Swagelok® Ammonia Sampler

Installation, Operation, and Maintenance Manual

This manual contains important information for the safe and effective operation of the Swagelok® ammonia sampler. Users must read and understand its contents before operating the sampler.

Swagelok®

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Safety

Safety Summary

Signal Words and Safety Alert Symbols Used in This Manual

WARNING Statements that indicate a hazardous situation which, if not avoided, could result in death or serious injury.

CAUTION Statements that indicate a hazardous situation which, if not avoided, could result in minor or moderate injury.

NOTICE Statements that indicate a hazardous situation which, if not avoided, could result in damage to the equipment or other property.

⚠ Safety alert symbol indicating a potential personal injury hazard.

Safety Instructions

⚠ **WARNING: Read this entire manual prior to installation, operation, or maintenance of the Swagelok ammonia sampler. Failure to do so can result in serious injury or death.**

⚠ **WARNING: Ammonia is a hazardous chemical, and exposure can have serious health implications. Follow all plant standards when handling ammonia and operating this equipment.**

⚠ **CAUTION: This equipment includes a heater that can have surfaces temperatures in excess of 140°F (60°C). Operating the Swagelok ammonia sampler without the insulation cover in place will expose these surfaces, which can be a risk for burns.**

⚠ **CAUTION: This equipment involves handling of liquid ammonia, which can be at an extremely cold temperature. Take appropriate precautions to avoid "burns" and/or frostbite.**

NOTICE: Be certain to follow all local, municipal, provincial, state, and/or federal standards and laws while installing, operating, or maintaining this equipment. Refer to the authority having jurisdiction for any clarification of specific standards or laws that may impact how this equipment is used.

Introduction

Ammonia is a chemical commonly found in nature and commonly used in industry. It is used as a cleaner, a fuel, a refrigerant, a precursor for producing other chemicals, and in many other applications. However, by far the most common use for ammonia, encompassing almost 90% of global output, is fertilizer production. Due to the widespread use of fertilizer in agriculture around the globe, ammonia production can be found in almost all regions of the world.

One concern for the production, storage, and transportation of ammonia is maintaining a minimum water content in the liquid ammonia, typically 0.2%. The Swagelok® ammonia sampler is designed to sample liquid ammonia at or around its boiling point to safely and consistently verify this minimum water content.

Theory of Operation

There are multiple standards that identify a process or procedure for sampling the ammonia to verify the minimum water content. One such standard, the *Guideline Method for Determining Minimum of 0.2% Water in Anhydrous Ammonia*, CGA G-2.2, defines a method by which the user takes a sample in a glass residue tube, shown in Figure 1.

With the CGA G-2.2 procedure, the user takes a sample of liquid ammonia by filling the residue tube to the 100 mL graduation line. The ammonia is then evaporated, and all that remains is a small amount of water. Next, that water is heated to 120°F (48°C) for 10 to 15 minutes to bake out any dissolved ammonia content. Finally, after the bake-out, the amount of water can be measured using the graduations (0 to 1 mL) on the stem of the residue tube. Having started with 100 mL, it is an easy calculation to determine the percentage of water content that was present in the sample.

Manual sampling methods such as this have many potential problems:

- The individual taking the sample is exposed to the liquid ammonia and therefore significant personal protective equipment (PPE) is required—goggles, gloves, respirator, chemical suit, etc.
- The sample size is dependent on the operator to dispense the correct sample size. Any variation in sample volume will directly impact the accuracy of the results.
- As the cold ammonia fills the warm glass, the ammonia immediately begins to evaporate. This rolling boil makes it difficult to accurately fill the residue tube to the 100 mL graduation.
- Inconsistent rates of heating can lead to inconsistency in sample results.

The Swagelok ammonia sampler addresses all these issues by utilizing a closed sampling fixture, prechilling the residue tube, semiautomating the process by which the residue tube is filled, and by controlling the heating cycle. See Figure 5 for an overview of the sampling process.

Figure 1
Residue Tube

Closed Sample Fixture: The **residue tube**, either 100 mL or 250 mL, is installed in a fully enclosed sample fixture that isolates the operator from the ammonia. See Figures 2 and 3. This fixture is constructed using concentric glass pipes that are affixed to a **heated aluminum block** on the bottom and capped at the top. The **residue tube** is installed inside the center 2 in. glass pipe and the bottom of this section is filled with a heat transfer fluid (glycol). This conducts heat to/from the **residue tube** and acts as a "heat sink" to buffer any rapid temperature changes.

Figure 2
Sample Fixture

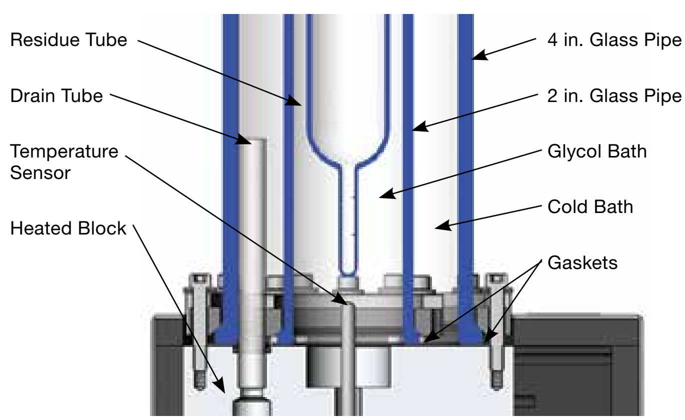


Figure 3
Cross Section of Fixture

Prechilling the Residue Tube: Cold ammonia is used to fill the space between the two glass pipes, creating a cold bath. The cold bath draws heat out of the fixture and residue tube, which prevents aggressive boiling when the cold ammonia sample contacts the residue tube. Additionally, the act of filling the cold bath clears the supply line of older ammonia and ensures a fresh sample.

The fill level of the cold bath is controlled using an elevated drain tube. As the cold bath fills, the ammonia will reach the top of the drain tube and spill over to the drain connection. This prevents the ammonia level from rising too high.

Semiautomated Sample Dispensing: As shown in Figure 4, a **PVC cap assembly** is fitted to the **residue tube t**o assist with the filling process. This cap assembly includes an **overflow tube**, which is aligned to the fill line on the **residue tube**. When dispensing the sample, the ammonia fills the **residue tube** until the level reaches the bottom of the **overflow tube**. At that point, the gas trapped in the top of the **residue tube** prevents the **residue tube** from filling any further, and the flow of ammonia is forced through the **overflow tube** and out. The overflow spills into the cold bath, ensuring a consistent sample size.

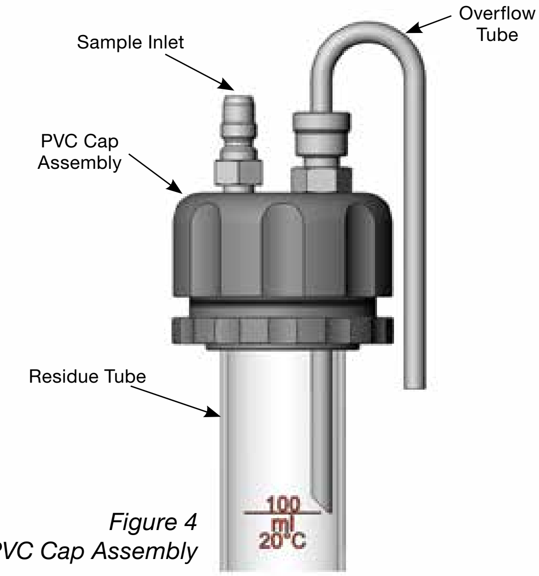


Figure 4
PVC Cap Assembly

Precise Heating Cycle Control: Once the sample is dispensed, the cold bath is drained, and the heater is turned on. This heater warms the glycol and residue tube, evaporating the sample in a controlled manner. After the ammonia is completely evaporated, the remaining water is heated to 120°F (48°C)[1] and held at that temperature for 10 minutes[1]. At that point, the amount of remaining water can be measured, and the sample's water content can be calculated.

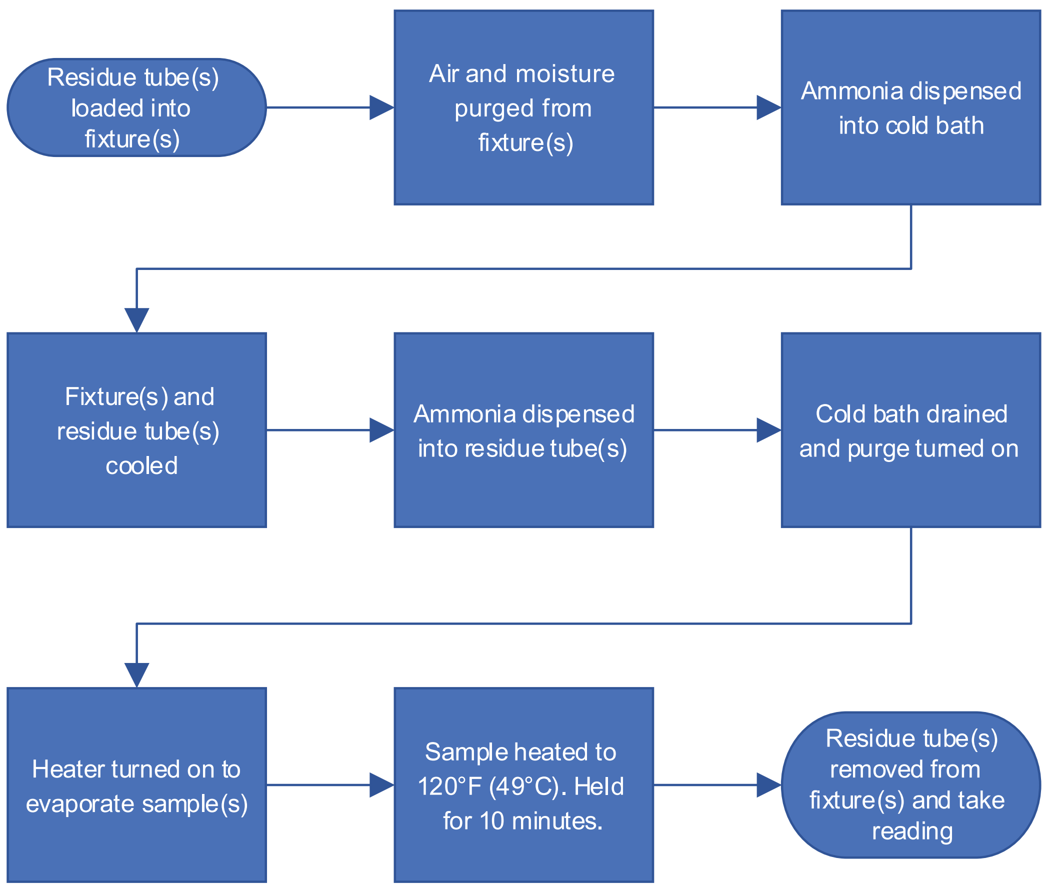


Figure 5 General Sampling Process

[1]These are default values that are user-configurable within the program.

Installation

Selecting a Sample Point in the User's System

Selecting an appropriate sample point is essential for successful sampling of liquid ammonia. There are several important considerations:

1. **Pressure –** For Swagelok ammonia samplers with dual fixtures, the maximum recommended inlet pressure is 233 psig (16.0 bar; 16.3 kg/cm^2; 1.60 MPa). For samplers with a single fixture, the maximum recommended inlet pressure is 59 psig (4.0 bar; 4.1 kg/cm^2; 0.41 MPa). For higher pressures, install a pressure-reducing regulator at the sampler's inlet.

   WARNING: Never plug, restrict, or install a shutoff valve on the sampler's drain connection. A blocked, restricted, or plugged drain can cause pressure in the fixture(s) to rise to dangerous levels.

2. **Temperature –** The Swagelok ammonia sampler is only intended to sample liquid ammonia. A mixed phase sample may lead to inaccurate results and unsatisfactory operation. An ideal sample point will be able to supply ammonia at a temperature below its atmospheric boiling point. Refer to Figure 6. The higher the temperature, the more likely it will be that the ammonia will flash to a gas as it is dispensed in the unpressurized sample fixture(s).

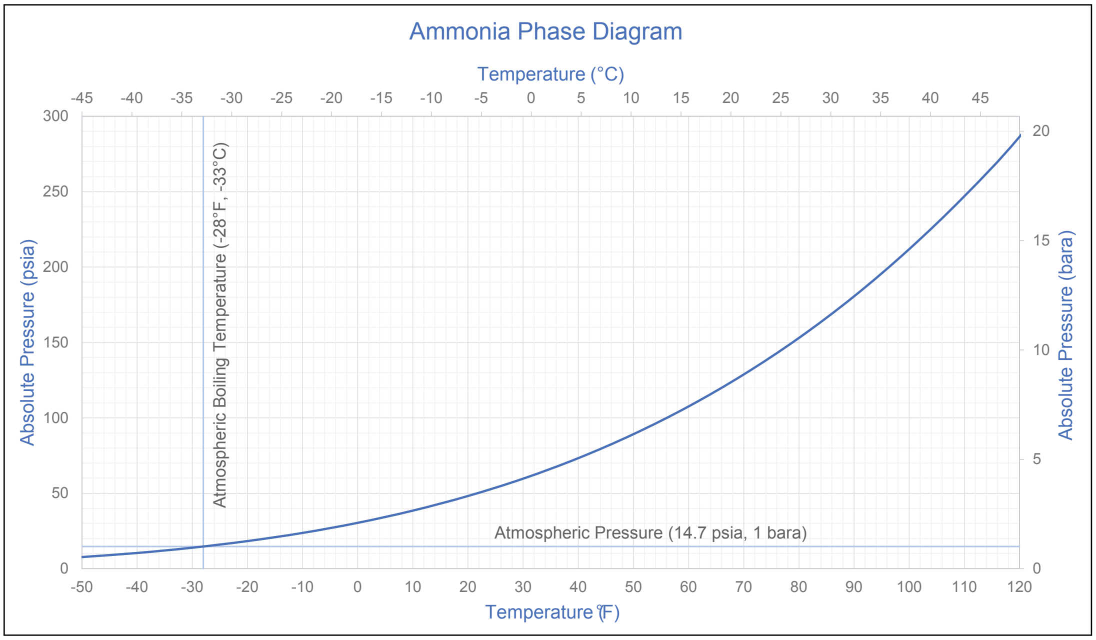


Figure 6 Ammonia Phase Diagram

3. **Distance –** The farther away the sampler is from the sample point, the more likely it is to warm up and change phase. It is recommended to install the sampler as close as practical to the sample tap and insulate the supply line to minimize temperature rise.

4. **Sample Tap, Return, and Drain –** If available, use of existing process connections may be most convenient. Where they are not already available, new connections may need to be installed. See **Ammonia Supply**, **Ammonia Return**, and **Ammonia Drain** under **Plumbing Connections** for appropriate selection criteria.

Mounting

The Swagelok ammonia sampler should be mounted to a rigid framework or wall capable of supporting its weight. The approximate weights of the different versions of the samplers are as follows:

- Single Fixture, 100 mL: 195 lb (88 kg)
- Dual Fixture, 100 mL: 220 lb (100 kg)
- Single Fixture, 250 mL: 205 lb (93 kg)
- Dual Fixture, 250 mL: 230 lb (104 kg)

The sampler should be mounted at a comfortable height to allow convenient viewing of the gauges, flowmeters, and residue tubes and to allow clearance for the door to open. However, it should not be mounted so high that it becomes difficult to load the residue tubes into the fixture. Figure 7 shows the gauges and flowmeters mounted at a height of approximately 60 in. (1.5 m).

CAUTION: Always take into consideration the height of the individuals who will be operating the sampler and determine the mounting height as necessary to maximize ergonomics.

NOTICE: Select a mounting location that does not expose the sampler to damage from the surrounding environment.

