



How Grab Sampling Can Help Improve Your Plant's Safety

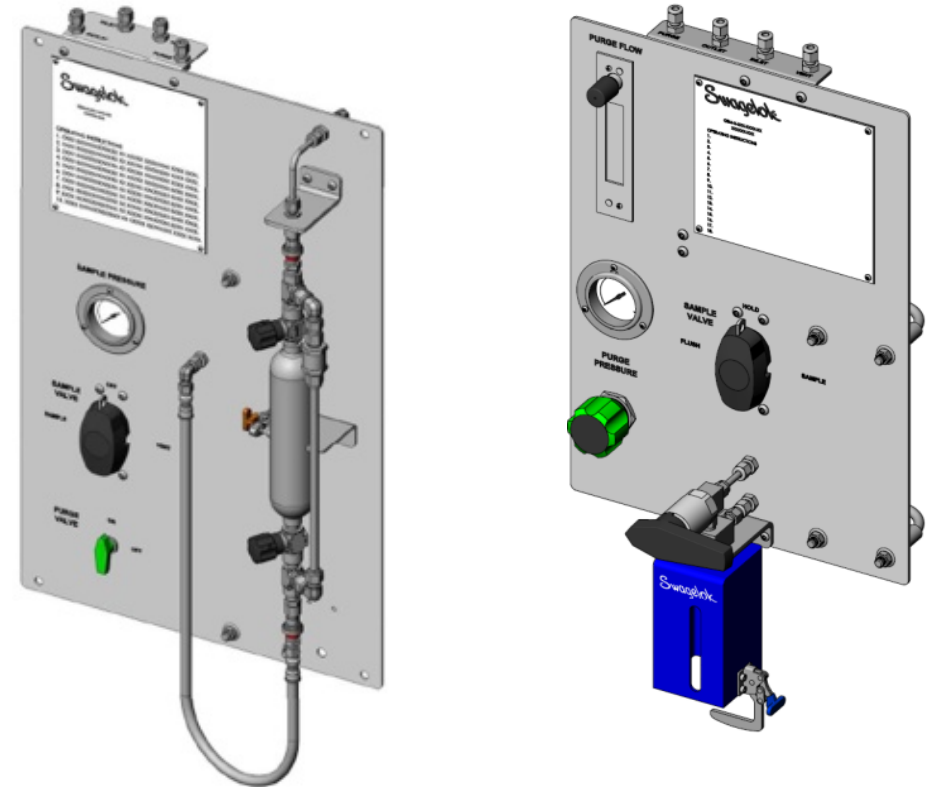


Matt Dixon

Application Commercialization Manager

What Is Grab Sampling?

- Collection of a sample of fluid in a pipeline, tank, or system
- Sample is transported to laboratory for analysis
- Many different types in two broad categories:
 - Cylinder panels
 - Bottle panels
- Other names:
 - Spot sampler
 - Laboratory sampler
 - Field sampler



Grab Sampling in Processes

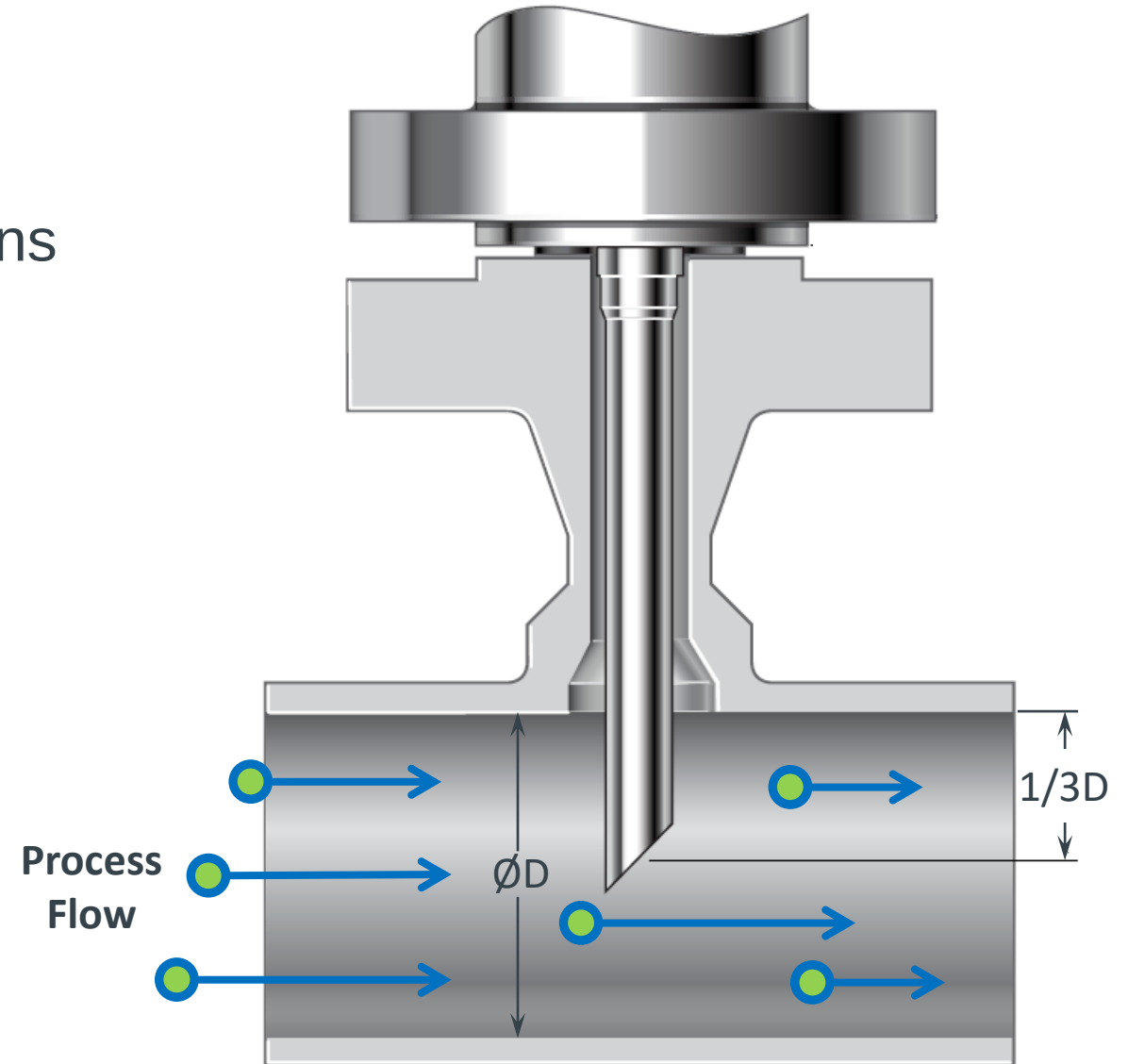
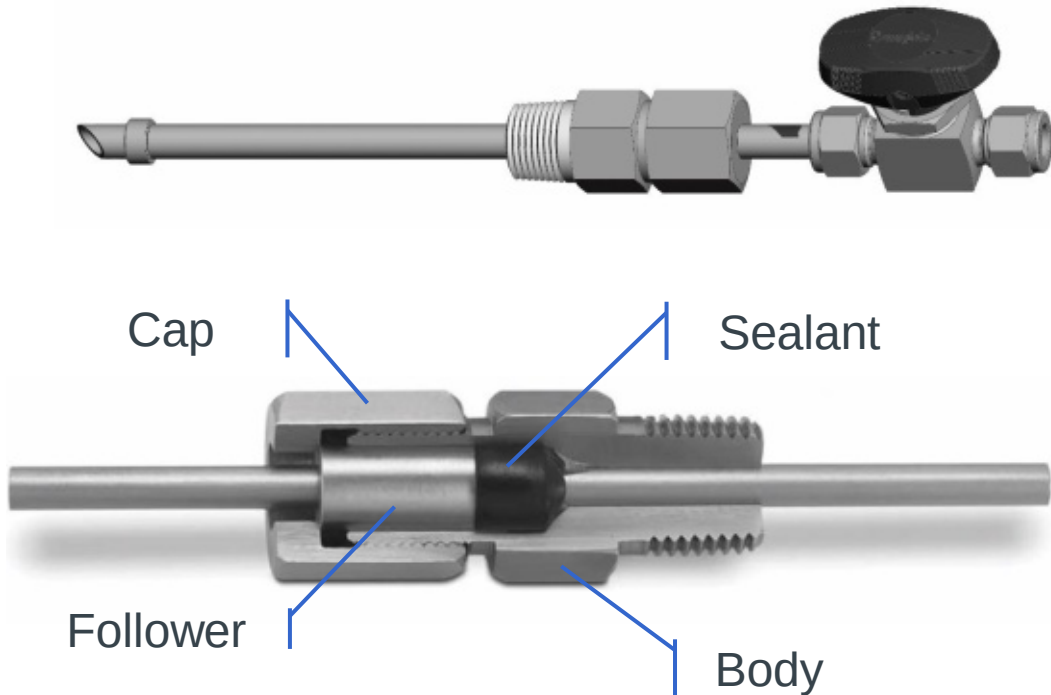
Why Grab Sampling?

