



Swagelok®

Improve safety and performance of Gas Distribution Systems



Wilco Landkroon & Marco van den Broek

13 July 2023

Introduction Swagelok



Wilco Landkroon
Field Engineer / Trainer



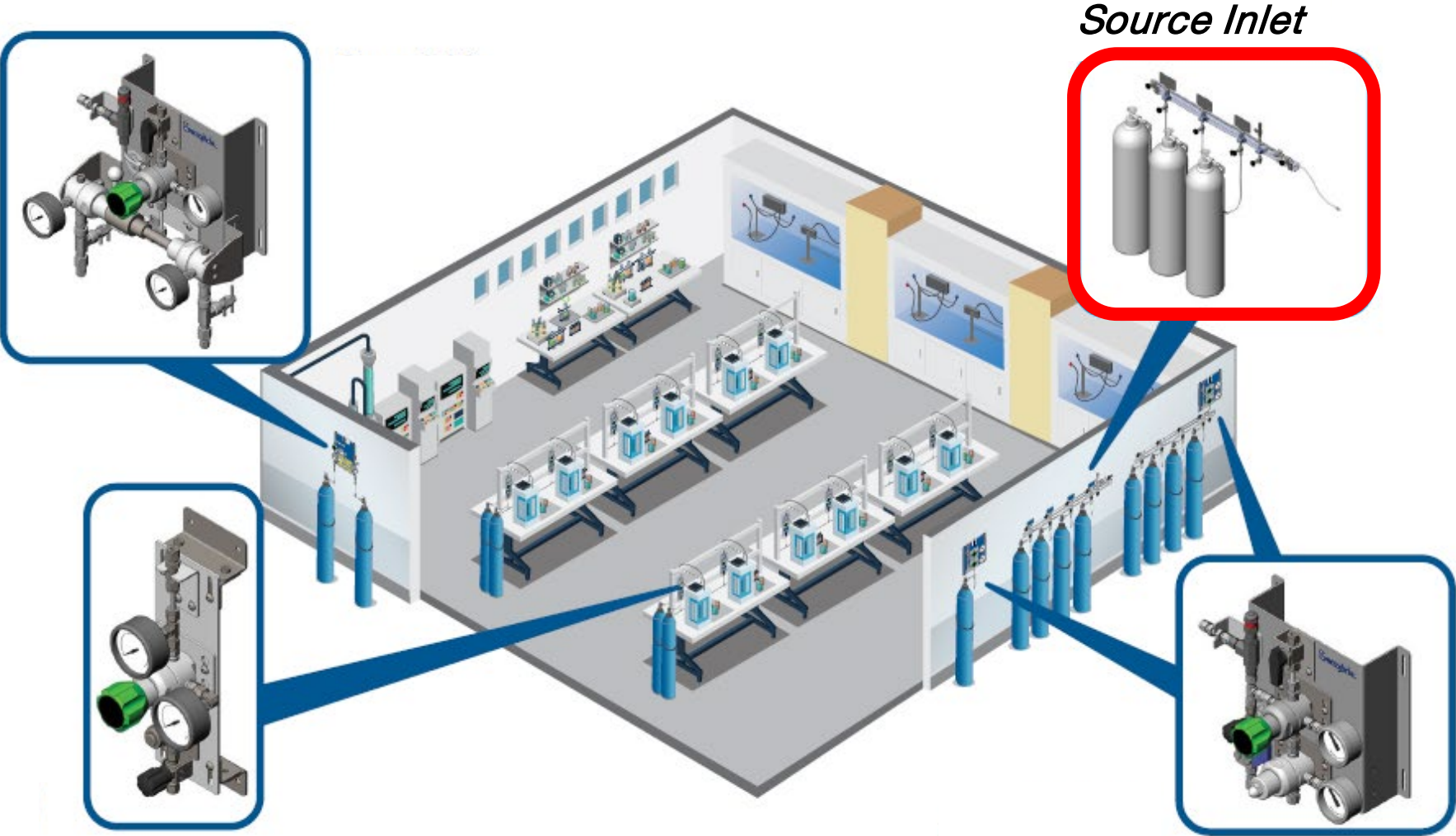
Marco van den Broek
Sales Engineer

Agenda

- What is a Gas Distribution System?
- Regulator flow curves
 - Droop
 - Lockup
- Supply Pressure Effect
 - Single vs multiple regulator stages
- Changeover panels
 - Operation
 - Selecting changeover pressure
- Selecting line regulation
- Questions



What is a Gas Distribution System?



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Auto-Changeover

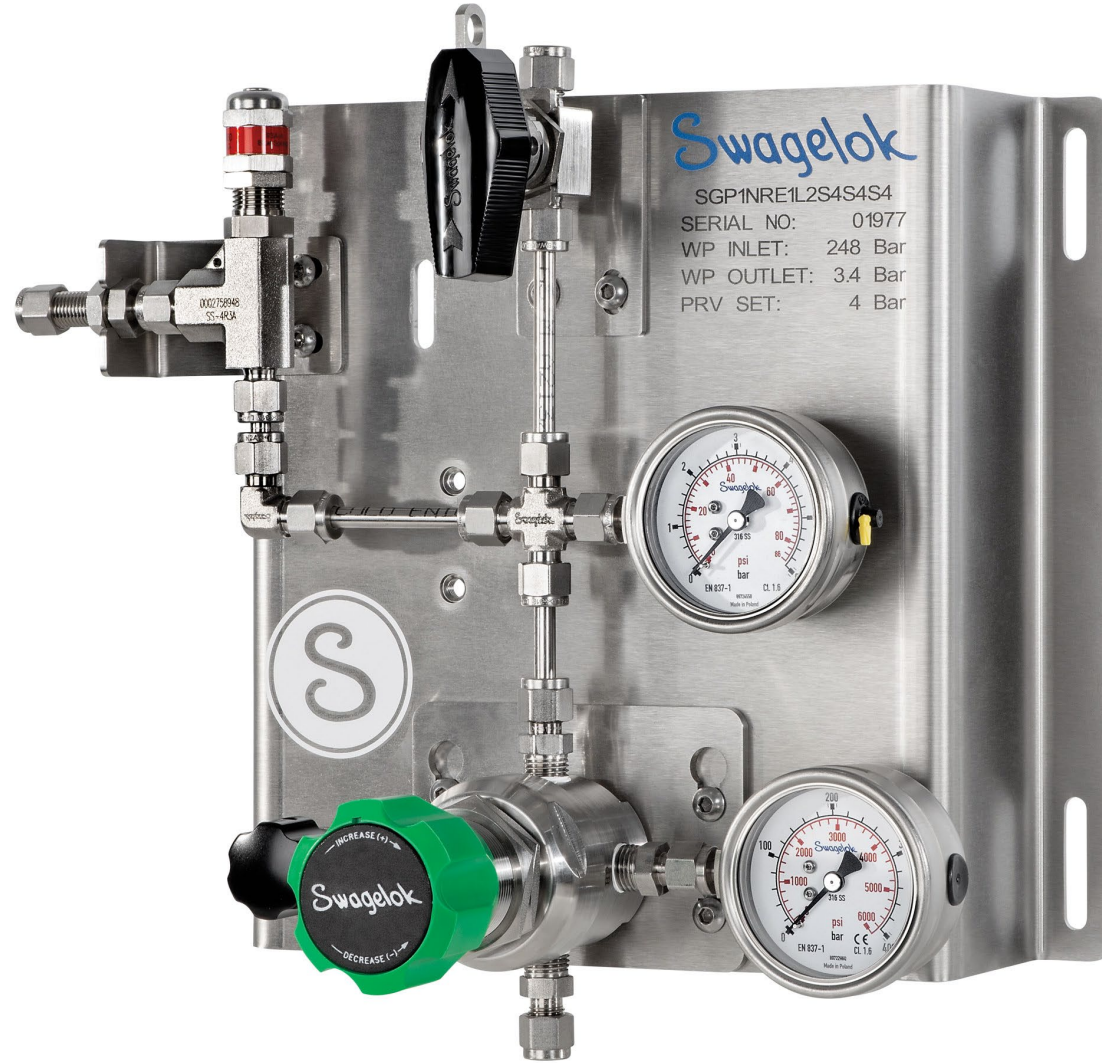
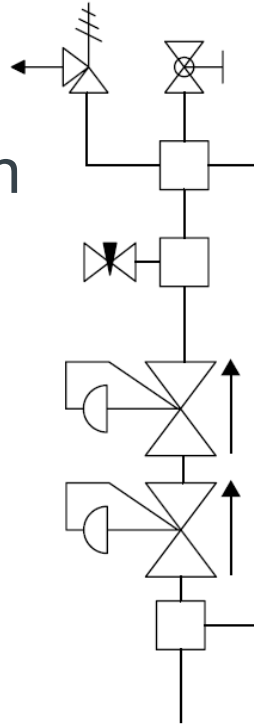


What is a Gas Distribution System?



