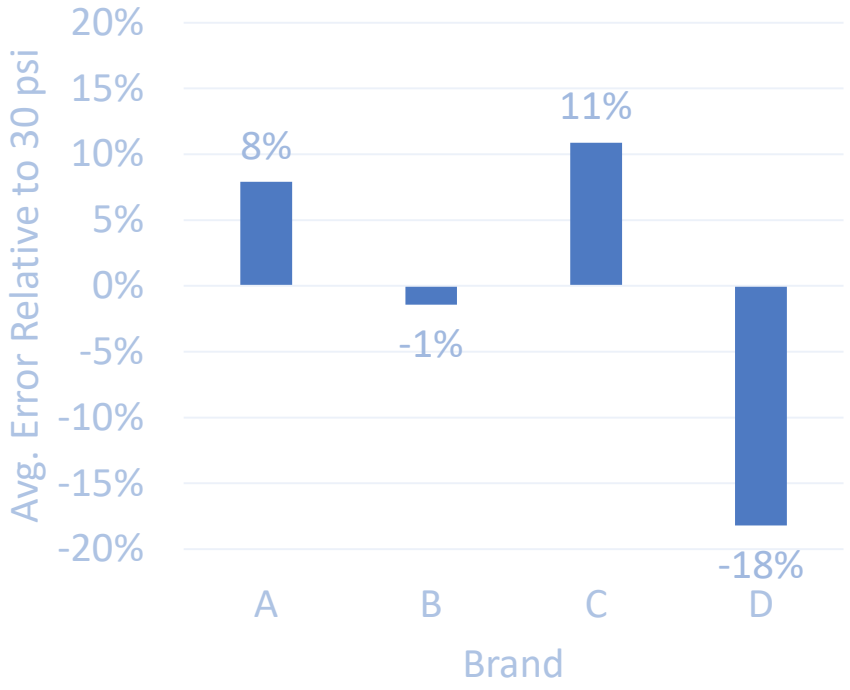
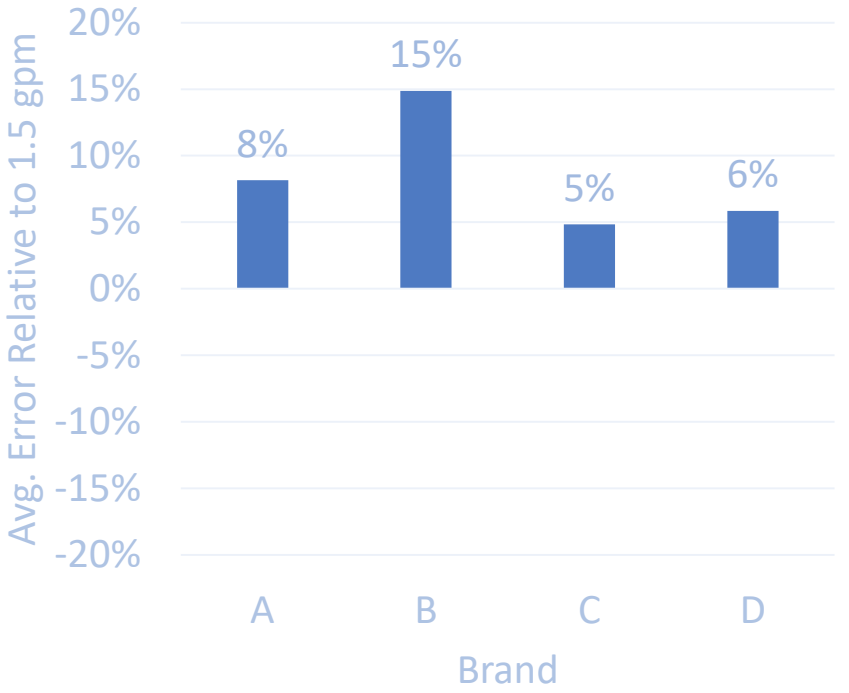
Average Pressure & Flowrate Error Rising Limb – 1.5 gpm