- Validation of the process conditions
- Validation that end products meet specifications
- Loading platforms, reference sample of sold product
- Evaluation of environmental emissions according to local regulations
- Validation of online analyzers



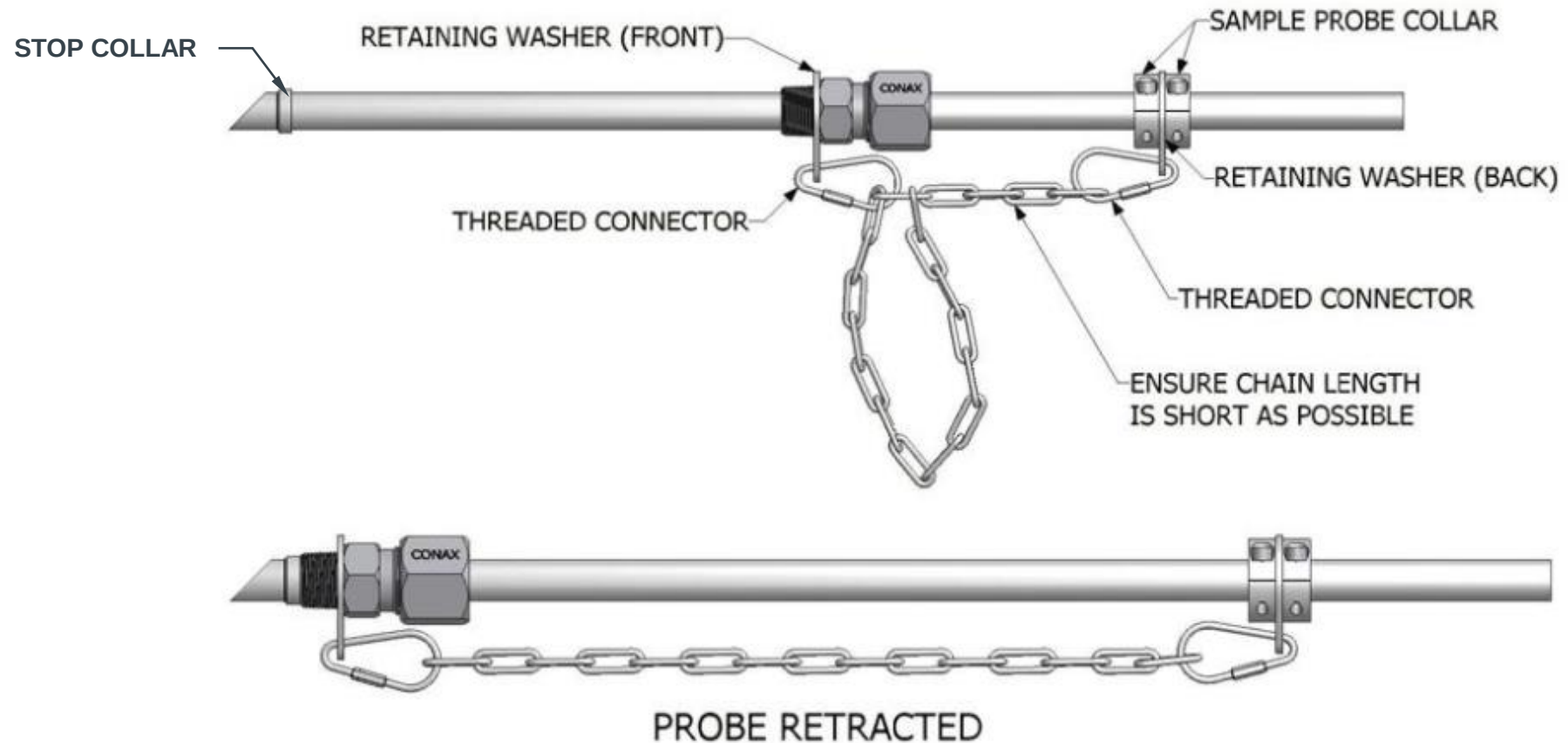
Sample Probes

- Sample from middle third of pipe
- Fixed probes vs retractable
 - Retractable Probes: Safety Concerns



Retractable Probe Safety

- Stop Collars
- Safety Chains

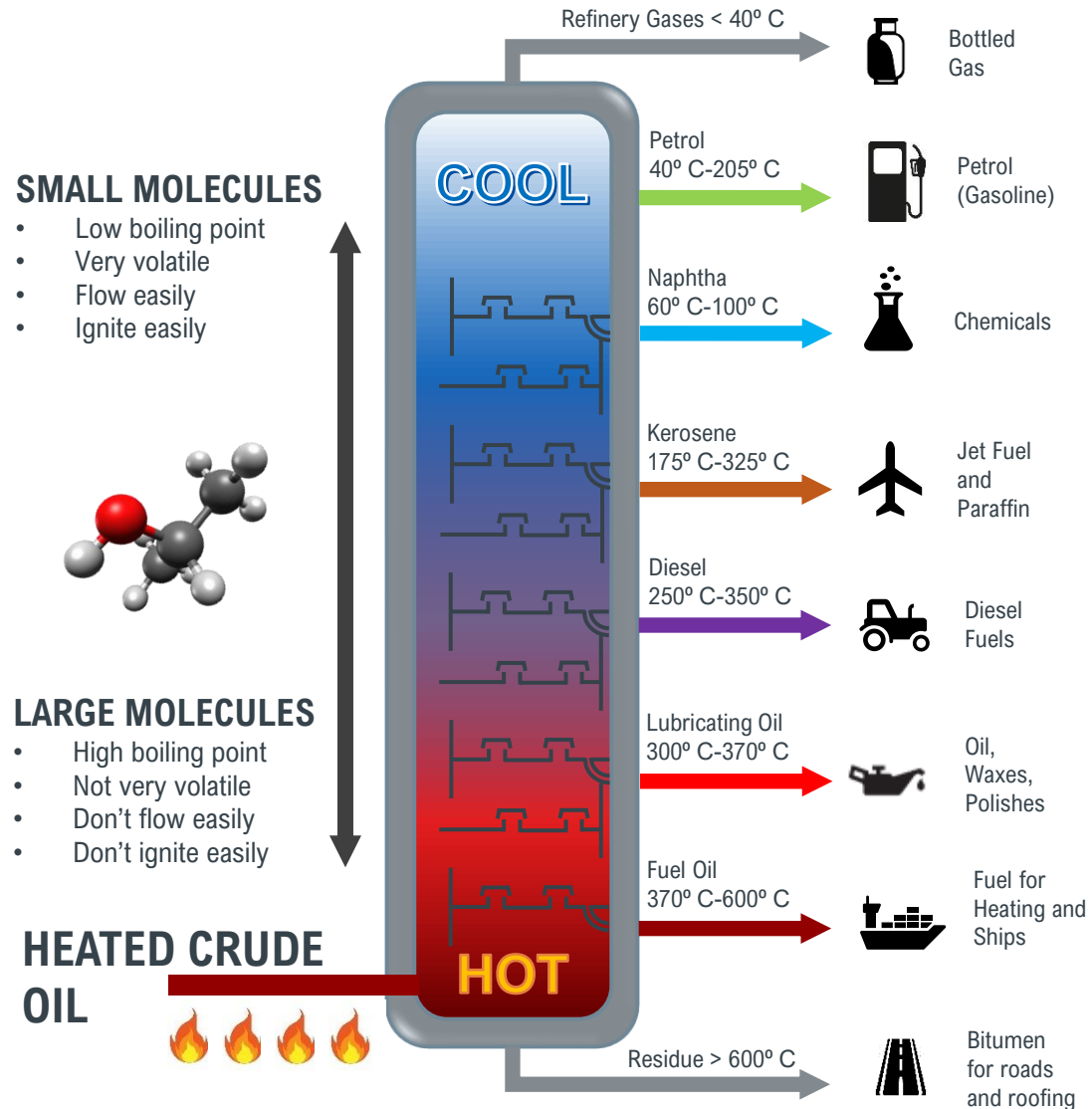


Sample Container Selection – Safety Considerations

- Toxicity – Sample cylinders are better for toxic samples
- Handling Damage – How will container be transported?
- Consequences of broken bottles – Cuts, exposure, contamination
 - Consider coated bottles
- Pressure – Bottles are not pressure-containing (non-volatile liquids only)