Gas Panel

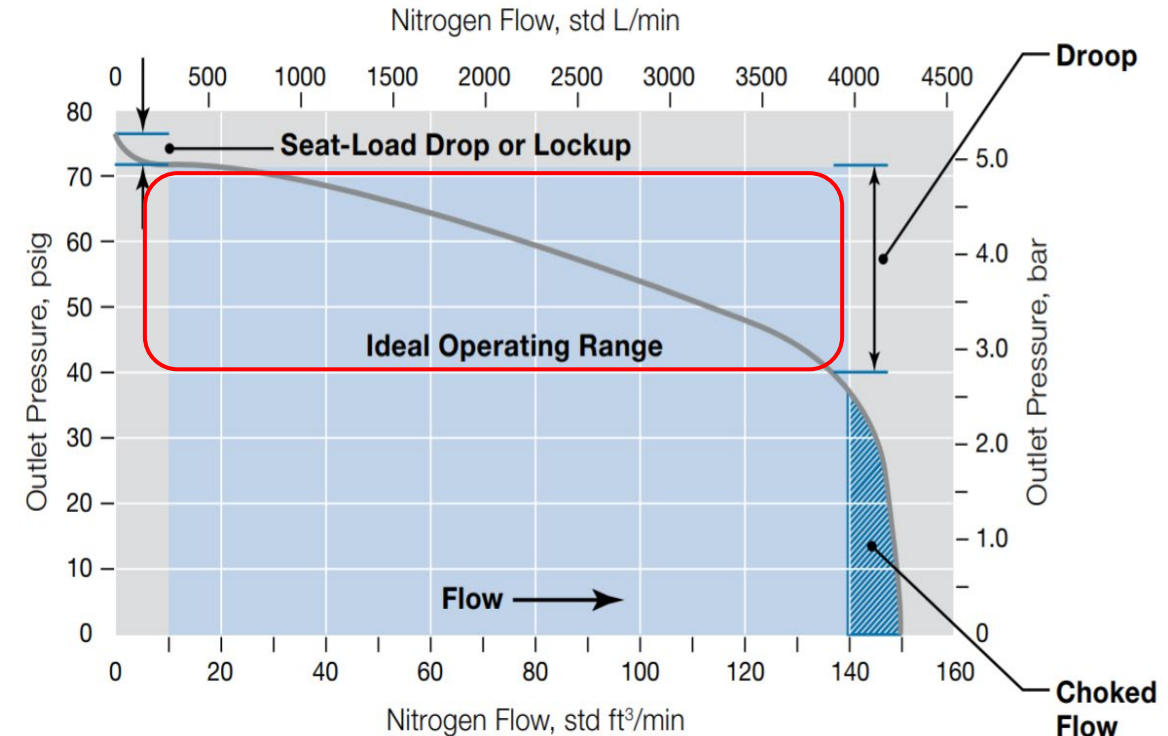
- First point of gas control
- Single- or Dual stage
- Dual stage configuration to minimize DROOP / SPE / Joule Thomson effect
- Vent and Relief options to enhance safety



How Pressure Regulator Selection Affects Gas Distribution Performance?

Flow curve consists of three parts:

- A steep drop on the far left, which shows seat-load drop or lockup
- The ideal operating range, a relatively flat part in the middle
- A steep drop on the far right, which shows the choked-flow area



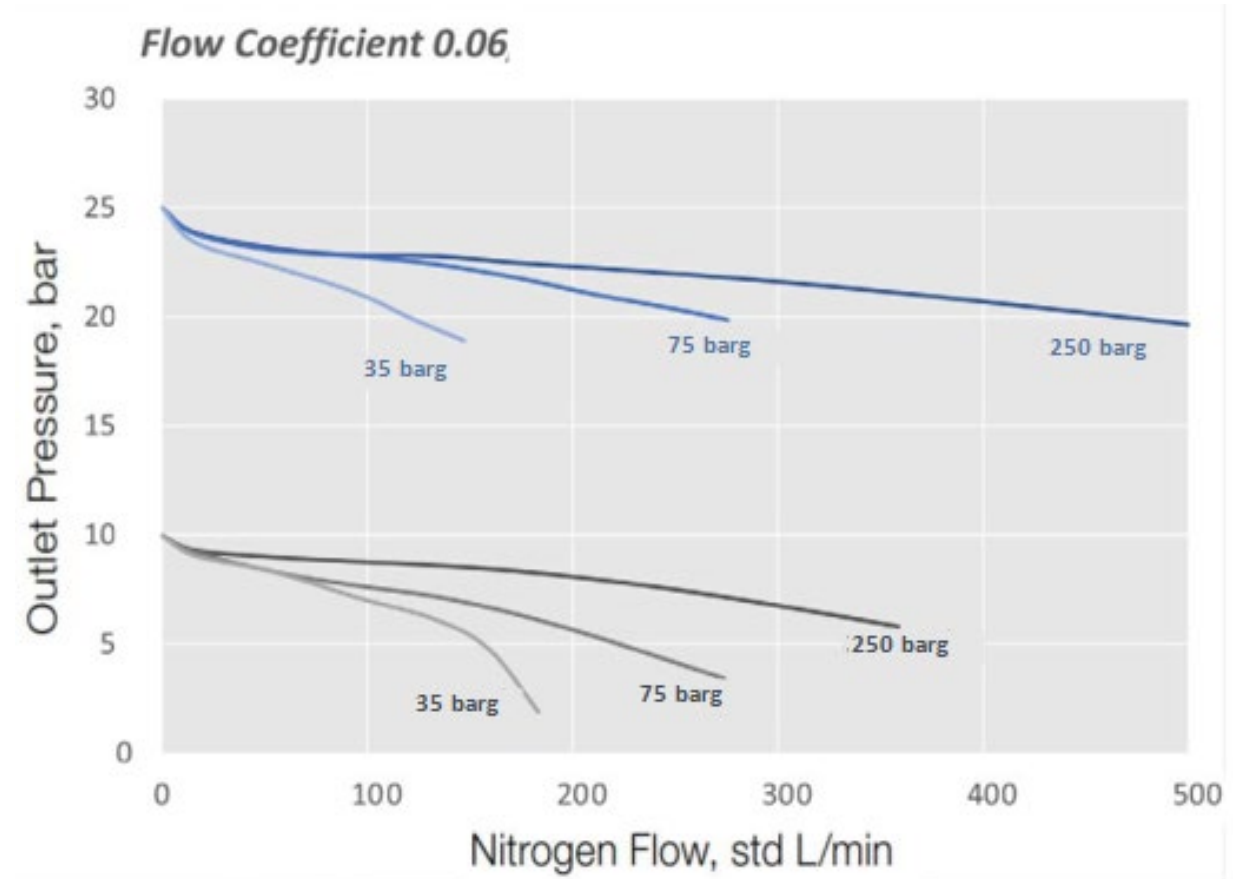
Families of Curves

Characteristics:

- Flow performance is less sensitive to outlet pressure
- Much more sensitive to inlet pressure
- ↓ Inlet pressure = ↓ Flow capacity

Why is it important:

- As your cylinder drains, flow capacity is reduced
- With multiple regulation stages, downstream regulator is limited by upstream setting



