SENSIRION
THE SENSOR COMPANY

Sensor Fluidic Ports and Tubing Connections

Application Note for Liquid Flow Sensors

Preface

Each Sensirion liquid flow meter is equipped with a specific type of fluidic port. The type of port has been selected for best sensor performance and ease of use in a wide range of applications. Each type of fluidic port has been designed for use with a certain type or certain types of tubing (tubing material, inner and outer tubing diameter).

This application note lists the applicable port-tubing combinations and relevant fitting material or adapters for the kinds of fluidic ports used.

Content

1 Overview of Fluidic Ports and Tubing Combinations

The following figure shows the type of fluidic port for each liquid flow meter and highlights the appropriate tubing dimensions for each sensor.

		Tubing OD	1/32" (0.80 mm)	1/16" (1.6 mm)		1/8" (3.2 mm) and 1.8-3.0 mm			≥4 mm	≥3/16" (≥4.8 mm)
		Tubing ID	≤0.020" (0.50 mm)	≤0.030" (0.75 mm)	0.040" (1.0 mm)	<1/16" (<1.6 mm)	1/16" (1.6 mm)	≥0.080" (≥2.0 mm)	any	any
Fluidic Port	Sensor									
UNF 6-40 coned port	LG16-0025		1	-	-	-	-	-	-	-
	LG16-0150		1	-	-	-	-	-	-	-
	LG16-0430		1	-	-	-	-	-	-	-
	SLI-0430C		1	-	-	-	-	-	-	-
UNF 10-32 coned port	SLG-0025		2	3	3	6	6	6	-	-
	SLG-0075		2	3	3	6	6	6	-	-
	SLG-0150		2	3	3	6	6	6	-	-
UNF 1/4"-28 flat bottom port	LG16-0431		8	4	4	5	5	5	7	7
	SLI-0430		8	4	4	5	5	5	7	7
	LG16-1000		-	4	4	5	5	5	7	7
	SLI-1000		-	4	4	5	5	5	7	7
	SLF3S-0600F		-	4	4	5	5	5	7	7
	LS32-1500		-	4	4	5	5	5	7	7
	SLS-1500		-	4	4	5	5	5	7	7
	SLF3S-1300F		-	4	4	5	5	5	7	7
	LG16-2000		-	4	4	5	5	5	7	7
	SLI-2000		-	4	4	5	5	5	7	7

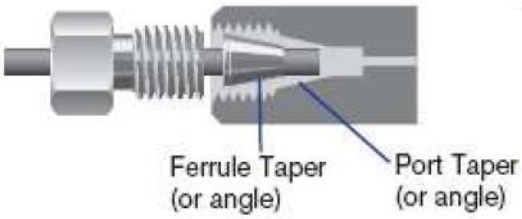
Fig. 1: Fluidic port types of Sensirion liquid flow meters and relevant connection tubing dimensions. Green fields indicate recommended combinations. The numbers indicate in which subsection of section 3 in this document the specific port-tubing combination is described in detail.

2 Types of Fluidic Ports

This section gives a brief overview on the types of ports used in Sensirion's liquid flow meters. A more detailed description and further information can be found e. g. in the "All About Fittings" guide by John W. Batts, IV, available on the internet.

2.1 Coned Port

In coned ports, a conical ferrule is compressed between a conical receptacle on the port and the connected tube. This leads to a reliable seal between tube, ferrule, and port. The ferrule is crimped onto the tubing during tightening of the fitting. Coned ports provide the best pressure resistance, a minimized dead volume, and thus the best performance in very flow rate and very high-pressure applications. In some configurations, the connection tube protrudes into a pilot hole in the port. For use with smaller outer diameter (OD) tubing, a special ferrule, which also matches the pilot hole, needs to be used.