Sample Container Selection



PHASES

GAS



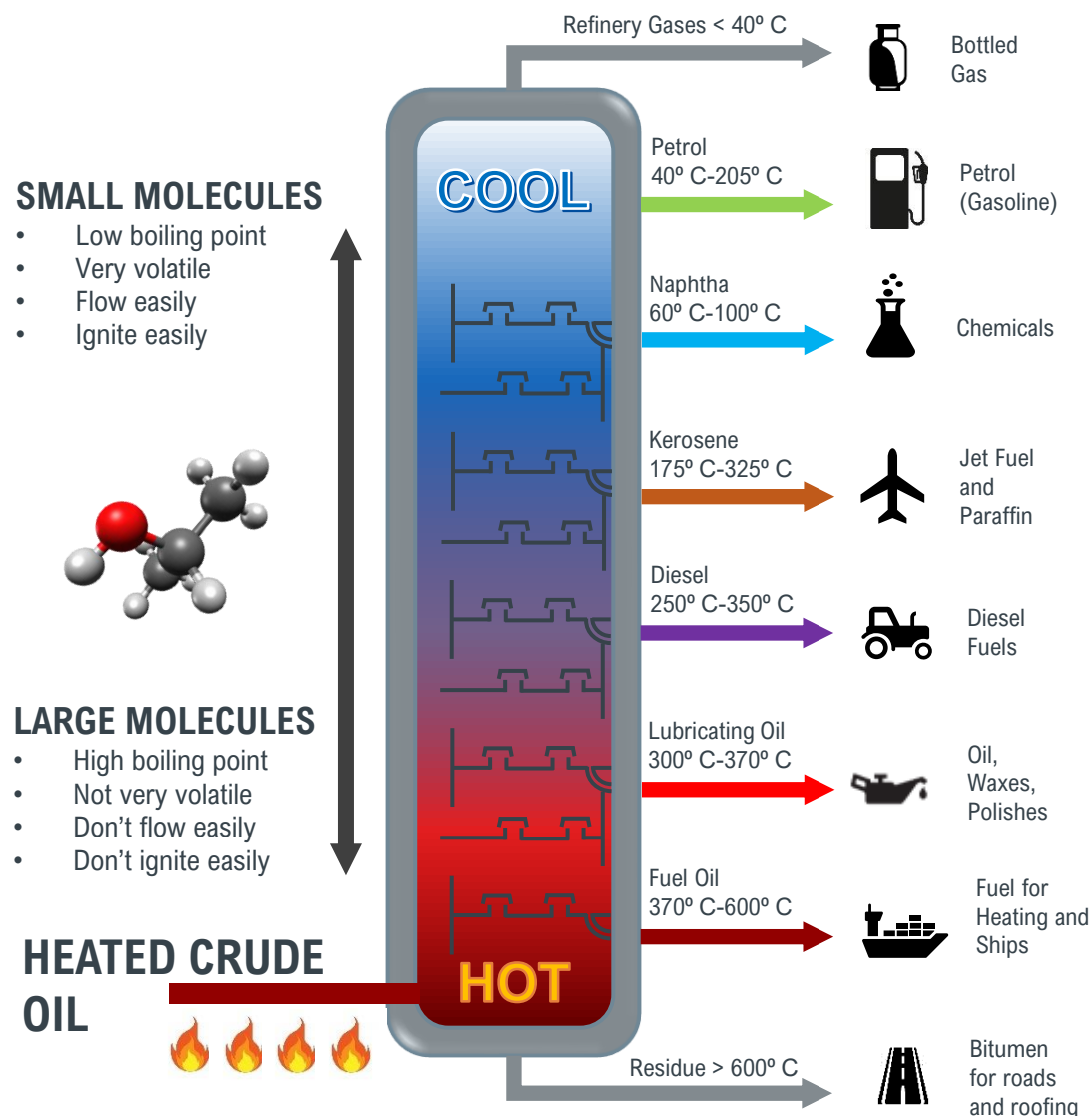
VOLATILE LIQUID



LIQUID



Sample Container Selection



Name of Alkane	How many carbons ?	Chem Formula	Boiling Point in °C	State at (20°C)	Melting Point in °C
Methane	1	CH_4	-162	gas	-183
Ethane	2	C_2H_6	-39	gas	-172
Propane	3	C_3H_8	-42	gas	-188
<i>n</i> -Butane	4	C_4H_{10}	0	gas	-138
<i>n</i> -Pentane	5	C_5H_{12}	36	liquid	-130
<i>n</i> -Hexane	6	C_6H_{14}	69	liquid	-95
<i>n</i> -Heptane	7	C_7H_{16}	98	liquid	-91
<i>n</i> -Octane	8	C_8H_{18}	126	liquid	-57
<i>n</i> -Nonane	9	C_9H_{20}	151	liquid	-54
<i>n</i> -Decane	10	$\text{C}_{10}\text{H}_{22}$	174	liquid	-30

Sample Cylinders – Overpressurization

- Thermal expansion of liquid can damage cylinders that are 100% liquid filled (liquid is not compressible)
- Three primary over-pressure options:
 - Rupture Disc
 - Relief Valve
 - Outage Tube



Sample Cylinders – Overpressurization Protection

Rupture Disc or Relief Valve

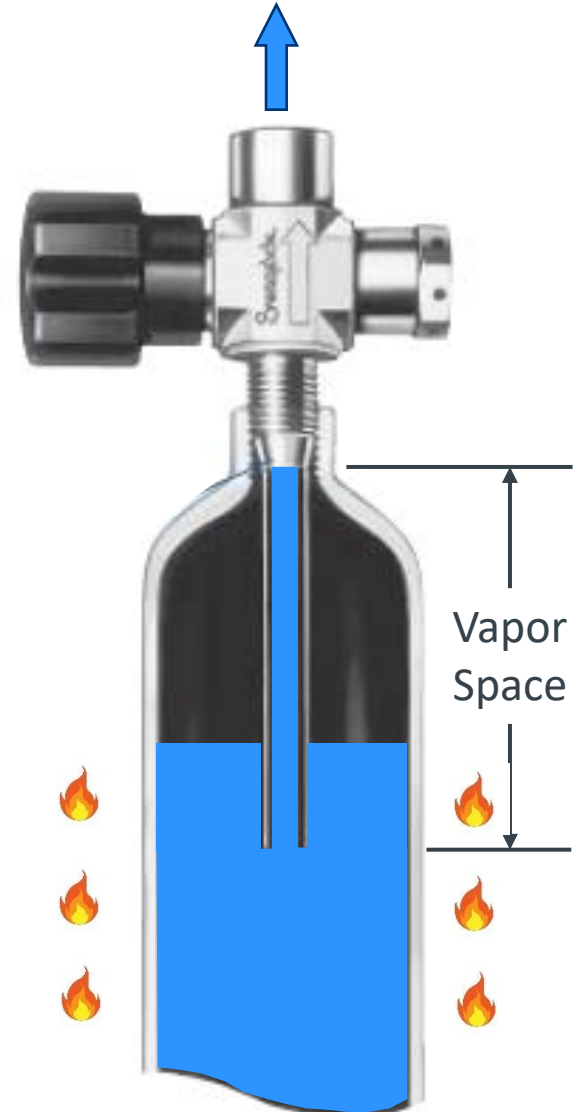
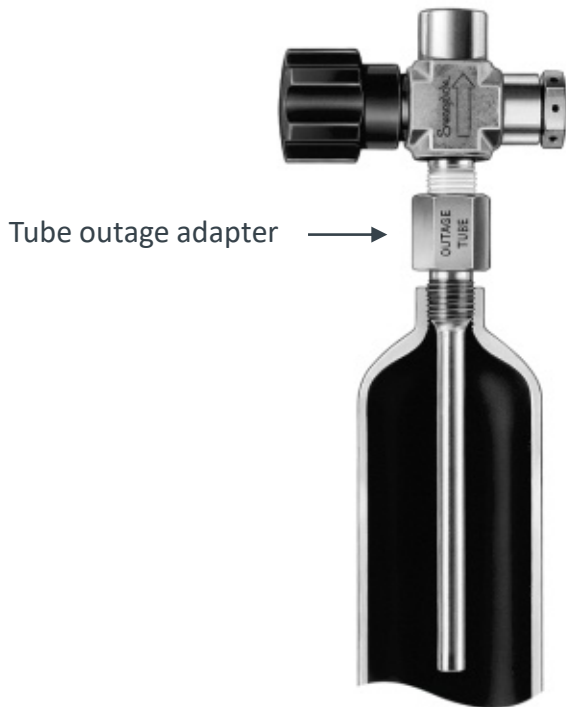
- Relieve pressure/sample to atmosphere
- Available in a tee or integral to cylinder valves
- Should not be used for toxic fluids



Sample Cylinders – Overpressurization Protection

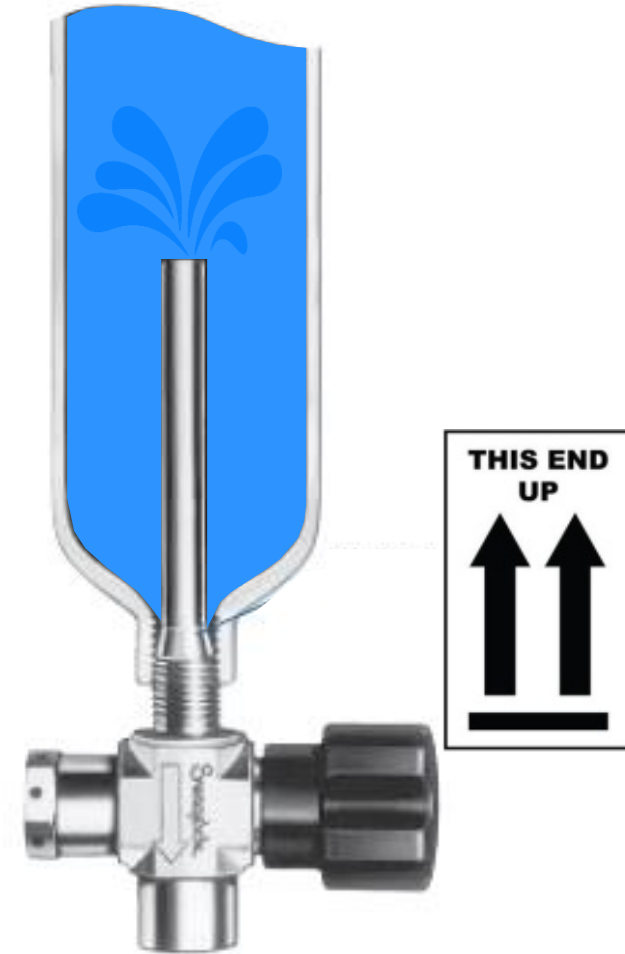
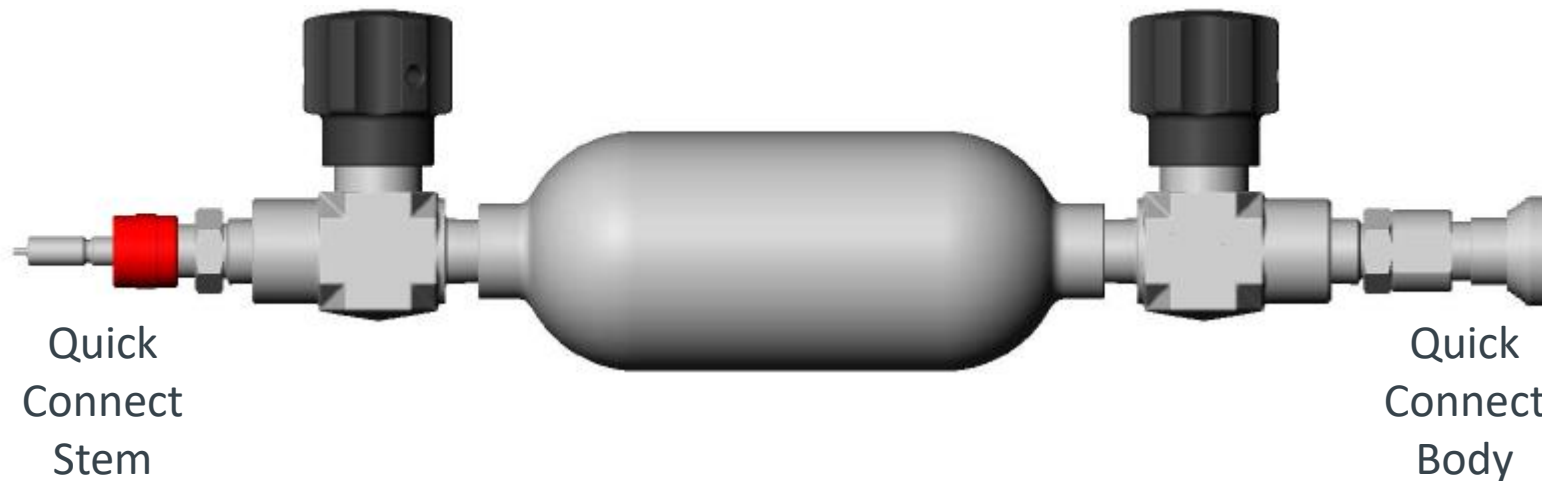
Outage Tubes