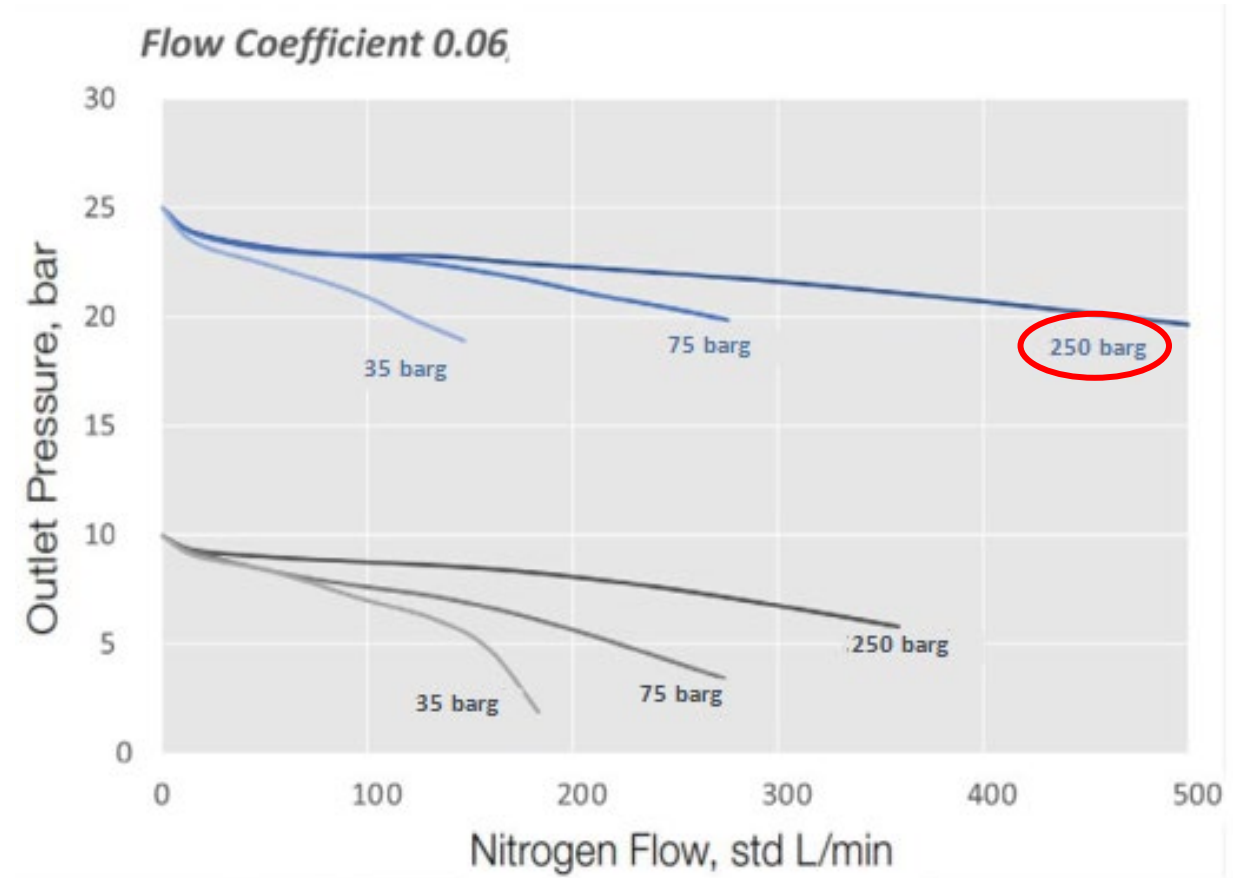
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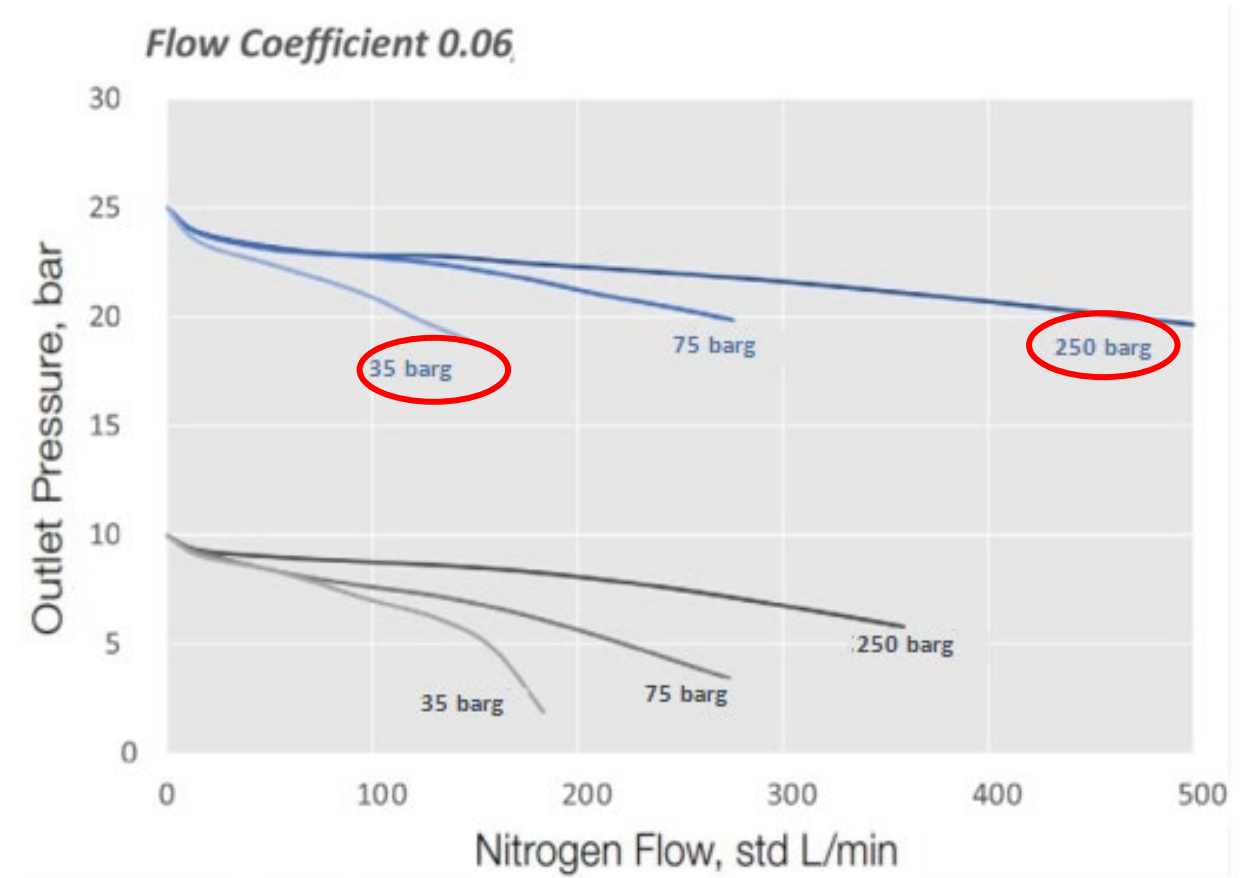
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SPE- Supply Pressure Effect

General-Purpose Diaphragm-Sensing, Pressure-Reducing Regulators (KPR Series)

The KPR series is a compact regulator with excellent accuracy, sensitivity, and set-point pressure stability.

Features

- Convoluted, nonperforated diaphragm
- Metal-to-metal diaphragm seal
- Low internal volume
- Two-piece cap design provides linear load on the diaphragm seal
- High-flow, dual-gauze-type filter in inlet ports

Technical Data

Maximum Inlet Pressure

- 3600 psig (248 bar)
- 6000 psig (413 bar) with PEEK seat

Pressure Control Ranges

- 0 to 10 psig (0.68 bar) through 0 to 500 psig (34.4 bar)

Flow Coefficient (C_v)

- 0.06 and 0.20
See page 41 for flow graphs.
- 0.02 and 0.50 also available

Supply-Pressure Effect

Flow Coefficient (C_v)	Pressure Control Range	
	Up to 100 psig (6.8 bar)	250 psig (17.2 bar) and Higher
	Supply Pressure Effect, %	
0.02	0.3	0.5
0.06	1.0	1.5
0.20	1.7	2.5
0.50	2.3	3.3

Maximum Operating Temperature

- 176°F (80°C) with PCTFE seat
- 392°F (200°C) with PEEK seat
- 212°F (100°C) with PEEK seat and maximum inlet pressure greater than 3600 psig (248 bar)

Weight

- 2.4 lb (1.1 kg)



Ports

- 1/4 in. female NPT inlet, outlet, and gauge ports (all body materials)
- 1/4 in. tube butt weld inlet, outlet, and gauge ports (316 SS body material only)
- 1/4 in. VCR® inlet, outlet, and gauge ports (316 SS body material only)

SPE- Supply Pressure Effect (Inlet Dependency)

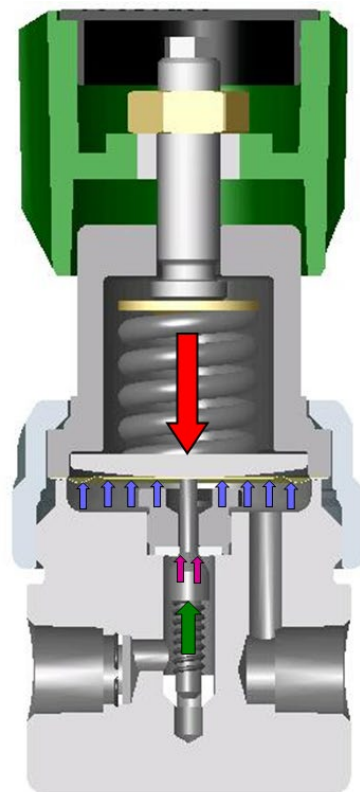
If inlet pressure **drops** ↓, the outlet pressure goes **up** ↑
 OR
 If inlet pressure goes **up** ↑, the outlet pressure **drops** ↓

Theory

The inlet pressure creates a force (**F4**) on the poppet valve. The higher the inlet pressure, the higher the force