2.2 Flat Bottom Port

In flat bottom ports, the Ferrule is pressed against the flat bottom of the port and is also compressed against the tube. By design, only the bottom face of the port, the ferrule and the tube are in contact with the fluid. Depending on the outer diameter of the connecting tube, different ferrules need to be used. This port is commonly used in low and moderate pressure applications and in combination with larger tubes. It is used on most of Sensirion's liquid flow meters.

Note that nuts on the flat bottom ports should only be tightened finger-tight if not specified otherwise in the sensor's datasheet.

2.3 Barbed Connector

Barbed connectors provide a quick, simple and inexpensive way to connect soft tubing to a hard fitting. Barbs are very common in low pressure fluidic applications. However, at higher pressures the soft tubing can expand and may slip off the fitting. The barb provides some resistance and for improved reliability the tube may be secured using a clamp. A variety of barbed adapters for different inner tube diameters is available for flat bottom or coned ports.

2.4 Luer Connector

The Luer taper is widely used, especially in medical applications. It provides sealing by pushing a coned male piece in to a coned female counterpart. The friction between the two parts holds the connection. For a more secure connection, the fitting may also be equipped with a lock ring (Luer lock). While luer connections are very easy to handle, they are in general not as long term reliable as dedicated fittings and are not optimized for dead volume.

3 Description of Specific Port-Tubing Combinations

3.1 UNF 6-40 Coned Port with 1/32" OD Tubing (LG16-0025, LG16-0150, LG16-0430, SLI-0430C)

The low flow rate LG16 (LG16-0025, LG16-0150, LG16-0430) and the SLI-0430C sensors use a coned port with UNF 6-40 thread compatible with Vici® NanovolumeTM fittings for 1/32" OD PEEK tubing.

Part description	*Part Number*	*Image*
One-piece nut / ferrule NanovolumeTM	Vici: JR-C-NNFFPK	
One-Piece Fingertight Fitting, Valco, 6-40 Coned, for 1/32" OD	Idex: M-645	

Table 3.1

3.2 UNF 10-32 Coned Port with 1/32" OD Tubing (SLG-0025, SLG-0075, SLG-0150)

Different fittings are available for the UNF 10-32 coned port of the SLG flow meters. The ferrule PK-132 provides a convenient solution to use the SLG flow meters with 1/32" OD tubing. The ferrule should be used in combination with the U-400 stainless steel nut.

Part description	*Part Number*	*Image*
PEEK Ferrule for 1/32" tubing on 10-32 coned ports, with stainless steel ring.	Idex: PK-132	
Stainless steel nut for UNF 10-32 thread	Idex: U-400	

Table 3.2

3.3 UNF 10-32 Coned Port with 1/16” OD Tubing (SLG-0025, SLG-0075, SLG-0150)

The UNF 10-32 coned port of the SLG sensors has been designed for use with 1/16" OD stainless steel or plastic (PEEK) tubing. Depending on the pressure requirements of the application, the one- or two-piece finger tight PEEK fittings may be used. For high-pressure applications, a stainless steel ferrule & nut should be used.
The ports of the SLG flow sensors are compatible with Thermo Fisher Scientific nanoViper™ fittings.

Part description	*Part Number*	*Image*
PEEK Ferrule for 1/16" tubing on 10-32 coned ports	Idex: PK-100	
Finger tight nut for UNF 10-32 thread	Idex: PK-110	
One-piece finger tight fitting for 1/16" OD tubing	Idex: F-120	
Stainless steel ferrule for 1/16" tubing on 10-32 coned ports	Idex: U-401	
Stainless steel nut for UNF 10-32 thread	Idex: U-400	
Stainless steel fitting for 1/16" OD steel tubing for high pressure applications (double sealing) short version.	Idex: VHP-200	
Stainless steel fitting for 1/16" OD steel tubing for high pressure applications (double sealing) long version.	Idex: VHP-205	
Reusable fitting for 1/16" OD stainless steel tubing.	Idex: VHP-320	

Table 3.3

3.4 UNF 1/4"-28 Flat Bottom Port with 1/16" OD Tubing (SLF3S-0600F, LG16-0431, SLI-0430, LG16-1000, SLI-1000)

On the SLF3x, SLI, SLS, LS32 and some of the LG16 flow sensors a standard flat bottom port with 1/4"-28 UNF thread is used. For the lower flow rate sensors (SLF3S-0600F, SLI-0430, LG16-0431, SLI-1000 and LG16-1000), this port may be used with 1/16” (1.6 mm) outer diameter tubing. For the LS32-1500, SLS-1500, SLF3S-1300F, LG16-2000, and SLI-2000 flow sensors larger tubing should be used. See next section.