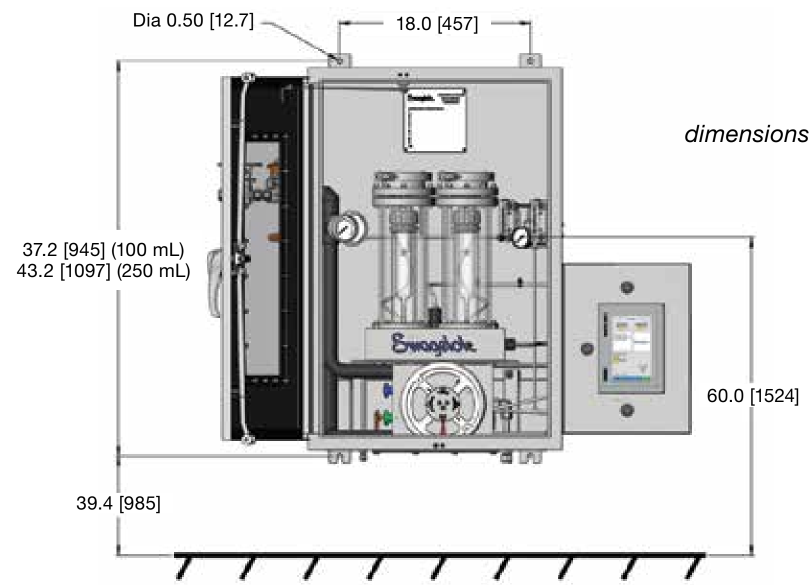


Figure 7 Swagelok Ammonia Sampler Mounting (not to scale)

Plumbing Connections

Refer to Figure 8 for connection port locations. Additionally, refer to *Swagelok® Tube Fitting Instructions*, MS-12-01, for instruction on how to properly assemble and reassemble Swagelok tube fittings.

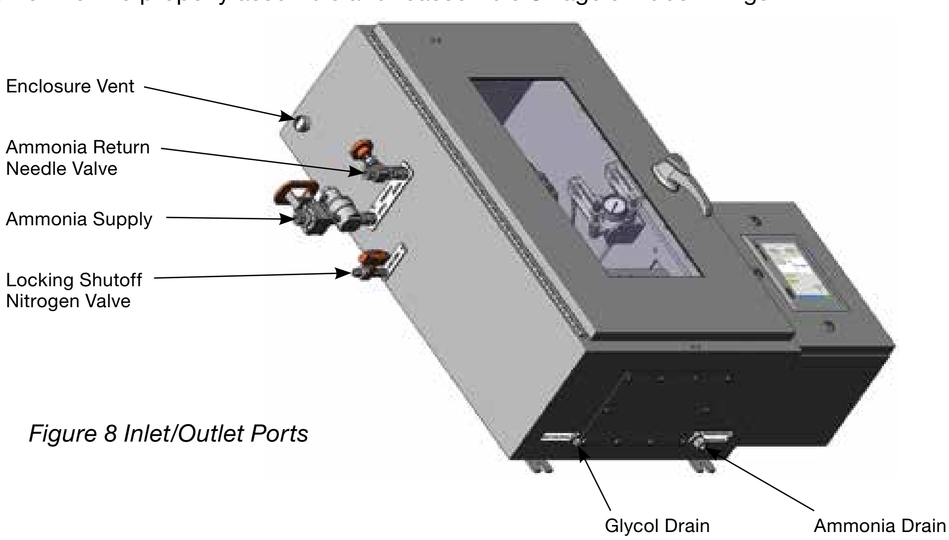


Figure 8 Inlet/Outlet Ports

Nitrogen

The Swagelok ammonia sampler uses nitrogen as a purge gas for the electrical and main enclosures and to purge the sample fixture(s). Note that the locking shutoff valve shown in Figure 8 is provided loose and will need to be assembled to the nitrogen inlet connection. This valve can be installed in any orientation.

The connection on the valve is a ¼ in. Swagelok tube fitting. For class 1 division 2 assemblies, connect a 50 to 500 psig (3.4 to 34.4 bar; 3.5 to 35 kg/cm^2; 0.34 to 3.4 MPa) clean, dry nitrogen supply to the valve inlet. For ATEX zone 2 assemblies, the inlet should be regulated to 90 to 100 psig (6.2 bar to 6.9 bar; 6.3 kg/cm^2 to 7 kg/cm^2; 0.62 MPa to 0.69 MPa).

NOTICE: It is recommended that the nitrogen enclosure purge should flow continuously in order to minimize ammonia ingress and corrosion of the electrical components in the control enclosure. The nitrogen supply and enclosure purge should only be shut off during installation and maintenance of the sampler.

WARNING: Because nitrogen is continuously flowing, installing the Swagelok ammonia sampler in an enclosed space may necessitate monitoring the surrounding oxygen levels to reduce the asphyxiation hazard.

Ammonia Supply

Note that the locking shutoff valve shown in Figure 8 is provided loose and will need to be assembled to the ammonia supply connection. This valve can be installed in any orientation. If ordered, the optional pressure-reducing regulator (not shown) may also be provided loose. This regulator should be installed between the inlet shutoff valve and the ammonia supply connection with the flow direction towards the enclosure. Connect the ammonia supply tubing to the valve inlet, which is a ½ in. Swagelok tube fitting.

For Swagelok ammonia samplers with dual fixtures, the maximum recommended inlet pressure is 233 psig (16.0 bar; 16.3 kg/cm^2; 1.60 MPa). For samplers with a single fixture, the maximum recommended inlet pressure is 59 psig (4.0 bar; 4.1 kg/cm^2; 0.41 MPa). For systems with higher pressures, install a pressure-reducing regulator between the shutoff valve and the sampler's inlet.

The minimum rated inlet temperature for the Swagelok ammonia sampler is –44°F (–42°C). The maximum recommended temperature is –28°F (–33°C), which is the atmospheric boiling point of ammonia. Higher temperature ammonia increases the risk of vaporizing as the ammonia is dispensed in the unpressurized sample fixture(s). For this reason, it is recommended to install the sampler **as close to the sample tap as practical and insulate the supply line** to minimize temperature rise.

Ammonia Return

The ammonia return connection is provided to allow ammonia to pass through the sampler and return to the process. This flow helps to ensure that a fresh sample is maintained at the sampler. Additionally, flowing ammonia through the sampler provides less opportunity for the ammonia to absorb heat in the supply line, which reduces the chance of the ammonia vaporizing.

Note that the needle valve shown in Figure 8 is provided loose and will need to be assembled to the ammonia return connection. It should be installed with the flow direction away from the enclosure. Connect tubing from the ½ in. Swagelok tube fitting valve outlet to a lower-pressure point in the process. Note that in order to ensure flow through the sampler, this return point must be at a lower pressure than the supply. When a pressure regulator is used on the supply, the return pressure must also be less than the outlet of the regulator.

Alternative Installation: For installations where there is no return to the process line, the ammonia return can be connected to a drain. In this case, it is recommended to only turn on the ammonia supply while actively sampling in order to avoid waste.

Ammonia Drain

The ammonia drain is an outlet from which the cold bath drains by gravity and through which the ammonia vapors and nitrogen purge exit the sampler. This drain, which is a ½ in. Swagelok tube fitting, should be connected to a drain or sewer that can accept liquid ammonia, gaseous ammonia, and the nitrogen purge. The maximum allowable back-pressure on the drain connection is 7.3 psig (0.50 bar; 0.51 kg/cm^2; 0.050 MPa). However, under normal circumstances, this pressure should be kept to 5 psig (0.34 bar; 0.35 kg/cm^2; 0.034 MPa) or less. The drain line should be sloped continuously from the sampler to the drain or sewer system.

WARNING: Never plug, restrict, or install a valve on the sampler's drain connection. A blocked, restricted, or plugged drain can cause pressure in the fixture(s) to rise to dangerous levels.

Alternative Installation: For situations where there is no suitable drain or sewer system to accept the liquid ammonia, the ammonia drain can be connected to an evaporation tank (not included) where the ammonia can be held until it evaporates. See Figure 9. This tank should be vented to a flare system. Where regulations and plant standards allow, the tank can be vented to atmosphere in a remote location away from personnel and sensitive equipment. The tank should be located below the sampler, with the drain line sloped downward from the sampler to the tank, allowing the liquid ammonia to drain via gravity.

The evaporation tank should be at least 1 gallon (4 liters) to allow the entire contents of the fixtures to drain. For installations where the ammonia return is tied into the drain, the tank should be large enough to accommodate 20 to 30 minutes of return flow. See **Ammonia Return Flow Valve** under **Initial Setup** to determining the flow rate and tank volume.

WARNING: For installations where the ammonia return flows into the evaporation tank, the ammonia supply will need to be turned on and off each time that a sample is taken to avoid overflowing the evaporation tank.

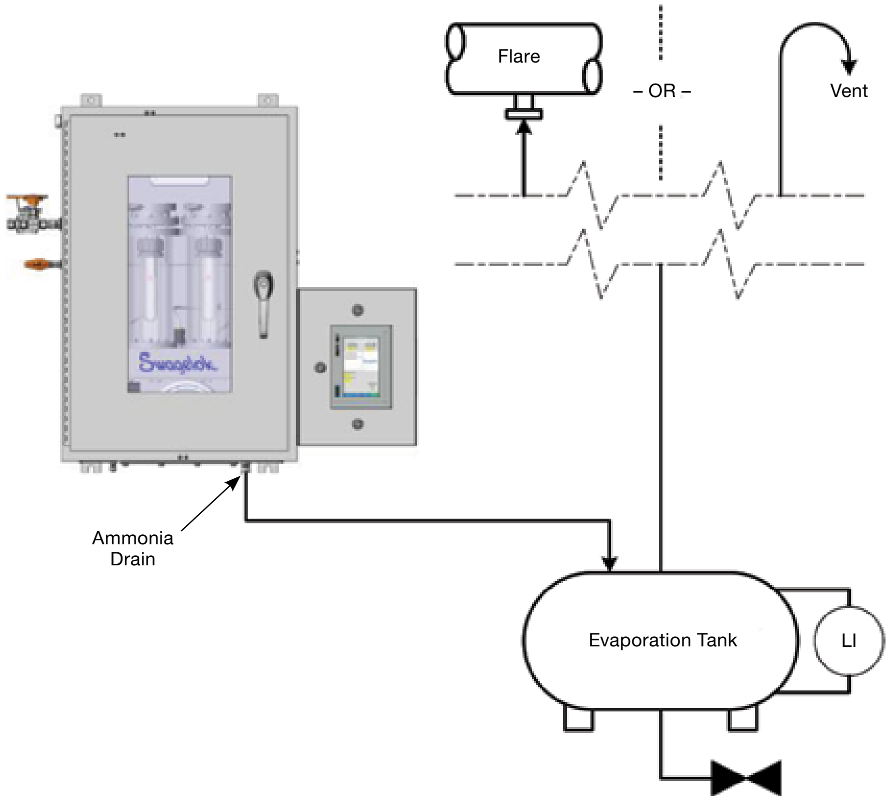


Figure 9 Evaporation Tank

Glycol Drain

The glycol drain is provided plugged and does not need to be connected to any external drain or disposal system, except during maintenance.

Electrical Connections

WARNING: This Swagelok ammonia sampler is designed to be installed in a potentially hazardous environment. Depending on the model that was ordered (see **Ordering Information**), the electrical components of the sampler are rated for either a North American Class 1, Division 2, or ATEX Zone 2 environment. Field connections to the sampler are the responsibility of the user and should be consistent with these standards.

Note that since all the components in the electrical enclosure are rated for the hazardous area, the provided purge is not required to meet the hazardous area classification. The purge is only provided for corrosion protection, as a means of keeping potentially corrosive ammonia vapors out of the electrical enclosure.

See **Electrical Schematics** for a complete electrical schematic.

Electrical Penetrations

The Swagelok ammonia sampler is provided without penetrations for the power and external signal connections. Guidelines for cable gland enclosure side entry positions are as follows:

- Do not put cable gland holes closer than 1.63 inches (41.4 mm) from any edge of enclosure wall or edge of gland plate enclosure opening
- Prior to putting holes in the enclosure wall or gland plate; verify that the selected cable gland will have sufficient clearance for the sealing washer and lock nut
- Maximum hole diameter is major thread diameter of cable gland plus 0.03 inches (0.7 mm)
- Minimum material maintained between M16 through M32 cable glands = 0.59 inches (15.0 mm)
- Minimum material maintained between M35 through M75 cable glands = 0.79 inches (20.0 mm)
- Minimum material maintained between M75 through M100 cable glands = 1.38 inches (35.0 mm)
- If a combination of cable gland sizes are to be installed, always maintain the larger cable gland minimum material distance between them

With ATEX samplers that use flexible cables and cable glands to connect the power and/or external signals, the cables must be clamped near the control enclosure. Devices such as a Cooper Capri® anchorage module or another device may be used.

NOTICE: When making the penetrations, be sure to protect the components inside the enclosure from damage and/or contamination.

External Bonding

For ATEX samplers, a 5/16-18 stud is provided on the right side of the control enclosure to facilitate external bonding. Use a wire/cable that is #11 AWG (4mm^2) minimum.

Power Connections

Depending on the model that was specified (see **Ordering Information**), the power requirements are as follows:

- 120 VAC, 1 Ø, 50 to 60Hz, 5.5 Amps
- 230 VAC, 1 Ø, 50 to 60Hz, 2.9 Amps

It is recommended that a disconnect (not included) be installed between the power source and the Swagelok ammonia sampler.

Connect the line, neutral, and ground wires to the terminal blocks as shown in Figure 10.

- Wires should be #20 AWG (0.5 mm^2) minimum to #12 AWG (4 mm^2) maximum
- Wires should be stripped 0.39 in. (10 mm)
- The recommended tightening torque is 9 in.·lb (1.0 N·m)

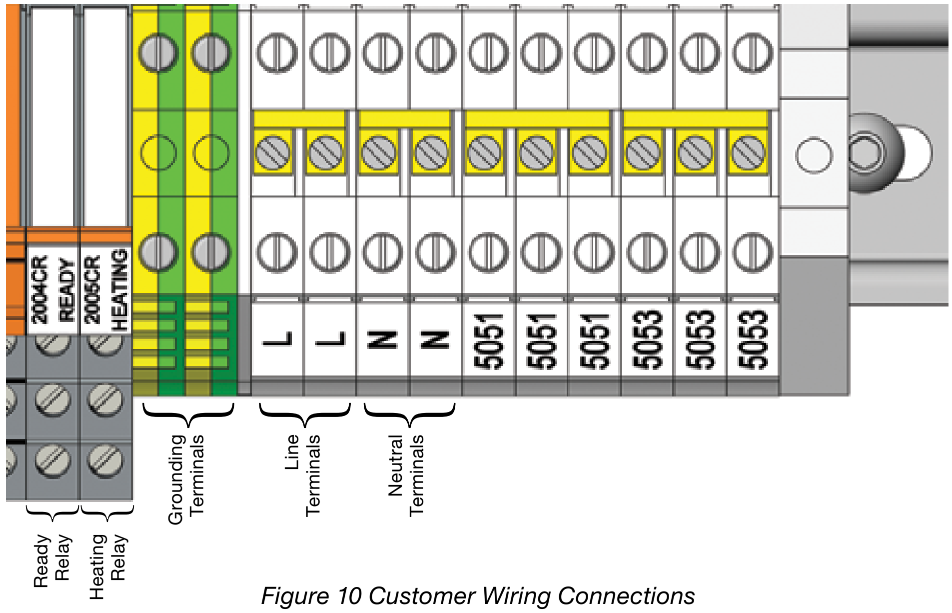


Figure 10 Customer Wiring Connections

Relay Outputs

The Swagelok ammonia sampler provides two relay outputs to indicate the current state within the sampling process. See **Theory of Operation** for an overview of the process. See the voltage and current ratings on page "Specifications Summary" on page 42.

- Heating Relay – The heater is currently on and is evaporating the sample
- Ready Relay – The cycle is complete, and the sample reading can be taken

Connect signal wires to the relay terminals 11 and 14 as shown in Figures 10 and 11.

- Signal wires should be #26 AWG (0.14 mm^2) minimum to #14 AWG (2.5 mm^2) maximum
- Wires should be stripped 0.20 in. (5.1 mm) to 0.31 in. (8.0 mm)
- The recommended maximum tightening torque is 5.3 in.·lb (0.6 N·m) to 7.0 in.·lb (0.8 N·m)

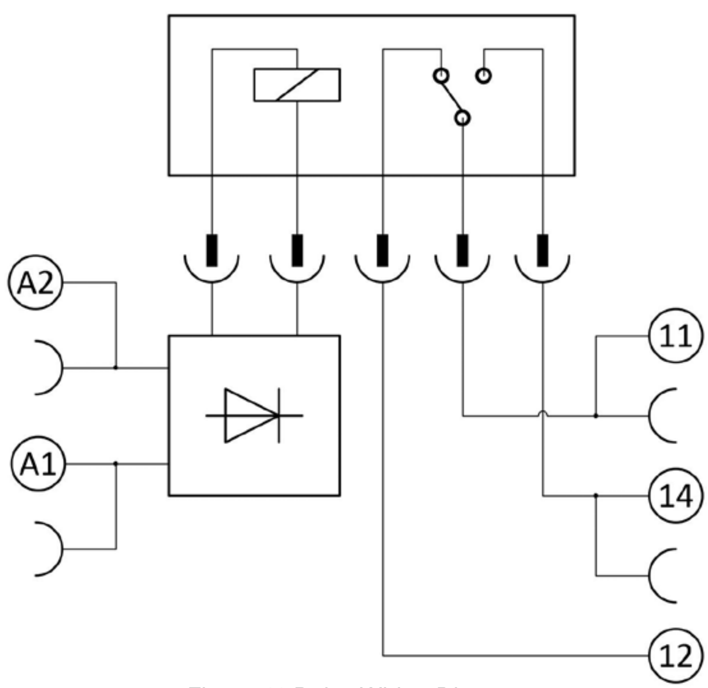


Figure 11 Relay Wiring Diagram

Initial Setup

Pressures, flows, and other settings outlined in this section should only need to be set during initial commissioning. Thereafter, they should only be adjusted as necessary to accommodate process changes or during maintenance. As an extra precaution, valve handles may be removed after initial setup to limit accidental adjustment or tampering.

