Improve safety and performance of Gas Distribution Systems

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Introduction Swagelok

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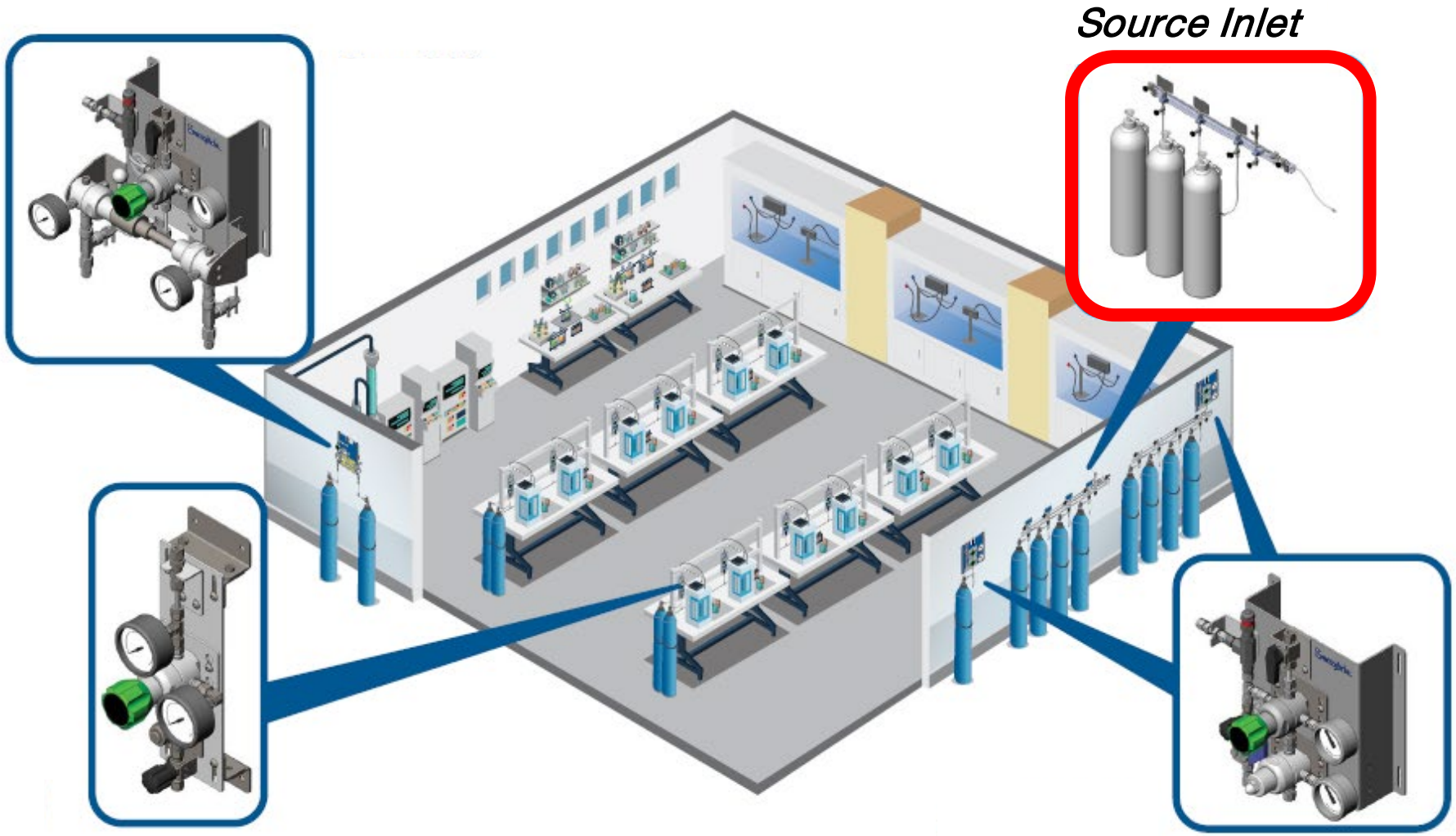
Agenda

- 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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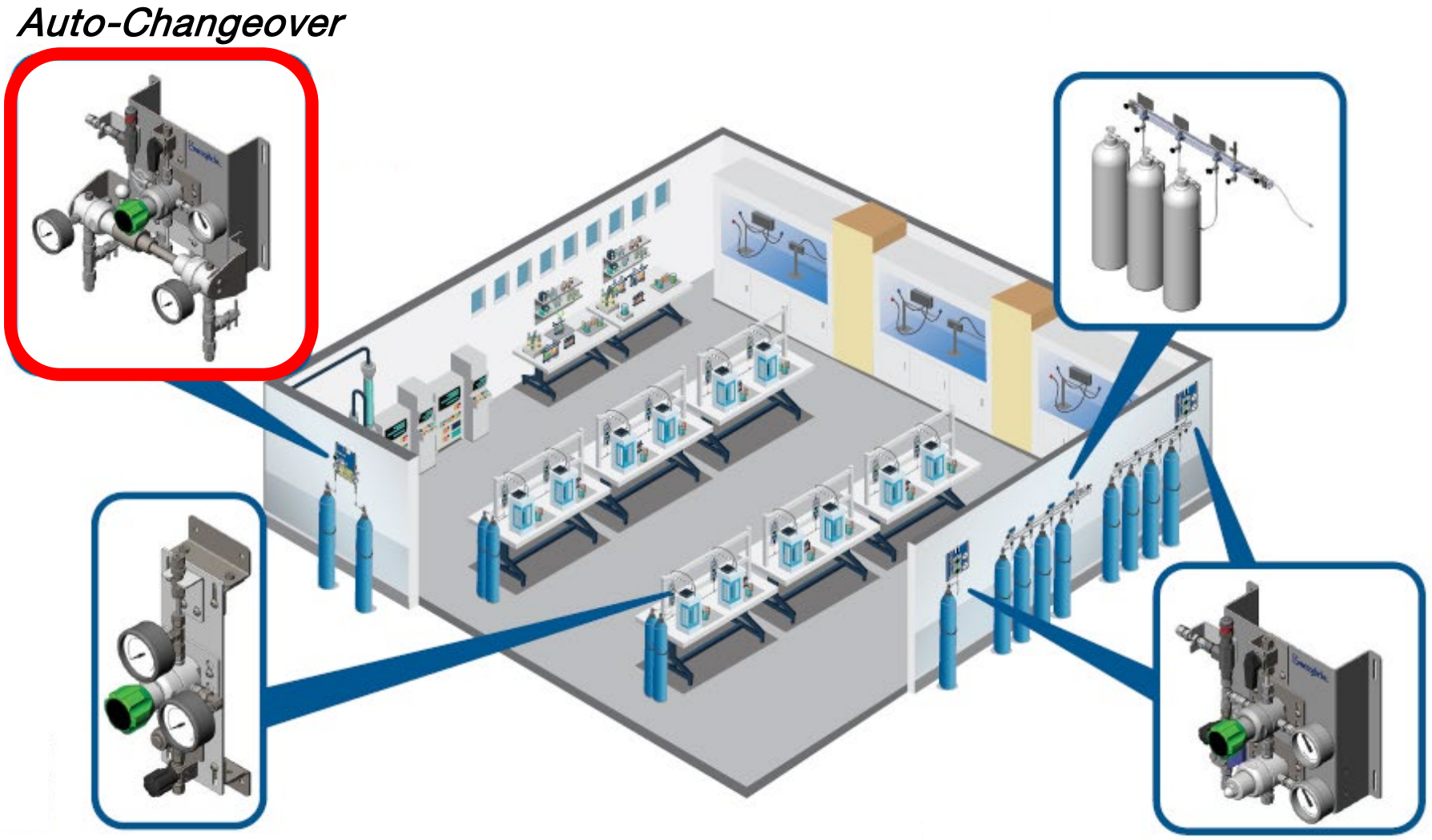
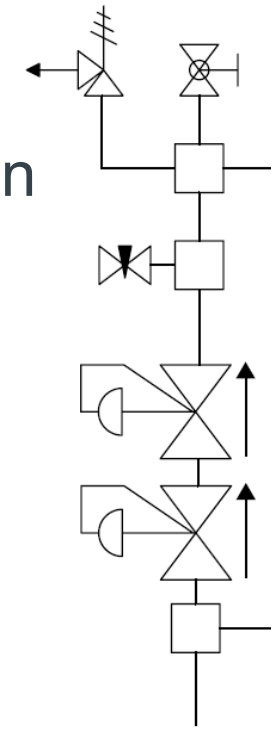
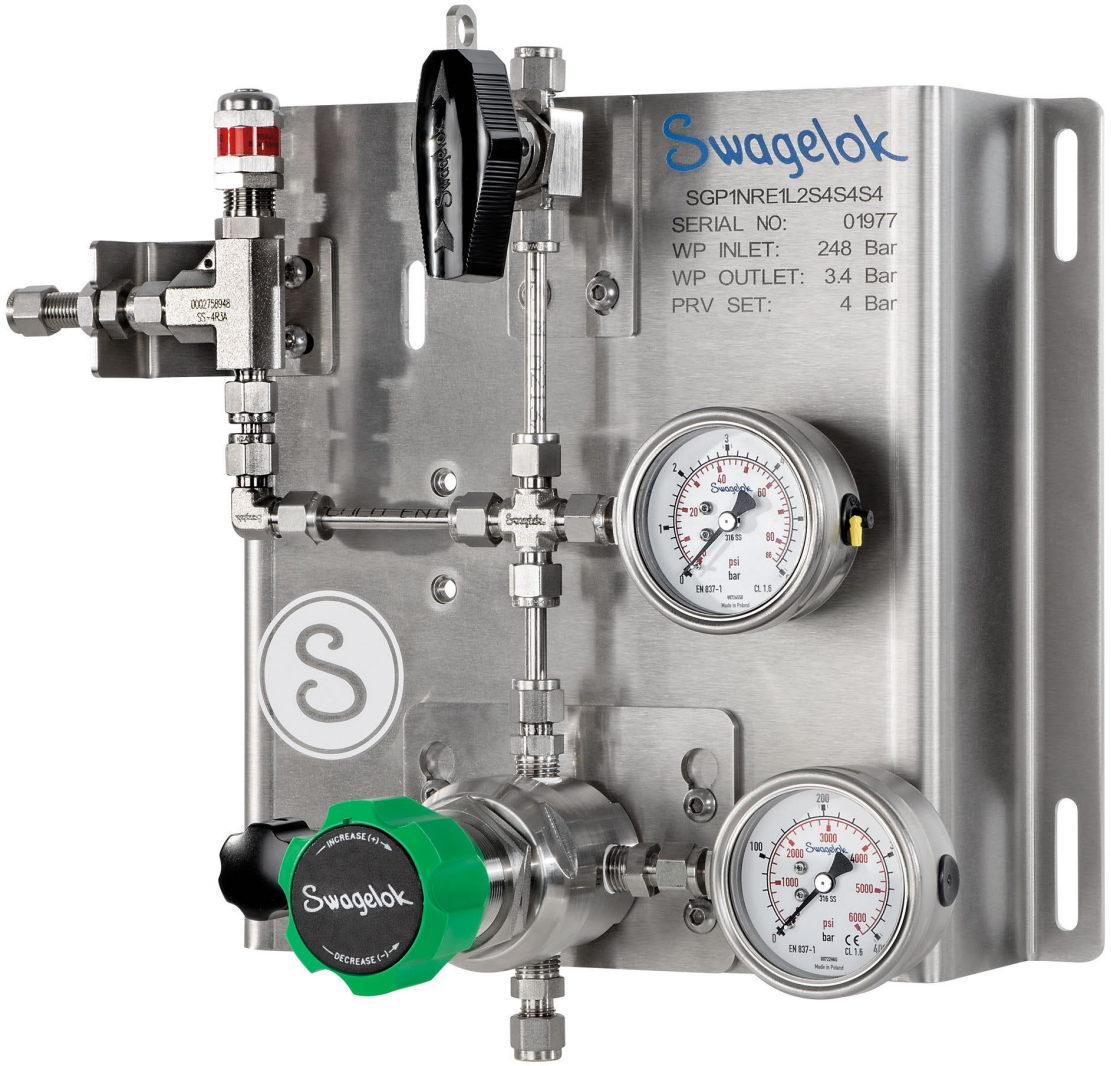