Part description	*Part Number*	*Image*
Ferrule for 1/16" OD tubing on 1/4"-28 flat bottom port (ETFE, blue)	Idex: P-200	
Fingertight nut for 1/16" OD tubing on 1/4"-28 flat bottom port (POM, black)	Idex: P-201	
Nut and ferrule set (P-200 + P-201)	Idex: XP-201	
(other materials and colors also available)		

Table 3.4

3.5 UNF 1/4"-28 Flat Bottom Port with 1/8" OD Tubing (and 1.8mm to 3.0 mm ID Tubing) (SLF3S-0600F/-1300F, LG16-0431/-1000/-2000, SLI-0430/-1000/-2000, LS32-1500, SLS-1500)

The following table lists the recommended fitting types for the SLI, SLS, LS32 and some of the LG16 flow meters. In order to avoid adverse fluidic effects leading to reduced sensor performance, SLF3S-0600F should be used with ID 1.0 mm tubing or larger, the LS32-1500 and SLS-1500 should be used with ID 1/16" (1.6 mm) tubing or larger, and the SLF3S-1300F, LG16-2000 and SLI-2000 should be used with ID 2.0 mm tubing or larger. Therefore, not all of the ferrules listed below are recommended for all sensors.

Part description	*Part Number*	*Image*
Finger tight nut for 1/8" OD tubing on 1/4"-28 flat bottom port (POM, green)	Idex: P-305	
Nut and ferrule set POM green (P-305 + P-300)	Idex: XP-305	
Short finger tight nut for 1/8" OD tubing on 1/4"-28 flat bottom port (PEEK, natural)	Idex: P-335	
Nut and ferrule set PEEK short (P-335 + P-300)	Idex: XP-335	
Extra-long finger tight nut for 1/8" OD tubing on 1/4"-28 flat bottom port (ETFE, natural)	Idex: P-310N	
Ferrule for 1/8" (3.2 mm) OD tubing on 1/4"-28 flat bottom port (ETFE, yellow) *	Idex: P-300	
Ferrule for 3 mm OD tubing on 1/4"-28 flat bottom port (ETFE, orange) *	Idex: P-343	
Ferrule for 2.5 mm OD tubing on 1/4"-28 flat bottom port (ETFE, white) *	Idex: P-353	
Ferrule for 1.8 mm and 2.0 mm OD tubing on 1/4"-28 flat bottom port (ETFE, green) *	Idex: P-342	
(other materials and colors also available)		

** Please see your sensor's datasheet for restrictions on inner diameter of the connection tubing.*

Table 3.5

3.6 Adapters for UNF 10-32 Coned Port with Larger OD Tubing (>1/16”) (SLG-0025, SLG-0075, SLG-0150)

For accurate measurements of lowest flow rates, as covered by the SLG flow meter family, the fluidic fitting should be selected carefully. Sensirion recommends to use the fittings recommended in sections 2.2 and 2.3 with the corresponding 1/32” or 1/16” OD tubing whenever possible. However, sometimes different tubing dimensions need to be used for specific reasons. In this case the following adapters can be used to connect larger tubes to the UNF 10-32 coned port of the SLG flow meters, particularly in low pressure applications.

Note: Some of the adapters have a significant internal volume and may introduce a dead volume at the fitting connection. If air is being trapped in the fitting this may increase the settling time of the flow rate in the fluidic system and therefore reduce its response time at the low flow rates of the SLG sensors.
Especially barbed adapters (for soft tubing) or luer fittings should be used with caution due to the above described issue.