- Vapor space determined by length of tube
 - Specified as percentage of cylinder volume
- Liquid can expand into vapor space



Outage Tubes

- Cylinder must be oriented vertically
- Avoid installing upside-down
 - Add “this end up” arrow on cylinder
 - Install quick-connect stem on one end, body on other



Outage Tubes

- So how much vapor space do we *really* get??
 - Depends on pressure & procedure

Actual Vapor Space (Worst Case):

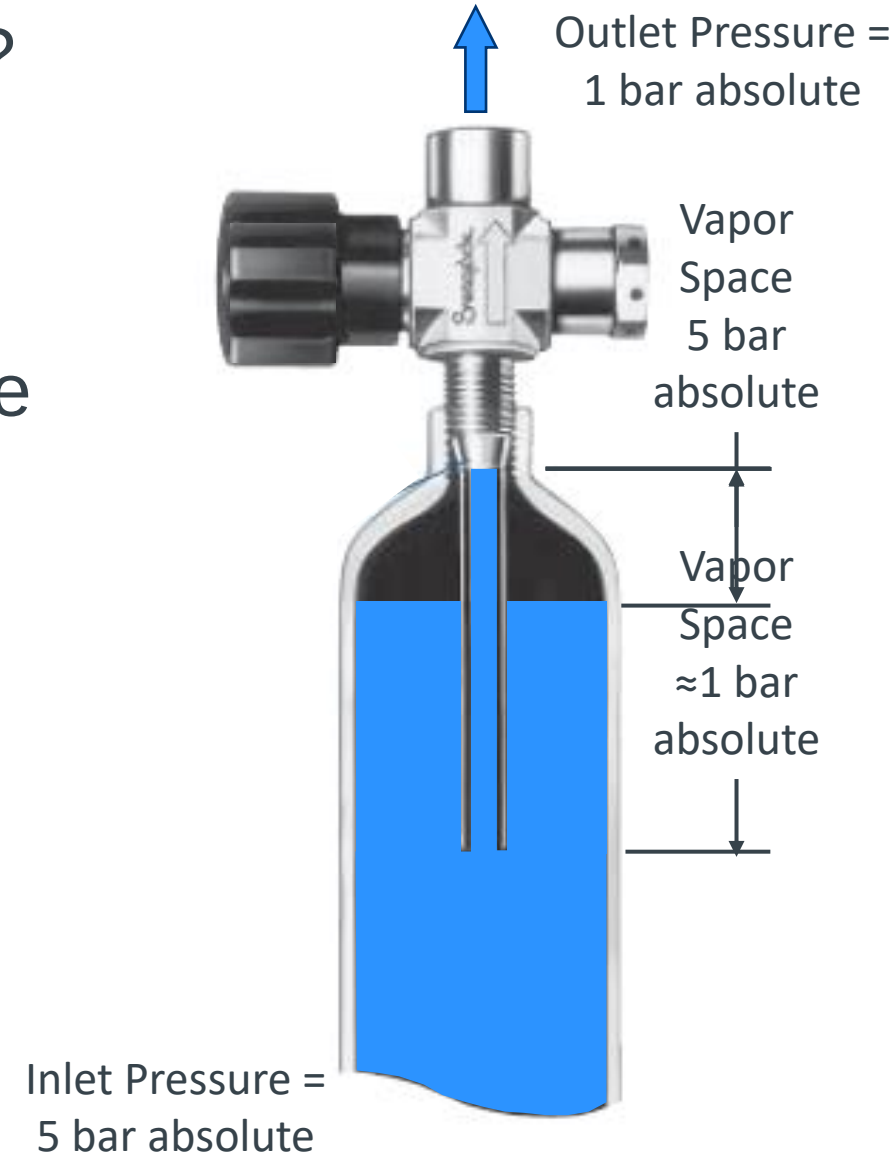
Cylinder: 1000mL with 20% Outage Tube

$$P_1 V_1 = P_2 V_2$$

$$(1 \text{ bar}) \times (200\text{mL}) = (5 \text{ bar}) \times V_2$$

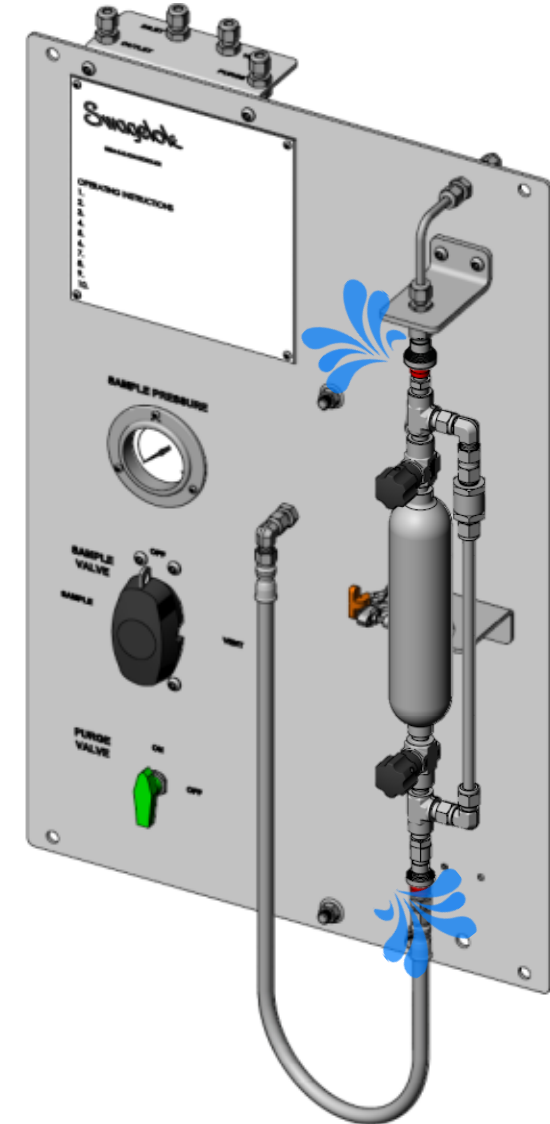
$$V_2 = 40\text{mL outage}$$

- How to mitigate?
 - Pre-charge cylinder with nitrogen
 - Add back-pressure regulator

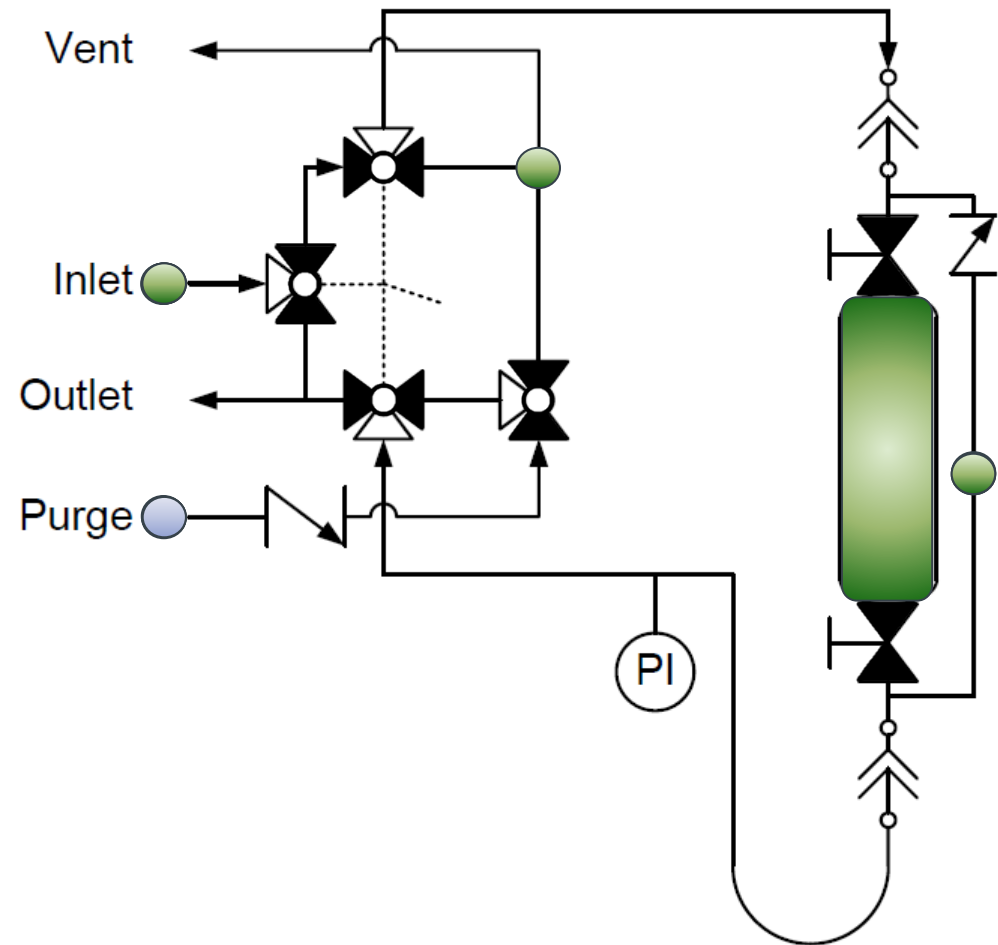
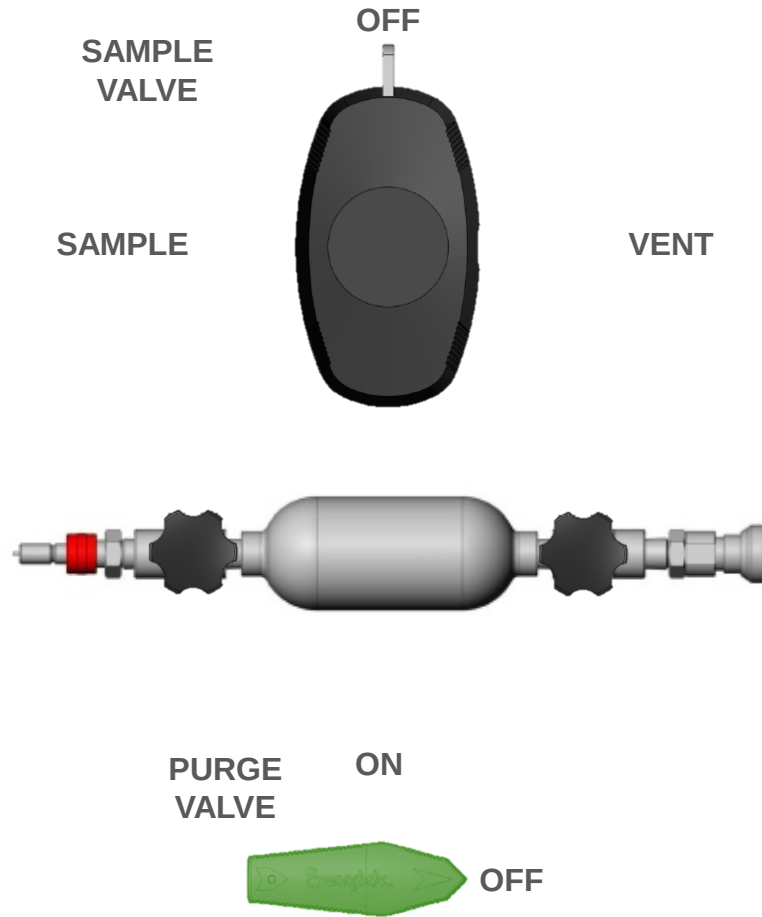