What is a Gas Distribution System?

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

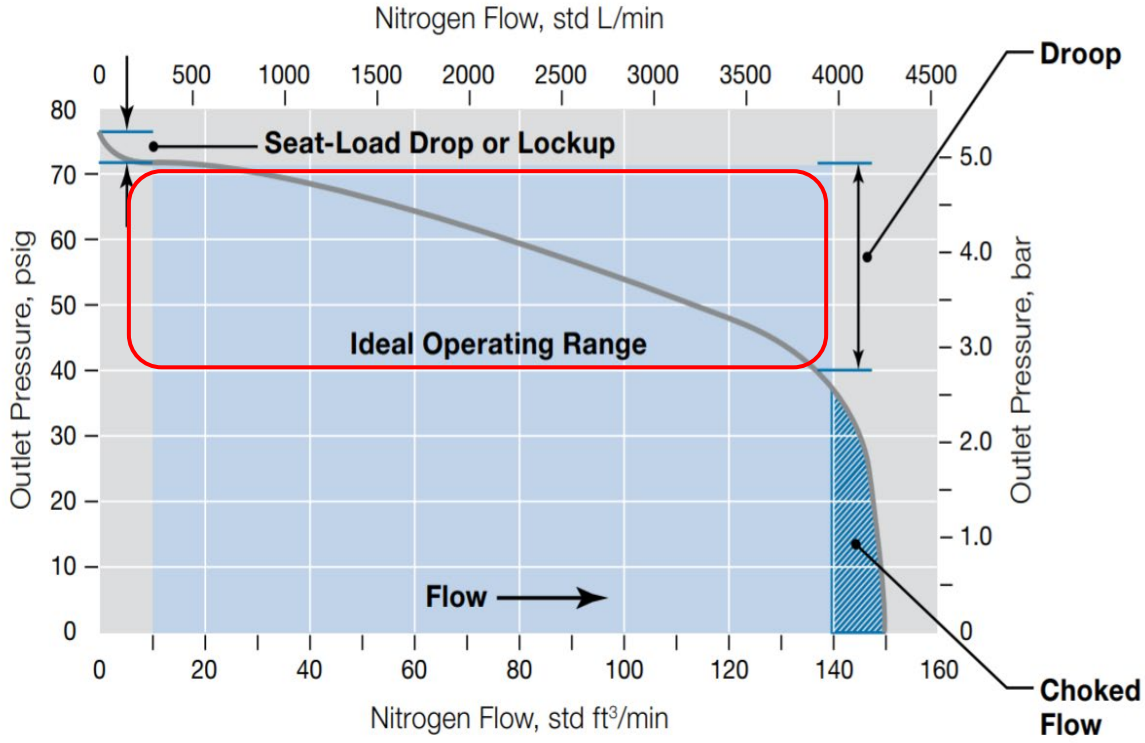




How Pressure Regulator Selection Affects Gas Distribution Performance?