This will affect the balance equation:

$$F1 = F2 + F3 + F4$$



F1 = Spring Force

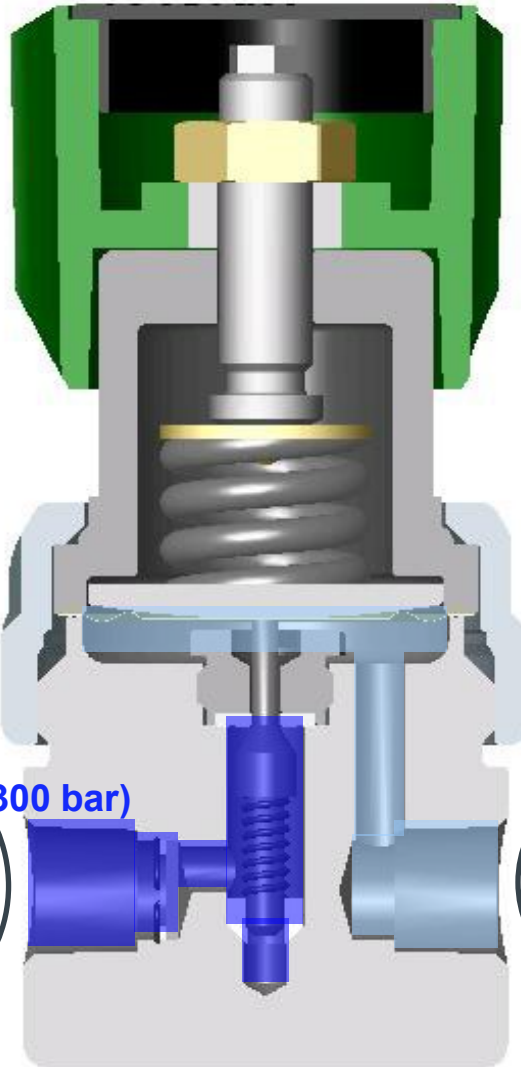
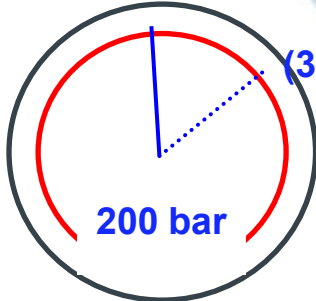
F2 = Poppet Spring Force

F3 = Outlet Pressure Force

F4 = Inlet Pressure Force

SPE- Supply Pressure Effect Single-Stage

1. Upstream pressure decreases as cylinder is depleted



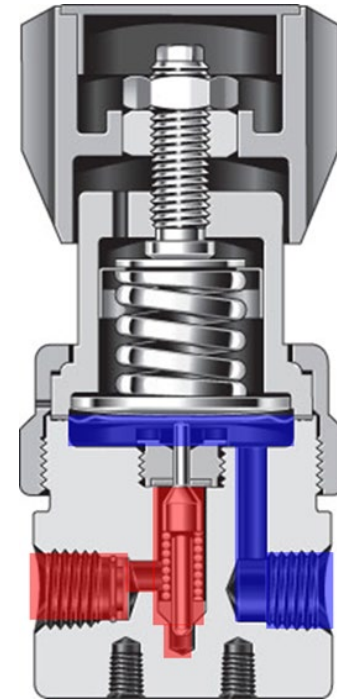
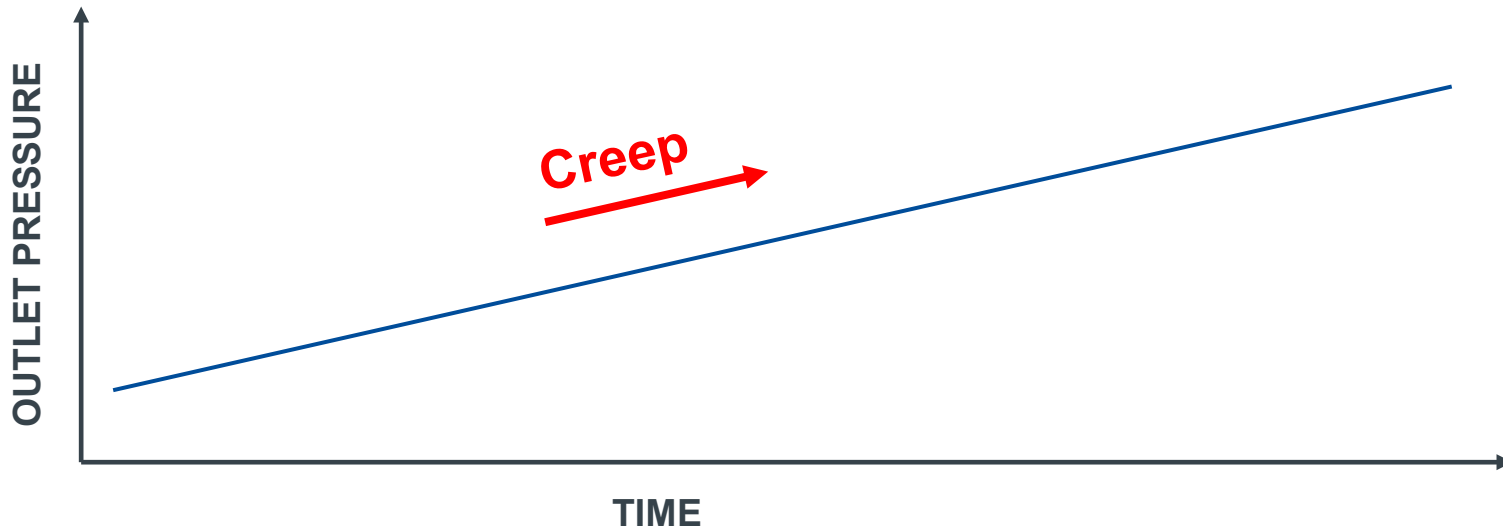
P_{inlet} decreases from 300 to 200 = 100 bar
1% of 100 bar = 1 bar
 P_{outlet} increases 1 bar

2. Downstream pressure increases 1% of the inlet decrease



Creep

- Outlet pressure increases over time
- If the poppet does not fully seat in the orifice, inlet pressure may continue to bleed through the orifice.
 - Over time, this leakage can increase to the point where the outlet pressure equals the inlet pressure

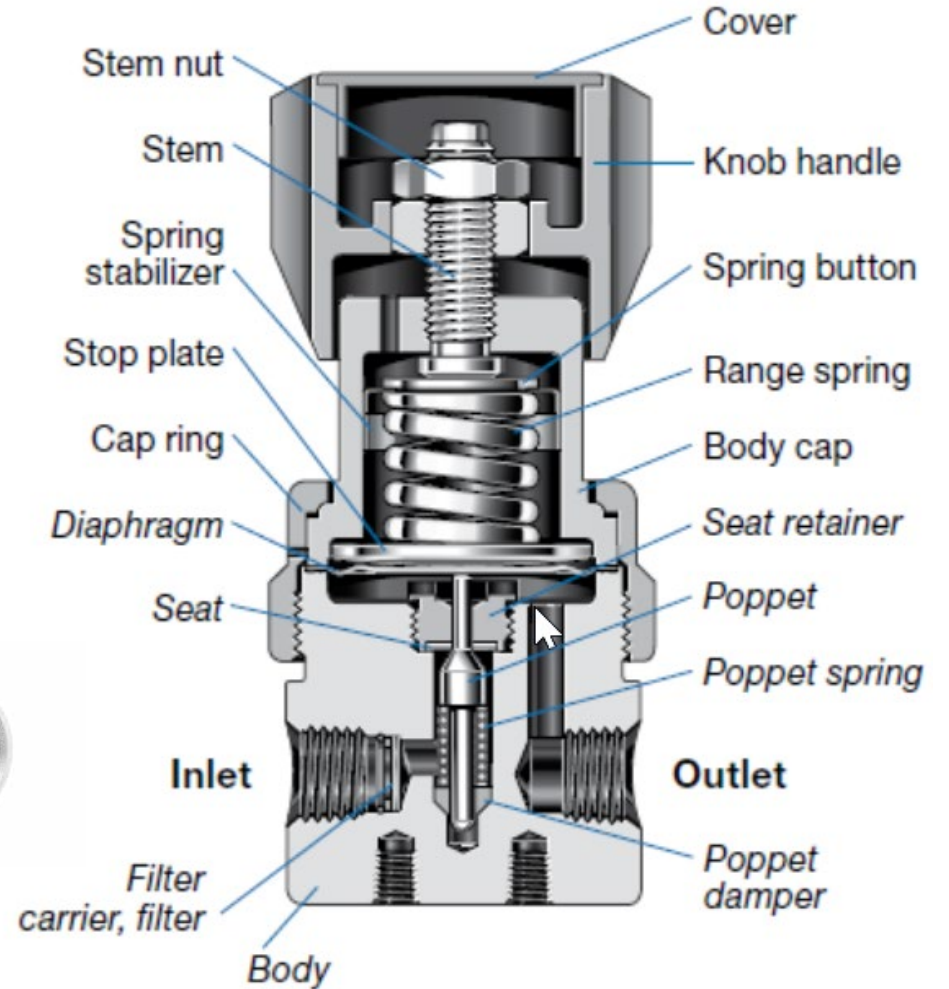


Filtration – Increase Uptime and Improve Safety

Filters are used to remove particulate matter from the gas stream in which they are deployed.