Adjusting Fill Levels, Pressures, and Flowrates

Reference Figure 12 for the location of regulators, valves, and flowmeters used to control and monitor fluid flow in the Swagelok ammonia sampler.

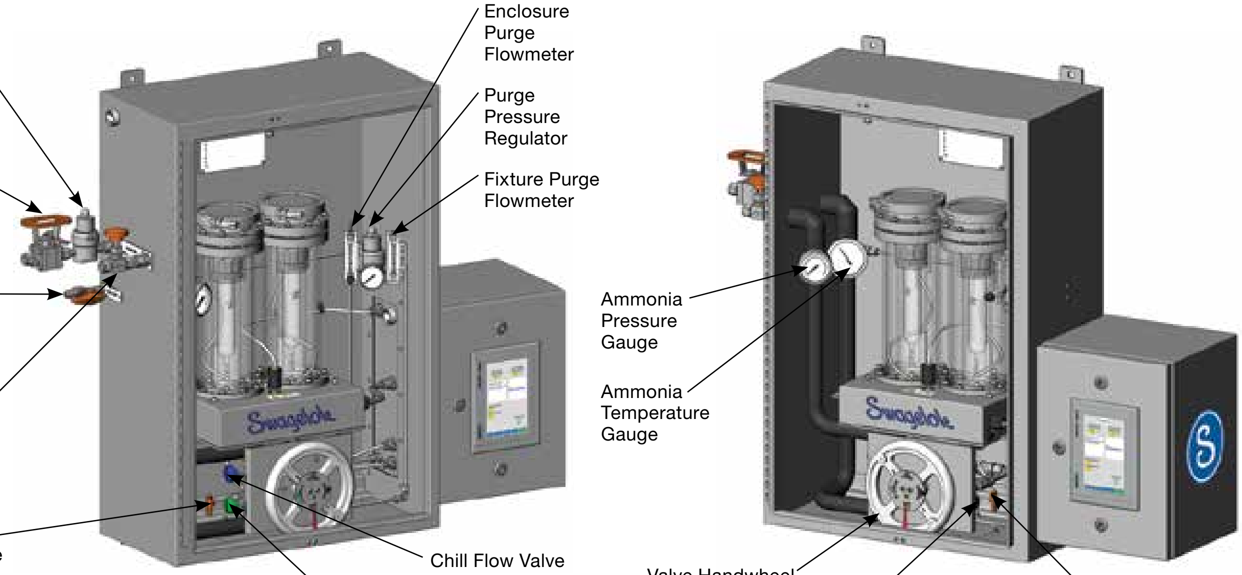


Figure 12 Setup Controls (Door Hidden for Clarity)

Purge Pressure and Enclosure Purge

The purge pressure and enclosure purge should be set at the same time because changing one setting will impact the other.

1. Open the **nitrogen supply valve**.
2. Close the **fixture purge valve** by turning it fully clockwise.
3. Close the valve on the **enclosure purge flowmeter** by turning it fully clockwise.
4. Adjust the **purge pressure regulator** to 20 psig (1.3 bar; 1.4 kg/cm^2; 0.13 MPa) by removing its antitamper (dome-shaped) nut and rotating the stem clockwise.
5. Adjust the valve on the **enclosure purge flowmeter** to set the flow to 3 slpm.
6. If the regulator's outlet pressure changes, adjust the regulator back to 20 psig (1.3 bar; 1.4 kg/cm^2; 0.13 MPa).
7. Repeat Steps 5 and 6 until the pressure and flow are stable at 20 psig (1.3 bar; 1.4 kg/cm^2; 0.13 MPa) and 3 slpm, respectively.
8. Replace and tighten the regulator's antitamper nut. Verify regulator setting has not changed.

Fixture Purge

The purge pressure and enclosure purge flowrate should be set prior to setting the fixture purge flowrate. See **Purge Pressure and Enclosure Purge** under **Initial Setup**.

1. Open the nitrogen supply valve.
2. Rotate the valve handwheel clockwise to the PURGE position.
3. Adjust the fixture purge valve (black handle) until the fixture purge flowmeter reads the appropriate flowrate:
   - Single-Fixture Samplers: 1.5 slpm
   - Dual-Fixture Samplers: 3 slpm
4. Rotate the valve handwheel counterclockwise to the OFF position.

Ammonia Pressure

For high-pressure ammonia sample points, a pressure-reducing regulator can be used. Some Swagelok ammonia samplers are provided with this regulator and the below procedure details how to adjust it. For field installation of a different regulator, refer to the manufacturer's instructions.

1. Open the ammonia supply valve.
2. Open the ammonia return flow valve ½-turn.
3. Adjust the ammonia pressure regulator to 40 psig (2.8 bar; 2.8 kg/cm^2; 0.28 MPa) by removing its antitamper (dome-shaped) nut and rotating the stem clockwise.

   NOTICE: Where the sample is being returned to a point in the process with higher pressure, this regulator setpoint can be adjusted higher as necessary. For Swagelok ammonia samplers with dual fixtures, the maximum recommended inlet pressure is 233 psig (16.0 bar; 16.3 kg/cm^2; 1.60 MPa). For samplers with a single fixture, the maximum recommended inlet pressure is 59 psig (4.0 bar; 4.1 kg/cm^2; 0.41 MPa).
4. Replace and tighten the regulator's antitamper nut.

Ammonia Return Flow

The intent of the ammonia return flow is to help to ensure that a fresh sample is maintained at the sampler. Additionally, flowing ammonia through the sampler provides less opportunity for the ammonia to absorb heat in the supply line, which reduces the chance of the ammonia flashing to a gas in the lines.

For these reasons, the goal is to get the ammonia from the sample point to the Swagelok ammonia sampler in 1 minute or less. This transportation time is a function of the flowrate and the internal volume of the tubing between the sample point and the Swagelok ammonia sampler. While this exact flowrate is not critical to the process, it is important to set an approximate flowrate.

1. Determine the length of tubing between the sample point and the Swagelok ammonia sampler.
2. Use Table 1 to determine the internal volume per length of tubing.
3. Calculate the total internal volume by multiplying the total length of tubing by the volume per length. Since the goal is to transport the sample from the sample point to the sampler in 1 minute, this internal volume is also the target flow per minute.

Tubing Internal Volume										
	in.						mm			
Tubing Size	3/8 × 0.035	3/8 × 0.049	3/8 × 0.065	1/2 × 0.049	1/2 × 0.065	1/2 × 0.085	10 × 1.0	10 × 1.5	12 × 1.0	12 × 1.5
L/ft	0.014	0.012	0.009	0.029	0.025	0.021	0.015	0.012	0.024	0.019
L/m	0.047	0.039	0.030	0.094	0.082	0.069	0.050	0.038	0.079	0.064

Table 1 Tubing Internal Volume

4. Open the ammonia return flow valve ⅛-turn and note the ammonia pressure as shown on the ammonia pressure gauge.
5. Determine the pressure at the point where the ammonia is returned to the process (or drain).
6. Calculate the differential pressure by subtracting the pressure at the process return (or drain) from the pressure shown on the ammonia pressure gauge.
7. Based on the differential pressure and the target flow rate, use Table 2 to identify the approximate number of turns to open the ammonia return flow valve. Interpolate as necessary.

Ammonia Return Flow, L/min											
Differential Pressure				**Ammonia Return Valve – Turns Open**							
psig	**bar**	**kg/cm^2**	**MPa**	**1/16**	**1/8**	**1/4**	**1/2**	**3/4**	**1**	**1 1/2**	**2**
5	0.34	0.35	0.03	0.03	0.06	0.13	0.26	0.38	0.51	0.77	1.02
10	0.68	0.70	0.07	0.05	0.09	0.18	0.36	0.54	0.72	1.09	1.45
20	1.3	1.4	0.13	0.06	0.13	0.26	0.51	0.77	1.02	1.54	2.05
40	2.7	2.8	0.27	0.09	0.18	0.36	0.72	1.09	1.45	2.17	2.90
60	4.1	4.2	0.41	0.11	0.22	0.44	0.89	1.33	1.78	2.66	3.55
80	5.5	5.6	0.55	0.13	0.26	0.51	1.02	1.54	2.05	3.07	4.10
100	6.8	7.0	0.68	0.14	0.29	0.57	1.15	1.72	2.29	3.44	4.58
120	8.2	8.4	0.82	0.16	0.31	0.63	1.26	1.88	2.51	3.77	5.02
140	9.6	9.8	0.96	0.17	0.34	0.68	1.36	2.03	2.71	4.07	5.42
160	11.0	11.2	1.10	0.18	0.36	0.72	1.45	2.17	2.90	4.35	5.80
180	12.4	12.6	1.24	0.19	0.38	0.77	1.54	2.31	3.07	4.61	6.15
200	13.7	14.0	1.37	0.20	0.41	0.81	1.62	2.43	3.24	4.86	6.48
220	15.1	15.4	1.51	0.21	0.42	0.85	1.70	2.55	3.40	5.10	6.80
240	16.5	16.8	1.65	0.22	0.44	0.89	1.75	2.66	3.55	5.33	7.10

Table 2 Ammonia Return Flow – Differential Pressure vs. Valve Turns Open

8. From the closed position (fully clockwise), open the ammonia return flow valve by this number of turns to set the approximate flowrate.

Example:

- Tubing between sample point and sampler: ½ in. × 0.049 in., 25 ft long
- From Table 1, the volume per foot is determined to be 0.029 L/ft

  – 0.029 L/ft × 25 ft = 0.73 liters and therefore 0.73 L/min flowrate required
- Ammonia pressure (as shown on ammonia pressure gauge): 50 psig (3.4 bar; 3.5 kg/cm^2; 0.34 MPa)
- Process pressure at ammonia return point: 10 psig (0.68 bar; 0.70 kg/cm^2; 0.068 MPa)

  – Differential pressure = 50 psig – 10 psig = 40 psig
- Referring to Table 2, in the line for 40 psig, ½-turn open should result in a flow of 0.72 lpm, which is acceptable. The ammonia return flow valve will be opened ½-turn to approximately achieve the desired flow.

Chill Flow

The flow of ammonia into the cold bath(s) should be as high as possible without causing excessive spraying within the fixture. A typical target flowrate for filling the cold bath(s) is as follows:

- Single-Fixture Samplers: 0.5 L/min
- Dual-Fixture Samplers: 1.0 L/min

This flow rate can be set by opening the chill flow valve (blue handle) a specific number of turns.

1. Note the ammonia pressure as shown on the ammonia pressure gauge.
2. Based on this pressure, use Table 3 to identify the appropriate number of turns to open the chill flow valve. Interpolate as necessary.

Ammonia Chill Flow, L/min											
Ammonia Pressure				**Chill Valve – Turns Open**							
PSI	**Bar**	**Kg/cm²**	**MPa**	**1/16**	**1/8**	**1/4**	**1/2**	**1**	**2**	**5**	**8**
5	0.34	0.35	0.03	0.09	0.17	0.32	0.38	0.49	0.68	1.10	2.10
10	0.68	0.70	0.07	0.13	0.24	0.45	0.54	0.69	0.95	1.60	2.90
20	1.3	1.4	0.13	0.18	0.34	0.63	0.76	0.98	1.40	2.20	–
40	2.7	2.8	0.27	0.26	0.49	0.89	1.10	1.40	1.90	–	–
60	4.1	4.2	0.41	0.32	0.59	1.10	1.30	1.70	2.30	–	–
80	5.5	5.6	0.55	0.37	0.69	1.30	1.50	2.00	2.70	–	–
100	6.8	7.0	0.68	0.41	0.77	1.40	1.70	2.20	3.00	–	–
120	8.2	8.4	0.82	0.45	0.84	1.50	1.90	2.40	–	–	–
140	9.6	9.8	0.96	0.48	0.91	1.70	2.00	2.60	–	–	–
160	11.0	11.2	1.10	0.52	0.97	1.80	2.10	2.80	–	–	–
180	12.4	12.6	1.24	0.55	1.00	1.90	2.30	2.90	–	–	–
200	13.7	14.0	1.37	0.58	1.10	2.00	2.40	–	–	–	–
220	15.1	15.4	1.51	0.61	1.10	2.10	2.50	–	–	–	–
240	16.5	16.8	1.65	0.63	1.20	2.20	2.60	–	–	–	–

Table 3 Ammonia Chill Flow – Ammonia Pressure vs. Valve Turns Open

3. From the closed position (fully clockwise) open the chill flow valve by this number of turns to set the approximate flowrate.

Example:

- Dual-Fixture Sampler:
  - Target flow rate = 1.0 L/m
- Ammonia pressure (in sampling cabinet): 40 psig (2.7 bar; 2.8 kg/cm²; 0.28 MPa)
- Referring to Table 3:
  - ¼-turn = 0.89 L/m
  - ½-turn = 1.1 L/m
- The blue chill flow valve should be opened approximately ⅜-turn to achieve the 1.0 L/m flow rate

Sample Flow

The flow of ammonia into the residue tube(s) should be set at a flowrate that allows the tube(s) to be filled in a reasonable amount of time without excessive bubbling/splashing while filling. A typical target flowrate for filling the residue tube(s) is as follows:

- Single-Fixture Samplers: 10 mL/s
- Dual-Fixture Samplers: 20 mL/s

This flow rate can be set by opening the sample flow valve (green handle) a specific number of turns.

1. Note the ammonia pressure as shown on the ammonia pressure gauge.
2. Based on this pressure, use Table 4 to identify the appropriate number of turns to open the sample flow valve Interpolate as necessary.

Ammonia Sample Flow, mL/s											
Ammonia Pressure				**Sample Valve – Turns Open**							
PSI	**Bar**	**Kg/cm²**	**MPa**	**1/16**	**1/8**	**1/4**	**1/2**	**1**	**2**	**5**	**8**
5	0.34	0.35	0.03	1.7	3.3	5.1	5.5	6.9	9.6	13	30
10	0.68	0.70	0.07	2.5	4.7	7.2	7.8	9.7	14	19	42
20	1.3	1.4	0.13	3.5	6.6	10	11	14	19	27	–
40	2.7	2.8	0.27	4.9	9.4	14	16	19	27	38	–
60	4.1	4.2	0.41	6.0	12	18	19	24	33	46	–
80	5.5	5.6	0.55	7.0	13	21	22	27	38	–	–
100	6.8	7.0	0.68	7.8	15	23	25	31	43	–	–
120	8.2	8.4	0.82	8.5	16	25	27	34	47	–	–
140	9.6	9.8	0.96	9.2	18	27	29	36	–	–	–
160	11.0	11.2	1.10	9.8	19	29	31	39	–	–	–
180	12.4	12.6	1.24	10	20	31	33	41	–	–	–
200	13.7	14.0	1.37	11	21	32	35	43	–	–	–
220	15.1	15.4	1.51	12	22	34	37	46	–	–	–
240	16.5	16.8	1.65	12	22	36	38	49	–	–	–

Table 4 Ammonia Sample Flow Ammonia Pressure vs. Valve Turns Open

3. From the closed position (fully clockwise) open the sample flow valve by this number of turns to set the approximate flowrate.

Example:

- Single-Fixture Sampler:
  - Target flow rate = 10 mL/s
- Ammonia pressure (in sampling cabinet): 40 psig (2.7bar; 2.8 kg/cm²; 0.28 MPa)
- Referring to Table 4:
  - ⅛-turn = 9.4 mL/s
  - ¼-turn = 14 mL/s
- The green sample flow valve should be opened slightly more than ⅛-turn to achieve the 10 mL/s flow rate

Glycol

Within each fixture, the section inside the bottom of the 2 in. glass pipe should be filled with a heat transfer fluid. Propylene glycol or a glycol/water mix is the most commonly available fluid, though others can be used if they are compatible with the **glass pipe**, **residue tube**, EPDM **gasket**, aluminum **heated block**, and if they have a sufficiently low freezing point.