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



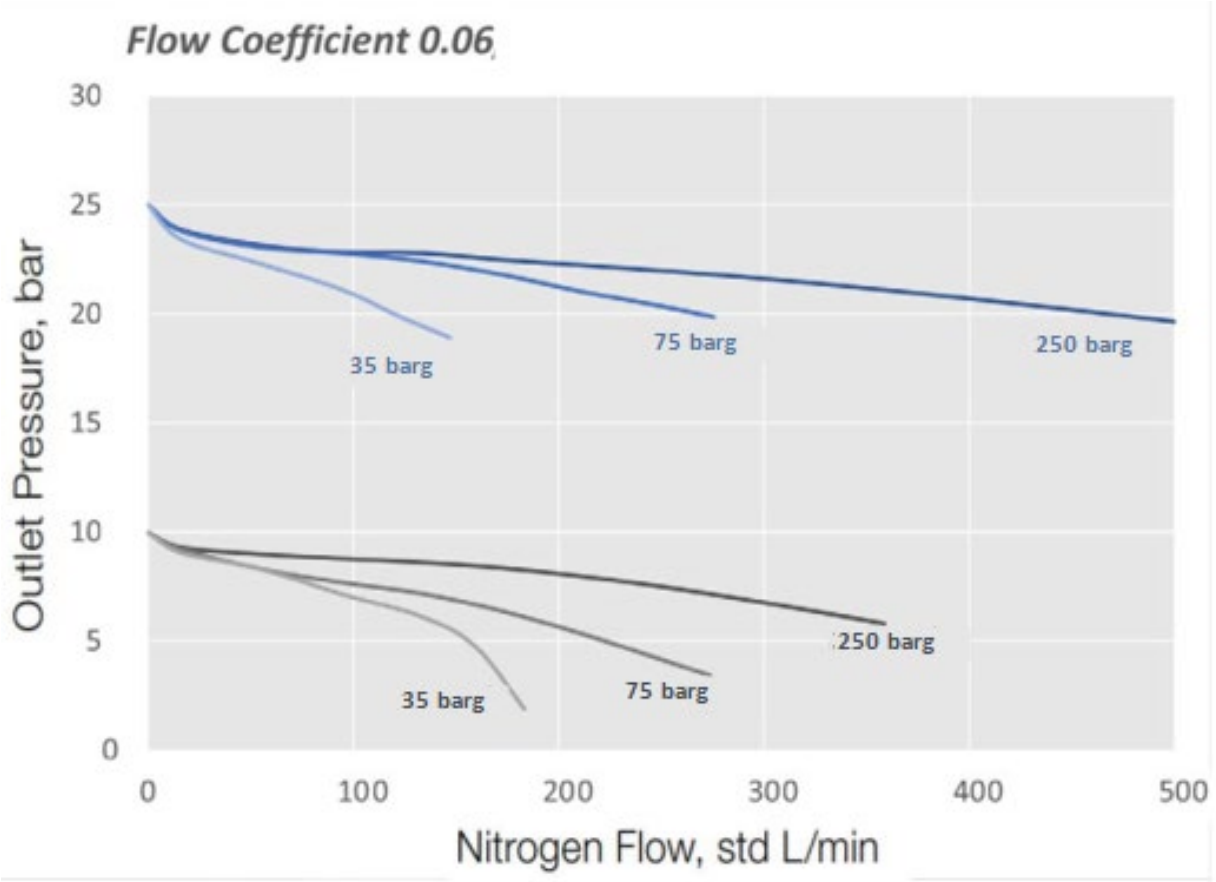
Families of Curves

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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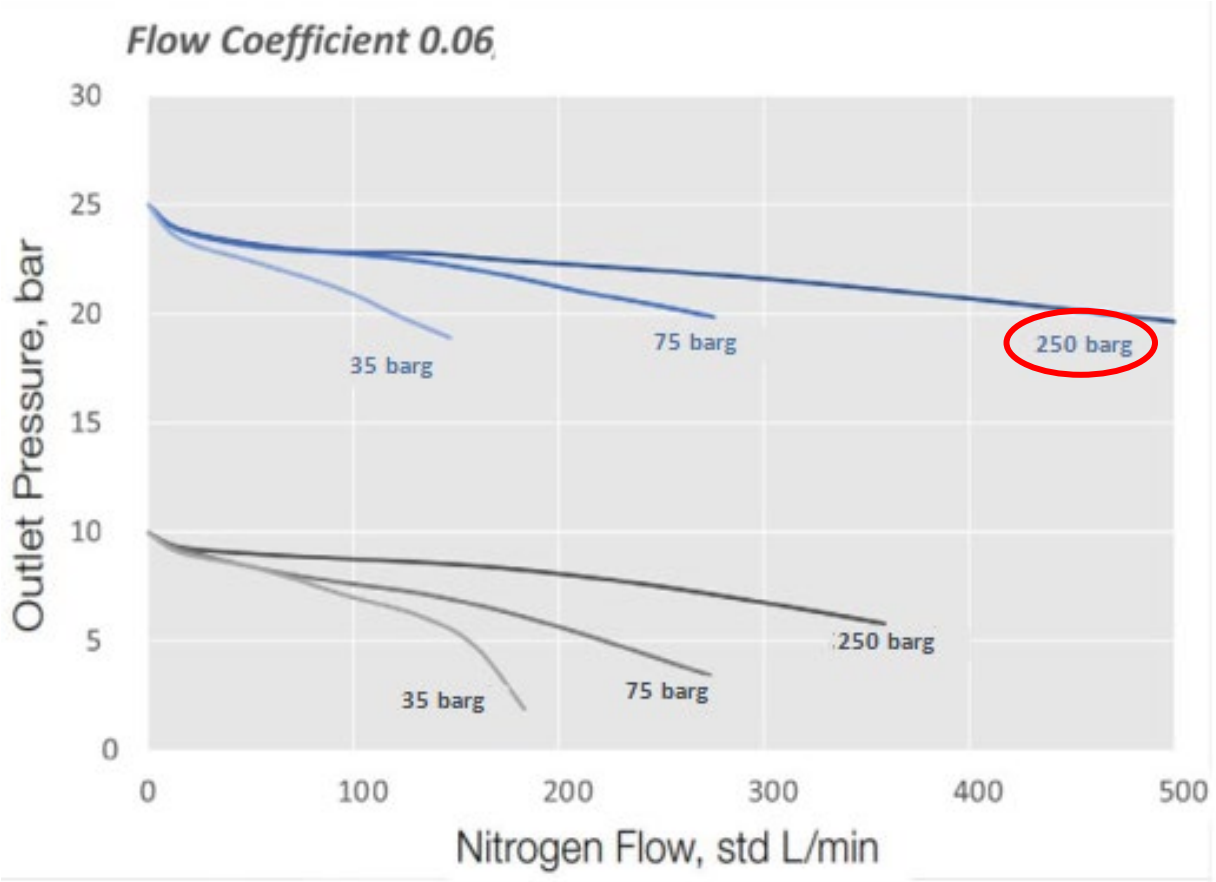

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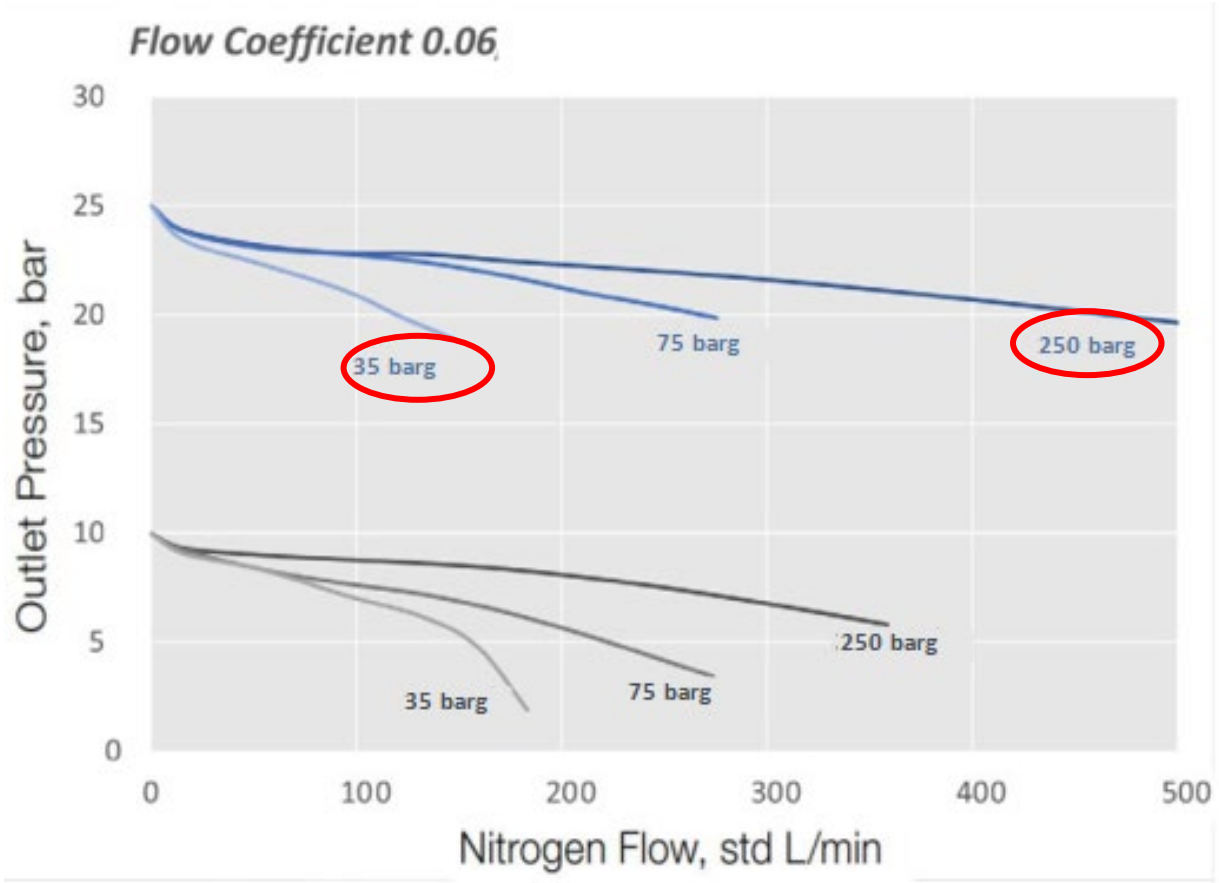


SPE- Supply Pressure Effect

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

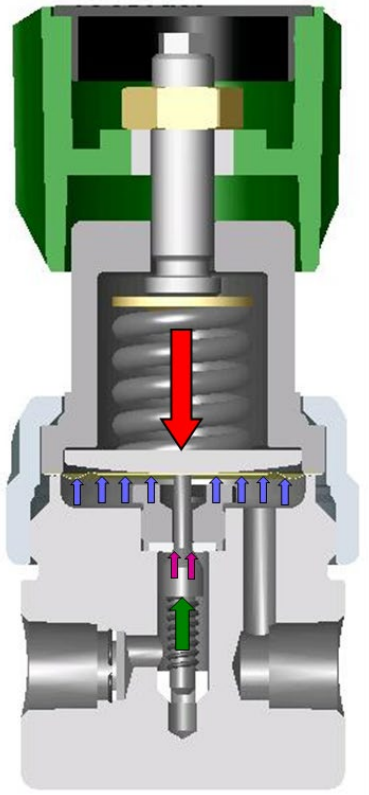
If inlet pressure goes **up** ⬆, the outlet pressure **drops** ⬇