Purge Function

- Flush old sample from panel
 - Before or after sampling
- Purge cooling sample before it plugs
- Remove toxic sample from panel
 - Quick-connect spillage: up to 3 mL
- Purge through quick-connects
 - Spillage → purge fluid, not sample



Grab Sample Panel with Purge



Sample Cylinder Maintenance

- Sample cylinders are more prone to wear and tear.
- Cylinder areas to monitor:
 - Leakage / Corrosion / Internal surface conditions / Cylinder expansion
 - Working conditions of components
 - Improperly installed components
- Periodic inspection is important for safety and quality control.



Sample Bottle Types

- Metal “can”
 - Typically used for high-temperature & high-viscosity samples (non-toxic)
- Open-top bottle
 - Glass or plastic
 - Not worries about vapors (non-toxic)
 - Clear vinyl coating for shatter-resistance
- Bottle with cap & septum
 - Contains vapor/spills
 - Requires dual (fill & vent) needles to pierce septum



Sampling with Sample Bottles

- Sample valve required
 - Needles/nozzle to dispense sample
 - Shroud
 - Hold/protect bottle
 - Guard against needle sticks
 - Flow orifice
- Bottles are not pressure-containing
- Purge for cleanliness & exposure
- Spring return (“Deadman”) handle



Bottle Sampler – Safety Considerations

- Sample toxicity
 - Use bottle with septum
 - Switch to sample cylinder
- Sample pressure & flow rate
 - Add restriction orifice
- Overfilling/overflowing of bottle
 - Use fixed-volume design



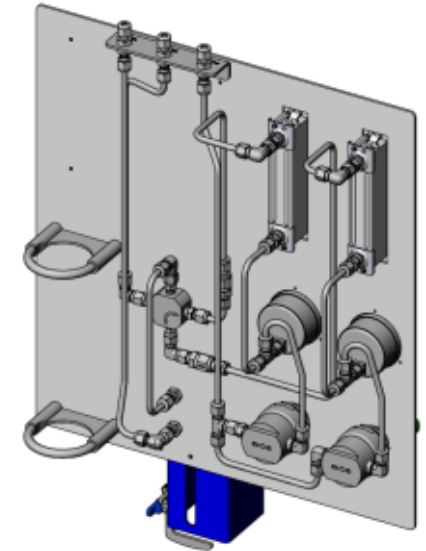
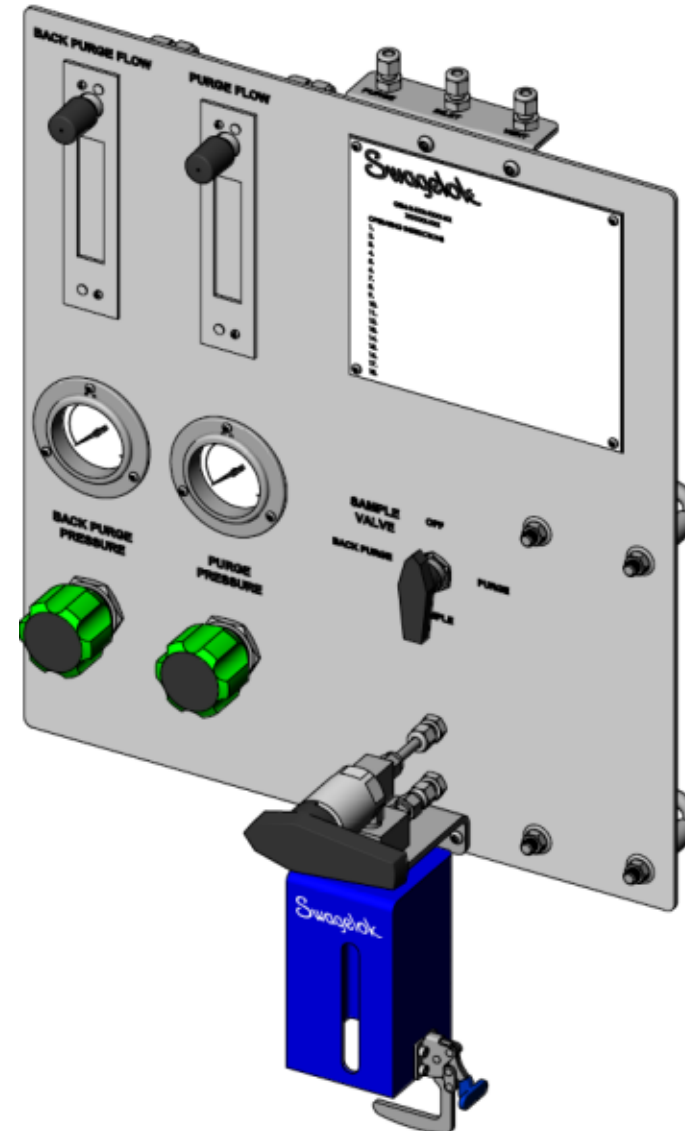
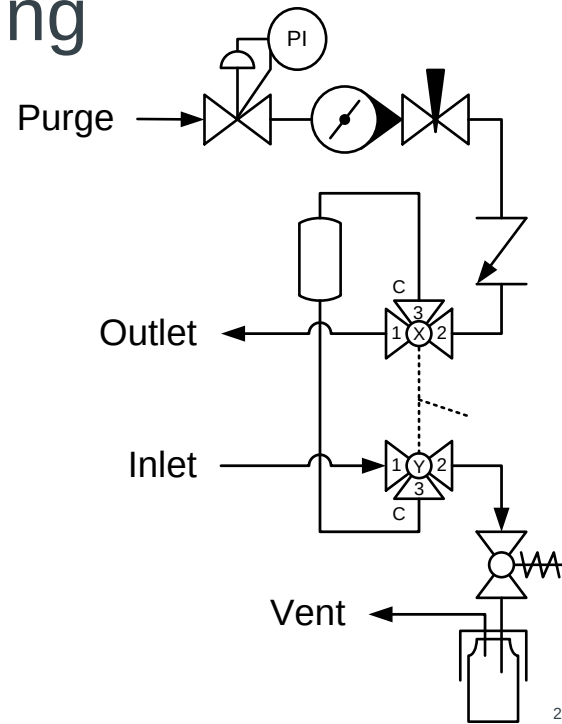
Swagelok GSL – Fixed Volume

Controls volume dispensed

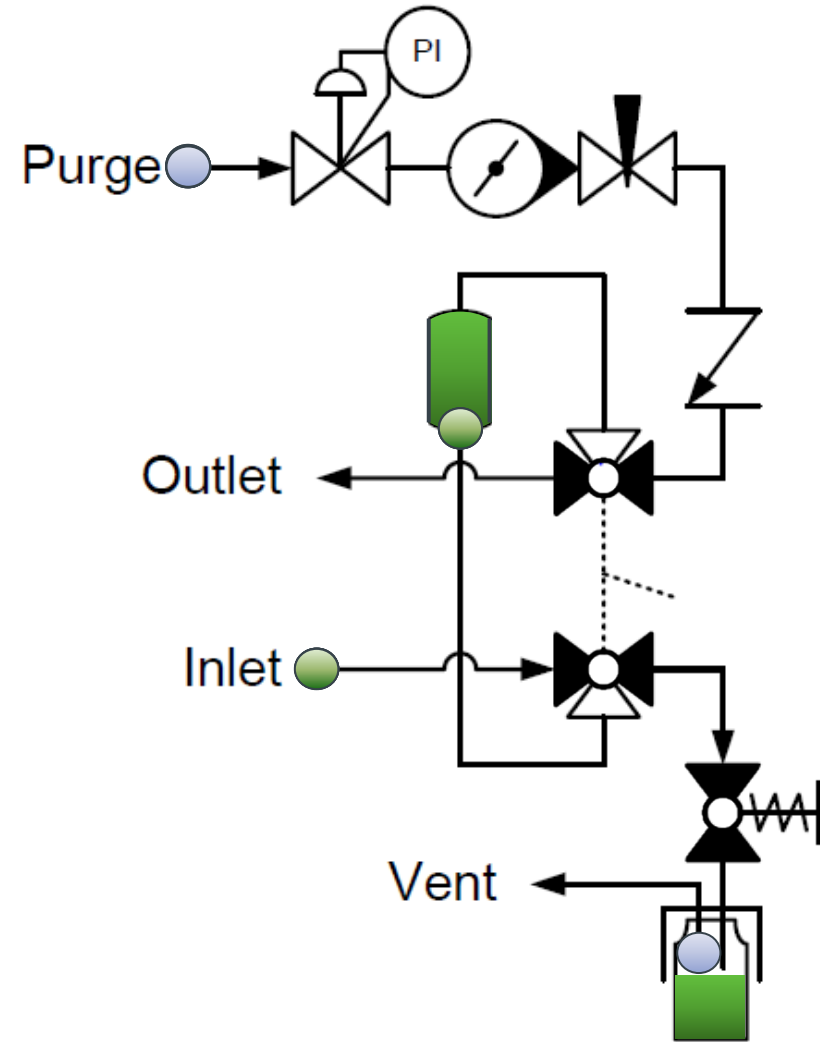
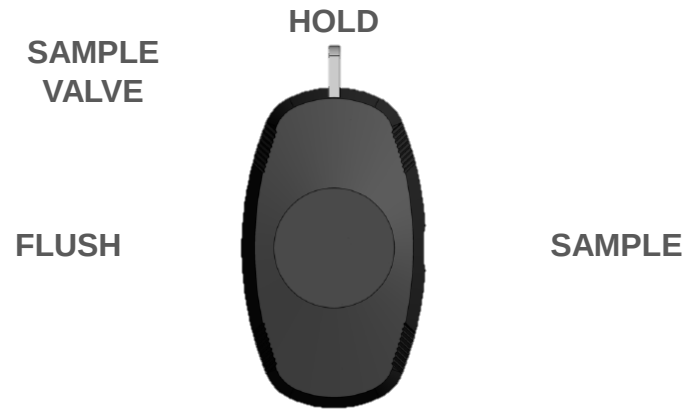
- Target Fill: 60-80% bottle volume
- Prevents overfilling
- Sampling from high-pressure sources