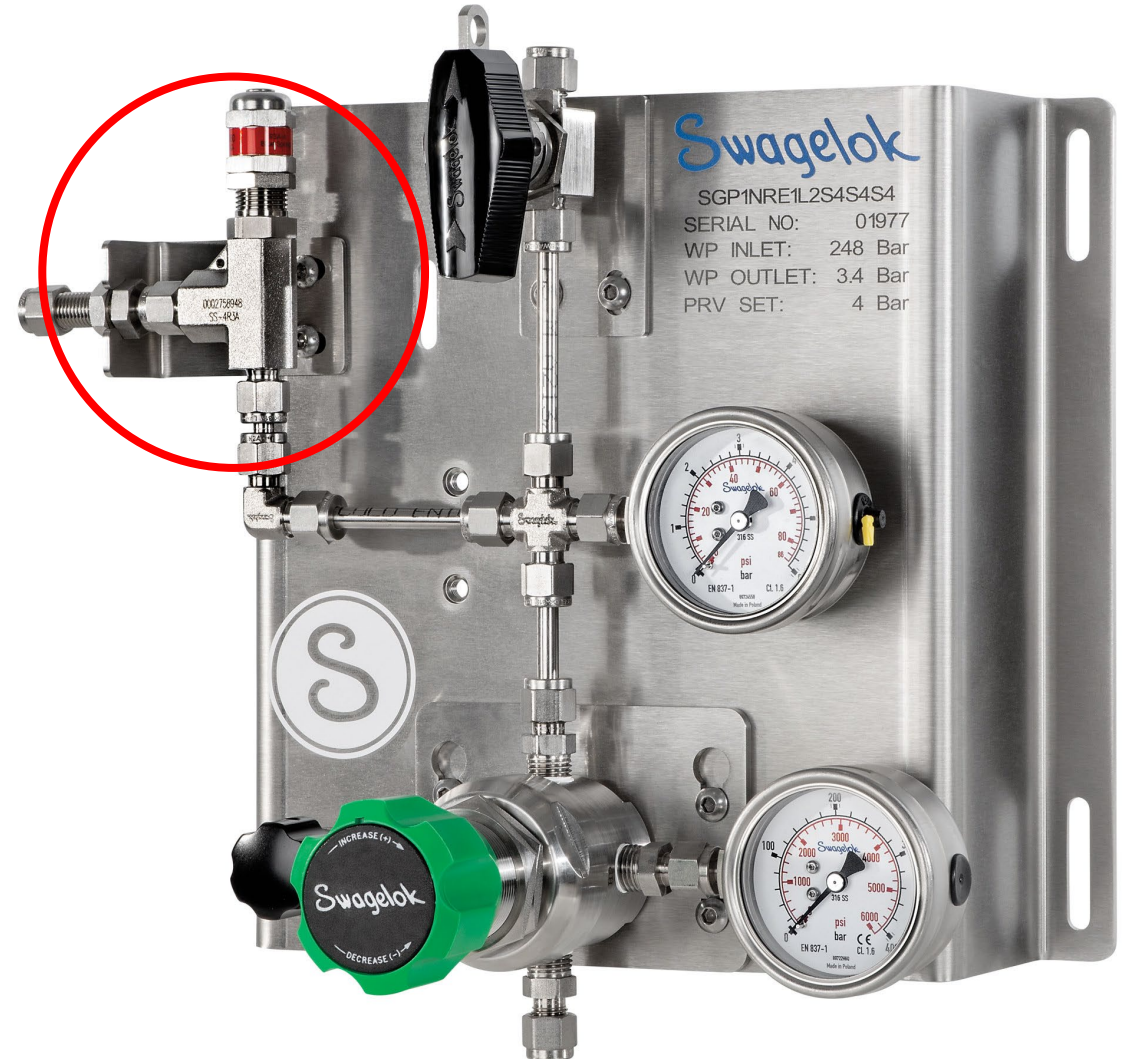
Match the filter to the task

Materials of Construction

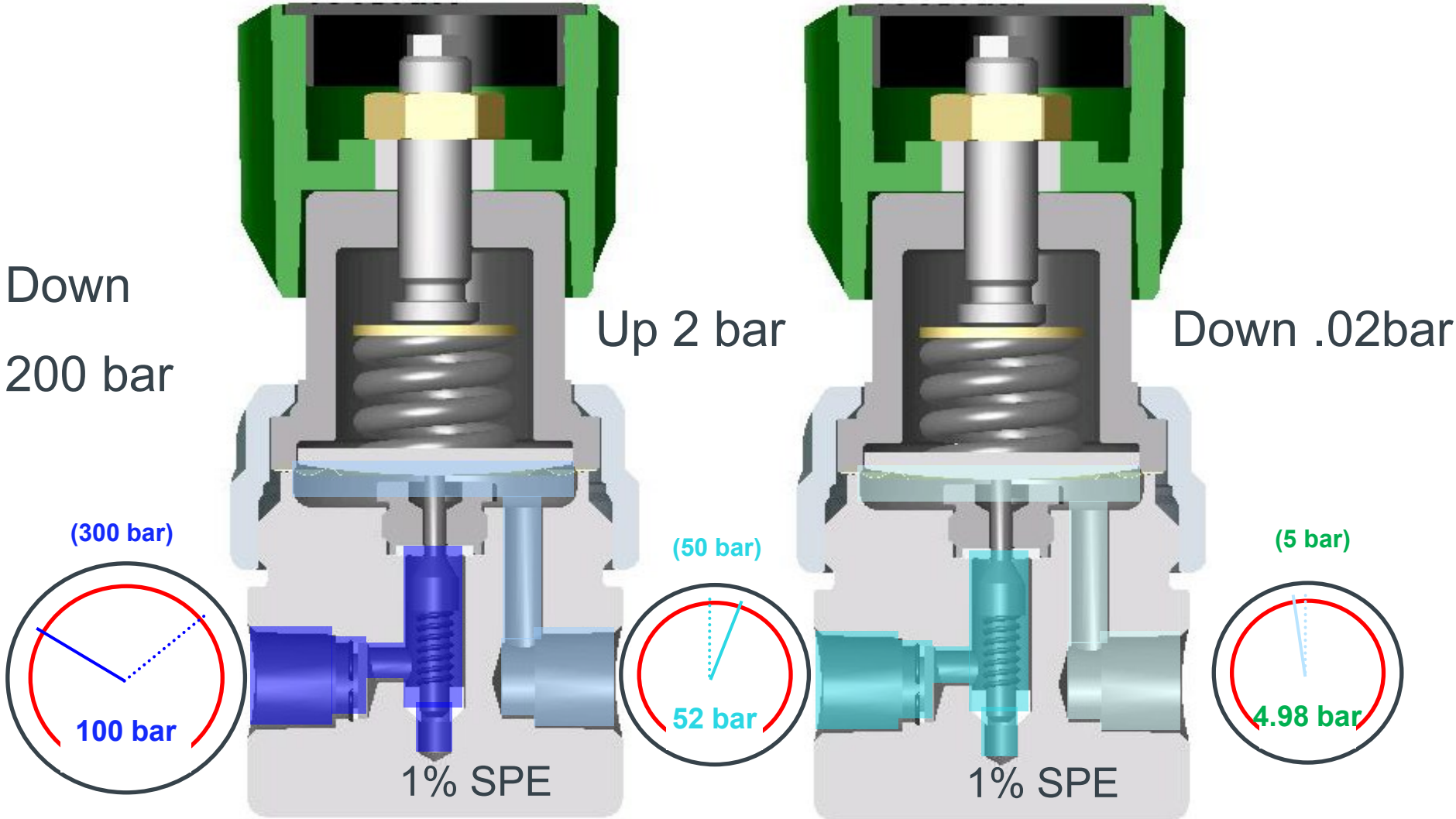


Relief Valve Setting

- If relief valve is located downstream, consider SPE
- Typical set pressure: 110% working pressure (10% over)
- If regulator is set at 100% working pressure, SPE may cause the relief valve to open
- Mitigate SPE or relief valve setting may need to increase to accommodate