With the **residue tube(s)** installed, the level of the **glycol** should be filled approximately to the level indicated in Figure 13 (dashed line).

Use a funnel or hose to pour **glycol** into the fixture, periodically inserting the **residue tube(s)** to check the level. If overfilled or contaminated, **glycol** can be drained by removing the plug in the glycol drain on the bottom of the enclosure and allowing glycol to drain.

The approximate capacity of the **glycol** in the Swagelok ammonia sampler is as follows:

- Single-Fixture: 250 mL
- Dual-Fixture: 450 mL

NOTICE: For samplers with dual fixtures, the **glycol baths** of the two fixtures are ported together in the **heated aluminum block**. When checking the level of **glycol**, verify that a **residue tube** is installed in each fixture.

NOTICE: If underfilled, there might be less-than-expected heat transfer between the **cold bath(s)**, **residue tube(s)**, and **heated aluminum block**.

NOTICE: If overfilled, there will be additional **glycol** in the system that will slightly slow down the process. Additionally, the resulting buoyant forces might cause the **residue tube(s)** to float in the fixture(s).

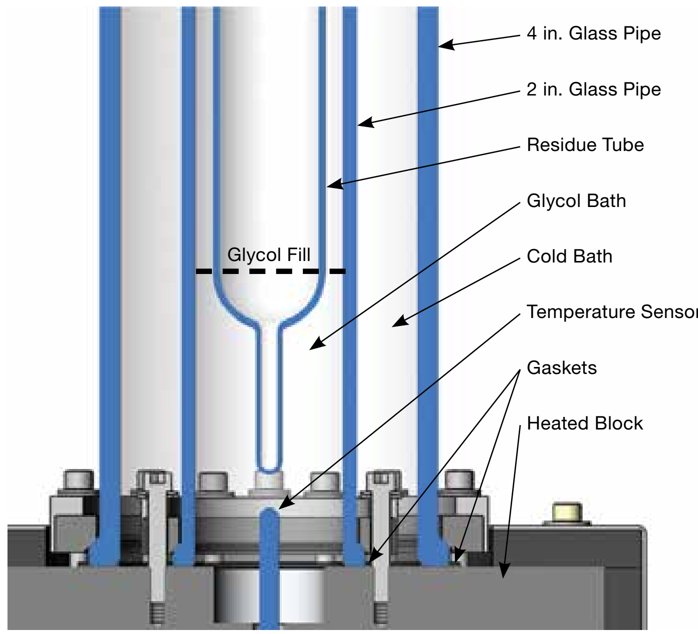


Figure 13 Glycol Fill Level

Isolating Left/Right Fixture (Dual-Fixture Samplers)

With dual-fixture samplers, it is possible to take a single sample, using only one of the two fixtures. To turn off the flow of ammonia to the residue tube in the left or right fixtures, use the left fixture shutoff valve or right fixture shutoff valve. These are the orange-handled valves to the right/left of the valve handwheel. When the handle is horizontal, the fixture will be isolated.

Note that these valves do not stop the flow of ammonia into the cold baths, nor do they isolate the glycol baths of the two fixtures. The cold baths and glycol baths of the left/right fixtures are internally ported and cannot be isolated from one another.

CAUTION: Because the cold baths of the left and right fixtures cannot be isolated from each other, it is important to make sure both fixtures are closed prior to taking a sample, even if only one fixture is being used.

It is recommended that residue tubes be loaded into both fixtures, even if only one will be used. Because the glycol baths are connected together, loading only one residue tube will change the displacement of glycol and impact how far the residue tube is submerged. If only one residue tube is available, the glycol level may need to be adjusted (see **Glycol** under **Initial Setup**) to ensure proper submersion.

Program Screens

Main Program Screen

The main program screen (Figure 14) displays the current status of the sampler, provides instructions, etc.

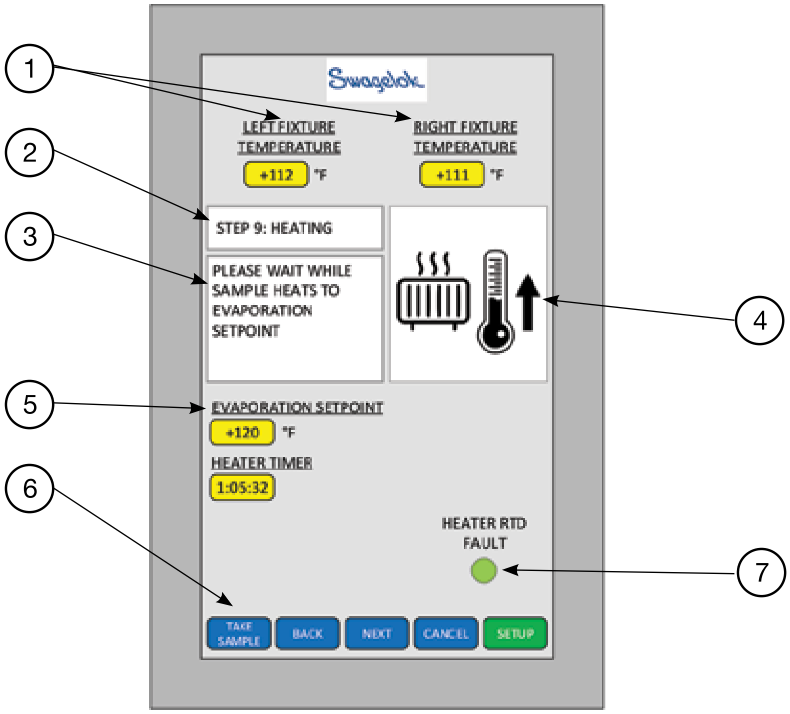


Figure 14 Main Program Screen

1. **Fixture Temperature(s) –** The temperature of each fixture is displayed at the top of the screen.
2. **Caption –** The caption will display the name of the current step in the sampling process.
3. **Instructions –** Detailed instructions and notifications will appear in this box.
4. **Image –** An image illustrating the current step in the process is displayed next to the caption and instructions.
5. **Data –** Various data and statistics are displayed below the instructions. Depending on the step in the sampling process, this might include setpoints, timers, and temperatures. When the sampler is idle, this section will display statistics from the previous sampling cycle.
6. **Buttons –** Buttons are provided to navigate through the sampling process and access the setup screen. Note that not all buttons are shown at the same time. Only applicable buttons are shown at each step of the sampling process.
   - TAKE SAMPLE – Initiates the sampling process
   - BACK – Goes back to the previous step in the sampling process
   - NEXT – Advances to the next step in the sampling process
   - CANCEL – Aborts the current sampling process
   - DONE (not shown) – Ends the sampling process after the final step in the sampling process
   - SETUP – Navigates to the setup screen
7. **Fault Indicator –** This indicator turns from green to red if there is a fault detected with the heater control resistance temperature detector (RTD). The RTD is on the top of the fixture block. A fault is triggered if the RTD signal is lost or if the RTD reads a temperature outside of the normal range, –76°F to 176°F (–60°C to 80°C). This fault resets itself once the RTD signal is within the normal range.

Setup Program Screen

From the setup program screen (Figure 15), the user can adjust setpoints and other aspects of the sampler's function and display. The setpoints can be adjusted by pressing the yellow setpoint field and typing in a new value. See **Program Setup** for details about each parameter. Press the MAIN button to return to the main screen.

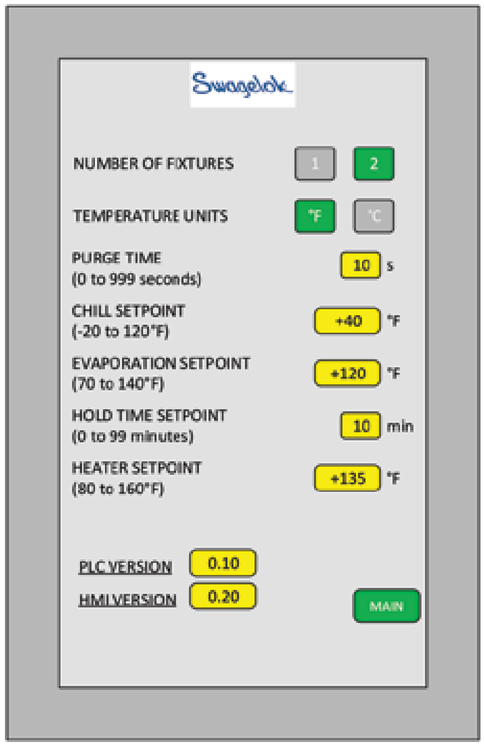


Figure 15 Setup Program Screen

Program Setup

The operational parameters of the program can be adjusted as necessary to fine-tune or customize the sampling process. To change these parameters, from the main screen press the SETUP button.

If the user-entered value is below the noted lower limit, the setpoint will revert to the lower limit. Likewise, if the user-entered value is above the upper limit, the setpoint will revert to the upper limit. These operational parameters will be factory-set to the noted default values based on the model configuration.

Number of Fixtures

Select either 1 or 2 to specify the number of fixtures in the sampler. This will be factory-set based on the configuration of the sampler.

NOTE: For samplers with dual fixtures, if 1 is selected, only the temperature of the left-side fixture will be monitored and displayed. The temperature of the right-side fixture will be ignored.

Temperature Units

Select either °F or °C to change the display of temperature units on the various program screens. This will be factory-set to match the units on the ammonia temperature gauge in the main sampling cabinet.

Purge Time Setpoint

The purge time setpoint defines the amount of time for which the sample fixture(s) will be purged at the start of the cycle. The intent is to remove air and moisture from the residue tube(s) prior to sampling. This duration is a function of the fixture purge flowrate and the total volume of the residue tube(s). The purge time should be long enough to allow the volume of the residue tubes to be exchanged 3 times to effectively remove the air and moisture from the residue tubes.

- The default value for a sampler with a 100 mL sample size is 20 seconds
- The default value for a sampler with a 250 mL sample size is 40 seconds
- The valid range for the purge time is 0 to 999 seconds

Chill Setpoint

The chill setpoint is the temperature to which the fixture will be cooled down during the chill step in the sampling process. When stepping through the sampling process, the fixture must be cooled to this temperature prior to dispensing the sample.

- The default value is 40°F (4°C)
- The valid range for this value is –20°F (–28°C) to 120°F (48°C)

Evaporation Setpoint

The evaporation setpoint is the temperature to which the sample will be heated during the heating step in the sampling process. When the heater is turned on, it will stay on until the fixture(s) reaches the evaporation setpoint. It will then be maintained at this temperature for an amount of time as defined by the hold time setpoint. Note that this temperature may be defined by plant standards and/or local regulations.

- The default value is 120°F (48°C)
- The valid range for this value is 70°F (20°C) to 140°F (60°C)
- The tolerance on this value is ± 2°F (± 1°C) and cannot be changed
- The evaporation setpoint **must** be set higher than the chill setpoint

Hold Time Setpoint

The hold time setpoint defines the amount of time for which the sample will be held at temperature, after the sampler heats to the evaporation setpoint. Note that this hold time may be defined by plant standards and/or local regulations.

- The default value is 10 minutes
- The valid range for this value is 0 to 99 minutes

Heater Setpoint

The heater setpoint is the temperature that the heater will maintain in order to heat the fixtures. The higher the temperature, the faster the fixtures will heat, but heating the fixtures too quickly can cause some amount of water to be evaporated with the sample. Additionally, heating too quickly can cause the fixtures to overshoot the evaporation setpoint.

Setting the heater setpoint 15°F (8°C) higher than the evaporation setpoint is appropriate in most situations. However, in colder climates or where a higher evaporation setpoint is used, it may be necessary to set the heater setpoint higher relative to the evaporation setpoint. Likewise, in warmer climates or when using a lower evaporation setpoint, it may be necessary to set the heater setpoint closer to the evaporation setpoint.

- The default value is 135°F (57°C)
- The valid range for this value is 80°F (26°C) to 160°F (71°C)
- The hysteresis on this value is ± 5°F (± 2.7°C) and cannot be changed
- The heater setpoint **must** be set higher than the evaporation setpoint

Operation

Attaching Cap Assembly to Residue Tube

CAUTION: The stem of the residue tube is fragile. Handle with care to avoid breaking it.

Each residue tube must be fitted with a cap assembly that seals to the top of the tube. This provides for the controlled filling operation described in **Theory of Operation**. Figure 16 shows a cross-sectional view of this cap assembly.

To install the **cap assembly** onto the residue tube:

1. Slide the **retainer** onto the **residue tube** with the threads facing the open end.
2. Insert the open end of the **residue tube** and **retainer** into the cap.
3. Rotate the cap so that the **overflow tube** is on the side of the **residue tube** near the graduation mark.
4. Tighten the retainer with light hand pressure.
5. Loosen the **overflow tube fitting** by turning the knurled nut counterclockwise (Figure 17).
6. Adjust the **overflow tube** up/down to align the tip of the tube with the graduation line on the **residue tube**. See Figure 18.
7. Tighten the **overflow tube fitting** by turning the knurled nut clockwise to finger-tight.

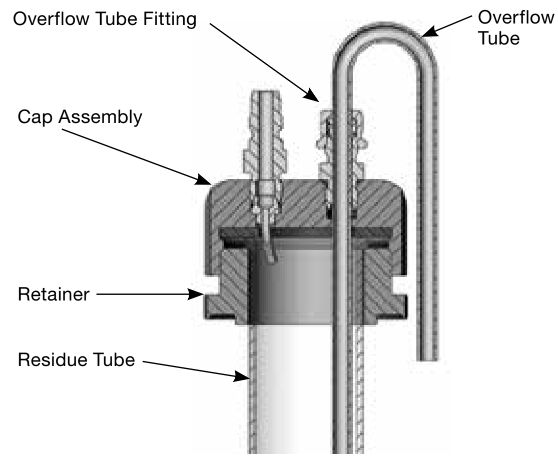


Figure 16 Residue Tube Cross-Section

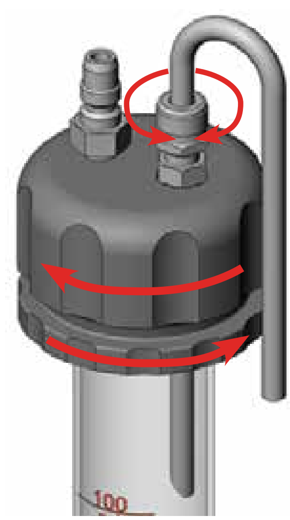


Figure 17 Residue Tube Cap Assembly

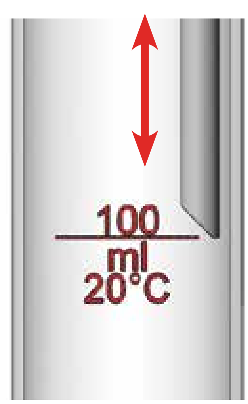


Figure 18 Overflow Tube Adjustment

To remove the cap assembly from the residue tube, hold the cap in one hand and loosen the retainer by turning it counterclockwise.

Installing Residue Tube Into Fixture

CAUTION: The residue tube is fragile. Handle with care to avoid breaking it.

After the cap assembly is assembled to the residue tube, the tube can be installed into the sample fixture. For samplers with dual fixtures, repeat for each fixture.

1. Verify the **cap assembly** has been assembled to the **residue tube**. See **Attaching Cap Assembly to Residue Tube** under **Operation**.
2. Verify that the valve handwheel is in the OFF position and that there is no ammonia present in the fixture. Purge out any ammonia vapors as necessary by turning the handwheel clockwise to the PURGE position and then returning to the OFF position when complete.

   WARNING: Open the cap only after confirming that all ammonia has been evaporated or drained and purged from the fixture to avoid operator exposure.
3. Remove the clamp at the top of the fixture by loosening the thumb screw counterclockwise and rotating the clamp segments.
4. Remove the cap and gasket and place them aside. Note that sometimes the cap can stick in place over time due to residue buildup and/or lack of lubrication. If the cap sticks in place, it can be gently pried loose with a screwdriver or other tool.

   NOTICE: To avoid leaks, take care not to scratch the cap or mating kwik-clamp ferrule.
5. Pull out the quick-connect/hose assembly and hook it over the edge of the sanitary ferrule so that it is out of the way, as shown in Figure 19.
6. As shown in Figure 19, pivot the residue tube into the fixture and insert it into the 2 in. glass pipe. The bottom of the retainer should rest on the top of the 2 in. glass pipe, and the residue tube should be approximately centered.
7. Rotate the residue tube so that the graduations are facing the operator.
8. Couple the quick-connect/hose assembly to the quick-connect stem on the cap assembly. Verify that the hose is not kinked and hangs loosely in space between the 4 in. and 2 in. glass pipes.
9. Lubricate the gasket as necessary with a compatible lubricant to avoid sticking. Reinstall gasket and cap to top of fixture.
10. Install the clamp and tighten the thumbscrew with moderate hand pressure to approximately 25 in.·lb (2.8 N·m). The orientation of the clamp is not critical.