Typical uses:

- Direct pipeline sampling

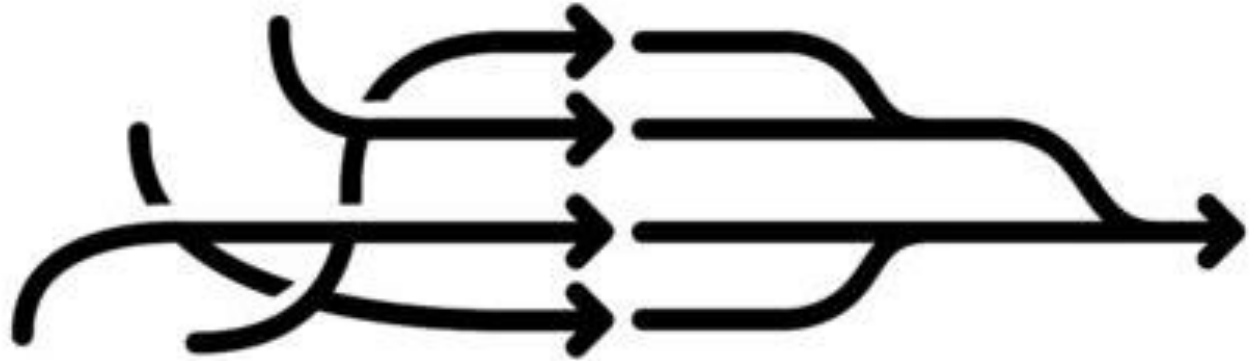


Swagelok GSL – Fixed Volume



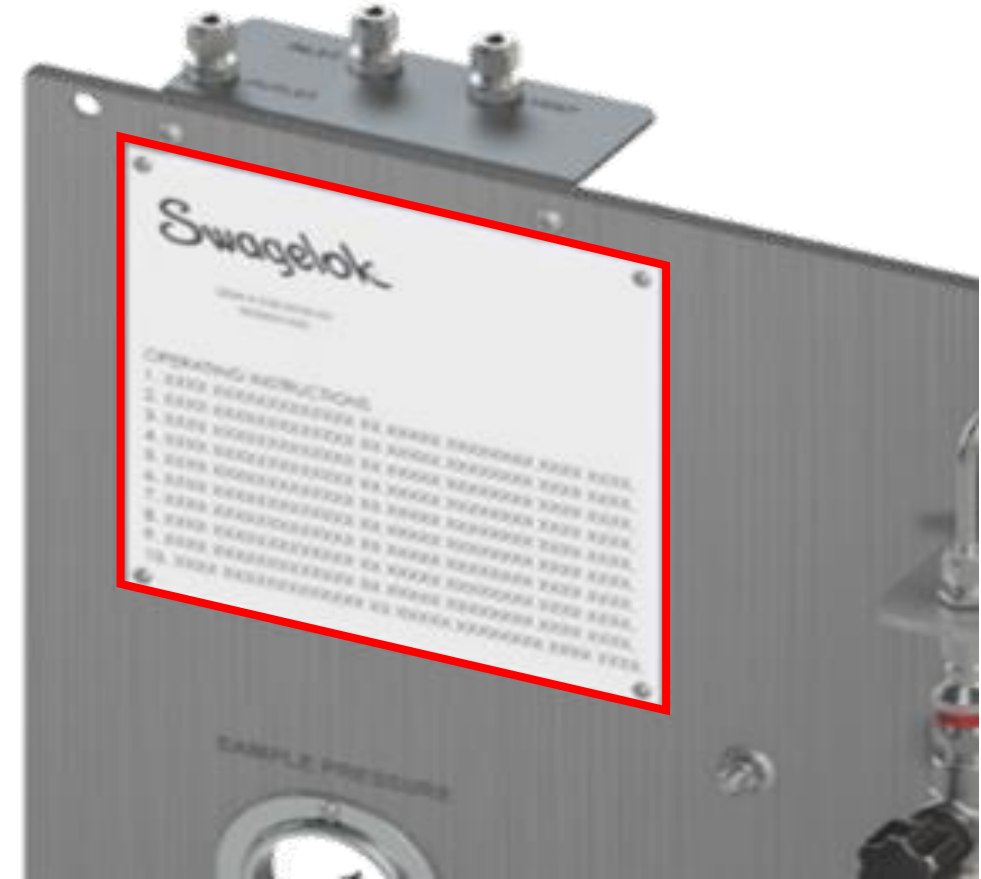
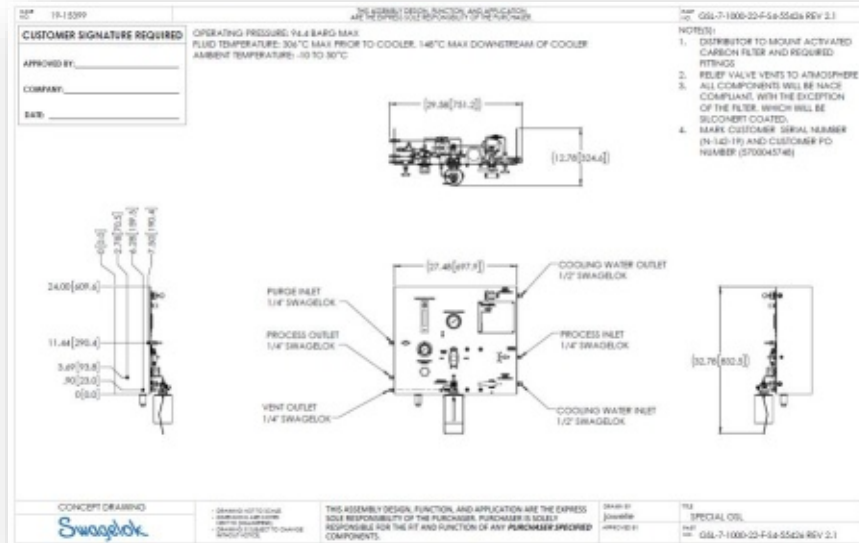
Safety in Operation

- Operated by humans
 - Errors more likely
 - Consequences much higher
- Reducing Errors:
 - Documentation
 - Simplification
 - Automation



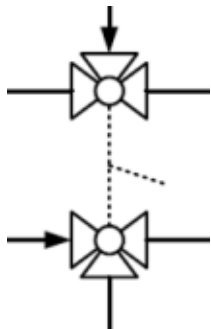
Documentation

- Engraved placard on panel
 - Instructions
 - Schematic
- Sales / as-built drawings

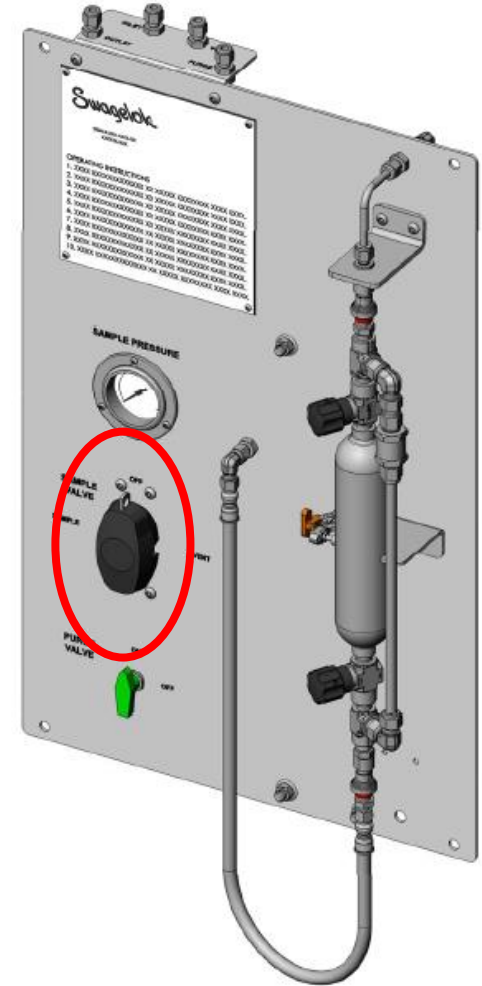
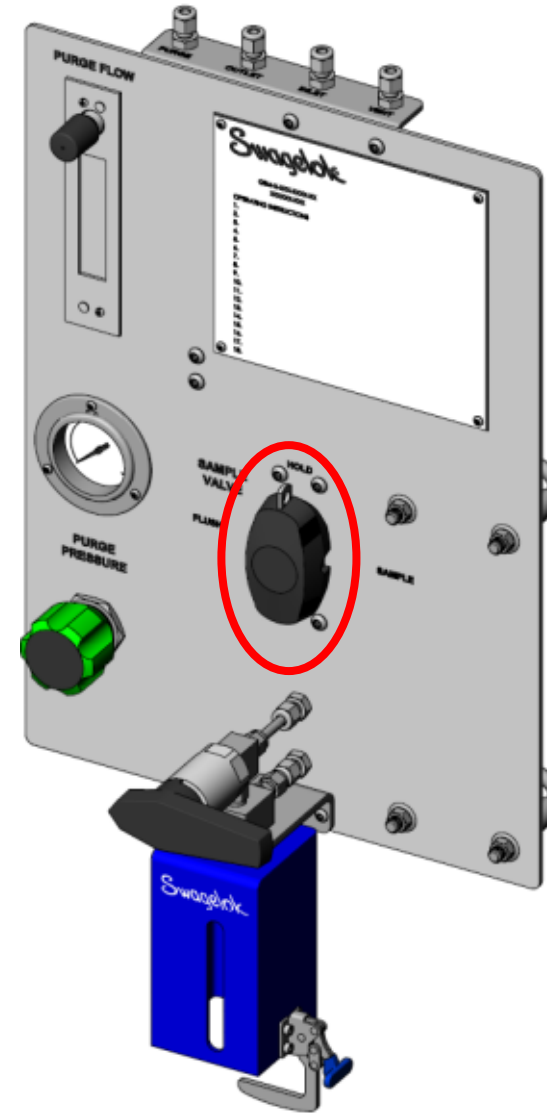
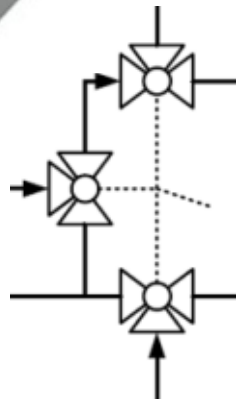