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

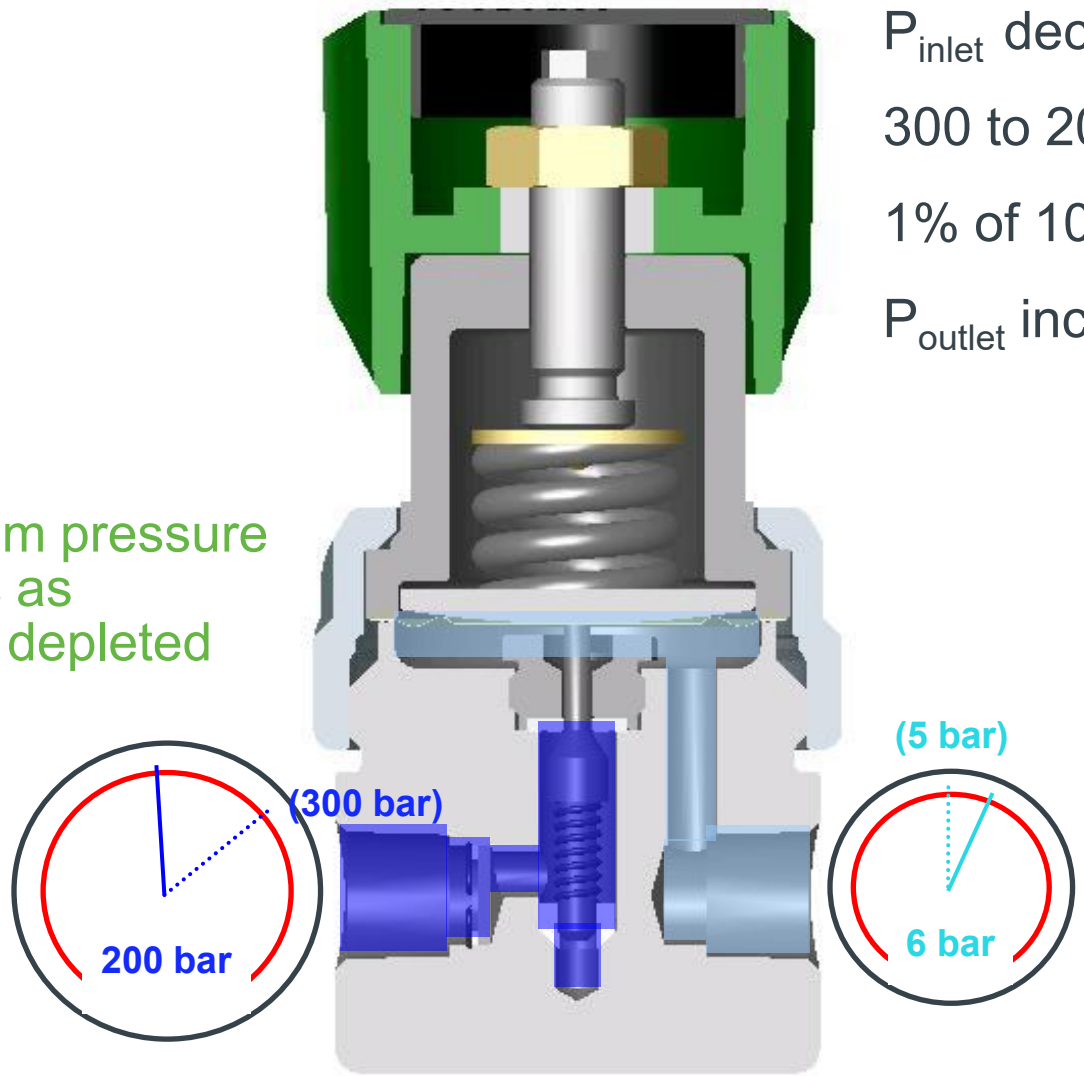
P_{inlet} decreases from

300 to 200 = 100 bar

1% of 100 bar = 1 bar

P_{outlet} increases 1 bar

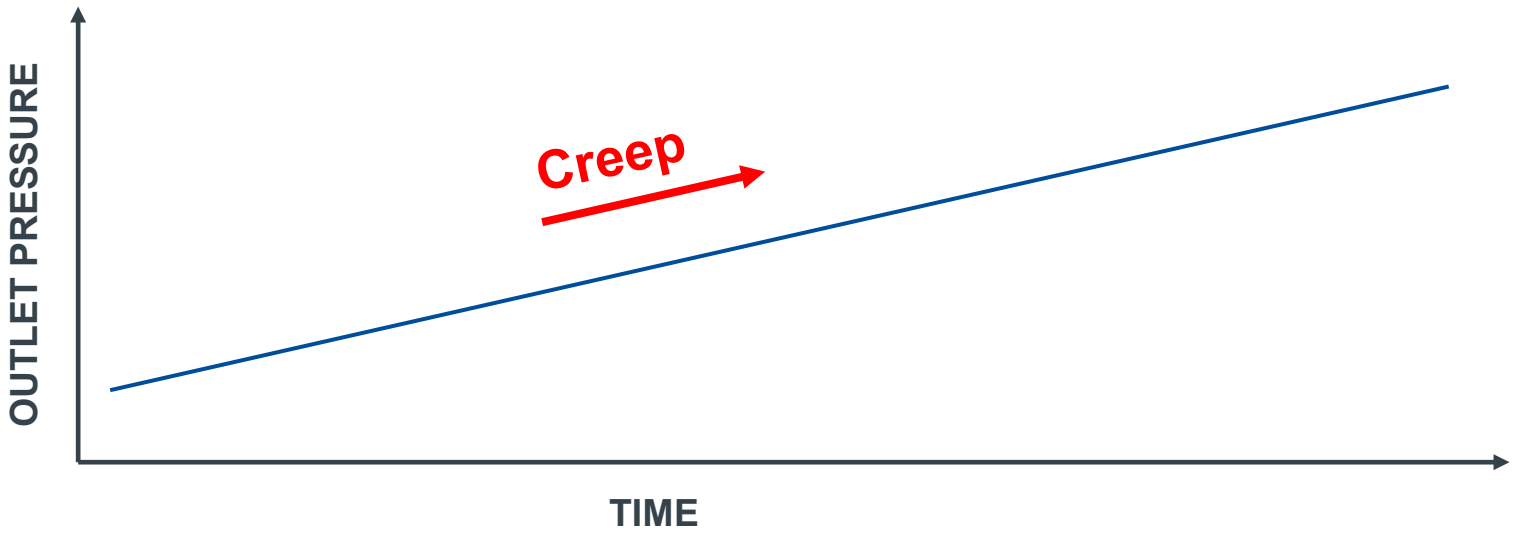
1. Upstream pressure decreases as cylinder is depleted