Part description	*Part Number*	*Image*
Adapter 10-32 coned male to 1/4-28 female flat bottom port (PEEK, natural)	Idex: P-652	
See section 2.5 for connecting 1.8 mm – 3.2 mm OD tubing to the 1/4-28 flat bottom port.		
Adapter 10-32 coned male to barb for tubing ID 1/16” (1.6 mm) for tubing ID 1/8” (3.2 mm) for tubing ID 3/16” (4.8 mm)	 Idex: P-663 Idex: P-664 Idex: P-665	
Adapter UNF 10-32 coned port male to Luer lock female (ETFE, natural)	Idex: P-642	

Table 3.6

3.7 Adapters for UNF 1/4”-28 Flat Bottom Port with Larger OD Tubing (>1/8”) (SLF3S-0600F/-1300F, LG16-0431/-1000/-2000, SLI-0430/-1000/-2000, LS32-1500, SLS-1500)

The UNF 1/4"-28 flat bottom port can only accommodate tubing up to 1/8” OD. When larger tubing needs to be connected to the sensor, adapters with a 5/16-24 or 1/2-20 flat bottom port need to be used. A corresponding nut and the applicable ferrule can then be attached to the tubing. In general, threaded adapters provide a reliable and durable seal. Barbed adapters (for soft tubing) or luer fittings may be convenient for installation but may provide a less reliable seal. They should be used with consideration.

Note 1: Some of the adapters have a significant internal volume or may introduce a dead volume at the fitting connection. This may increase the settling time of the flow rate in the fluidic system and therefore reduce its response time at low flow rates (SLI-0430 and LG16-0431).

Note 2: Some of the adapters have a small diameter through hole. This may adversely affect the sensor performance at higher flow rates (SLF3S-1300F, SLI-2000, LG16-2000, SLS-1500, LS32-1500). For best performance, the inner diameter of the connection tubing (and the adapter!) should be equal to or larger than the inner diameter of the flow meter. See the corresponding notes in the table below.

Part description	*Part Number*	*Image*
Adapter 1/4"-28 male to 5/16"-24 flat bottom port	Idex: P-681	
Fingertight Nut for 5/16"-24 flat bottom port	Idex: P-132	
Ferrule for 4 mm OD tubing on 5/16"-24 flat bottom port (PCTFE, natural)	Idex: P-139	
Ferrule for 4 mm OD tubing on 5/16"-24 flat bottom port (ETFE, natural)	Idex: P-344	
Ferrule for 3/16” (4.8 mm) OD tubing on 5/16"-24 flat bottom port (ETFE, blue)	Idex: P-133	

Adapter 1/4"-28 male to 1/2"-20 flat bottom port (PCTFE, natural)	Idex: P-684	
Fingertight Nut for 1/4" OD tubing on 1/2"-20 flat bottom port (PEEK, black)	Idex: U-655	
Ferrule for 1/4" OD tubing on 1/2"-20 flat bottom port (ETFE, natural)	Idex: U-650	
Fingertight Nut for 5/16" OD tubing on 1/2"-20 flat bottom port (PEEK, black)	Idex: U-662	
Ferrule for 5/16" OD tubing on 1/2"-20 flat bottom port (ETFE)	Idex: U-660	

Adapter 1/4"-28 flat bottom male to barb for 1/16" (1.6 mm) ID tubing * for 3/32" (2.4 mm) ID tubing for 1/8" (3.2 mm) ID tubing	e.g. Value Plastics: ABR004-J1A Value Plastics: ABR007-J1A Value Plastics: ABR013-J1A	

** This adapter has an ID of 1.5 mm. See your sensor’s datasheet for restrictions on inner diameter of the connection tubing.*

Adapter 1/4"-28 male to luer lock female	Value Plastics: BSFTLL-J1A	

Adapter 1/4"-28 male to luer lock male	Value Plastics: ABSML-J1A	

Table 3.7

4 Fittings and Adapters Included in Flow Meter Kits and Evaluation Kits

This section provides a list of fluidic fittings included in Sensirion's Flow Meter Kits and Evaluation Kits. All information is provided for convenience only and is subject to change without notice.
If any sensor is installed into a specific application with a specific type of fitting, the corresponding fitting has to be purchased separately from the original source.