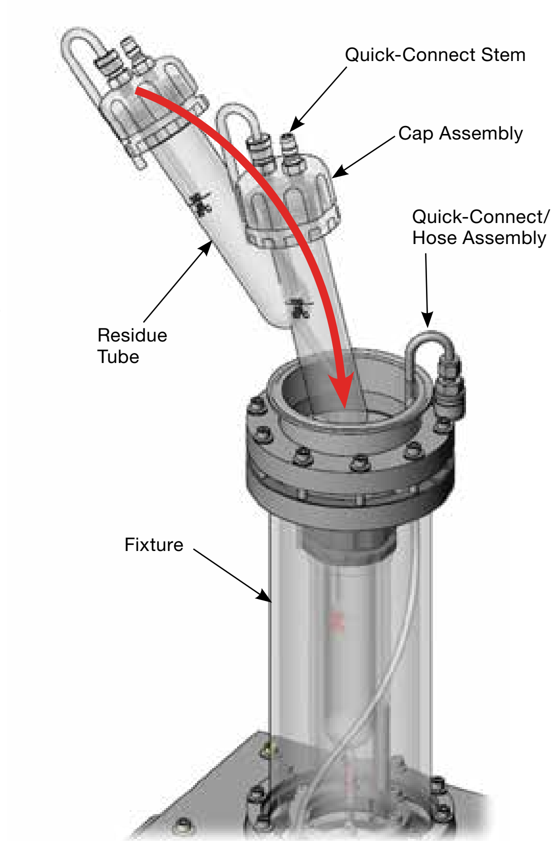


Figure 19 Pivoting Residue Tube Into Fixture

WARNING: Failure to properly close and clamp the cap in place could result in ammonia leaks and operator exposure.

Taking a Sample

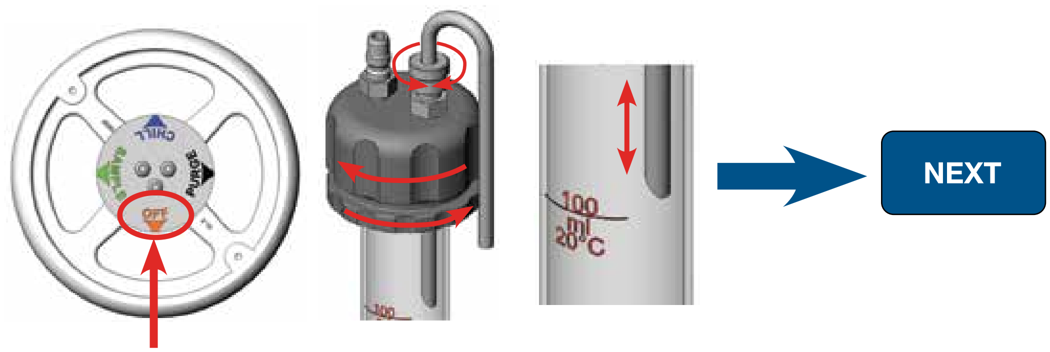
Use the following instructions to take an ammonia sample and evaporate it. This procedure applies to both single-fixture and dual-fixture samplers.

NOTICE: It is important to turn the valve handwheel in the specified direction to avoid sample contamination.

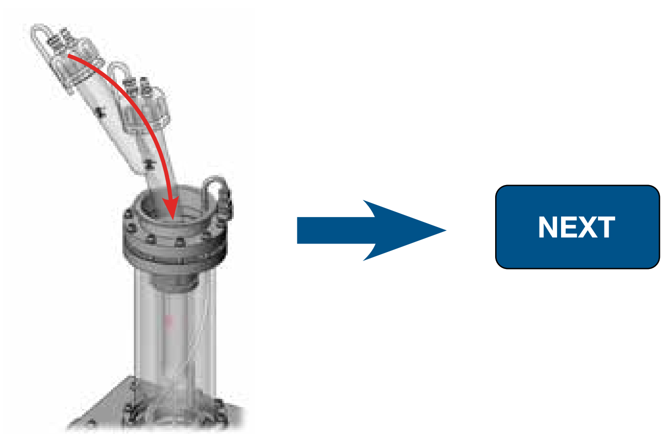
Prior to beginning, ensure that the ammonia supply is turned on and flowing.

In all cases, begin the sampling procedure by pressing the TAKE SAMPLE button on the sampler's main screen. Follow along with the on-screen instructions, which are reflected below. Press the NEXT button to go from step to step.

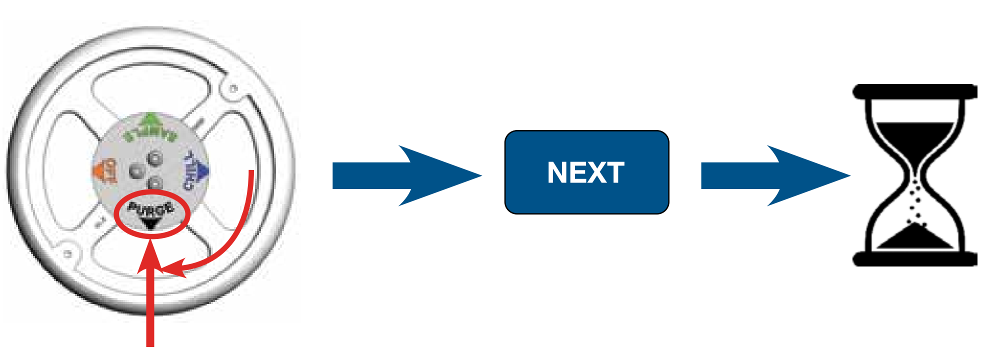
1. With the valve handwheel in the OFF position, install a cap assembly onto the residue tube(s). See **Attaching Cap Assembly to Residue Tube** under **Operation** for details. Once installed, press NEXT on the screen.



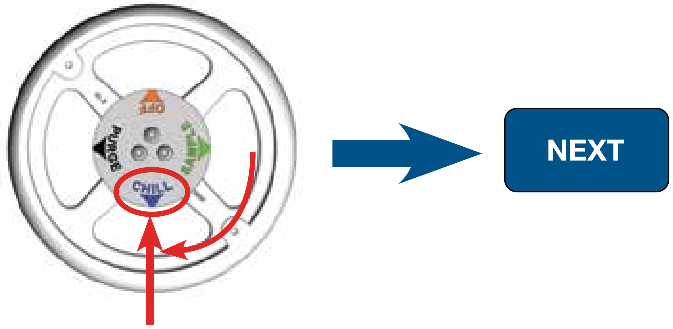
2. Insert the empty residue tube(s) into the fixture(s) and close the lid(s). See **Installing Residue Tube Into Fixture** under **Operation** for details. Once installed, press NEXT on the screen.



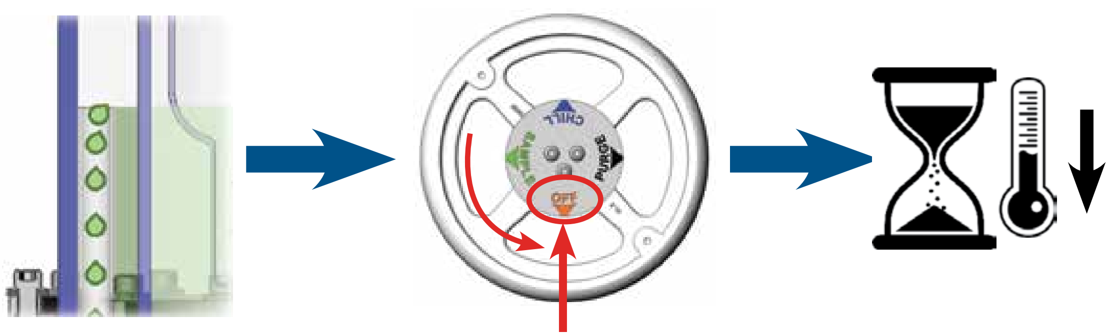
3. Prepurge the fixture(s) by turning the valve handwheel clockwise to the PURGE position. Press NEXT on the screen and wait for the timer to expire before advancing to the next step.



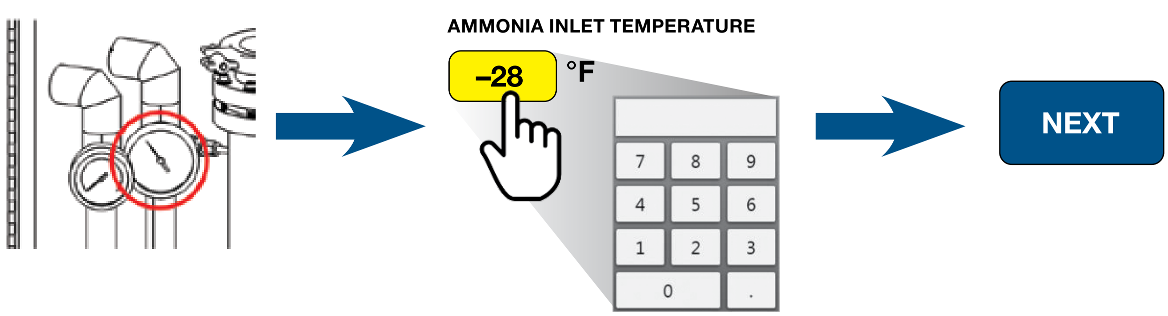
4. Fill the cold bath(s) by turning the valve handwheel clockwise to the CHILL position, then press NEXT on the screen. Note that if the fixture temperature is already at or below the chill setpoint then Steps 4 and 5 are not necessary and the program will skip ahead to Step 6.



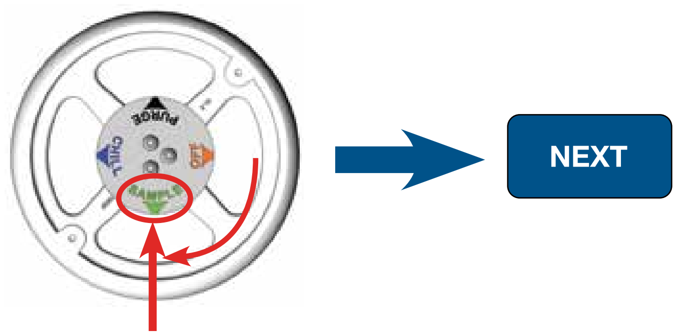
5. When the ammonia reaches the top of the drain tube(s) and spills over, turn off the ammonia by turning the valve handwheel counterclockwise to the OFF position. Wait for the fixture temperature to cool down to the chill setpoint before advancing to the next step. If desired, Steps 4 and 5 may be repeated if the rate of cooling slows. The program will automatically advance when the fixture temperature falls below the chill setpoint.



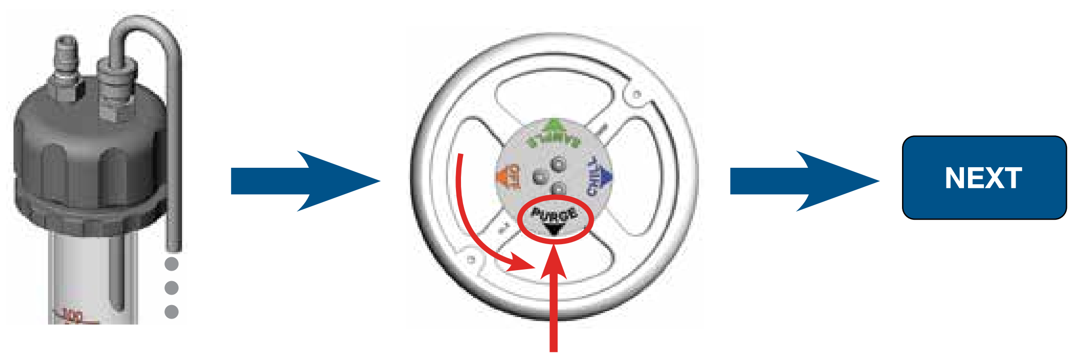
6. Note the temperature of the incoming ammonia as measured on the ammonia temperature gauge. Enter this value on the screen by first pressing the AMMONIA INLET TEMPERATURE field and then typing a value. Once entered, press NEXT on the screen.



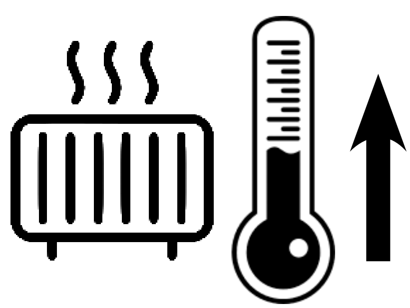
7. Fill the residue tube(s) by turning the valve handwheel clockwise to the SAMPLE position, then press NEXT on the screen.



8. When ammonia overflows from the residue tube(s) into the cold bath, turn on the purge by rotating the valve handwheel counterclockwise to the PURGE position. Press NEXT on the screen to advance to the next step.

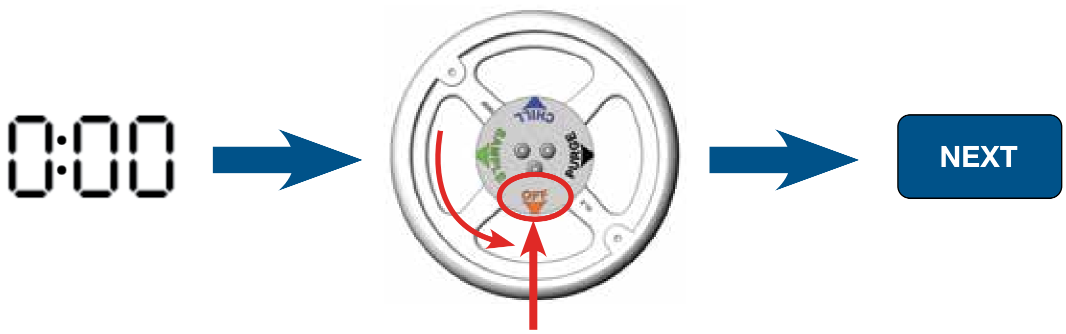


9. The heater will turn on and evaporate the sample.



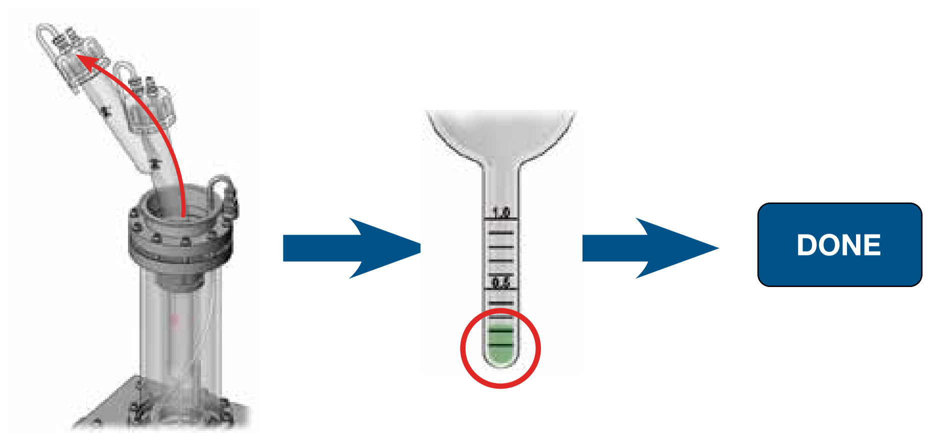
10. Once the sample is evaporated and the temperature in the fixture(s) has reached the evaporation setpoint, the hold timer will start.

11. After the timer expires, turn the valve handwheel counterclockwise to the OFF position, then press NEXT on the screen.



12. Open the fixture(s), remove the residue tube(s), and read the amount of water in the sample(s). Press DONE on the screen to review the statistics from the previous cycle: starting temperature, ammonia inlet temperature, and heating cycle time.

    NOTE: Clean residue tube(s) between samples.



To take a single sample with a dual-fixture sampler, see **Isolating Left/Right Fixture (Dual-Fixture Samplers)** under **Initial Setup**.

Maintenance

General Preventative Maintenance

Maintenance Item	Typical Frequency	Instructions/Notes
Adjust valve packings	Inspect for leakage upon first commissioning with cold ammonia and then inspect monthly thereafter.	When leakage is detected, adjust valve packing(s). See **Adjusting Valve Packings**.
Tighten fixture screws	Yearly	See **Fixture Screw Torque and Pattern** for torque requirements.
Inspect glycol fill level	Monthly/as needed	Verify the glycol fill level is as shown in **Glycol** under **Initial Setup**. Refill if necessary.
Replace glycol	Yearly or when the glycol is fouled with ammonia.	1. Open fixture(s) after ensuring that no ammonia is present. 2. Drain glycol by removing plug from glycol drain connection. 3. Refill glycol according to **Glycol** under **Initial Setup**.
Cleaning	Monthly/as needed	Use a soft cloth and cleaning solution to wipe down surfaces inside and outside of the main sampling enclosure. Clean up spills, residue, condensation, etc. To avoid an electrostatic charge, wipe the exterior surface of the control enclosure with a damp cloth only.