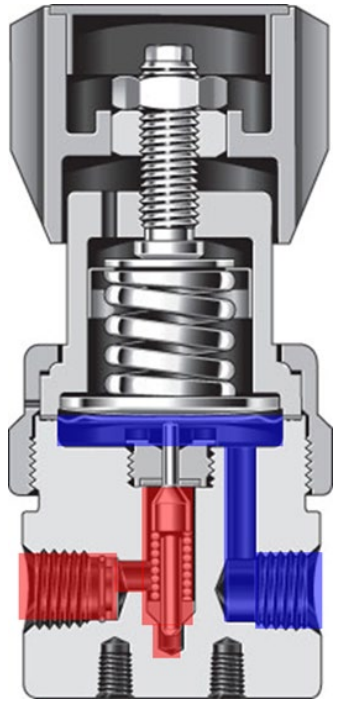


2. Downstream pressure increases 1% of the inlet decrease

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

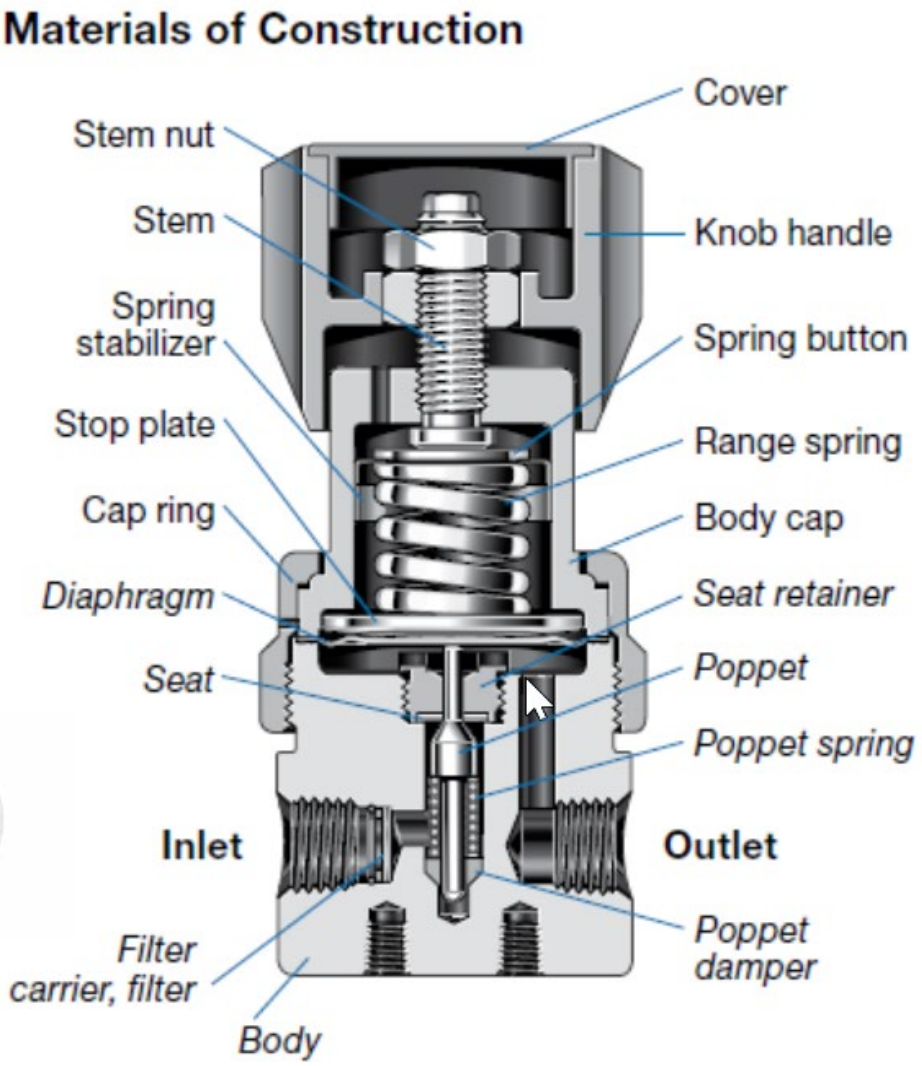




Filtration – Increase Uptime and Improve Safety

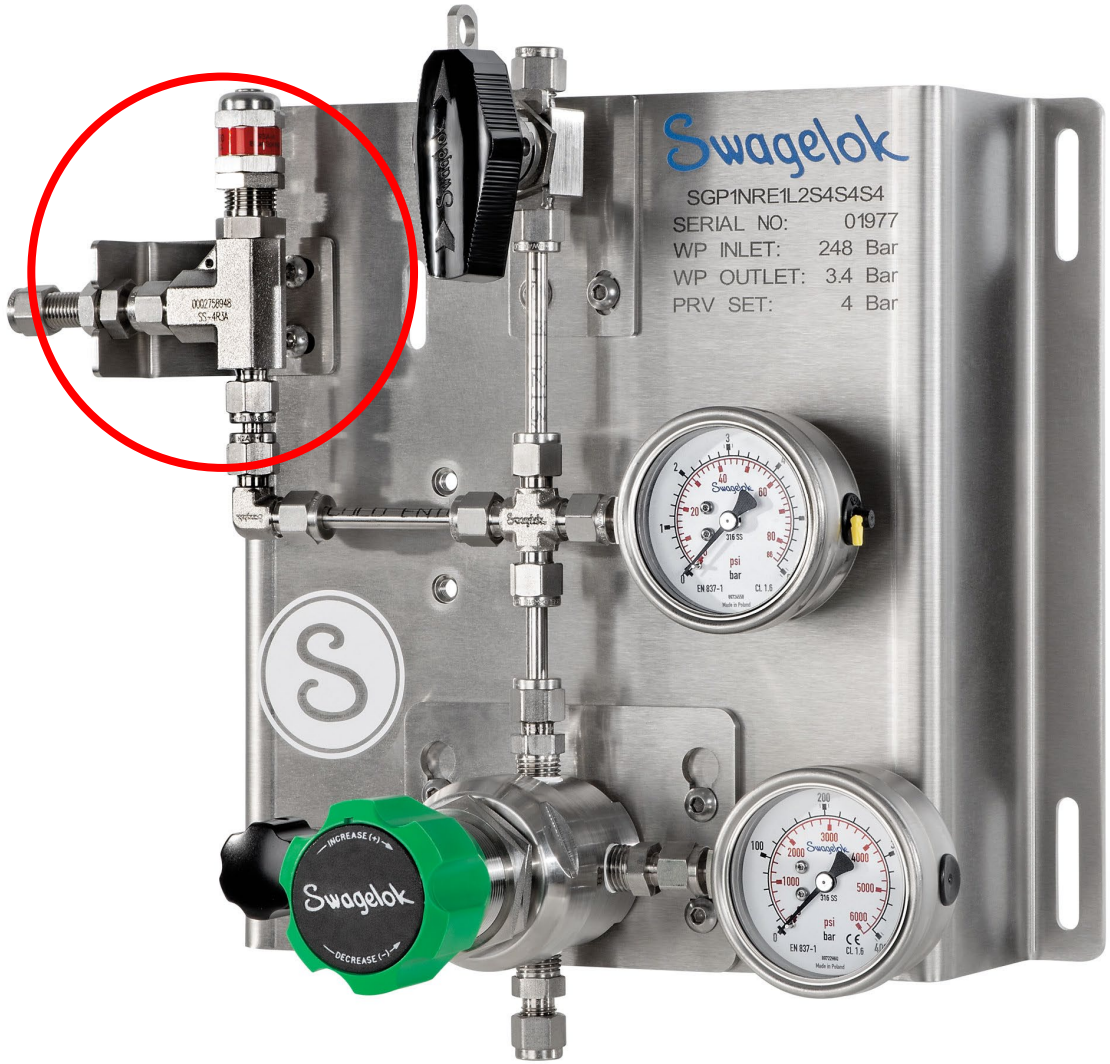
Filters are used to remove particulate matter from the gas stream in which they are deployed.

