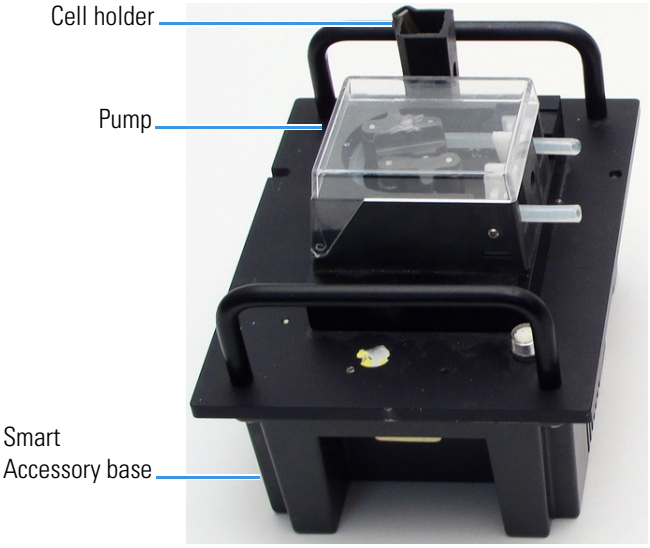
Smart Sipper Accessory

The Thermo Scientific™ Smart Sipper™ includes a pump and cell holder mounted on a Smart Accessory base, a silicone tubing kit and a special front panel for the sample compartment that is specific to the model of Evolution spectrophotometer.

The sipper can be modified to support long path cells if required. Contact your Thermo Scientific UV-Vis sales representative for details on purchasing and installing a long path cell holder.

The sipper can be used alone and operated manually or with semi-automated workflows, or connected to an autosampler for fully-automated sampling.



It is important to use the correct tubing for the pump and flow cell. For more information, see Smart Sipper Tubing Kits under Tubing Specifications.

Silicone tubing is suitable for most aqueous solutions. Other kits are available for sampling strongly acidic or corrosive liquids or biological materials.

Tip Leave the instrument and accessory powered on when the pump is idle and some liquid in the sample intake container. The accessory will periodically "sip" a small volume to redistribute the pressure on the tubing.

Installing the Smart Sipper

It is not necessary to power off the instrument when installing or removing this accessory.

1. Open the sample compartment and remove any existing cell holder or accessory.
2. Install the Smart Sipper.

   Refer to the instructions for installing a Smart accessory in the instrument user guide.

   The software displays a prompt to initialize the accessory.

CAUTION Avoid pinch hazard. Keep hands and objects clear of the accessory during initialization.

3. Click **OK** to initialize the accessory.

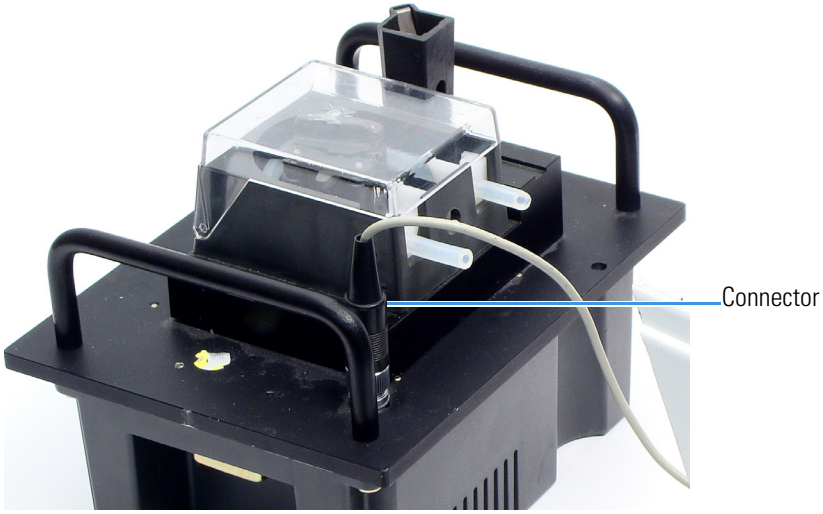
   Initialization reads information about the accessory and resets the pump motors.

4. Install the Sipper sample compartment front panel.

   Note If you are setting up the Sipper for use with an autosampler, skip this step.

   Connect the cable from the Sipper front panel to the socket on the Smart Sipper base.

   To connect the cable, align the pins in the cable connector with the socket in the Smart Sipper base. Plug in the connector and hand tighten the collar.



Installing Pump Tubing

We provide two sizes of silicone tubing with the Smart Sipper (for high and low volume sampling). It is important to use the correct tubing for the pump.

It is also important to use pump tubing that is compatible with the types of samples you plan to measure with the Smart Sipper. The silicone tubing is suitable for most aqueous solutions. Other kits are available for use with acidic solutions (C-Flex material), for biological materials (Chem–Durance Bio material) and for organic solvents and highly acidic or caustic liquids (Viton material).