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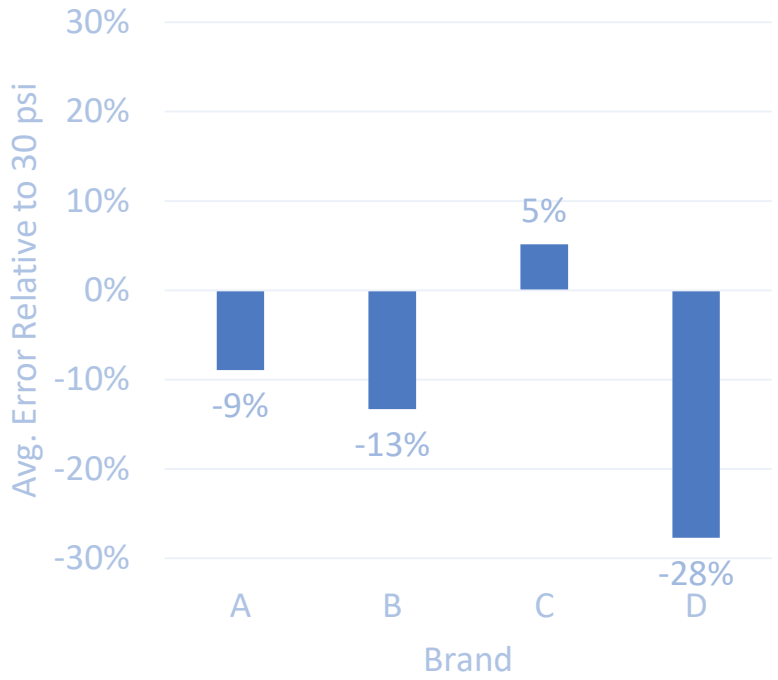