Match the filter to the task

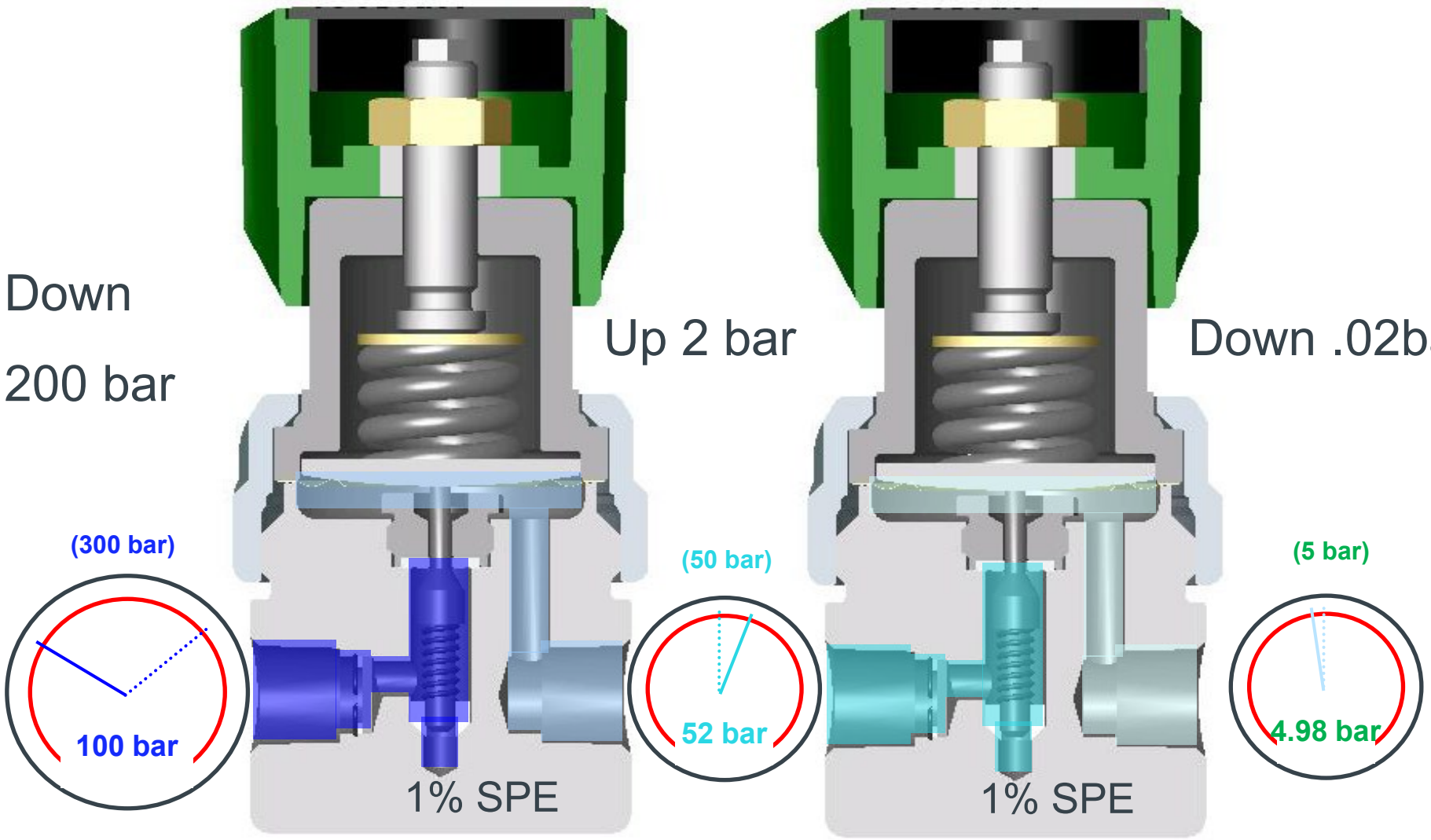


Relief Valve Setting

- 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

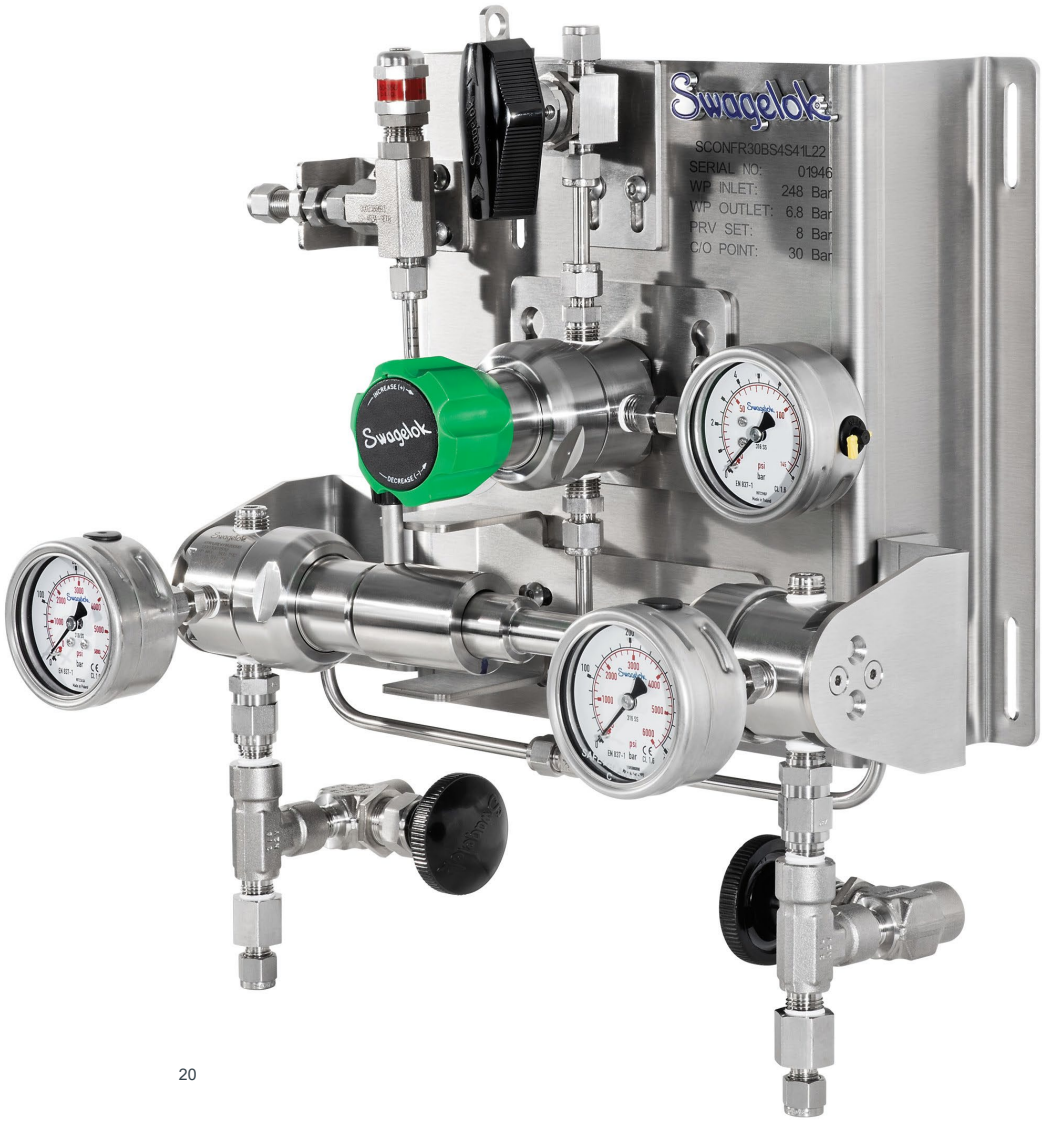


SPE- Supply Pressure Effect Dual-Stage



AutoChangeover

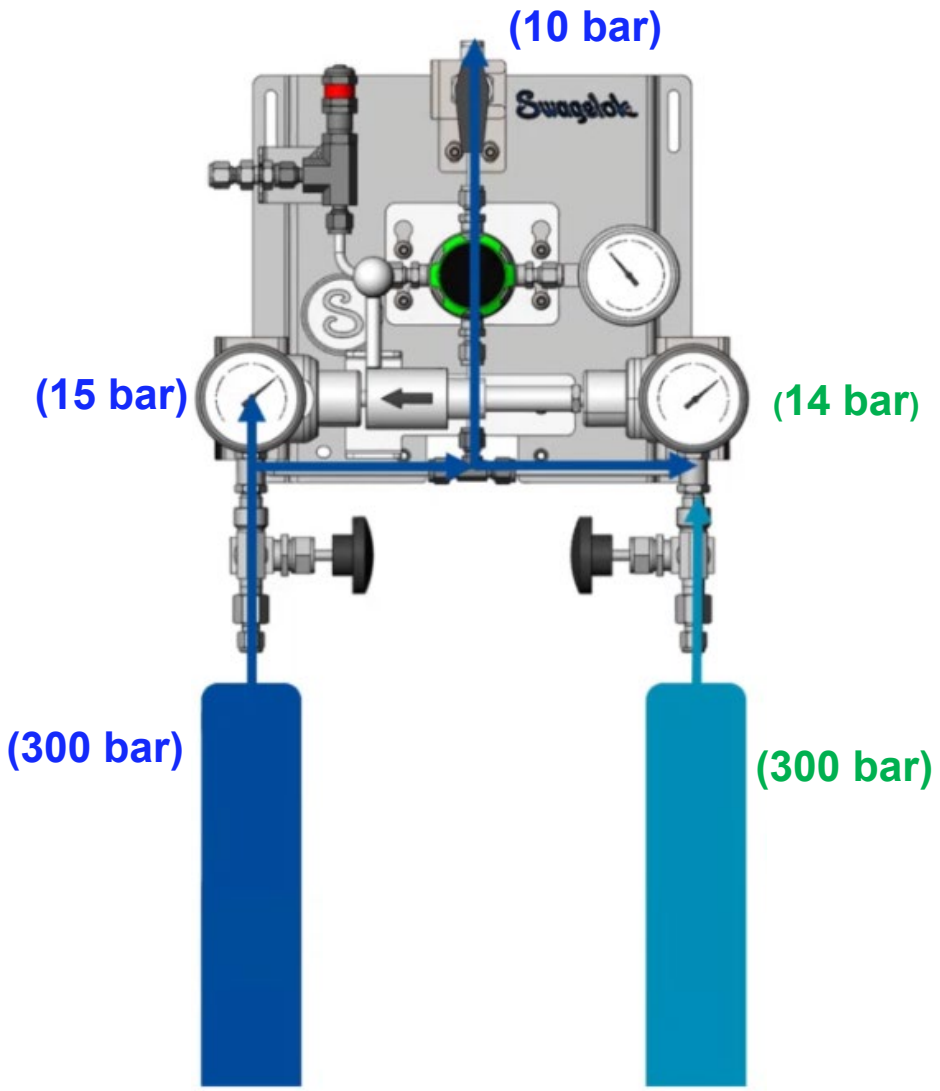
- One- or two-stage regulator panel
- What does it do?
  - Two inlet sources
  - Use one source at a time
  - Automatically changes from one to the other – no operator intervention required
- User selectable “primary” source



