Swagelok® Remote Monitoring System

Application Guide

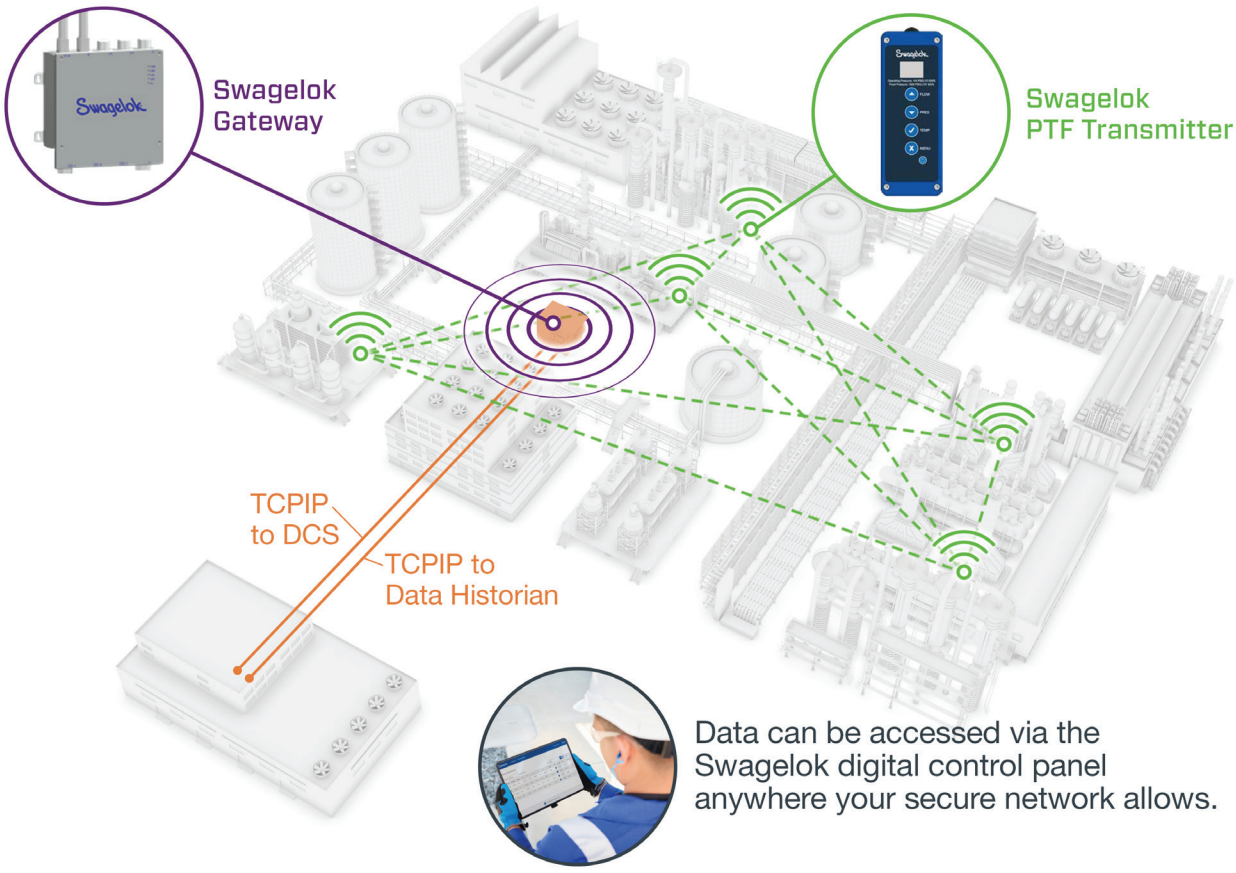
Swagelok®

Contents

What Is a Swagelok® Remote Monitoring System?

The Swagelok® remote monitoring system combines wireless sensors and secure networking equipment, giving you remote access to continuous system data points such as pressure, temperature, and flow. Unlike analog devices, digital sensors in the remote monitoring systems have the advantage of providing a user with the ability to trend system data over time. With this critical information at your fingertips, you can quickly diagnose system issues and make data-driven decisions.