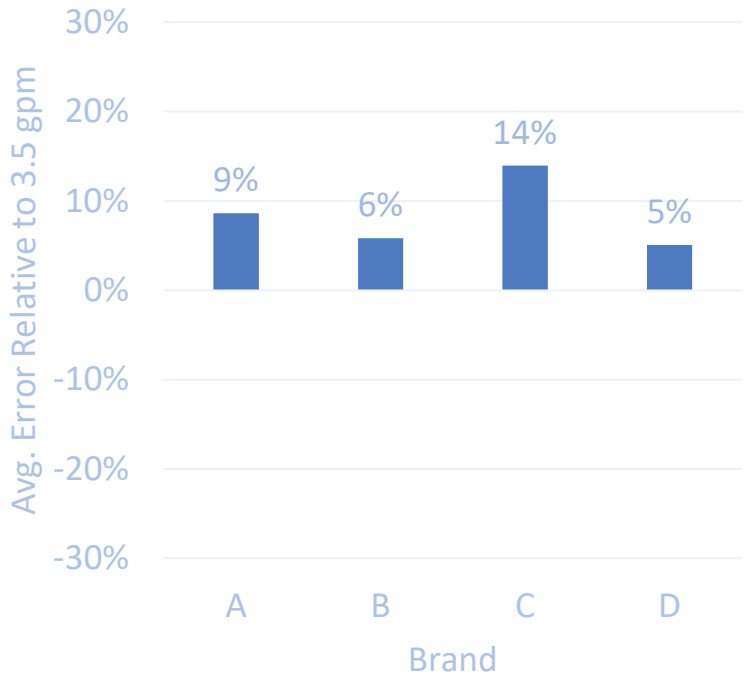

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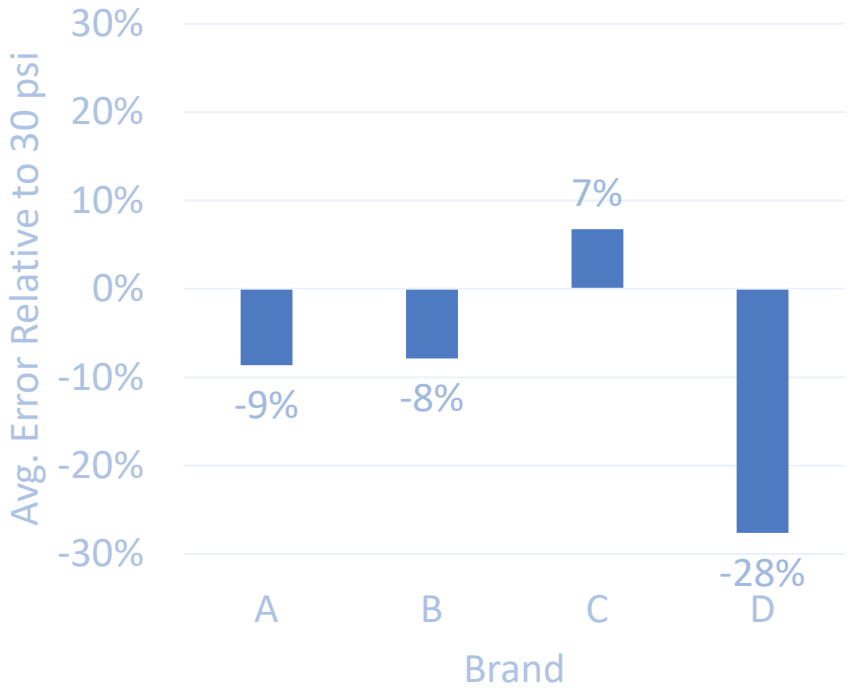
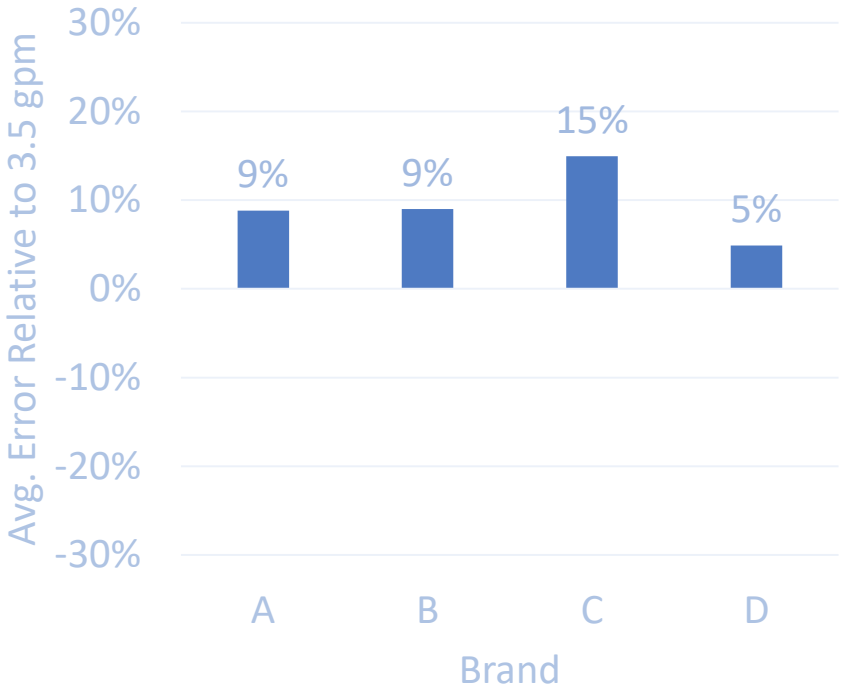
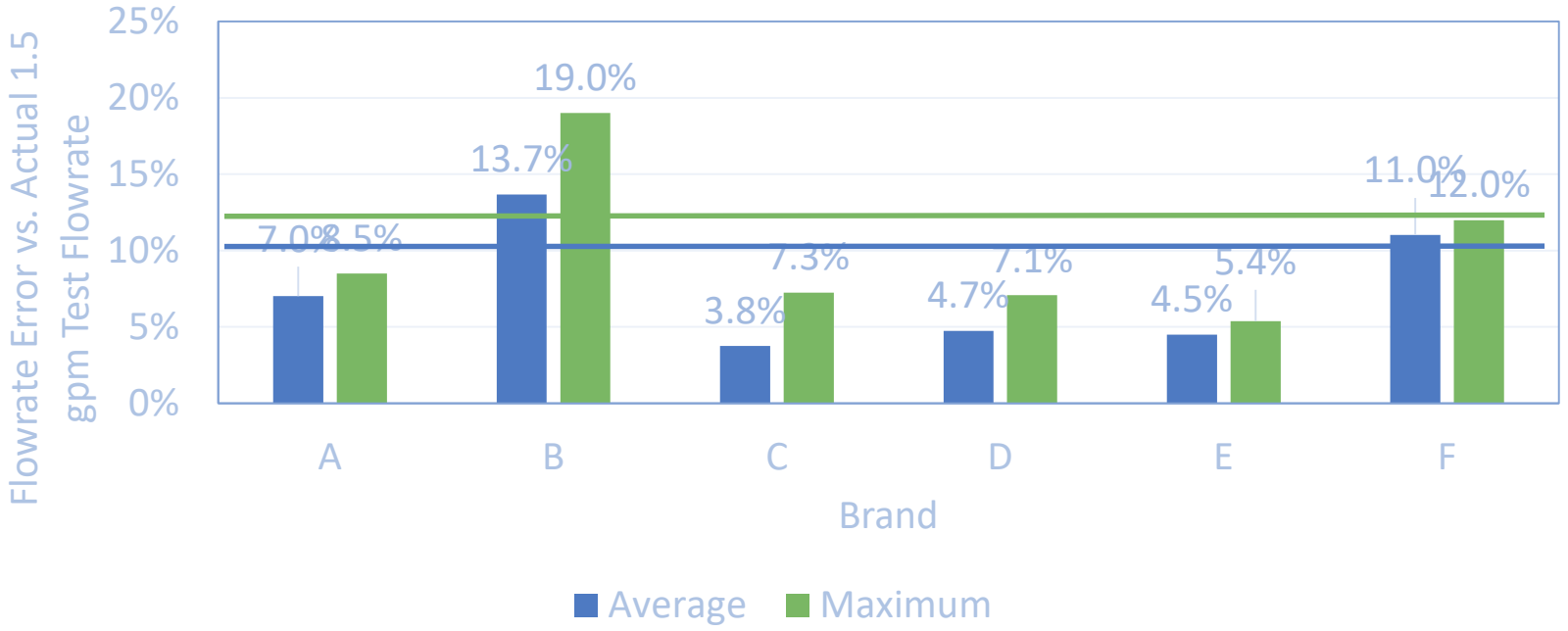




Recommendations

- Consider testing only the rising limb of pressure, e.g. for a 30 psi PRB, 40, 60, 70 psi test
- Consider testing only 1.5 gpm since this flowrate is similar to the majority of sprinklers in the field
- No compelling difference between 1.5 gpm & 3.5 gpm results
- Consider a maximum of 10-15% plus/minus deviation in peak flowrate at 1.5 gpm
- Consider average flowrate deviation maximum of 10-15% plus/minus at 1.5 gpm

Error Analysis on Individual Samples Criteria: 1.5 gpm actual flowrate rising limb



EPA Spec Criteria

- Flowrate at max operating pressure compared to calibration flowrate shall be within +/- 12.0%
- Average of all test flowrates compared to calibration flowrate shall be within +/- 10.0%
- Average outlet pressure at initial calibration point shall not be less than 2/3 of regulation pressure

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