100% UPTIME

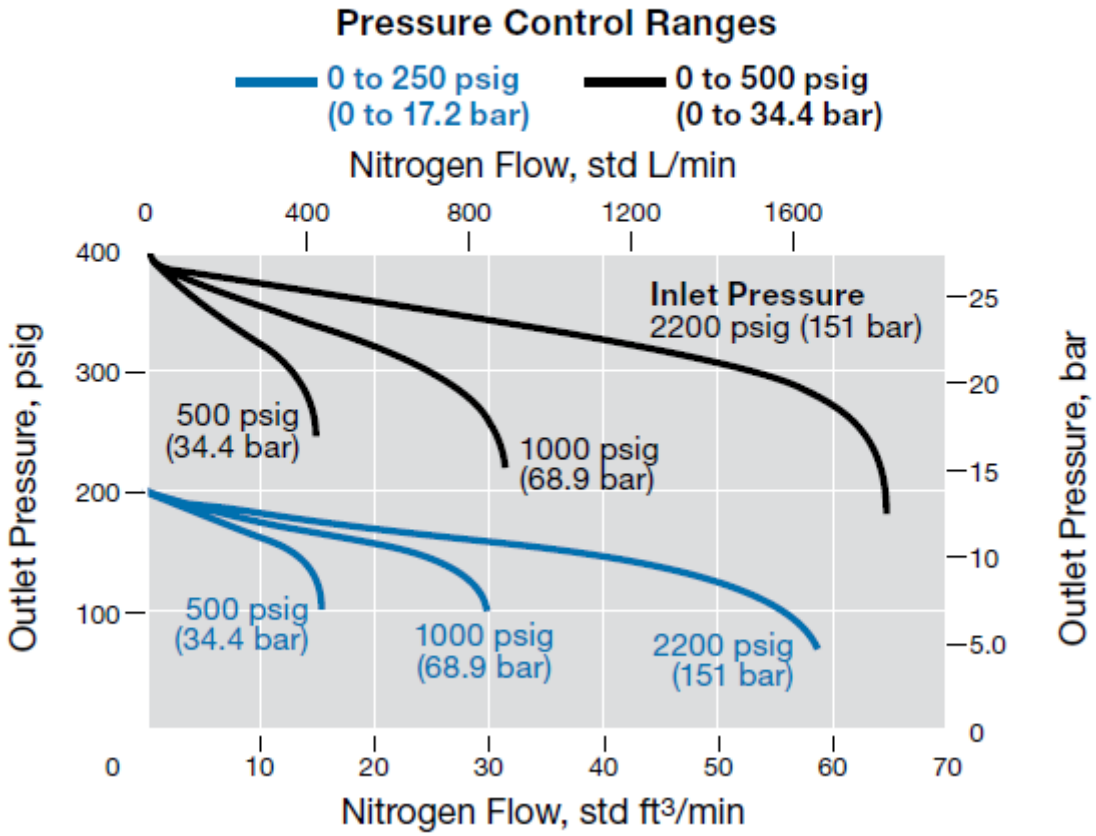
Changeover Selection

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



Changeover Selection

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



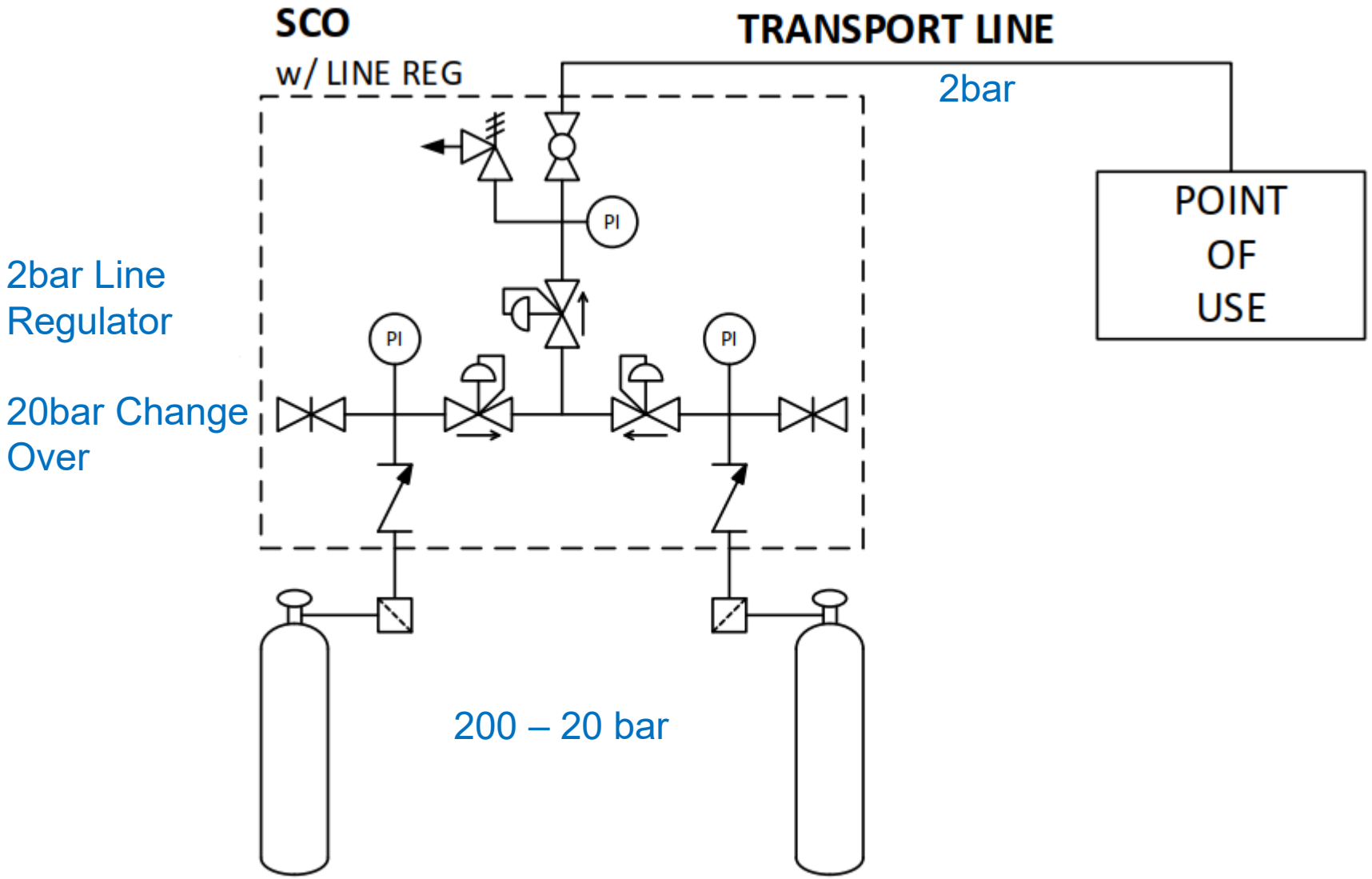
- Changeover with line regulator
  - Remember flow curve families!

↑ Flow capacity line reg

↑ Changeover pressure

↓ Gas cylinder usage

Optimize Gas Distribution System



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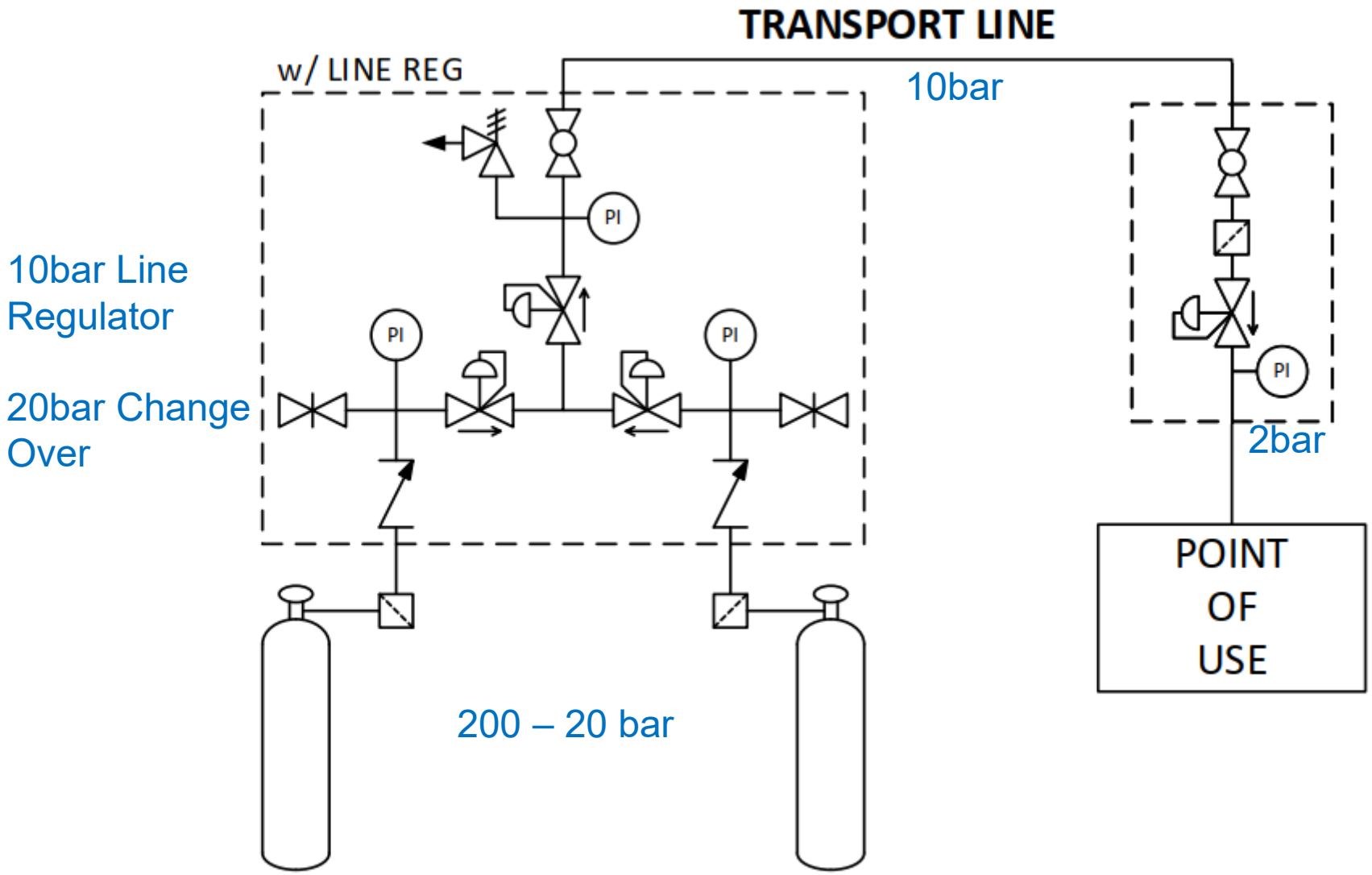
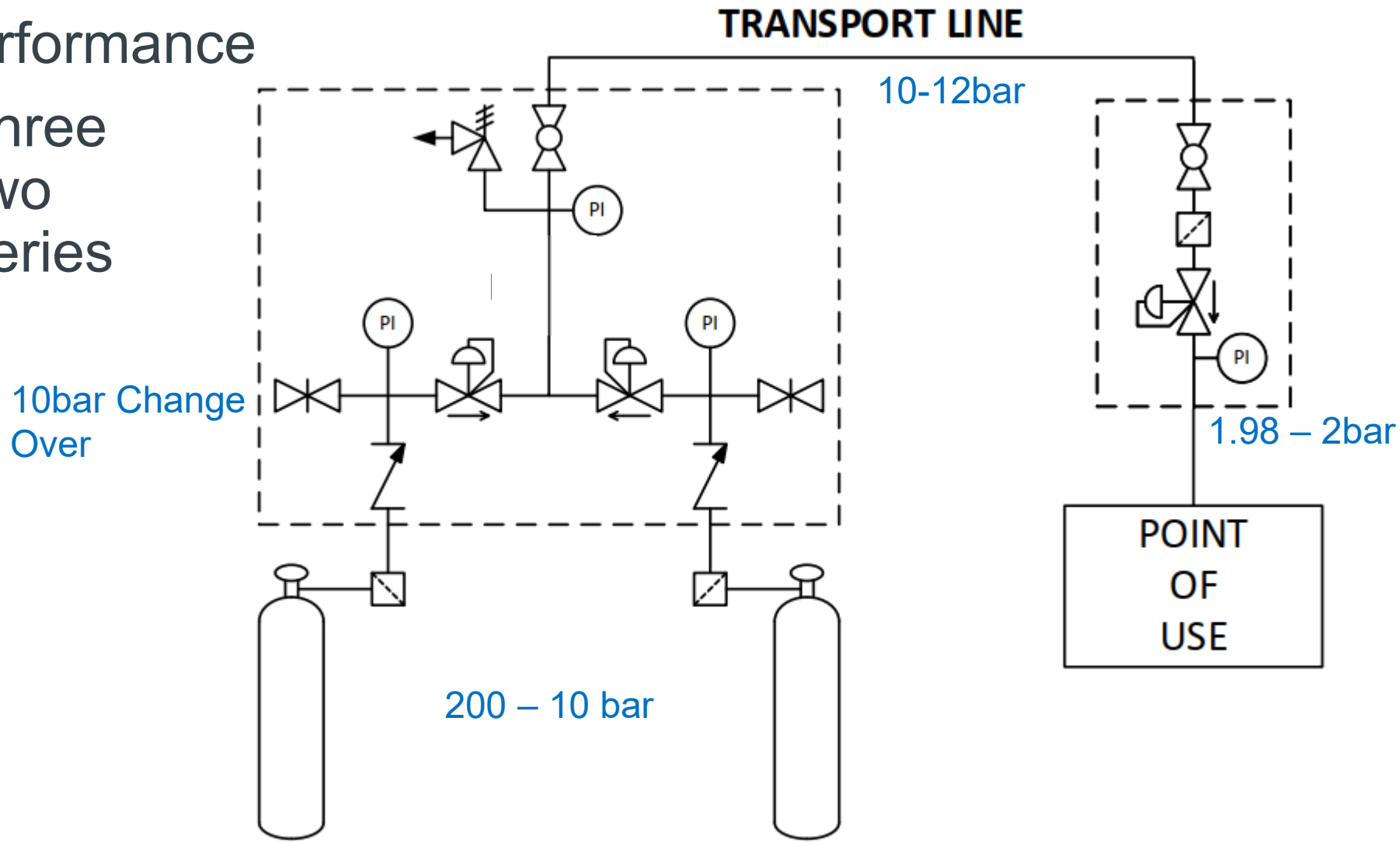