The remote monitoring system consists of two hardware components and user interface software. Swagelok® PTF transmitters are battery powered sensors that can be easily installed in fluid systems to transmit key system information. This data is sent wirelessly to the Swagelok® gateway. The gateway collects information from all your sensors, combining it into a database that can be accessed by your facility's distributed control system (DCS) or sent to a data historian. Transmitter data is also available locally on the Swagelok gateway through our graphical user interface (Swagelok® digital control panel)—a dashboard where you can view current sensor information. The Swagelok digital control panel allows you to manage multiple settings for the gateway and transmitter.



Remote Monitoring System Hardware

Swagelok PTF Transmitter

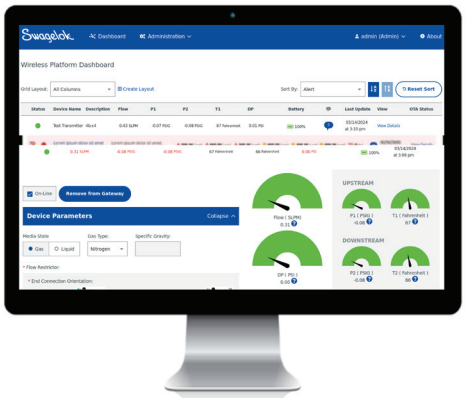
The Swagelok PTF transmitter is an edge sensor that takes pressure, temperature, and flow readings from your fluid system and wirelessly transmits that information to the Swagelok gateway. In designing the transmitter, Swagelok applied its deep knowledge of industrial fluid system applications for a simple set up process and reliable wireless performance. The transmitter handles all calculations within the unit, so no scaling of the signal is required. This simplifies the process and enables increased accuracy of results.

Swagelok Gateway

The gateway gathers the data from your fluid system's wireless PTF transmitters. It was designed with both ease of use and security in mind. Current data can be viewed through the Swagelok digital control panel. The historical data is compiled in a database that can be routed for use by your facility's DCS and data historian using RestAPI or Modbus TCP/IP protocols.

Swagelok Digital Control Panel

The digital control panel allows you to view your system data and customize its presentation to meet your needs. It is accessible from any web browser within your facility's secure local network, so there is no software to install and no additional license to purchase.



Design Principles

When designing a remote monitoring system that employs wireless technology, Swagelok took the following into consideration:

Security

Wireless devices and their accompanying networks need to be robust and secure. Swagelok employs a captive network that utilizes SmartMesh protocol, which allows for the following:

- Sensor data can only be accessed through your facility's local network. Information is not transmitted over the internet, only those employees behind your firewall can access it.
- Custom security extensions to implement digital certificates. As a means of positively commissioning only authorized devices on the network, also known as nodes, certificates prevent the participation of potential impostors acting in the role of a device on the network.
- Data transmitted between the sensor and gateway is encapsulated and encrypted.

For additional questions regarding cybersecurity please contact your local authorized Swagelok sales and service center.

Reliability

- The remote monitoring system employs a mesh network that allows instrument devices to connect not only to the gateway, but also each other. This allows the network to "self-heal" when any single connection is lost by making a connection to another sensor or the gateway directly.
- The communication protocol utilized by the PTF transmitter offers 99.999% reliable transmission of key system information. If a momentary signal disruption occurs, the PTF transmitter will reserve the data packet and resend when a connection is reestablished.
- Reliable data acquisition from analog devices requires human intervention, which can be prone to error. An analog device can be inaccurate, inoperable, or the technician can make a mistake recording data. Digital devices can remove both human and analog device errors and provide more accuracy.