❖ To install pump tubing

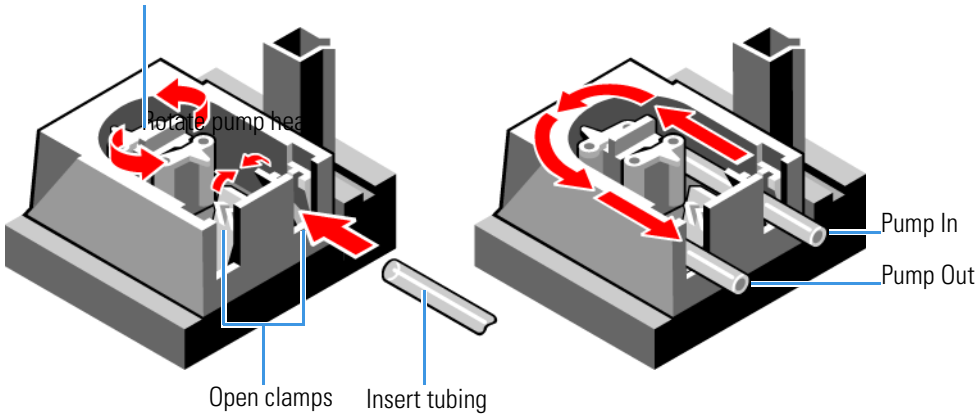
Installing pump tubing is significantly easier when the pump is not powered.

1. Lift up the front of the accessory far enough to disconnect the smart accessory connector from the base to cut power to the pump.

> **Tip** Removing the accessory from the sample compartment entirely will make the process even easier. You can take the flow cell out of the cell holder and leave it inside the sample compartment in order to remove the pump without disconnecting too many tubes.

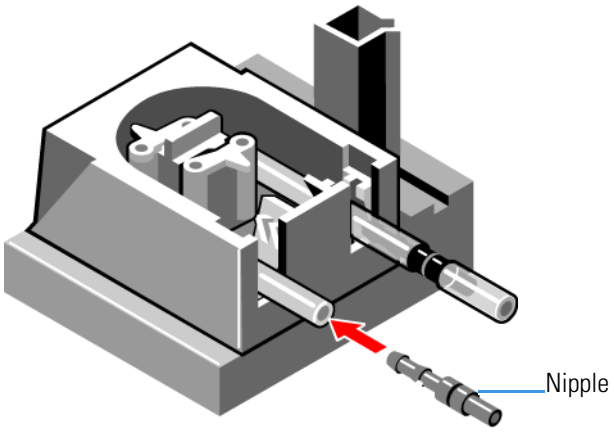
2. Cut a piece of pump tubing long enough to fit around the pump head and to extend approximately 3 cm out into the sample compartment on both sides. See diagrams.
3. Taking care not to stretch, slacken or twist the tubing, feed it counterclockwise around the track while you manually rotate the pump head.
4. Press the tubing into both clamps.

> **Note** Leave at least 2 cm of tubing extending beyond each clamp.



5. Insert an appropriate size connecting nipple into each end of the pump tubing.

   Use nipples from a Sipper tubing kit or equivalent nipples that are the correct size and compatible with your sample material.



NOTICE Remove the tubing from the pump before storing the accessory. Leave the instrument and accessory powered on when the pump is idle.

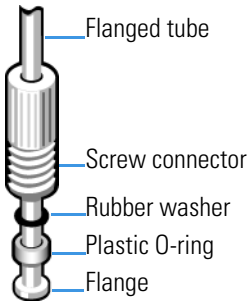
Installing Flow Cell Tubing

Make sure you can identify the in and out connectors on the flow cell. If the flow cell is not marked, check the documentation that came with the cell.

Tip We recommend flow cells with screw-caps. If you choose to use a flow cell with glass connectors, we recommend that you use #14 pump tubing and route a single, continuous piece of tubing from the **Out** connector of the flow cell to and around the pump head. To prevent leaks, push tubing onto connectors as far as possible (wet the tubing first if necessary). The cell position is so close to the pump-head that this does not require a lot of extra pump tubing. Use a connector to switch from pump-head tubing to PTFE to take the sample to the waste container.

For flow cells with screw-caps, install screw connectors, O-rings and washers that fit the cell ports, and tubing that has a flanged end (samples are provided in the tubing kits).

Flow cells typically come packaged with preassembled screw connectors. If your cell does not come with preassembled connectors, assemble the parts as shown.



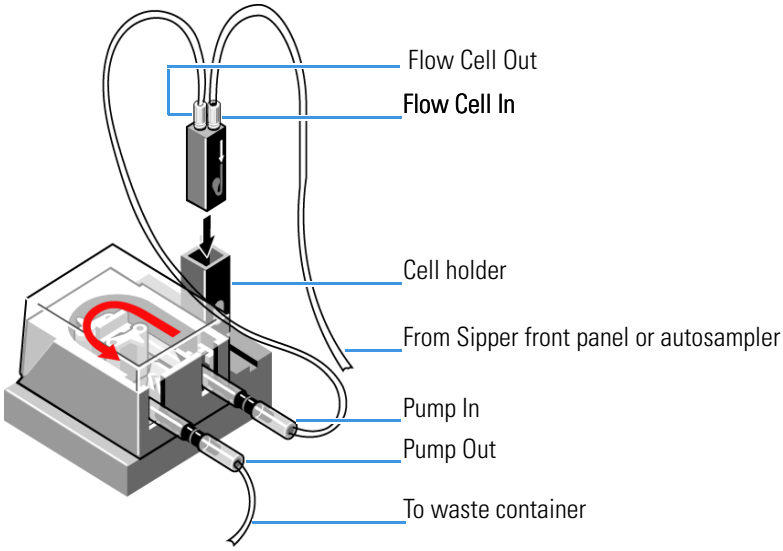
1. Pull the screw connector up from the flange by about 1 cm.
2. Push the tubing down into the well on the top of the flow cell until the flange contacts the bottom of the threaded well.