SPE- Supply Pressure Effect Dual-Stage



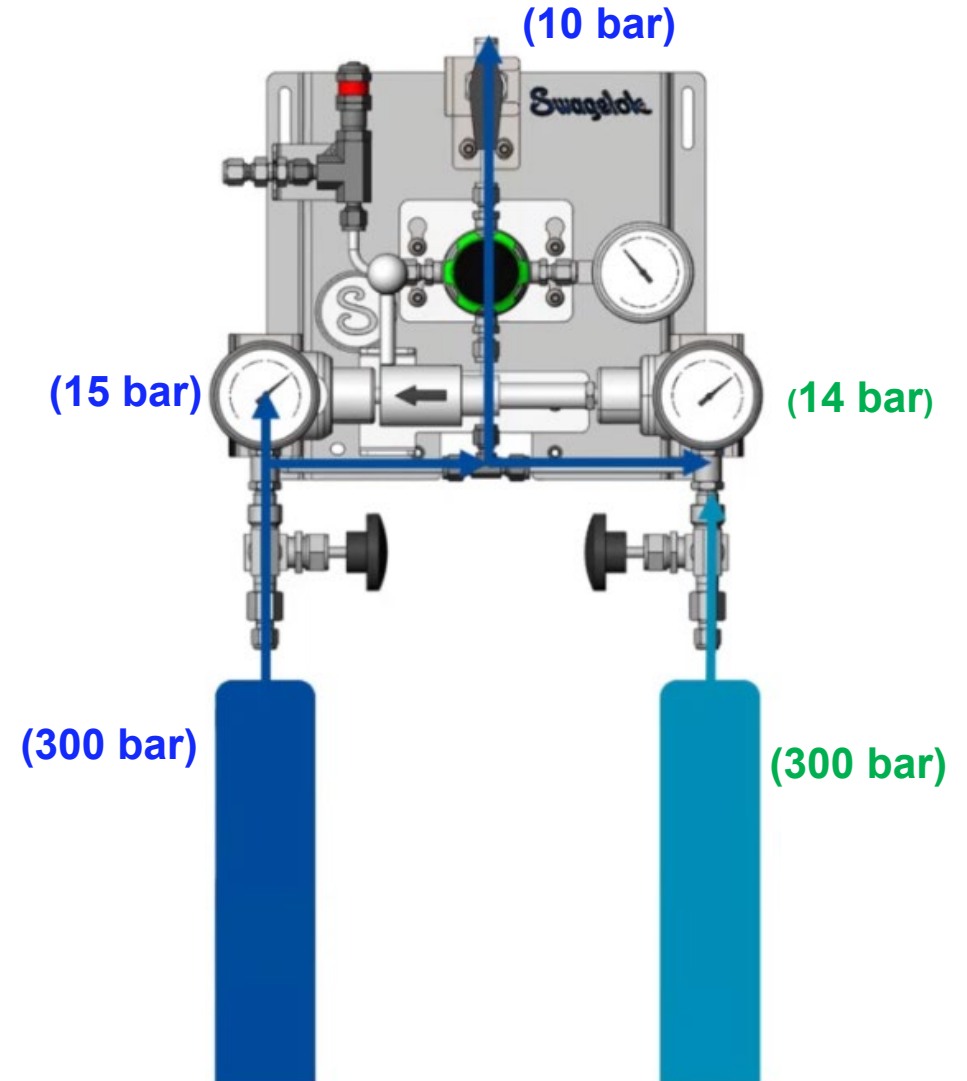
AutoChangeover

- One- or two-stage regulator panel
- What does it do?
 - Two inlet sources
 - Use one source at a time
 - Automatically changes from one to the other – no operator intervention required
- User selectable “primary” source



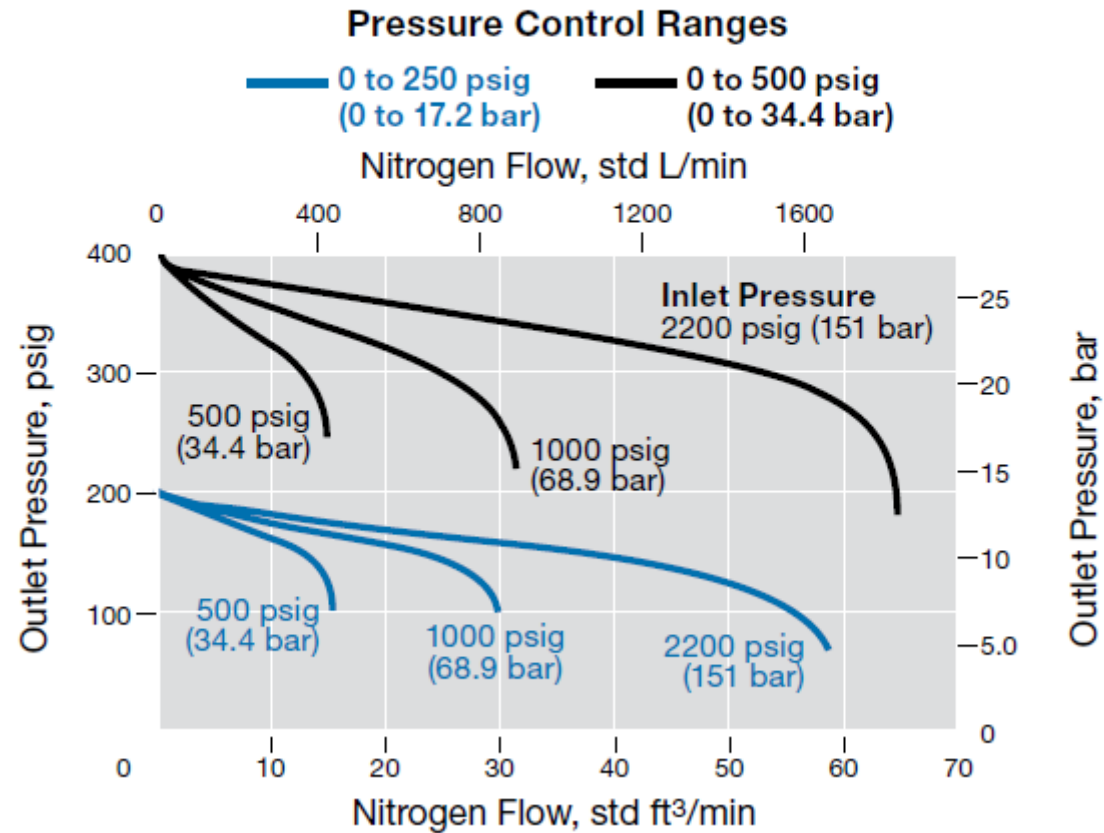
Changeover Selection

- Changeover pressure
 - Selectable from 3.4 - 34 barg
 - Pressure setting of the 1st stage regulators
 - Target $\geq 2:1$ pressure drop across regulators