Simplification – Geared Valve Assemblies

2-Valve
Switching Valve



3-Valve
Switching Valve



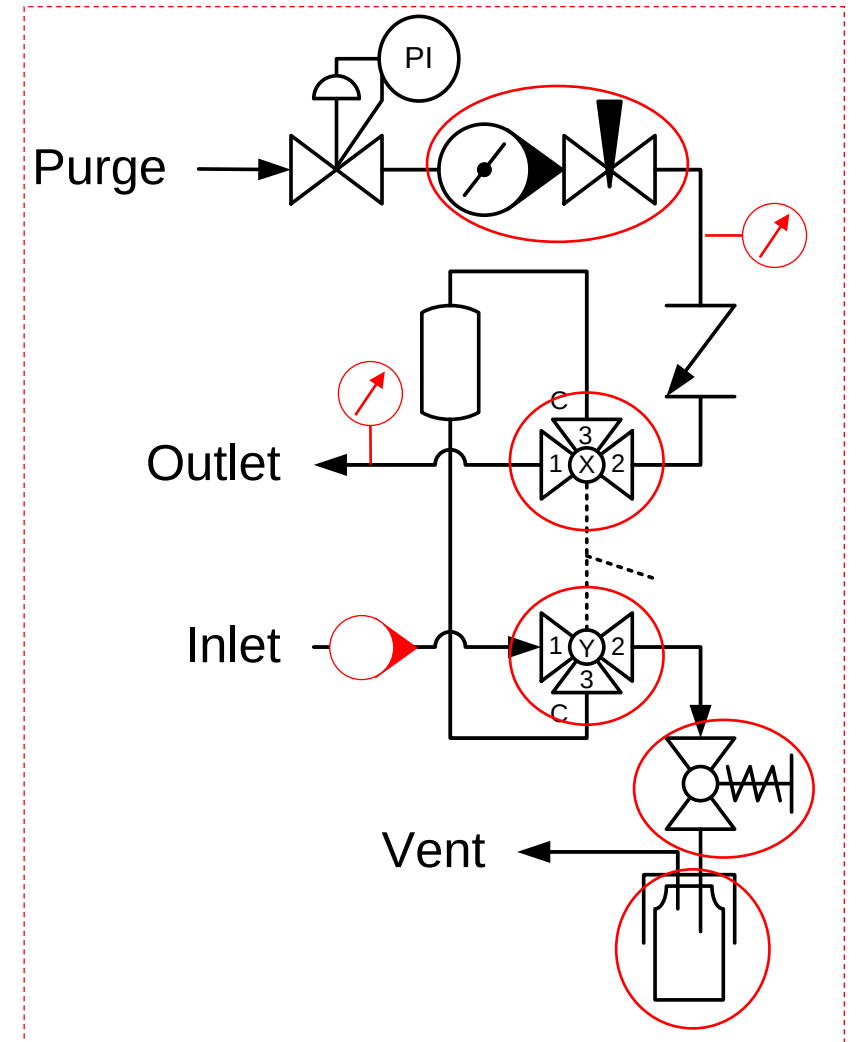
Automation

- Remove humans to the extent practical
 - Accuracy
 - Consistency
 - Safety
- Controlled by local PLC or Plant Control System
- Adding wires = hazardous area requirements
 - Class/Division
 - ATEX
 - IECx
- Higher up-front cost



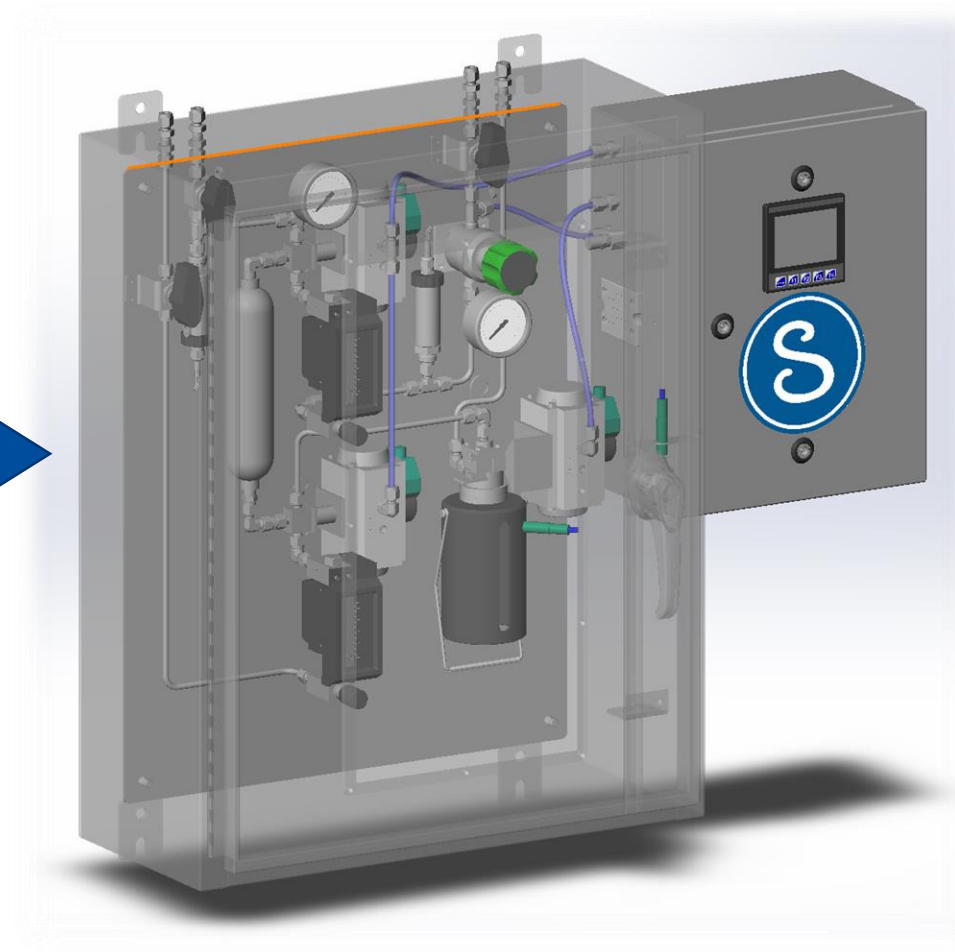
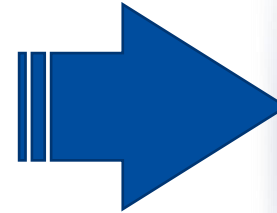
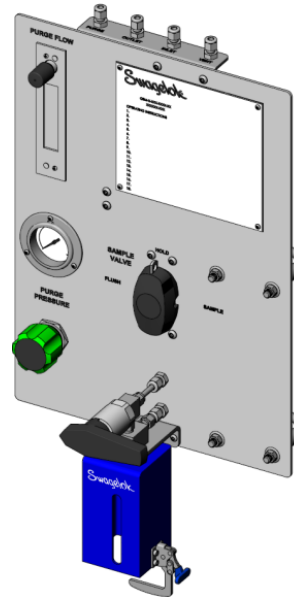
Fixed Volume GSL: How to Automate?