   Hold the flange in contact with the bottom of the well as you turn the screw connector to secure it.
3. Connect both sets of flow cell tubing to the flow cell.

   You will probably have a lot more PTFE tubing attached to the cell than you will need. The tubing will be trimmed at the next step.
4. Make sure that you keep track of which are the In and Out connectors on the flow cell.

Connecting the Flow Cell to the Pump

Take care not to stretch, crimp, fold or twist the flow cell tubing during installation.



1. Place the flow cell in the cell holder with the window facing to the right and left.
2. Route the tubing from the **Out** connector on the flow cell to the **Pump In** side of the pump tubing.

   Take care not to stretch, fold or crimp the PTFE flow cell tubing.
3. Measure the length of tubing you think you will need to make a strain-free connection, add 3 cm for error, and cut off the excess tubing.
4. Attach the cut end of the flow cell tubing from the **Out** connector to the **Pump In** side of the pump tubing using the connector that was installed at step 5 of Installing Pump Tubing.

Connecting Between the Flow Cell and the Sample

1. Thread the flow cell tubing from the **In** connector on the flow cell to one of
   - an autosampler sample probe
   - the metal tube (called the “beak”) on the sipper front panel
   - another sample source

   a. If connecting to an autosampler, thread the tubing out through the ports at the bottom of the standard sample compartment front cover and from there to the autosampler. Use the fittings supplied with the autosampler to connect between the flow cell tubing and the tubing that leads to the autosampler probe.

   b. If using the sipper beak, thread the flow cell tubing through the beak from the inside to the outside. The flow cell tubing should extend between 25 mm and 75 mm below the end of the beak so that it can be dipped into containers of sample and rinse solutions.

Tip

1. The volume of solution required to properly wash all traces of the previous sample out of a flow cell is generally considered to be six times the volume of the cell chamber plus the volume of the tubing leading from the beak to the cell. Total volume of sample or rinse solution required, and therefore total pumping time per sample, is minimized if the tubing between the cell and the beak is kept as short as possible.

   We recommend flow cells with a chamber volume of 160 mL. These cells have a window that is 2 mm wide and 8 mm tall – large enough to pass all or nearly all of the beam on every spectrophotometer in the Thermo Scientific product line. Following the rule of thumb above, the volume required to rinse one of these cells is 1 mL plus 6 times the volume of the tubing.
   —Its volume is 0.0028 mL per cm of length
   —It requires 0.17 mL of rinse solution per 10 cm of length
   —This tubing has an ID = 0.6 mm

2. Some samples may, over time, permanently contaminate the end of the tubing that dips into the sample container. Some customers choose to cut off the last approximately 1 cm of tubing on a regular basis to eliminate the risk of contamination from such build up. There are two operating modes that allow this measure to be taken without requiring frequent purchase of new flow cell tubing.

   a. Coil 20 to 30 cm of tubing from the In port of the flow cell inside the sample compartment between the cell and the beak. This coil acts as a "reservoir" of tubing that can be consumed 1cm at a time until it runs out and the flow cell tubing needs to be replaced.

   b. Purchase (independently) a suitable connector to go from one piece of 1/16–inch OD tubing to another and place this inside the sample compartment between the flow cell and the beak. The tubing between the connector and the sample can be replaced at will, without ever needing to replace the flow cell tubing.

   c. If connecting to another sample source, route the flow cell tubing to the source or to a connector that allows you to couple it to a different line leading to the source.

Tip This size PTFE tubing (1/16–inch OD) is widely used in chromatography. Suitable connectors can be found in the chromatography section of third party suppliers' catalogs.

If you chose a flow cell with glass connectors

Use a short piece of #14 pump tubing as a shunt to connect a length of plain 1/16–inch OD PTFE tubing from the In port of the flow cell to the sample source. The ID of #14 tubing is 1/16th inch so the PTFE fits into it nicely. You may need to wrap a cable tie around the pump tubing to get better contact with the PTFE to completely eliminate air leaks. Note that this method means that the sample comes into contact with soft pump tubing before entering the flow cell. If the sample should attack the pump tubing material this can lead to contamination of the sample, contamination of the flow cell and potentially to blockage of the narrow channels in the flow cell that renders the flow cell unusable.

Connecting the Pump to a Waste Container

1. Connect a suitable length of PTFE tubing to the **Pump Out** side of the pump head tubing using the connector inserted in step 5 of Installing Pump Tubing.
2. Thread this tubing out of the sample compartment through one of the openings at the base of the sample compartment front cover.

   Refer to "Routing Tubing or Cables into the Sample Compartment" in the spectrophotometer user guide for more information.

3. Route the tubing to the waste container.

Tip Good Laboratory Practice calls for waste containers to be placed inside a bucket capable of holding at least as much additional volume as the primary waste container. This is a safety measure to prevent spills in automated systems.

Before using your sipper you will need to calibrate the unit so that it knows for how long it must pump order to sip a particular volume. See "Calibrating the Sipper" for instructions. The sipper has only one speed and calibrates based on the number of turns of the pump required to deliver a certain volume. If you change the size of tubing used in the pump-head the volume pumped per revolution will also change, necessitating re-calibration of your sipper.

Calibrating the Sipper

Calibrate the Sipper configuration before using the accessory to analyze samples. Before you calibrate, install the pump tubing, Smart Sipper and flow cell, including all tubing connections.