Adjusting Valve Packings

WARNING: Failure to maintain/adjust valve packings and fixture screws could result in ammonia leaks and operator exposure.

WARNING: Before servicing any installed valve, you must
- depressurize the system
- cycle the valve

WARNING: Residual system media may be left in the valve.

All valve packings require periodic adjustment to maintain leak-tight performance. There are four types of valves in the Swagelok ammonia sampler that may require packing adjustments over the life of the valves (reference Figure 12):

- 1 series needle valves – chill/sample flow valves, ammonia return flow valve
- 42G series ball valves – left/right fixture shutoff valves (dual-fixture samplers only)
- 63 series ball valve – ammonia supply valve
- 43G series ball valves – ¼ in. geared valves (3)
- 45T series ball valves – ½ in. geared valve

The Swagelok ammonia sampler is provided with a packing adjustment tool (Figure 20) to help facilitate the packing adjustment of the 43G and 45T series valves. For the geared valves, this tool is designed to fit between the gear and the valve body and enable packing adjustment without removing the gears. The tool can be stored by threading it onto one of the bolts on the bottom of the enclosure.

Figure 20 Packing Adjustment Tool

1 Series Needle Valves Packing Adjustments – Flow Valves

Using a 5⁄8 in. open-end wrench (not included), turn the **packing nut** clockwise in 1⁄4-turn increments until leak-tight performance is achieved.

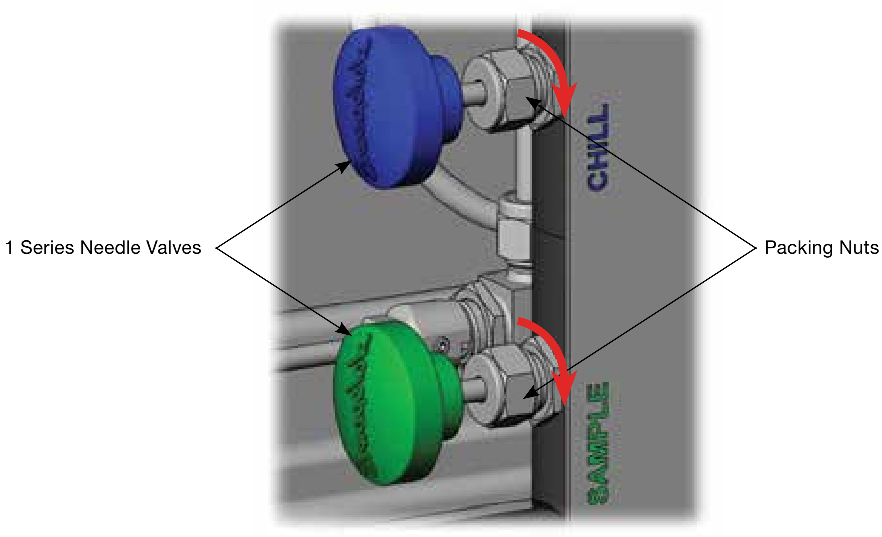


Figure 21 1 Series Valves

42G Series Ball Valves Packing Adjustments – Fixture Shutoff Valves

1. With the valve in either the open (vertical) or closed (horizontal) position, remove the **extended handle subassembly** by loosening the **set screw** in the handle hub.
2. Using a 5⁄16 in. wrench (not included), turn the **packing bolt** clockwise in 1⁄16-turn increments until leak-tight performance is achieved.
3. Reinstall the **extended handle subassembly** and tighten the set screw to 15 to 20 in.·lb (1.7 to 2.6 N·m).

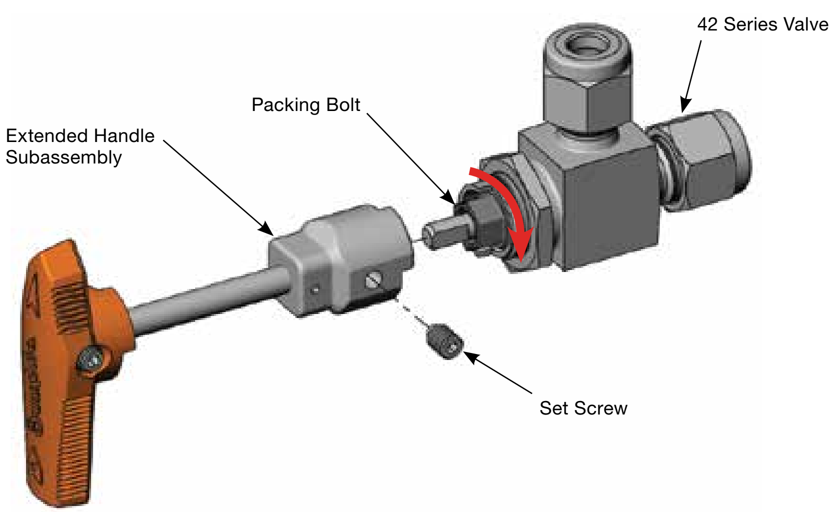


Figure 22 42G Series Valves

63 Series Ball Valve Packing Adjustments – Ammonia Supply Valve

1. With the valve in either the open (shown) or closed position, loosen and remove the **upper stem nut**.
2. Remove the **stem spring**, **stop lock plate**, **handle/sleeve**, and **grounding spring**.
3. Using a 9⁄16 in. wrench (not included), turn the **lower stem nut** clockwise in 1⁄16-turn increments until leak-tight performance is achieved.
4. Reinstall the **grounding spring**, **handle/sleeve**, **stop lock plate**, and **stem spring** (concave side up).
5. Replace the **upper stem nut** and tighten to 50 in.·lb (5.7 N·m).

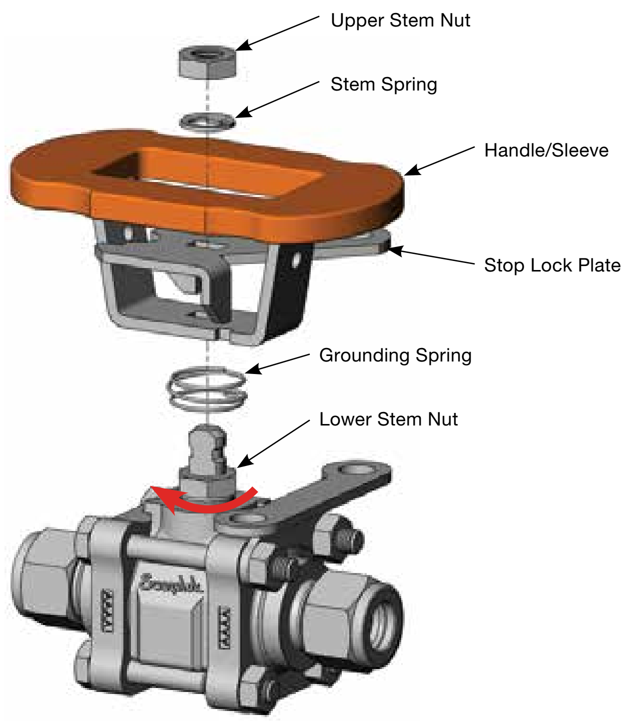


Figure 23 63 Series Valve

43G and 45T Series Ball Valves Packing Adjustments – Geared Valves

WARNING: Do not loosen the gears' set screws. Unpredictable or dangerous performance can result if any of the gears are loose or misaligned.

1. Turn the **handwheel** to the OFF position.
2. Remove the red pointer by loosening and removing the screws that hold it to the front of the enclosure.
3. Remove the valve **handwheel**, **handwheel label**, **hub,** and **cam** by loosening and removing the three **handle screws**.
4. Remove the valve cover plate by removing the two flat head **cover plate screws**.
5. To access the **packing bolt** for each valve, slide the included packing adjustment tool between the valve body and the gear. Use the large end of the tool for the center **45T series valve** and the small end for the smaller **43G series valve**.
6. Turn the **packing bolt** clockwise in 1/16-turn increments until leak-tight performance is achieved.
7. After tightening the valve packing(s), slide the **cam** and the **hub** onto the stem of the gear, aligning the screw holes (they only align in one orientation).
8. Reinstall the **cover plate** and secure it with the flat head **cover plate screws**, tightening the screws to 30 in.·lb (3.4 N·m).
9. Reinstall the **handwheel** and **handwheel label**. Align the screw holes and secure in place by inserting the three **handle screws** and tightening to 75 in.·lb (8.5 N·m).

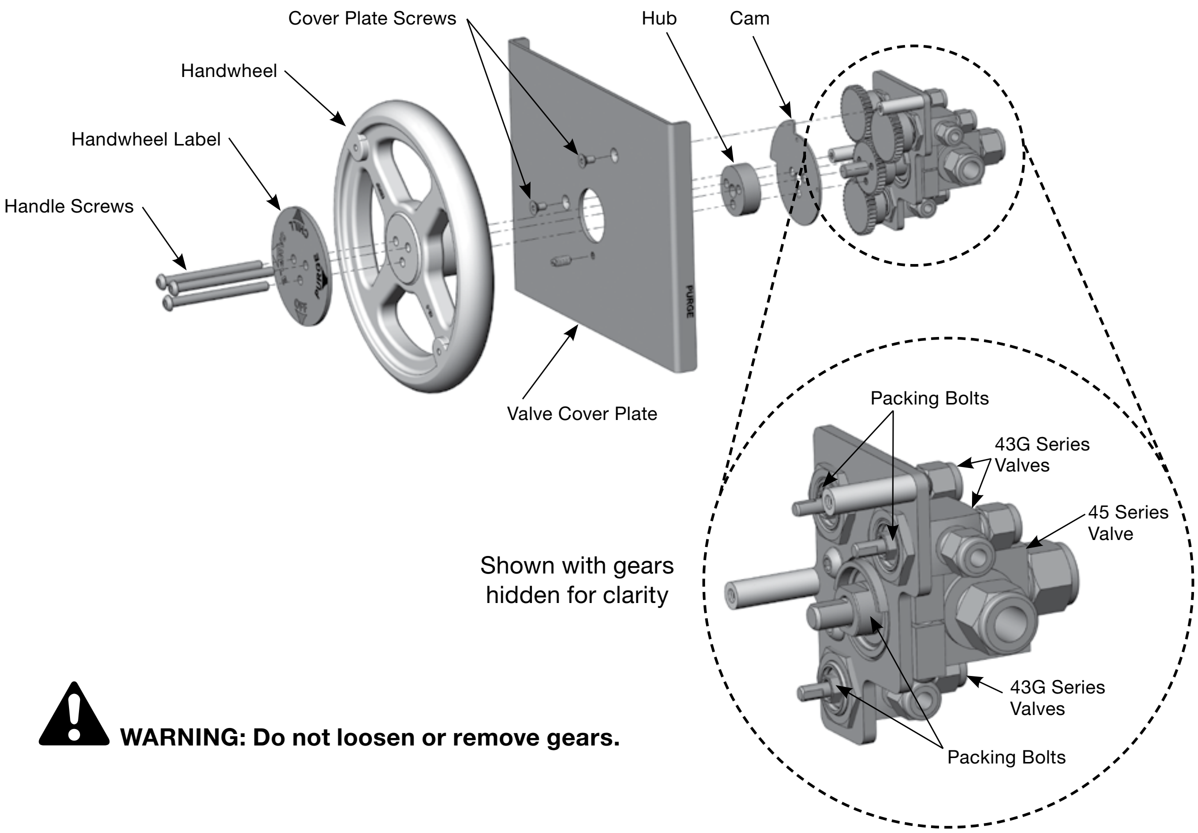


Figure 24 Geared Valve Assembly

Fixture Screw Torque and Pattern

In order to ensure proper gasket pressure and compression, the following screw torques should be used for the screws shown in Figure 25. The threads should be lubricated with Christo-Lube® MCG 173 or equivalent. Note the proper orientation of the spring washers as shown in Figure 26. Use a torque wrench outfitted with a 3⁄16 in. hex bit socket and extensions (if necessary) to tighten the screws in the multipass torqueing sequence as shown in Table 5.

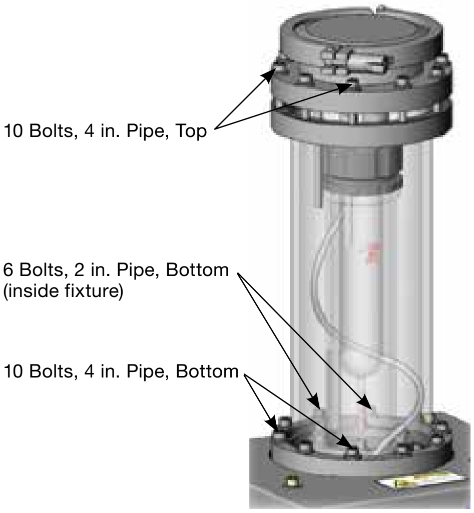


Figure 25 Fixture Screws

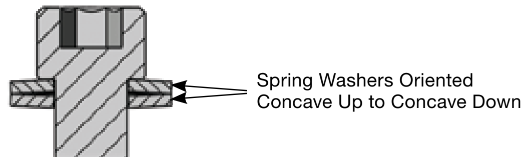


Figure 26 Spring Washer Orientation

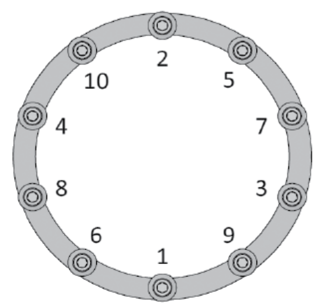
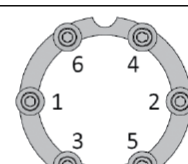
Fixture Screw Torque, in.·lb (N·m)						
	Torque, in.·lb (N·m)					
Fastener Location	1st Pass	2nd Pass	3rd Pass	4th Pass	5th Pass	Torque Sequence
4 in. Glass Pipe Bottom Screws (10)	5 (0.6)	10 (1.1)	17 (1.9)	25 (2.8)	25 (2.8)	
4 in. Glass Pipe Top Screws (10)	5 (0.6)	10 (1.1)	15 (1.7)	20 (2.3)	20 (2.3)	
2 in. Glass Pipe Bottom Screws (6)	5 (0.6)	10 (1.1)	15 (1.7)	20 (2.3)	20 (2.3)	

Table 5 Fixture Screw Torque

Troubleshooting

Symptom	Possible Cause	Potential Remedy
No/Low ammonia flow.	Ammonia supply valve is closed.	Open ammonia supply valve.
	Sample flow valve is closed.	Open and adjust sample flow valve according to **Sample Flow**.
	Ammonia is vaporizing in the tubing leading to the sampler.	The liquid can sometimes take several minutes to arrive at the sampler. Wait a few more minutes and continue with the sampling process once there is liquid present.
		Ensure that the tubing leading to the sampler is insulated.
		For ammonia that is only slightly above the atmospheric boiling point, increase the sample pressure by decreasing the bypass flow rate. See the ammonia phase diagram in Figure 6.
Ammonia is flowing erratically and/ or gushing into the fixture(s).		For ammonia that is well above the atmospheric boiling point, increase the bypass flow rate to deliver the ammonia to the sampler more quickly and give it less of a chance to absorb heat and change phase.
		Move the sampler closer to sample point.
		Choose a different sample point with a lower temperature. The maximum recommended temperature is –28°F (–33°C).
Incorrect or inconsistent fill level in residue tube.	Residue tube is not sufficiently chilled prior to dispensing sample.	Adjust the chill setpoint on the according to **Setup Screen** under **Program Setup**.
		Allow enough time for the residue tube to cool down.
	Overflow tube not aligned to the graduation line on the residue tube.	Adjust the overflow tube up/down as necessary to fine-tune the fill level according to **Attaching Cap Assembly to Residue Tube**.
The purge does not remove ammonia from supply lines and vinyl hose inside of fixture. (NOTE: It is normal to have a few droplets remaining.)	Vinyl hose inside of fixture is kinked.	Ensure that vinyl hose is not kinked or twisted.
	Purge is turned off or set too low.	Adjust the fixture purge according to **Fixture Purge** under **Initial Setup**.
		Ensure handwheel is rotated to Purge position while sample is evaporating.
		Ensure that the nitrogen supply valve is open.