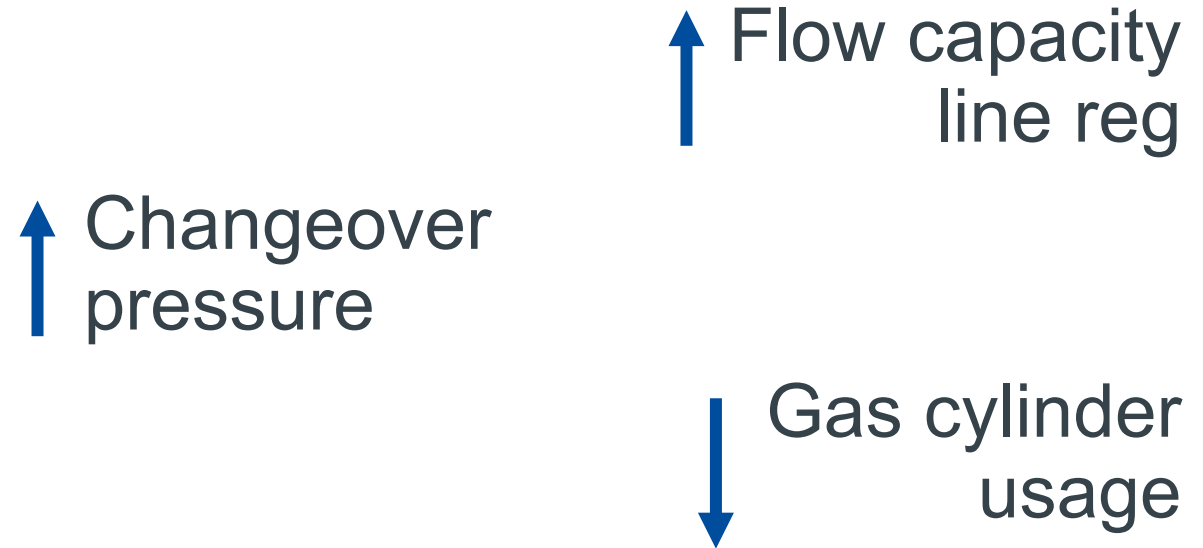


Changeover Selection

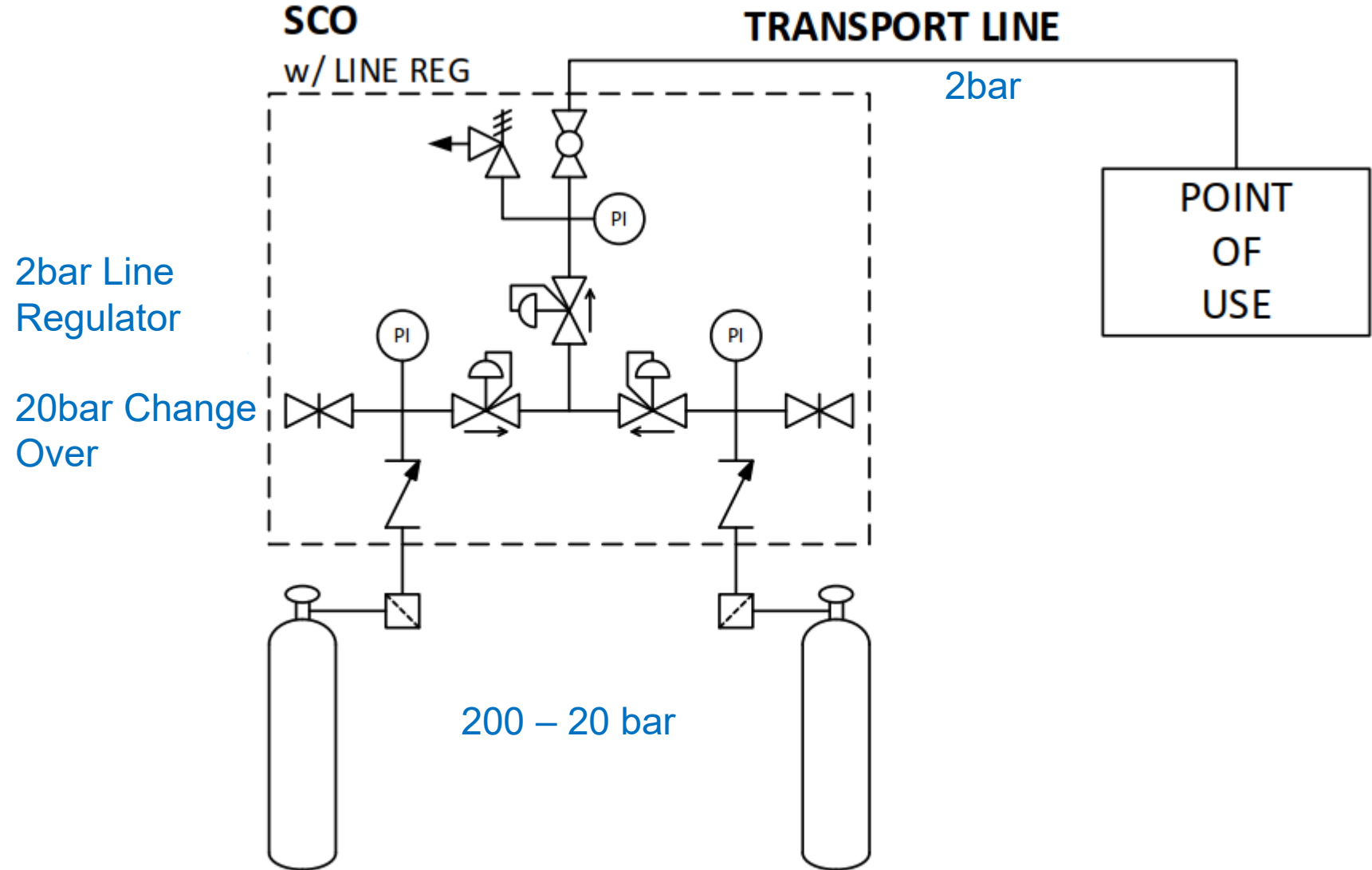
Flow Coefficient 0.06;
Maximum Inlet Pressure 3600 psig (248 bar)



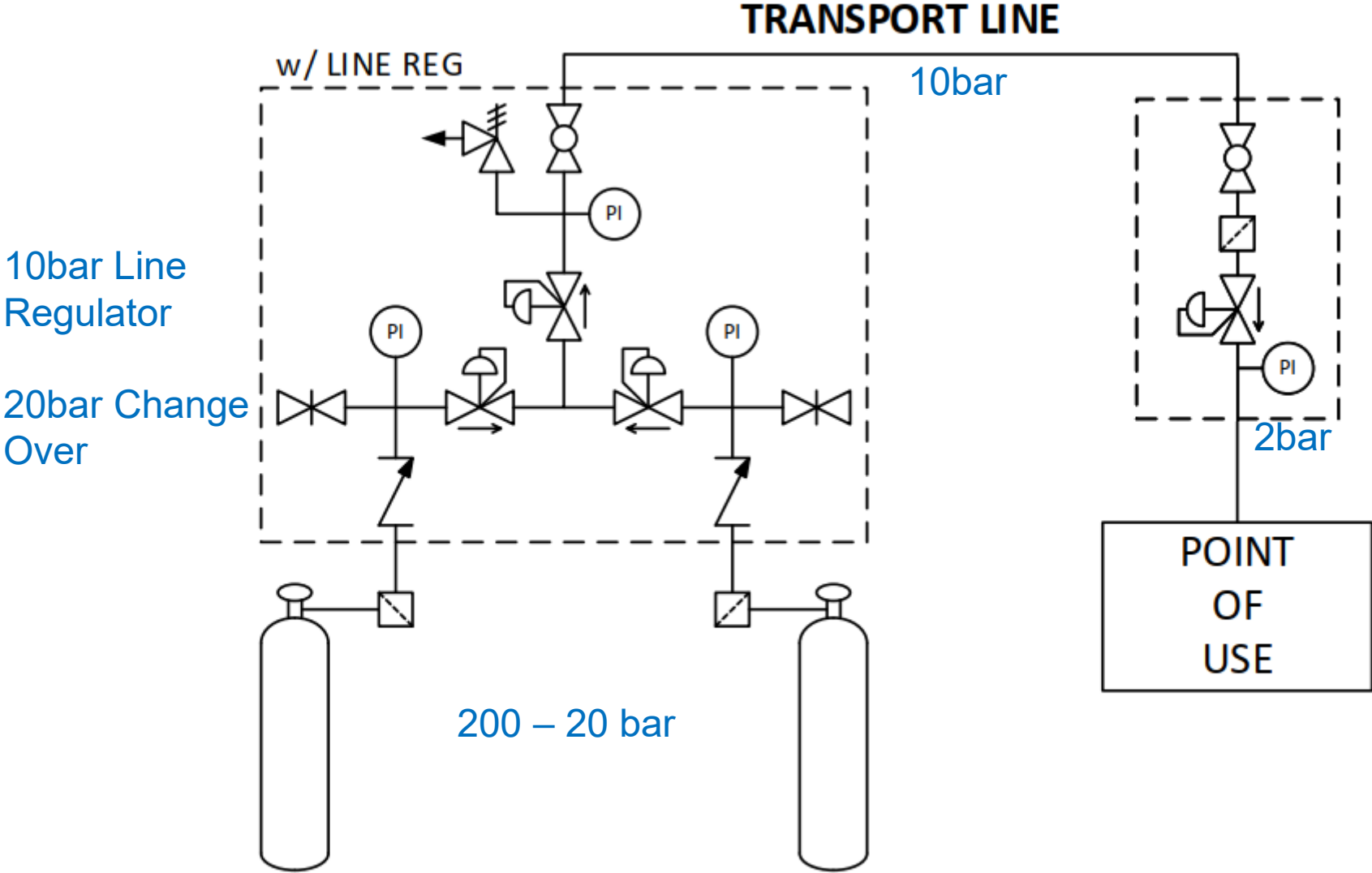
- Changeover with line regulator
 - Remember flow curve families!