CAUTION

- Avoid pinch hazard. Keep hands and objects clear of the accessory during operation.
- Évitez tout risque de pincement. Gardez vos mains, ainsi que tout objet, à l'écart de l'accessoire pendant fonctionnement.
- Quetschungen sind zu vermeiden. Hände und Objekte sind während der Operation vom Zubehör fern zu halten.
- Evitare il rischio di pizzicamento. Tenere mani e oggetti lontano dall'accessorio durante l'operazione.
- Evite riesgos de atrapamiento. Mantenga manos y objetos lejos del alcance del accesorio durante la operación.

Calibrating the sipper is an iterative process:

1. Tell the sipper to pump a particular volume of water.
2. Record the volume that it actually pumps.
3. If the volume is correct, the process is finished.
4. If the volume is incorrect, enter the volume from step 2 into the software.

   The software recalculates the number of turns of the pump-head required to deliver a known volume

5. Repeat from step 1 until the correct volume is pumped.

   Generally, no more than three iterations of the process are required to complete the calibration.

> **Note** In the following procedure we describe use of a graduated cylinder to measure the volume of water delivered by the pump. Most graduated cylinders are not calibrated to a particularly high level of accuracy. If a highly accurate calibration is required we recommend that the water pumped should be weighed and the volume calculated based on the literature value of the density of water at the temperature used.
>
> In order to achieve a reasonable level of accuracy in the calibration when using a graduated cylinder we recommend using a volume of at least 10 mL so that the impact of any error in the reading is small as a percentage of the total volume pumped.

❖ To calibrate the Sipper

1. Fill a graduated cylinder (25 mL cylinder recommended) with laboratory grade purified water or the solvent to be used for sample measurements.

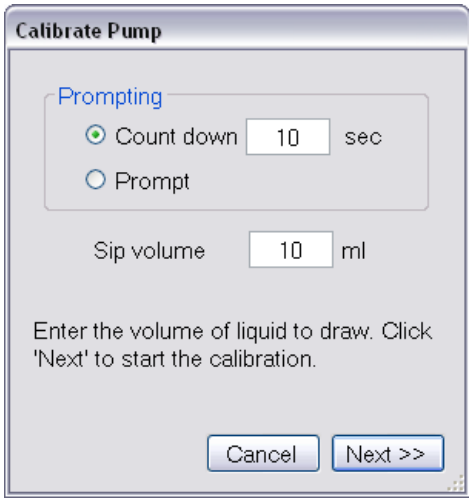
   The calibration will be more accurate if the viscosity of the solution used for calibration is similar to the viscosity of the sample solution.

2. Place the Sipper intake tube in the cylinder above the meniscus and the outlet tube in a waste container.

3. Open INSIGHT software and click **System Settings** > **Calibrations**.

4. Click **Calibrate** in the Sipper field.

   A prompt appears.



5. Enter the volume to be drawn for the calibration test in the Sip Volume box (typically 10 ml).

6. To display a prompt before each test, select **Prompt**.

   To sip automatically after a period of time, select **Count down** and enter the time.

7. Click **Next**.

   A prompt appears. The contents depends on the Prompting setting.

8. Record the volume of liquid in the cylinder then raise the cylinder so that the intake tube is far enough below the meniscus to allow the specified volume of water (+20%) to be sipped.

9. Click **OK** or **Pump Now** (or wait until the counter is finished).

   The Sipper attempts to draw the specified volume.

   A prompt requests the actual volume drawn.

10. Remove the inlet tube from the cylinder, record the volume of liquid remaining, and calculate the volume drawn.

    Enter this value in the Actual box and click **Next**.

11. Repeat steps 8 through 10 until the Actual volume matches the Expected volume.

12. Click **Done**.

Operation

In the selected INSIGHT software application, click **Settings > Accessories > Sipper** to display the settings for the Smart Sipper. The Sipper features appear only when a Smart Sipper is installed.

Table 1. Smart Sipper Settings

Feature	Description
Sip volume	For semi-automated sipper workflows, defines the volume to draw for each measurement. The sip volume must be greater than 0. Use sufficient volume to push any previous solution out of the flow cell. When the cell is filled, the sample material should also fill at least 8 cm of the inlet tube in front of the flow cell to prevent air bubbles from entering the cell. (Use an air gap if the sample material is limited.) Check the system for cross-contamination before taking measurements.
Settle time	For semi-automated sipper workflows, specifies a delay before the sample is measured to allow air bubbles to dissipate. Enter 0 to skip this step.

Feature	Description
Air gap duration	For semi-automated sipper workflows that include a “draw air” step, defines how long to draw air through the system to move a small sample volume to the flow cell. The correct setting depends on the **Sip volume** setting and the length of the inlet tube. Typically, draw sufficient air to push the sample into the cell but leave enough sample material to fill at least 8 cm of the inlet tube in front of the flow cell. Enter 0 to skip this step.
Rinse duration	For semi-automated sipper workflows that include a “rinse” step, specifies how long to draw the rinse solution through the system. Enter 0 to skip this step.
Sipper Workflows	Defines the sequence for semi- and fully-automated sipper workflows. For semi-automated workflows, use the **Measure** button in the software to start the workflow. • **Sip, settle, measure, prompt, return** draws the specified sip volume, delays the specified settle time, measures the sample, and prompts to move the inlet tube to the return container. When the user clicks **OK** or presses the Sipper front panel switch, returns the sample to the container. • **Sip, draw air, settle, measure, prompt, rinse, draw air** draws the specified sip volume and prompts to remove the inlet tube. When the user clicks **OK** or presses the front panel switch, draws air for the specified period, waits the specified settle time, measures the sample and prompts to place the inlet tube in the rinse solution. When the user clicks **OK** or presses the switch, draws the rinse solution for the specified time and prompts to remove the inlet tube. When the user clicks **OK** or presses the switch, draws air for the specified period. • **Autosampler in use**. Indicates the Sipper is connected to an autosampler for automated measurements. The autosampler workflow follows the sequence **sip, draw air, settle, measure**. Samples are measured using the selected application. Results are placed in the selected workbook.
Manual Control	Activates the Sipper front panel switch as a pump control. When the check box is selected, pressing the switch once causes the pump to draw through the inlet tube; pressing it again stops it. This feature is unavailable when an autosampler is connected to the instrument.