Symptom	Possible Cause	Potential Remedy
Ammonia vapors are present when the fixture is open.	The glycol is fouled with ammonia.	Drain and replace the glycol.
	The sample and/or the remnants of the cold bath are not completely evaporated.	Allow the heating cycle to finish prior to opening the fixture.
Ammonia vapors are present when the fixture is closed.	Ammonia is leaking from the valve packings.	Tighten the valve packings according to **Adjusting Valve Packings**.
	Ammonia is leaking from the sample fixture.	Verify the bolts for the 4 in. glass pipe(s) are tight according to **Fixture Screw Torque and Pattern**.
		Verify that the 4 in. kwik-clamp gasket and sealing surfaces are not scratched. Replace and/or rework as necessary.
Results from the Swagelok ammonia sampler do not match the results from other sampling methods.	The ammonia is being sampled from different points in the process.	Only compare results taken from the same sampling point.
	The sample obtained via other methods is contaminated due to ammonia vaporizing in the lines, which leaves behind extra water and other contaminants. This water and contamination are then absorbed by the initial liquid flow, thereby contaminating the liquid.	Once liquid ammonia begins to flow, allow it to flush out contamination prior to taking a sample. With the Swagelok ammonia sampler, filling the cold bath serves this function. With manual sampling methods, divert initial liquid flow to a drain or another disposal method prior to taking a sample.
The cooling process takes too long.	The chill set point is set too low.	Adjust the chill setpoint up according to **Temperature** under **Program Setup**.
	There is too much backpressure on the drain connection. The cooling process relies not just on the low temperature of the ammonia in the cold bath, but also the evaporative cooling of that ammonia. Excessive backpressure can inhibit that evaporation.	Ensure that the drain's backpressure does not exceed 7.3 psig (0.50 bar; 0.51 kg/cm^2; 0.050 MPa).
The heating process takes too long.	The heater is not turning on.	Verify that the Output 1 LED on the PLC and the indicator LED on relay 2003CR are lit. Verify voltage on terminal 2/T1 on relay 2003CR. Refer to electrical schematics in **Electrical Schematics.**
	The evaporation setpoint is set too high and the fixture is unable to achieve the temperature.	Adjust the evaporation setpoint according to **evaporation setpoint** under **Program Setup**.
	The heater setpoint is set too close to the evaporation setpoint. This will cause the heating to slow down as the fixture approaches the evaporation setpoint.	Adjust the heater setpoint according to **heater setpoint** under **Program Setup**.

Symptom	Possible Cause	Potential Remedy
The Heater RTD Fault is triggered (turned red on main program screen).	The heater got too hot.	Adjust the heater setpoint lower. If the heater is set to its highest possible setpoint 160°F (71°C) in a hot climate, then it may be possible to exceed the fault threshold 176°F (80°C).
	The heater got too cold.	The minimum operating temperature of the sampler is –4°F (–20°C), or –22°F (–30°C) with the optional control enclosure heater. If the ambient temperature gets cold enough to trigger the RTD fault –76°F (–60°C) then consider installing the sampler indoors.
	The RTD signal is not making it to the controller.	Verify that the RTD cable is attached to the RTD and tight.
		Replace the RTD.
The cycle will not start when the NEW SAMPLE button is pressed.	The RTD Fault is triggered.	See above.
The sampling cycle stopped and did not finish.	The CANCEL button was pressed.	Restart the sampling cycle.
	The cycle was stopped automatically when the RTD fault was triggered. NOTE: It is possible for the fault to trigger, which stops the sampling cycle, and then reset itself (returning to green) when the RTD returns to the normal range.	See above.
	The NEXT button was not pressed.	Press the NEXT button where prompted to advance from step to step.
The touchscreen displays the operating system instead of normal program screens.	The program failed to boot up or was exited.	Turn the power off/on to restart the controller.