4.1 SLG Flow Meter Kits (SLG-0025 Flow Meter Kit, SLG-0075 Flow Meter Kit, SLG-0150 Flow Meter Kit)

The following table lists the parts included with the SLG flow meter kits.

Part description	*Part Number*	*Quantity*
Stainless steel fitting for 1/16" OD steel tubing for high pressure applications (double sealing) short version.	Idex: VHP-200	
One-piece fitting for 1/16"	Idex: F-120	
PEEK Ferrule for 1/32" tubing on 10-32 coned ports, with stainless steel ring.	Idex: PK-132	

Table 4.1

4.2 SLI/SLS/SLF3x Flow Meter Kits (SLI-0430 Flow Meter Kit, SLI-1000 Flow Meter Kit, SLI-2000 Flow Meter Kit, SLS-1500 Flow Meter Kit, SLF3x Evaluation Kit)

The following table lists the parts included with the SLI/SLS/SLF3x flow meter kits.

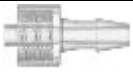
Part description	*Part Number*	*Image*
Nut (POM, green) and ferrule (ETFE, yellow) for 1/8" OD tubing.	Idex: XP-305	
Adapter 1/4"-28 flat bottom to barb for 1/16" (1.6 mm) ID tubing (black)	Value Plastics: ABR004-J1A-2	
Adapter 1/4"-28 flat bottom to barb for 3/32" (2.4 mm) ID tubing (white)	Value Plastics: ABR007-J1A-1	
Adapter 1/4"-28 flat bottom to barb for 1/8" (3.2 mm) ID tubing (white)	Value Plastics: ABR013-J1A-1	
Female Luer lock to 1/4"-28 flat bottom port	Value Plastics: BSFTLL-J1A	
Luer lock male to barb for 5/32" (4.0 mm) ID tubing	Value Plastics: MTLL240-J1A	
Luer lock male to barb for 3/16" (4.8 mm) ID tubing	Value Plastics: MTLL250-J1A	
Male Luer lock to 1/4"-28 flat bottom port	Value Plastics: ABSML-J1A-07	

Table 4.2

5 Suppliers

The following companies provide fittings, adapters and tubing as mentioned above:
Idex Health and Science: https://www.idex-hs.com/fluidics/fluidic-connections.html
Vici: www.vici.com
Nordson Medical: http://www.nordsonmedical.com/products/fm_index.aspx
Darwin microfluidics: Darwin Microfluidics (darwin-microfluidics.com)

In most countries you may be able to obtain parts through local distributors. Please refer directly to the individual companies.

6 Frequently Asked Questions

Q: Can I order suitable parts and connectors through Sensirion?
A: Due to the large variety of possible parts and needs of our customers, we are not able to offer this type of service. Please refer to one of the suppliers listed above.

Q: Where can I learn more about the different options and fitting designs?
A: We recommend ordering a catalogue of the suppliers listed above. We also recommend the "All About Fittings" Guide by Idex Health & Science. It can be found online.

Q: I want to use a sensor with an UNF 6-40 coned port for 1/32" tubing (LG16-0025, LG16-0150, LG16-0430, SLI-0430C) with a larger diameter tubing. Is there a suitable adapter available?
A: Unfortunately, no satisfactory standard solution for directly connecting larger diameter tubing to a UNF 6-40 coned port is available. A recommended alternative is to use a short piece of 1/32" OD tubing and a tube-to-tube adapter to a larger fitting (10-32 or 1/4-28).

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