Feature	Description
Sip Volume button	Immediately causes the pump to draw the specified sip volume through the inlet tube. This feature is unavailable when an autosampler is connected to the instrument.
Pump On/Pump Off buttons	Toggles between **Pump On** and **Pump Off**. **Pump On** causes the pump to draw continuously through the inlet tube; **Pump Off** causes it to stop. This feature is unavailable when an autosampler is connected to the instrument.

Leaks in the Sample Compartment

The pump is an electrical device. It makes heat and has ventilation holes in the sides of the casing below the baseplate. If enough liquid leaks that it runs across the baseplate and down the sides of the casing the liquid may enter through the vents and cause a short-circuit, damaging the accessory.

NOTICE We do not repair Smart Sipper Accessories that have suffered electrical damage due to spills. The only option is to purchase a replacement pump or accessory system.

See the recommendations for routine maintenance to prevent

- Pump-head tubing failure
- Leaks at the tubing connectors
- Leaks at the flow cell connections

Maintenance

Routine Maintenance

Examine pump tubing weekly and when pumping efficiency is impaired. Replace crimped or worn tubing. Most laboratories have a SOP that calls for replacing the pump-head tubing at a certain time interval “whether it needs it or not”.

Examine the connections between the pump-head tubing and the PTFE tubing weekly. If there are signs of leakage, replace components as necessary.

Examine the flow cell tubing connections weekly. Visual inspection only. Do not disconnect the screw fittings. If there are signs of leakage, replace the fittings. Most laboratories have a SOP that calls for replacing the flow cell tubing at a certain time interval “whether it needs it or not”. This is generally a lot less frequent than for pump-head tubing.

If using a flow cell with glass hose barbs rather than screw connectors, examine the connection between the rubber tubing and the glass hose barb weekly. Replace the rubber tubing immediately if there are signs of cracking. Replace the rubber tubing on a routine basis at a time interval derived from your experience in checking the condition of the rubber.

Cleaning

Spill Cleanup

- Lift the front of the accessory to disconnect it from the Smart connector and cause any spilled material to run off the back, not the sides.
- Clean up spilled chemicals or water immediately then remove the accessory from the sample compartment to complete cleaning.
- Clean up spills using an absorbent cloth, paper towels or sponge.
- Use a lint-free cloth dampened with plain water to wipe the area near the cell holder.
- Dry the surface with another cloth.

Cleaning Flow Cells

Rinse the flow cell and inlet tubing thoroughly with laboratory grade purified water after each analysis and before turning off the Smart Sipper. Keep the cell filled with purified water when not in use.

Follow the cell manufacturer's directions regarding routine cleaning. If no instructions are supplied, at least once a week, remove the flow cell from the accessory and soak it in a detergent solution, diluted according to the manufacturer's instructions. When finished, reconnect the cell and flush it thoroughly with laboratory grade purified water.

Tubing Specifications

We offer these Smart Sipper tubing kits:

- Silicone
- Acid-resistant
- Chemical-resistant
- Bio-compatible

Tubing kits include:

- Silicone and Acid-Resistant tubing kits contain two sizes suitable for high and low volume sampling
- Chemical resistant and Bio-Compatible tubing kits contain only one size tubing because these rubbers are significantly harder and more challenging for the pump head.

  The sizes chosen have been found to work successfully in the pump head.
- Flow cell tubing
- Connecting nipples or other suitable connectors

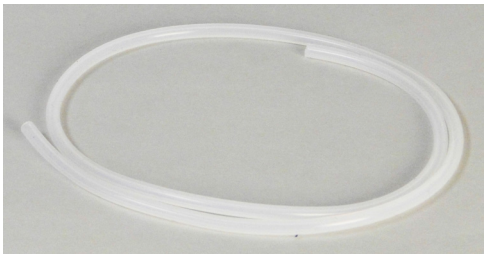
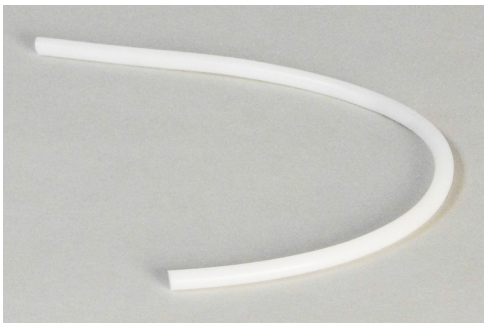
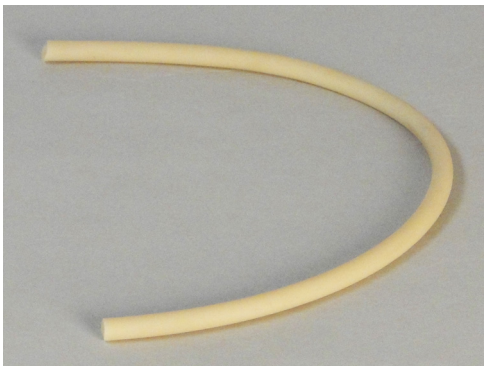
Detailed specifications are provided in the following table.