Appendix

Electrical Schematics

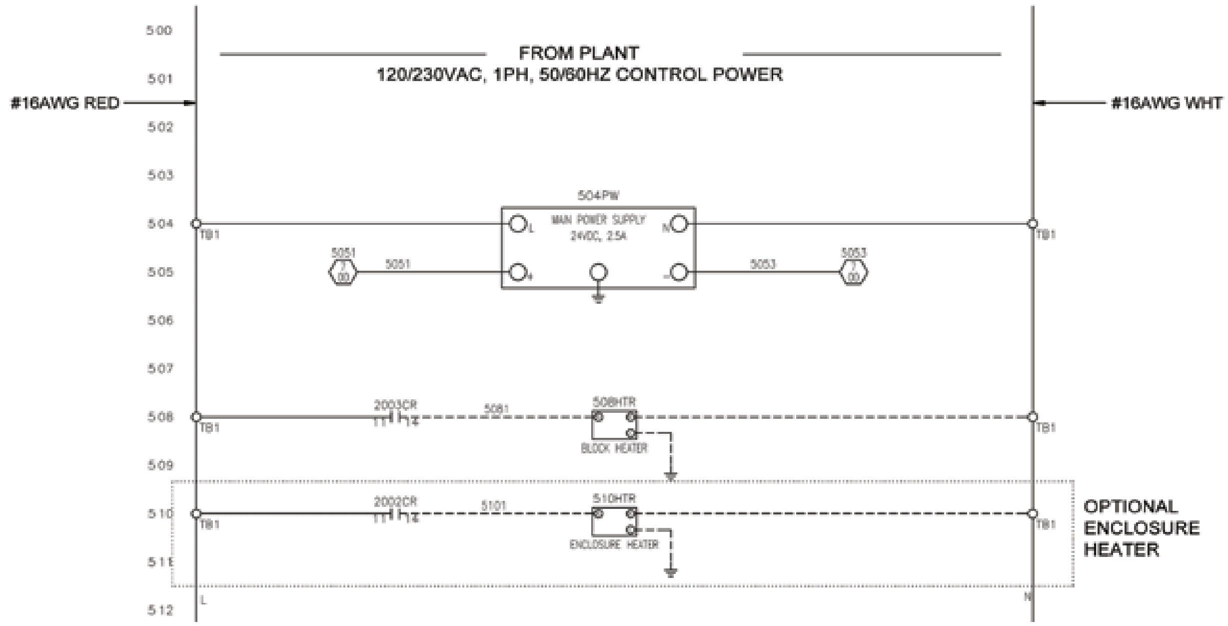


Figure 27 Electrical Schematic 120/230VAC Control Power

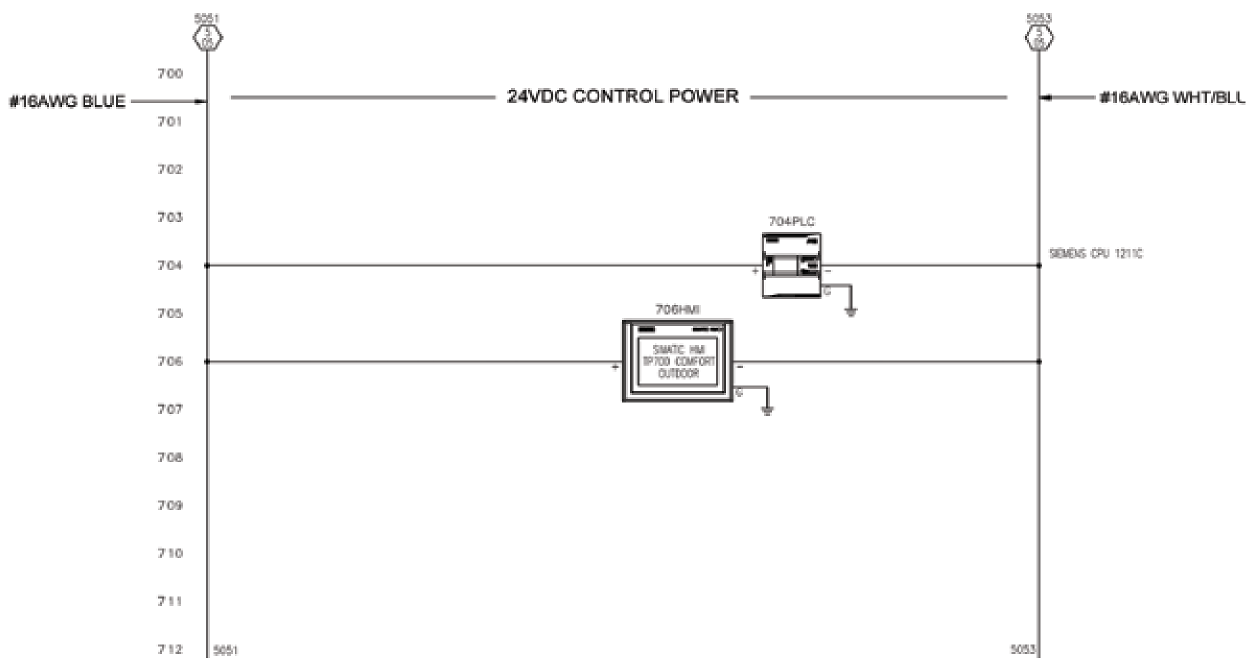


Figure 28 Electrical Schematic 24VDC Control Power

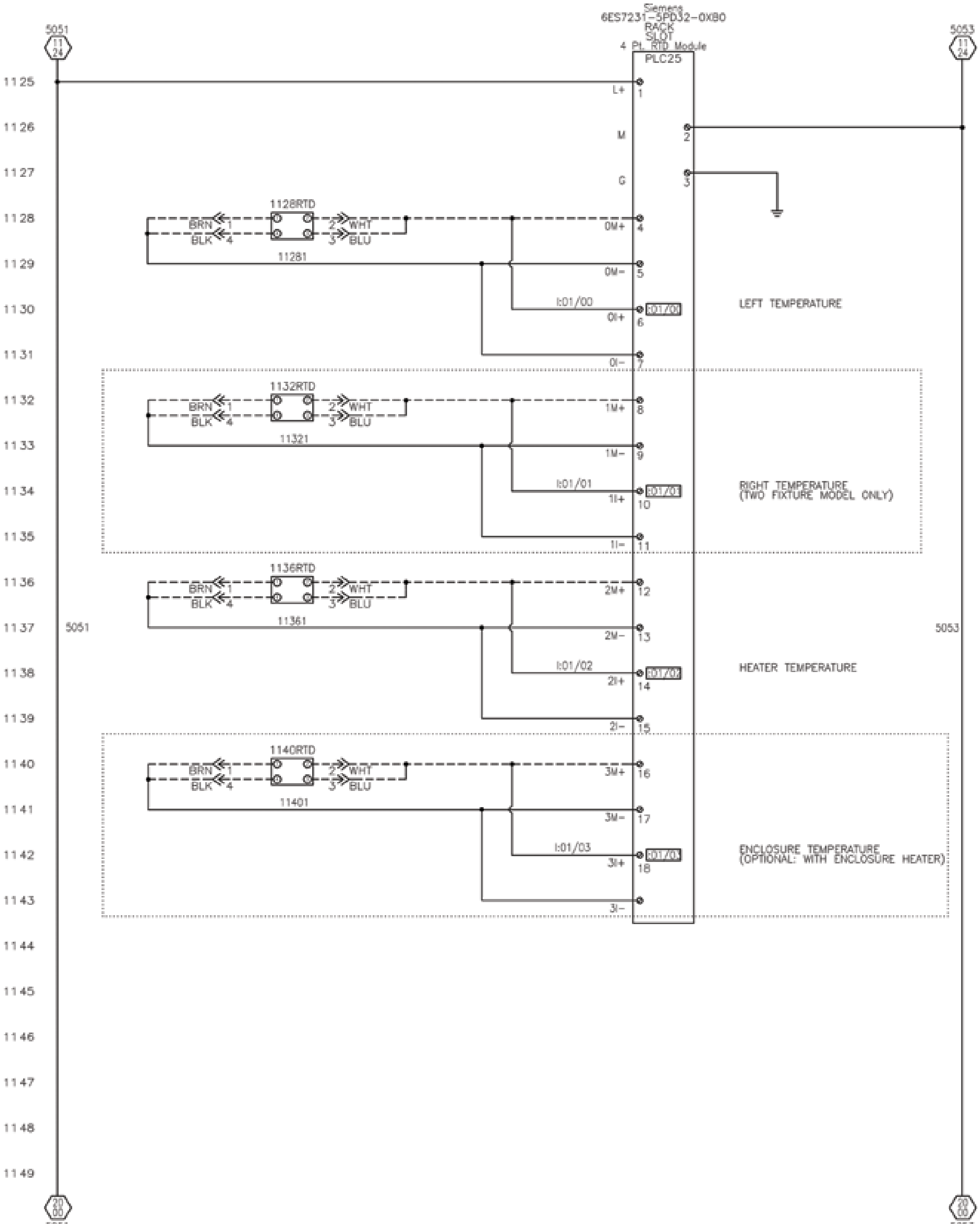


Figure 29 Electrical Schematic Analog Inputs

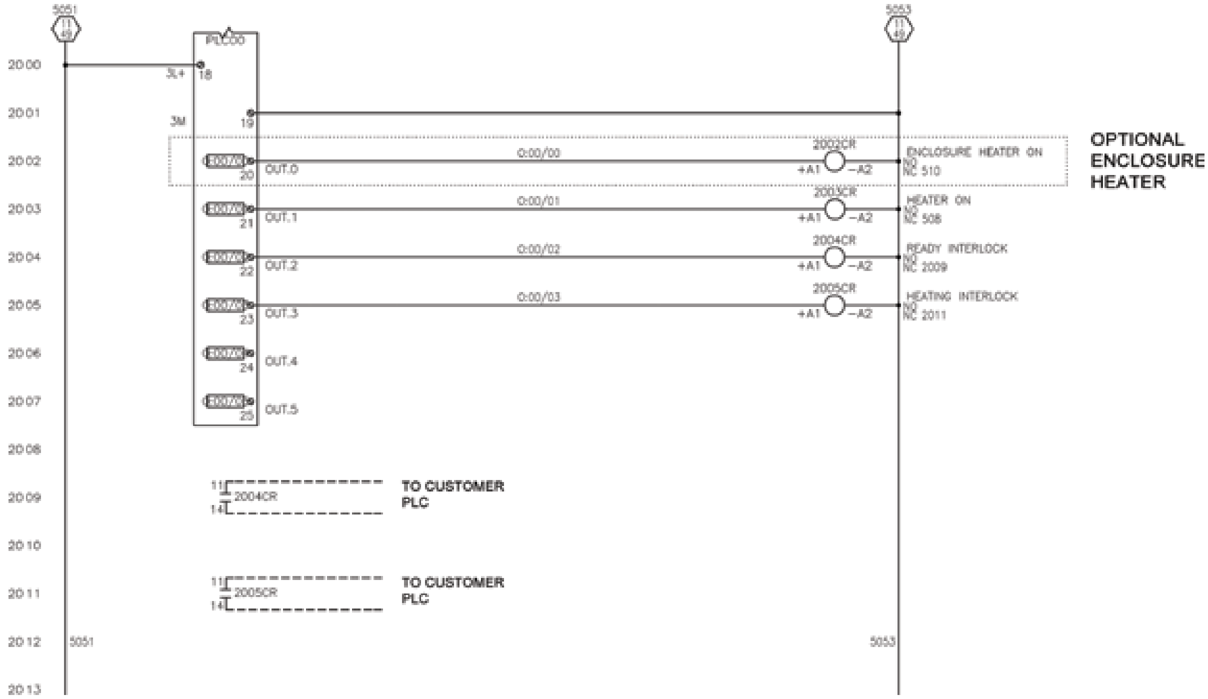


Figure 30 Electrical Schematic Digital Outputs

Plumbing Schematics

Single-Fixture Sampler Schematic

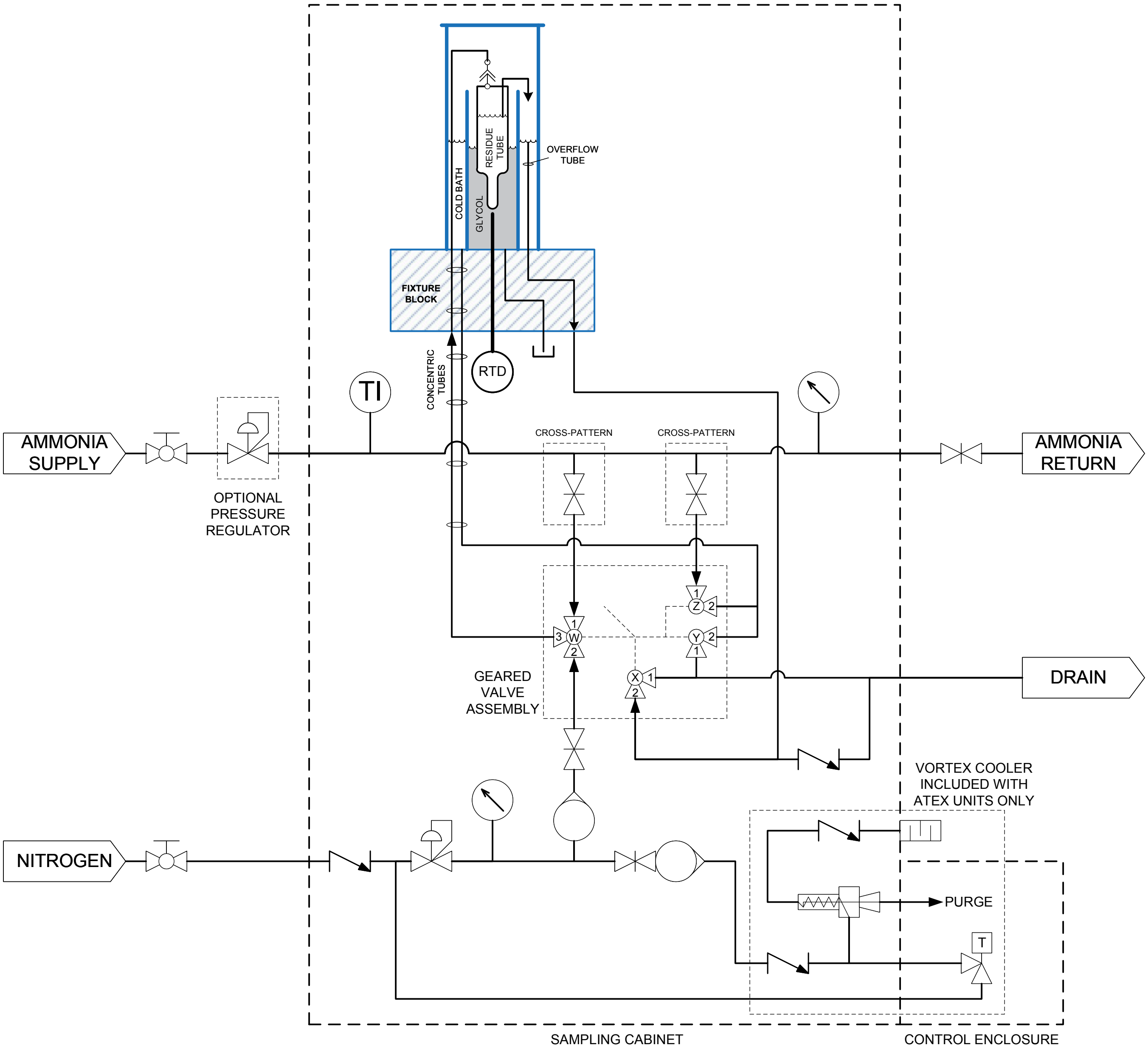


Figure 31 Plumbing Schematic for Single-Fixture Samplers

Dual-Fixture Sampler Schematic

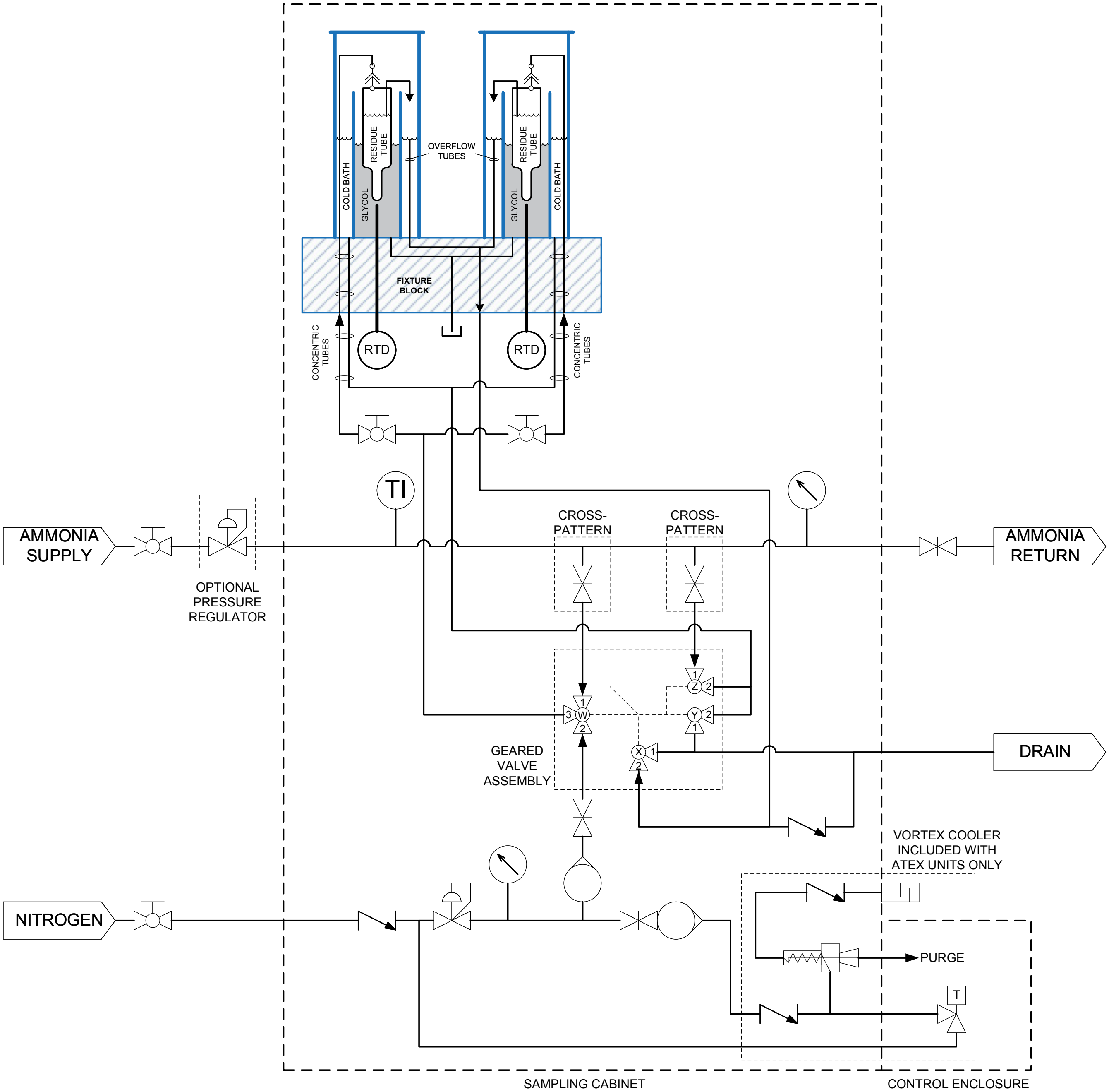


Figure 32 Plumbing Schematic for Dual-Fixture Samplers

Geared Valve Orientation

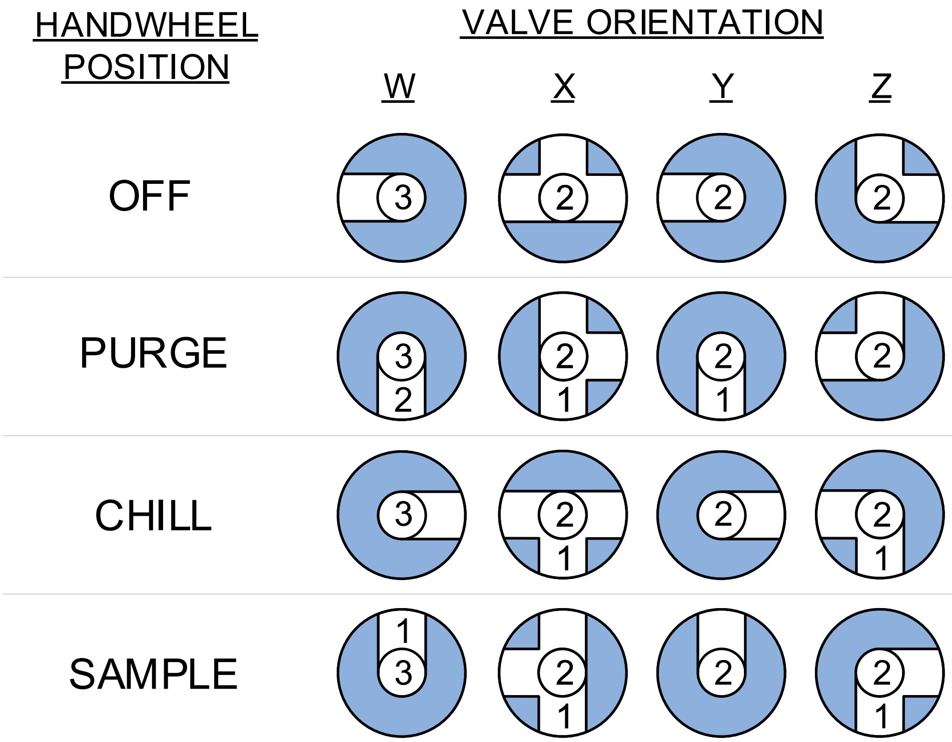


Figure 33 Orientation of Valves' Balls in Geared Mode Valve

Ordering Information

Build a Swagelok ammonia sampler ordering number by combining the designators in the sequence shown below.

1		2	3		4	5	6		7	8		9
SAS	**-**	**D**	**100**	**-**	**C**	**P**	**CS**	**-**	**120**	**EX**	**-**	**R**

1 Swagelok Ammonia Sampler

2 Number of Samplers

S = 1
D = 2

3 Size of Samples

100 = 100 mL
250 = 250 mL

4 Pressure Range

(see table below)

Inlet Pressure Range				
Range	**psig**	**bar**	**kg/cm²**	**MPa**
A	15	1	1	0.1
B	30	1.6	1.6	0.16
C	60	2.5	2.5	0.25
D	100	4	4	0.4
E	160	6	6	0.6
F	200	10	10	1
G	300	16	16	1.6
H	400	25	25	2.5

5 Pressure Units

P = psig
B = bar
K = kg/cm^2
M = MPa

6 Temperature Units

CS = Celsius
FS = Fahrenheit
DS = Dual scale

7 Voltage

120 = 120 VAC
230 = 230 VAC

8 Hazardous Area

EX = ATEX
FM = C1D2

9 Options

C = Calibration certs
L = Low temperature①
R = Inlet regulator
N = Canadian Registration Number

① Not available with ATEX samplers.

Specifications Summary

Reference **Ordering Information** for details on the sampler which has been specified.

- Maximum Ammonia Inlet Pressure:
  - Single-Fixture Samplers: 59 psig (4.0 bar; 4.1 kg/cm^2; 0.41 MPa)
  - Dual-Fixture Samplers: 233 psig (16.0 bar; 16.3 kg/cm^2; 1.60 MPa)
  - With Optional Inlet Regulator: 2200 psig (151 bar; 154 kg/cm^2; 15.1 MPa)
- Ammonia Inlet Temperature:
  - Minimum Temperature: –44°F (–42°C)
  - Maximum Recommended Temperature: –28°F (–33°C)
- Ammonia Flowrate: Typically less than 5 lpm
- Nitrogen Supply Pressure:
  - Class 1 Division 2 Sampler: 50 to 500 psig (3.4 to 34 bar; 3.5 to 35 kg/cm^2; 0.34 to 3.4 MPa)
  - ATEX Sampler: 90 to 110 psig (6.2 to 7.5 bar; ; 6.0 to 7.0 kg/cm^2; 0.62 to 0.75 MPa)
- Nitrogen Flow Rate:
  - Typical: less than 10 slpm
  - ATEX units operating above 95°F (35°C) ambient temperature: less than 100 slpm
- Maximum Back-Pressure, Ammonia Drain:
  - Continuous: 5 psig (0.34 bar; 0.35 kg/cm^2; 0.034 MPa)
  - Periodic: 7.3 psig (0.50 bar; 0.51 kg/cm^2; 0.050 MPa)
- Ambient Temperature T_a:
  - Maximum Temperature: 122°F (50°C) for C1D2 units and 104°F (40°C) for ATEX units
  - Minimum Temperature: –4°F (–20°C)
  - Minimum Temperature, With Optional Control Enclosure Heater: –22°F (–30°C)
- Heat Transfer Fluid (Glycol) Caspacity:
  - Single-Fixture Samplers: 250 mL
  - Dual-Fixture Samplers: 450 mL
- Approximate Weight:
  - Single Fixture, 100 mL: 195 lb (88 kg)
  - Dual Fixture, 100 mL: 220 lb (100 kg)
  - Single Fixture, 250 mL: 205 lb (93 kg)
  - Dual Fixture, 250 mL: 230 lb (104 kg)
- Power Requirements:
  - 120 Volt Samplers: 120 VAC, 1 Ø, 50 to 60Hz, 5.5 Amps
  - 230 Volt Samplers: 230 VAC, 1 Ø, 50 to 60Hz, 2.9 Amps
- Relay Outputs:
  - Voltage: 5 to 250 V AC/DC
  - See Figure 34
- Hazardous Area Classification:
  - ATEX Samplers:
    - > Ex II 3 G Ex db ec nA nC IIC T3 Gc
    - > ATEX Certificate No. UL 22 ATEX 2639X
    - > Swagelok Company, Solon, OH 44139
    - > 120 or 230 VAC, 1 Ø, 50 to 60Hz

    ⚠ WARNING – POTENTIAL ELECTROSTATIC CHARGING HAZARD – SEE INSTRUCTIONS
  - North American Samplers: Class 1, Division 2, Group B

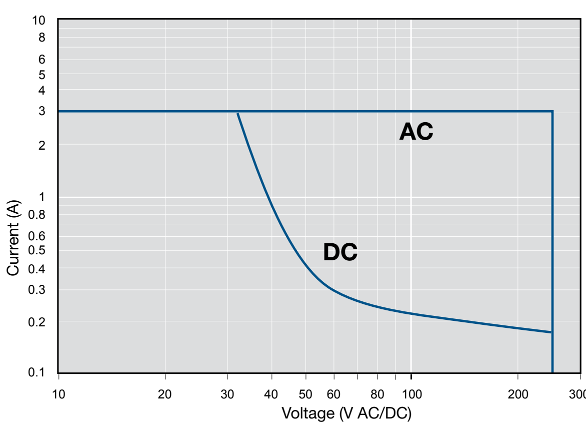


Figure 34 Relay Output Maximum Resistive Load

Spare Parts

Category	Ordering Number	Description
Glassware	K-557304-250MM	2 in. Inner glass pipe, 100 mL samplers
	K-557304-340MM	2 in. Inner glass pipe, 250 mL samplers
	K-577304-330MM	4 in. Outer glass pipe, 100 mL samplers
	K-577304-420MM	4 in. Outer glass pipe, 250 mL samplers
	MS-SAS-RT-100	100 mL residue tube
	MS-SAS-RT-100-NT	100 mL residue tube, calibrated
	MS-SAS-RT-250	250 mL residue tube
	MS-SAS-RT-250-NT	250 mL residue tube, calibrated
Residue Tube Caps	PVC-SAS-RT-CAP-100	Complete cap assembly for 100 mL residue tube
	PVC-SAS-RT-CAP-250	Complete cap assembly for 250 mL residue tube
Gaskets	K-EP40-SAS-GASKET-RT	EPDM gasket for residue tube cap assembly
	K-290018	4 in. sanitary gasket, EPDM
	EP40-SAS-GASKET-KIT	EPDM fixture gasket kit. Includes (2) gaskets for 4 in. outer glass pipe and (1) gasket for 2 in. inner glass pipe.
Heaters and Temperature Control	K-MS-SAS-HEATER-120V	Fixture heater, 120 VAC samplers, ATEX ,and C1D2
	K-MS-SAS-HEATER-230V	Fixture heater, 230 VAC samplers, ATEX, and C1D2
	K- MS-SAS-HEATER-ENCLOSURE	Control enclosure heater, ATEX, and C1D2
	K-MS-SAS-RTD-1.5	Heater control RTD, 1.5 in. long
	K-MS-SAS-RTD-2.5	Fixture monitoring RTD, 2.5 in. long
	K-MS-SAS-RTD-2.5-NT	Fixture monitoring RTD, 2.5 in. long, calibrated

For additional replacement parts, please contact your authorized Swagelok sales and service center.

Warranty Information

Swagelok products are backed by The Swagelok Limited Lifetime Warranty. For a copy, visit swagelok.com or contact your authorized Swagelok sales and service center.

Each product catalog and user manual is up to date at the time of printing; subsequent revisions to individual product catalogs and user manuals will be posted to **www.swagelok.com** and will supersede the printed version.

MS-13-335, RevB, August 2023