- Ensure enclosure door is closed
- Ensure bottle is in place
- Automate valves
- Ensure product flow and pressure
- Ensure purge flow and pressure

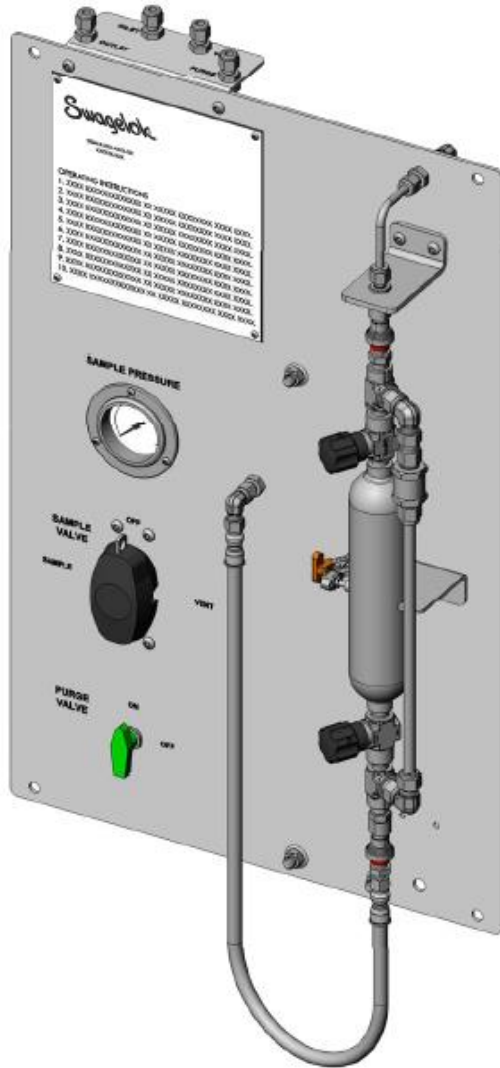


Fixed Volume GSL: Automated Version

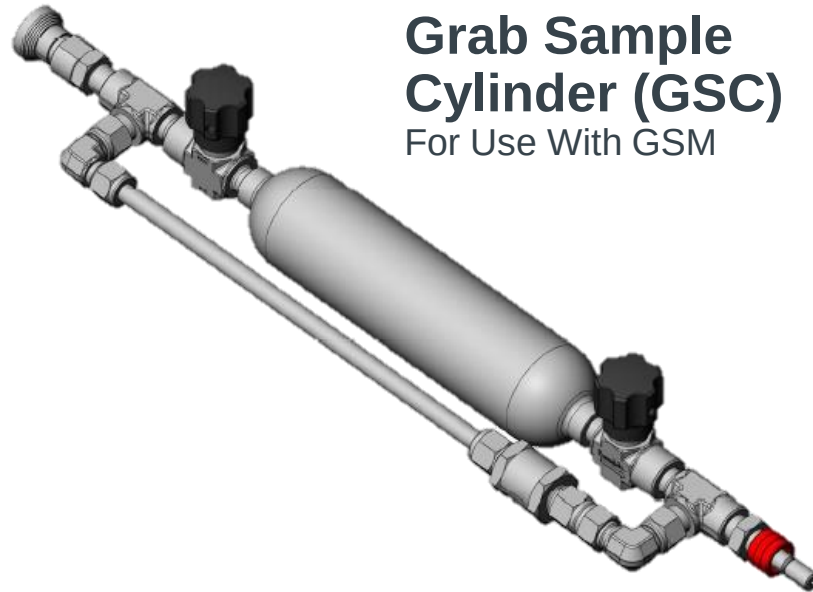
- Flowmeters w/ 4-20mA output
- Pressure Transducers
- Automated valves w/ feedback
- Sensor to detect bottle
- Sensor to detect enclosure door
- Touchscreen PLC
- Hazardous area rating



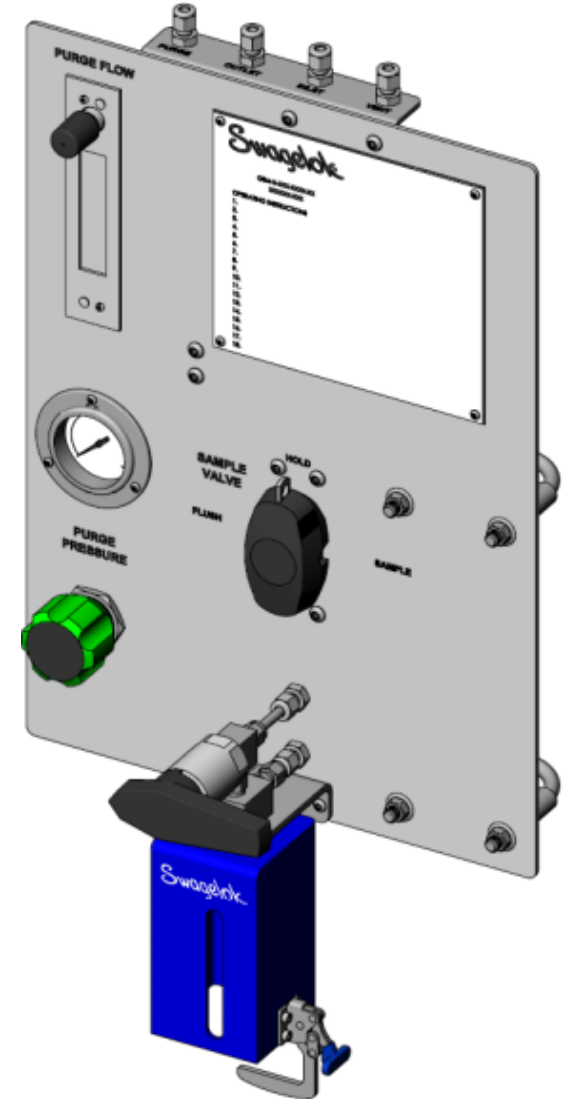
Swagelok Standard Grab Sample Panels



**Grab Sample
Module (GSM)**
Cylinder Style Panels



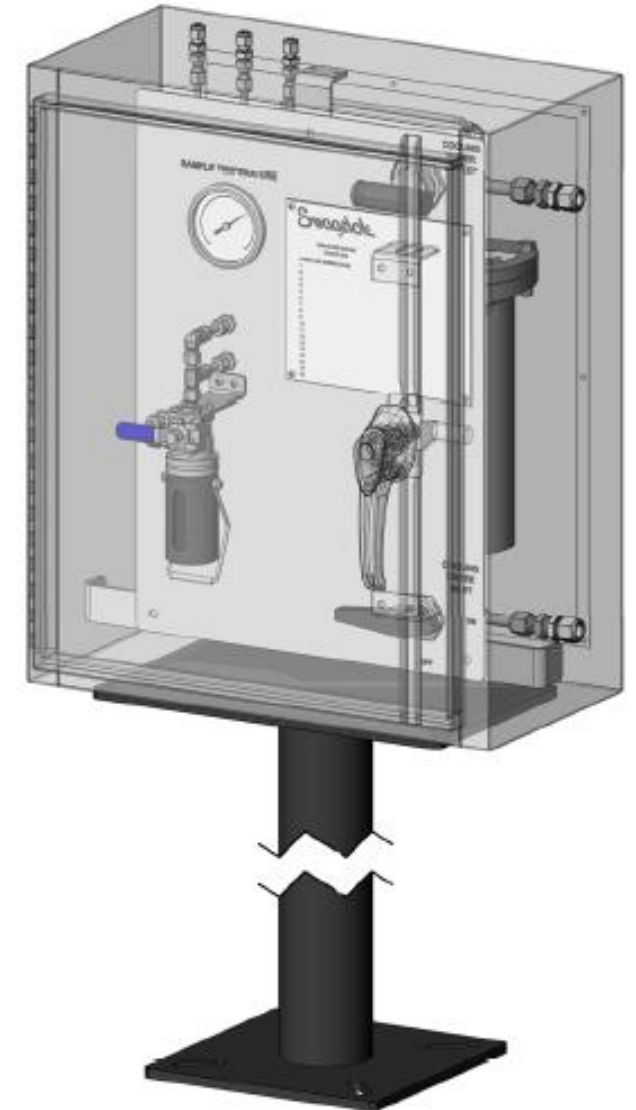
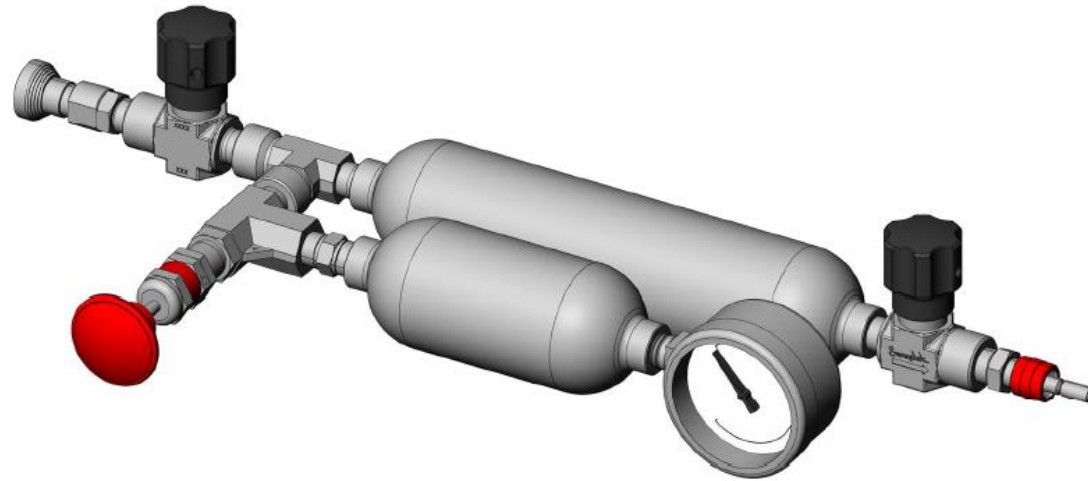
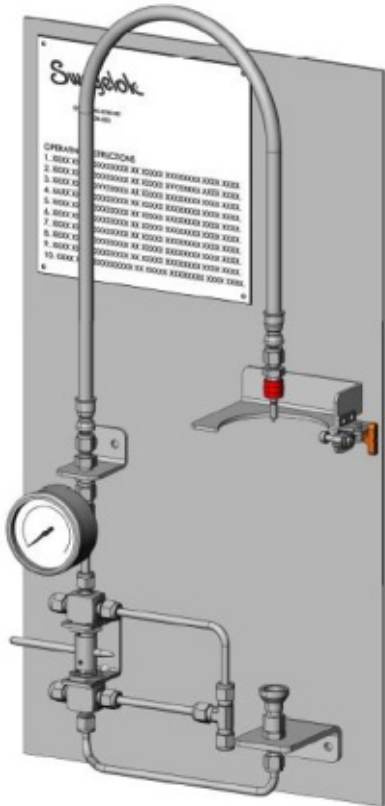
**Grab Sample
Cylinder (GSC)**
For Use With GSM



**Grab Sample
Liquid (GSL)**
Bottle-Style Panels

Grab Sample Panels – A Design Platform

- Limitless customization options
- Swagelok Sales & Services Centers certified for local engineering & support



Learn More

Expect an email from *PTQ* with a link to request more information about grab sampling. A representative from your authorized Swagelok sales and service center will reach out to you within 3 business days.

Meanwhile, read more about sampling system design and operation best practices on *Swagelok Reference Point*, our blog for industrial fluid system professionals.

You can also learn more about our grab sampling systems and services here:

<https://www.swagelok.com/en/services/design-assembly/grab-sampling-systems>

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