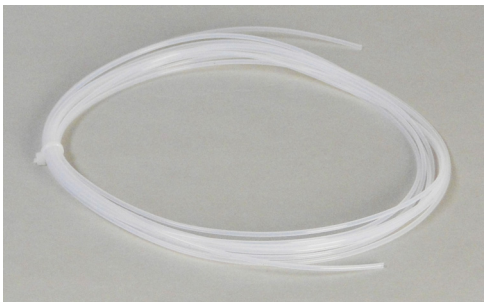
Table 2. Tubing Kit Specifications

	Silicone	Acid-Resistant	Chemical-Resistant	Bio-Compatible
Configuration	• Silicone pump tubing, #14 • Silicone pump tubing, #16 • PTFE flow cell tubing, 1.128 mm, 18G • Hose connection nipples	• C-Flex pump tubing, #14 • C-Flex pump tubing, #16 • PTFE flow cell tubing, 1.128 mm, 18G • Hose connection nipples	• Viton pump tubing, #16 • PTFE flow cell tubing, 1.128 mm, 18G • Hose connection nipples	• Bio-compatible pump tubing, #14 • PTFE flow cell tubing, 1.128 mm, 18G • Hose connection nipples
Max. Temperature	100 °C (212 °F)	40 °C (104 °F)	150 °C (302 °F)	74 °C (165 °F)
Min. Temperature	0 °C (32 °F)	0 °C (32 °F)	0 °C (32 °F)	0 °C (32 °F)
Sterilization method	Autoclave, Ethylene Oxide	Autoclave, Ethylene Oxide, Gamma Irradiation		Autoclave (121 °C, 1Kg/cm^2 pressure for 30 min), Ethylene Oxide
Applications	Standard pump tubing kit for use with non-corrosive aqueous liquids with low protein binding.	For use with aqueous acids and bases. Compatible with biological samples with very low protein binding.	For use with corrosives, solvents and oils. Offers excellent chemical resistance.	For use with life science samples with superior chemical resistance, specifically with acids, bases, various alcohols and inorganic compounds. Bio-compatible tubing meets FDA 21 CFR 177.2600 and USP Class VI regulations.

It is important to use the correct tubing for the pump and flow cell. The following table provides photos and descriptions.

Table 3. Tubing Descriptions

Tubing	Description
	Silicone pump tubing
	Acid-resistant pump tubing
	Chemical-resistant pump tubing
	Bio-compatible pump tubing

Tubing	Description
	Flow cell tubing
	Tubing connectors

Pump Tubing Specifications

Tubing used in the Smart Sipper pump must meet specifications for size and flexibility and must be compatible with your sample material. Use tubing from a Sipper tubing kit (available from us) or equivalent tubing that meets these specifications. See Smart Sipper Tubing Chemical Compatibility.

NOTICE Tubing that fits too tightly in the Sipper pump will cause excessive pump strain and wear. Tubing that is too loose will decrease pumping efficiency.

Table 4. Pump Tubing Specifications

	Pump Tubing Size	
Specification	**Size 14**	**Size 16**
Outer diameter	5 mm (0.20 in)	7 mm (0.28 in)
Inner diameter	1.6 mm (0.06 in)	3.2 mm (0.12 in)
Hose barb size	1.6 mm (0.06 in)	3.2 mm (0.12 in)

Smart Sipper Tubing Chemical Compatibility

These pump tubing kits are available from us:

- Silicone
- Acid-resistant
- Chemical-resistant
- Bio

Silicone pump tubing is suitable for most aqueous solutions and is recommended when the pump will be used for prolonged periods. Acid-Resistant pump tubing resists most acids and bases from pH 1 to 14 while remaining relatively soft such that is does not place much strain on the sipper pump. Chemical-resistant pump tubing withstands many strong acids, alkalis and organic solvents which corrode silicone rubber and is recommended when acidic solutions are run in the system. Bio pump tubing has superior chemical resistance to acids, bases, salts and ketones, meeting USP Class VI requirements and the FDA criteria for food contact.

Use the table below to verify that your chemicals are compatible with the provided tubing, or use other tubing that is compatible and meets our specifications. The table is a general guide. Each rating is based on ideal testing conditions used by tubing manufacturers. Temperature, length of service, chemical concentration, etc. can affect chemical resistance. Test the tubing under your experimental conditions.

Key	Meaning
A	No effect; little noticeable change
B	Minor effect; slight corrosion or discoloration
C	Moderate effect; not recommended for continuous use; softening, loss of strength, swelling and/or shrinkage
D	No data available