Optimize Gas Distribution System

Improve flow performance

- Change from three regulators to two regulators in series

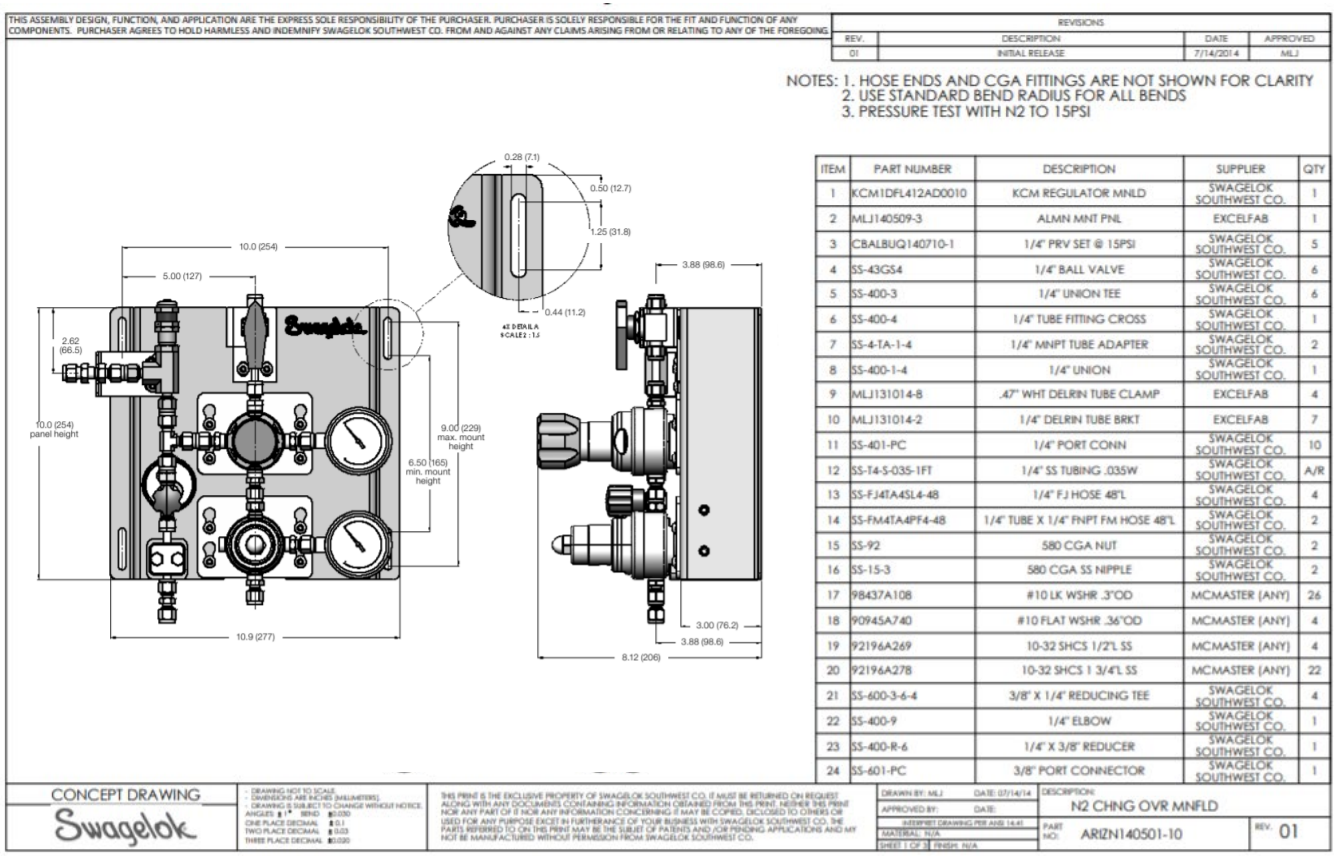


Review

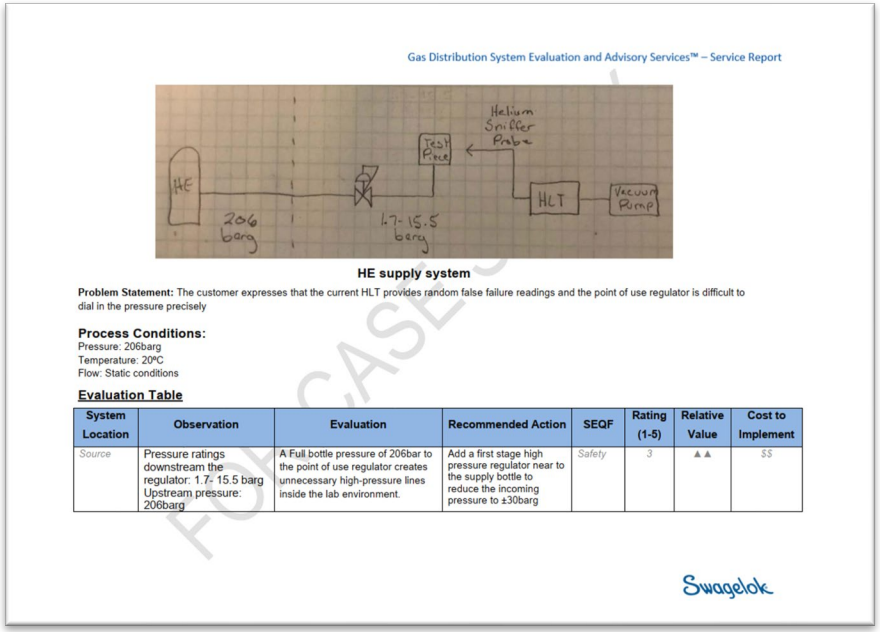
- Gas distribution systems require consideration of regulator performance
  - Supply Pressure Effect (SPE)
  - Lockup
  - Droop
- Regulator characteristics affect other choices in the system
  - Number of regulators
  - Flow performance
  - Relief valve setting
  - Changeover specification

How Swagelok can support your Gas Distribution System?

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



Gas Distribution System Evaluation and Advisory



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: 20ºC
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 ±30barg	*Safety*	*3*	▲▲	*$$*

Swagelok

Contact Swagelok

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