Optimize Gas Distribution System



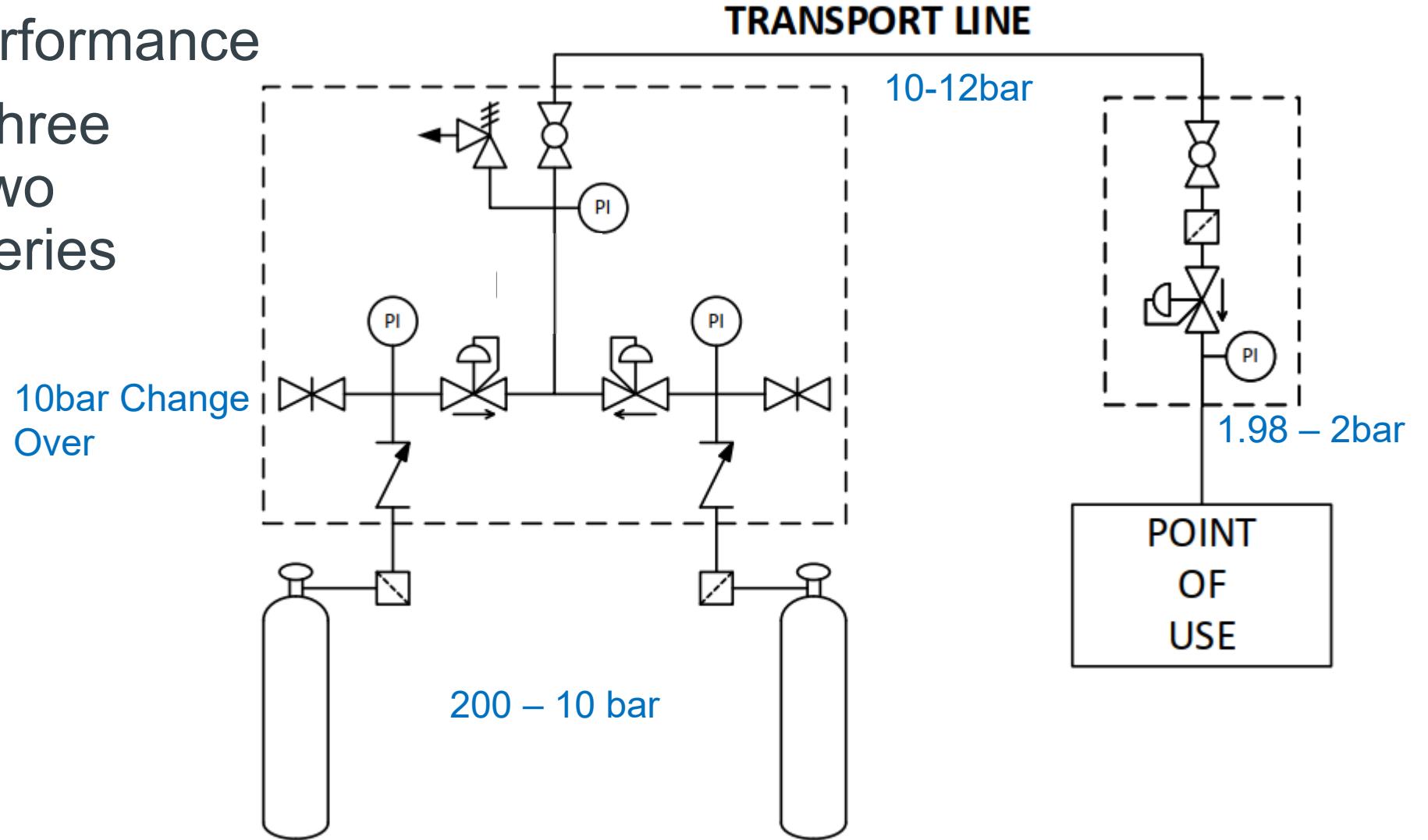
Optimize Gas Distribution System



Optimize Gas Distribution System

Improve flow performance

- Change from three regulators to two regulators in series



Review

- Gas distribution systems require consideration of regulator performance
 - Supply Pressure Effect (SPE)
 - Lockup
 - Droop
- Regulator characteristics affect other choices in the system
 - Number of regulators
 - Flow performance
 - Relief valve setting
 - Changeover specification



How Swagelok can support your Gas Distribution System?



- Customizable user's manual
- Drawings
- Complete bill of materials
 - Spare parts list if needed



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REV.	DESCRIPTION	DATE	APPROVED
01	INITIAL RELEASE	7/14/2014	MLJ

NOTES: 1. HOSE ENDS AND CGA FITTINGS ARE NOT SHOWN FOR CLARITY
2. USE STANDARD BEND RADIUS FOR ALL BENDS
3. PRESSURE TEST WITH N2 TO 15PSI

ITEM	PART NUMBER	DESCRIPTION	SUPPLIER	QTY
1	KCM1DFL412AD0010	KCM REGULATOR M/NLD	SWAGelok SOUTHWEST CO.	1
2	MLJ140509-3	ALMN MNT PNL	EXCELFAB	1
3	CBALBUQ140710-1	1/4" PRV SET @ 15PSI	SWAGelok SOUTHWEST CO.	5
4	SS-43GS4	1/4" BALL VALVE	SWAGelok SOUTHWEST CO.	6
5	SS-400-3	1/4" UNION TEE	SWAGelok SOUTHWEST CO.	6
6	SS-400-4	1/4" TUBE FITTING CROSS	SWAGelok SOUTHWEST CO.	1
7	SS-4-TA-1-4	1/4" MNPT TUBE ADAPTER	SWAGelok SOUTHWEST CO.	2
8	SS-400-1-4	1/4" UNION	SWAGelok SOUTHWEST CO.	1
9	MLJ131014-8	.47" WHI DELRIN TUBE CLAMP	EXCELFAB	4
10	MLJ131014-2	1/4" DELRIN TUBE BRKT	EXCELFAB	7
11	SS-401-PC	1/4" PORT CONN	SWAGelok SOUTHWEST CO.	10
12	SS-T4-S-035-1FT	1/4" SS TUBING .035W	SWAGelok SOUTHWEST CO.	A/R
13	SS-FJ4TA4SL4-4B	1/4" FJ HOSE 4BTL	SWAGelok SOUTHWEST CO.	4
14	SS-FM4TA4PF4-4B	1/4" TUBE X 1/4" FNPT FM HOSE 4BTL	SWAGelok SOUTHWEST CO.	2
15	SS-92	580 CGA NUT	SWAGelok SOUTHWEST CO.	2
16	SS-15-3	580 CGA SS NIPPLE	SWAGelok SOUTHWEST CO.	2
17	9B437A10B	#10 LK WSHR .3"OD	MCMMASTER [ANY]	26
18	90945A740	#10 FLAT WSHR .36"OD	MCMMASTER [ANY]	4
19	92196A269	10-32 SHCS 1/2" L SS	MCMMASTER [ANY]	4
20	92196A27B	10-32 SHCS 3/4" L SS	MCMMASTER [ANY]	22
21	SS-600-3-6-4	3/8" X 1/4" REDUCING TEE	SWAGelok SOUTHWEST CO.	4
22	SS-400-9	1/4" ELBOW	SWAGelok SOUTHWEST CO.	1
23	SS-400-R-6	1/4" X 3/8" REDUCER	SWAGelok SOUTHWEST CO.	1
24	SS-601-PC	3/8" PORT CONNECTOR	SWAGelok SOUTHWEST CO.	1

CONCEPT DRAWING
Swagelok

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DRAWN BY	DATE	DESCRIPTION
MLJ	07/14/14	N2 CHNG OVR M/NLD

APPROVED BY	DATE	PART NO.	REV.
		ARIZN140501-10	01

Gas Distribution System Evaluation and Advisory



Service Report

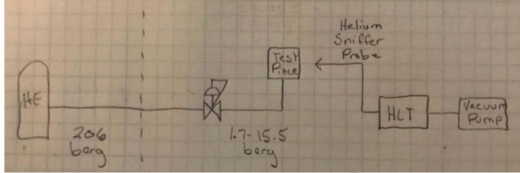
Gas Distribution System Evaluation and Advisory Services™

[COMPANY NAME]
[ADDRESS 1]
[ADDRESS 2]
[CITY], [STATE] [POSTAL CODE]
[COUNTRY]

Prepared by: [FIRST NAME LAST NAME]
[OR MONTH 20XX]
[Swagelok], [LOCATION OR BUSINESS NAME]



Gas Distribution System Evaluation and Advisory Services™ – Service Report




HE supply system

Problem Statement: The customer expresses that the current HLT provides random false failure readings and the point of use regulator is difficult to dial in the pressure precisely

Process Conditions:
Pressure: 206barg
Temperature: 20°C
Flow: Static conditions

Evaluation Table

System Location	Observation	Evaluation	Recommended Action	SEQF	Rating (1-5)	Relative Value	Cost to Implement
Source	Pressure ratings downstream the regulator: 1.7- 15.5 barg Upstream pressure: 206barg	A Full bottle pressure of 206bar to the point of use regulator creates unnecessary high-pressure lines inside the lab environment.	Add a first stage high pressure regulator near to the supply bottle to reduce the incoming pressure to 33barg	Safety	3	▲▲	\$\$





Contact Swagelok



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