Table 5. Chemical Compatibility for Smart Sipper Tubing Kits

	Pump Tubing Kit					Pump Tubing Kit			
Chemical	**Sil**	**Acid-R**	**Chem-R**	**Bio**	**Chemical**	**Sil**	**Acid-R**	**Chem-R**	**Bio**
Acetaldehyde	B	A	D	C	Hypochlorous acid	D	A	A	A
Acetate LMW	—	A	—	D	Iodine solutions	C	C	A	A
Acetic acid <5%	A	A	—	A	Iodoform	—	—	C	D
Acetic acid >5%	A	A	B	A	Kerosene	D	D	A	D
Acetic anhydride	C	B	D	A	Ketones	—	B	—	C
Acetone	C	C	D	B	Lacquer solvents	D	D	D	D
Acetonitrile	—	A	D	B	Lactic acid, 3–10%	A	A	A	A
Acetyl bromide	—	A	—	D	Lead acetate	D	A	D	A
Acetyl chloride	C	A	A	D	Linseed oil	A	D	A	B
Air	A	A	A	A	Lithium hydroxide	D	A	C	B
Aliphatic hydrocarbons	—	D	—	D	Magnesium chloride	A	A	A	A
Aluminum chloride	B	A	A	A	Magnesium sulfate	A	A	A	A
Aluminum sulfate	A	A	A	A	Malic acid	B	A	A	A
Alums	A	A	A	A	Manganese salts	B	A	A	A
Ammonia, gas/liquid	C	A	D	B	Mercury salts	—	A	A	A
Ammonium acetate	—	A	D	A	Methane	D	D	A	A
Ammonium carbonate	C	A	A	A	Methanol (methyl alcohol)	A	—	B	A
Ammonium chloride	C	A	A	A	Methyl chloride	D	A	B	D
Ammonium hydroxide	A	A	B	A	Methyl ethyl ketone (MEK)	D	—	D	C
Ammonium nitrate	C	A	A	A	Mixed acid (40% H2SO4, 15% HNO3)	—	—	—	A
Ammonium phosphate	A	A	A	A	Molybdenum disulfide	—	A	A	A
Ammonium sulfate	A	A	A	A	Monoethanolamine	B	B	D	D
Amyl acetate	D	D	D	D	Naphtha	D	D	A	D
Amyl alcohol	D	D	A	A	Natural gas	A	D	A	A
Amyl chloride	D	D	A	D	Nickel salts	A	A	A	A

	Pump Tubing Kit					Pump Tubing Kit			
Chemical	**Sil**	**Acid-R**	**Chem-R**	**Bio**	**Chemical**	**Sil**	**Acid-R**	**Chem-R**	**Bio**
Aniline	D	B	B	D	Nitric acid (dil)	B	A	B	A
Aniline hydrochloride	D	B	B	D	Nitric acid (med)	C	—	A	A
Aqua regia (80% HCl, 20% H)	D	—	B	A	Nitric acid (conc)	D	—	A	A
Aromatic hydrocarbons	—	D	A	D	Nitrobenzene	D	D	B	D
Arsenic salts	—	—	D	A	Nitrogen oxides	D	A	D	A
Barium salts	A	A	A	A	Nitrous acid	—	A	—	A
Benzaldehyde	B	D	D	C	Oils, animal	B	B	A	B
Benzenesulfonic acid	D	A	A	D	Oils, mineral	B	B	A	D
Bleaching liquors	B	B	A	A	Oils, vegetable	B	B	A	B
Boric acid	A	A	A	A	Oleic acid	D	A	B	C
Bromine	D	A	A	D	Oxalic acid, cold	B	A	A	A
Butane	D	D	A	B	Oxygen, gas	B	A	B	A
Butanol (butyl alcohol)	B	B	A	A	Palmitic acid, 100% in ether	D	—	A	C
Butyl acetate	D	D	D	D	Perchloric acid	D	A	A	A
Butyric acid	D	A	B	D	Perchloroethylene	D	B	A	D
Calcium oxide	A	—	A	A	Phenol (carbolic acid)	D	D	A	A
Calcium salts	B	A	A	A	Phosphoric acid, 50%	C	A	A	A
Carbon bisulfide	D	D	—	D	Phthalic acid	B	D	B	A
Carbon dioxide	B	A	A	A	Plating solutions	D	A	A	A
Carbon tetrachloride	D	B	A	D	Polyglycol	A	B	A	B
Chlorine, dry	D	A	A	C	Potassium carbonate	—	A	A	A
Chlorine, wet	D	A	B	C	Potassium chlorate	B	A	A	A
Chloroacetic acid	—	A	D	A	Potassium hydroxide (med)	B	A	D	A
Chlorobenzene	D	D	A	D	Potassium hydroxide (conc)	C	A	D	A
Chlorobromomethane	D	D	A	D	Potassium iodide	—	A	A	A
Chloroform	D	D	A	D	Propanol (propyl alcohol)	A	—	A	A

	Pump Tubing Kit					Pump Tubing Kit			
Chemical	**Sil**	**Acid-R**	**Chem-R**	**Bio**	**Chemical**	**Sil**	**Acid-R**	**Chem-R**	**Bio**
Chlorosulfonic acid	D	A	D	D	Pyridine	D	A	D	C
Chromic acid, 30%	C	A	A	B	Silicone fluids	C	B	A	A
Chromium salts	—	A	—	A	Silicone oils	C	B	A	A
Copper salts	A	A	A	A	Silver nitrate	A	A	A	A
Cresol	D	D	A	A	Soap solutions	A	A	A	A
Cyclohexane	D	D	A	D	Sodium bicarbonate	A	A	A	A
Cyclohexanone	D	D	D	C	Sodium bisulfate	—	A	A	A
Diacetone alcohol	B	A	D	A	Sodium bisulfite	A	A	A	A
Dimethyl formamide	B	B	D	A	Sodium borate	A	A	A	A
Dimethyl Sulfoxide (DMSO)	—	—	—	—	Sodium carbonate	A	A	A	A
Essential oils	C	B	—	D	Sodium chlorate	C	A	A	A
Ethanol (ethyl alcohol)	A	B	A	A	Sodium chloride	A	A	A	A
Ether	D	D	D	D	Sodium ferrocyanide	—	A	A	A
Ethyl acetate	B	D	D	D	Sodium hydrosulfite	—	A	—	A
Ethyl bromide	D	A	A	D	Sodium hydroxide (dil)	A	A	A	A
Ethyl chloride	D	A	A	D	Sodium hydroxide, 25%	B	B	A	A
Ethylamine	C	A	D	B	Sodium hydroxide (conc)	—	C	A	A
Ethylene chlorohydrin	C	A	A	A	Sodium hypochlorite, <5%	B	A	A	A
Ethylene dichloride	D	A	A	D	Sodium hypochlorite, >5%	B	A	A	A
Ethylene glycol	A	B	A	A	Sodium nitrate	D	A	A	A
Ethylene oxide	D	A	D	A	Sodium silicate	A	A	A	A
Fatty acids	C	B	A	C	Sodium sulfide	A	A	A	A
Ferric chloride	B	A	A	A	Sodium sulfite	A	A	A	A
Ferric sulfate	B	A	A	A	Steam, up to 40 psi	A	—	B	D
Ferrous chloride	C	A	A	A	Stearic acid	B	A	A	C
Ferrous sulfate	C	A	A	A	Styrene	D	D	A	D

	Pump Tubing Kit					Pump Tubing Kit			
Chemical	**Sil**	**Acid-R**	**Chem-R**	**Bio**	**Chemical**	**Sil**	**Acid-R**	**Chem-R**	**Bio**
Fluoboric acid	A	A	—	A	Sulfuric acid (dil)	D	A	A	A
Fluoroborate salts	—	A	—	A	Sulfuric acid (med)	D	A	A	A
Fluosilicic acid	D	A	A	A	Sulfuric acid (conc)	D	A	A	A
Formaldehyde	B	A	D	C	Sulfurous acid	D	A	B	A
Formic acid, 25%	B	A	D	A	Tannic acid	B	A	A	A
Freon® TMS	—	C	—	A	Tanning liquors	—	B	—	A
Gasoline, high-aromatic	D	D	A	D	Tartaric acid	A	A	A	A
Gasoline, nonaromatic	D	D	A	D	Tin salts	B	A	—	A
Glucose	A	A	A	A	Toluene (toluol)	D	D	A	D
Glue, P.V.A.	A	A	A	A	Trichloroacetic acid	D	A	C	A
Glycerin	A	B	A	A	Trichloroethylene	D	D	A	D
Hydriodic acid	—	A	A	A	Trisodium phosphate	—	A	A	A
Hydrobromic acid, 30%	D	A	A	A	Turpentine	D	D	A	D
Hydrochloric acid (dil)	D	A	A	A	Urea	B	A	—	A
Hydrochloric acid (med)	D	A	A	A	Uric acid	—	A	—	A
Hydrochloric acid (conc)	D	B	A	A	Water, fresh	B	A	A	A
Hydrocyanic acid	C	A	A	A	Water, salt	A	A	A	A
Hydrocyanic acid, gas, 10%	C	A	A	A	Xylene	D	D	A	D
Hydrofluoric acid, 50%	D	A	D	A	Zinc chloride	A	A	A	A
Hydrofluoric acid, 75%	D	A	D	C					
Hydrogen peroxide (dil)	A	A	A	A					
Hydrogen peroxide, 90%	B	D	A	B					

Troubleshooting

Problem	Possible Cause	Solution
Pump does not operate	The accessory is not installed properly or the wrong pump tubing is used.	Remove and reinstall the accessory including the Sipper front panel. Reconnect the cables to the front panel. See Installation. Ensure the pump tubing is the correct diameter and material. See Pump Tubing Specifications and Smart Sipper Tubing Chemical Compatibility.

Problem	Possible Cause	Solution
Pump does not draw	Pump tubing is crimped or damaged	Check the entire pumping system for damage or excessive wear and replace sections as necessary. To prevent crimping, remove pump tubing before storing the accessory. When the pump is idle, leave the instrument and accessory powered on and some liquid in the sample intake container. The accessory periodically "sips" a small volume to redistribute the pressure on the tubing.
	The pump tubing is not compatible with your sample	Chemical incompatibility manifests in many ways. e.g., • Silicone pump tubing becomes cloudy • Particles of rubber break off, potentially blocking narrow parts of the circuit • Tubing "melts" and the interior walls stick to one another where they are pressed by the pump-head, sealing the tubing. Many factors (temperature, length of service, chemical concentration, etc.) can affect chemical resistance; test the tubing under your conditions. See Smart Sipper Tubing Chemical Compatibility. Rinse flow cells and tubing thoroughly after use.
	Leak at a connector	If one of the connectors between the pump and the sample is leaking badly enough the pump may simply draw air through the gap and not pull any sample at all. Check all connectors and connections.

Problem	Possible Cause	Solution
Noise peaks in the spectral data or inconsistent results	There are air bubbles in the flow cell	Inspect the flow cell for bubbles, which diffract the light so less energy is passed to the detector. To prevent air bubbles from entering the cell, use sufficient volume so the sample material fills at least 8 cm of the inlet tube in front of the flow cell. (Use an air gap if the sample material is limited.) To remove air bubbles adhering to flow cell walls (occurs frequently with biological materials), remove the cell and soak it in a recommended detergent. When finished, reconnect the cell and flush it thoroughly with laboratory grade purified water.

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