Safety

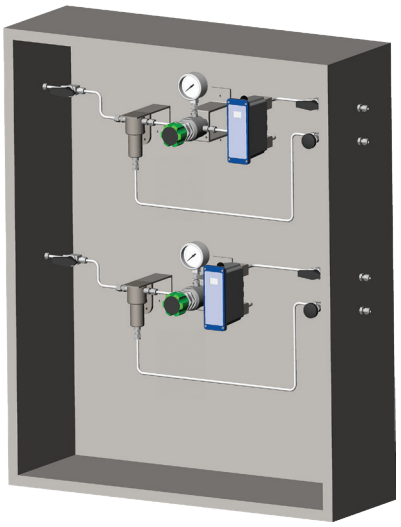
- System failures can be identified using the Swagelok digital control panel or through DCS integration where variable alarms such as high and low threshold limits can be set.
- Sensors incorporated into monitoring devices are subject to a pressure operating range based upon their design and fit for purpose. However, upset process conditions can cause momentary pressure spikes that, although outside the operating range of the sensor, will not damage the sensor for future use. The PTF transmitter was designed to accommodate intermittent pressure spikes up to the proof pressure rating.

  Note: Proof pressure, also known as over-range capacity, is the maximum pressure that may be applied to a device without changing its performance within the specifications. For more information regarding over-range capacity of the sensors, please contact your local Swagelok sales and service center to request a user test report.

PTF Transmitter Application Examples

Sample Conditioning Systems

Sample conditioning systems are designed to adjust the temperature, pressure, and flow of a sample stream so that it is under the appropriate conditions for use by analytical instruments located within an analyzer shelter. Often the cabinet contains an analog rotameter for the monitoring of system flow. The PTF transmitter is designed as a drop-in replacement for armored rotameters and can provide multi-variable data to a database for further analysis.

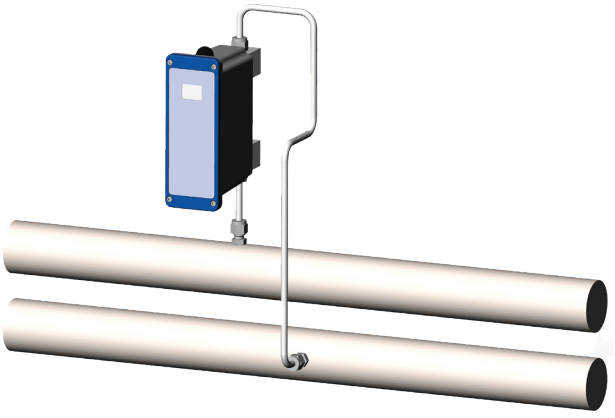


Remote Mounting Using Existing Orifice

The PTF transmitter can also be used with an existing orifice of known diameter that is located elsewhere in a system. By using a blind orifice in the PTF transmitter, impulse lines can be run into either end of the transmitter and the unit can be calibrated with the remote orifice to calculate flow for the system.

Static Pressure or Temperature Transmitter

If flow measurements are not needed, it may be easier to install, or more cost-effective to use, a single PTF transmitter as a pressure and temperature transmitter in place of a wired device. A blind orifice is used in the PTF transmitter, and impulse lines can be run into either end of the transmitter from two separate pressure and temperature measurements.



System Component Details – Transmitter

Description

The PTF transmitter is a wireless sensor that displays system pressure, temperature, and flow data locally on the device or can transmit that data via the gateway to a DCS, data historian, or display the information on the Swagelok digital control panel. Rated for operation in HazLoc environments, the transmitter can be placed either inside an enclosure or in outdoor environments. The unit is powered through a lithium-ion battery, eliminating the need to run electric power to each sensor.

- Measure system variables: The transmitter can be used to measure five different system variables: inlet pressure (P1), outlet pressure (P2), inlet temperature (T1), outlet temperature (T2), and flow. To calculate flow, the transmitter utilizes the two pressure and temperature sensors and a calibrated orifice. Each PTF transmitter is factory calibrated with the restrictor size chosen at time or ordering. One restrictor is included with each PTF transmitter. For more information on choosing the appropriate size restrictor, see page 14.

- Use in hazardous locations: The sensor is rated for hazardous location environments. With an ingress protection level of IP-65, the sensor is dust tight and can withstand normal weather conditions when located outside. If located within an enclosure, the PTF transmitter is rated for operating temperatures of 158°F (70°C). The wetted components of the flow path are suitable for fluids compatible with 316 stainless steel and FKM seals.

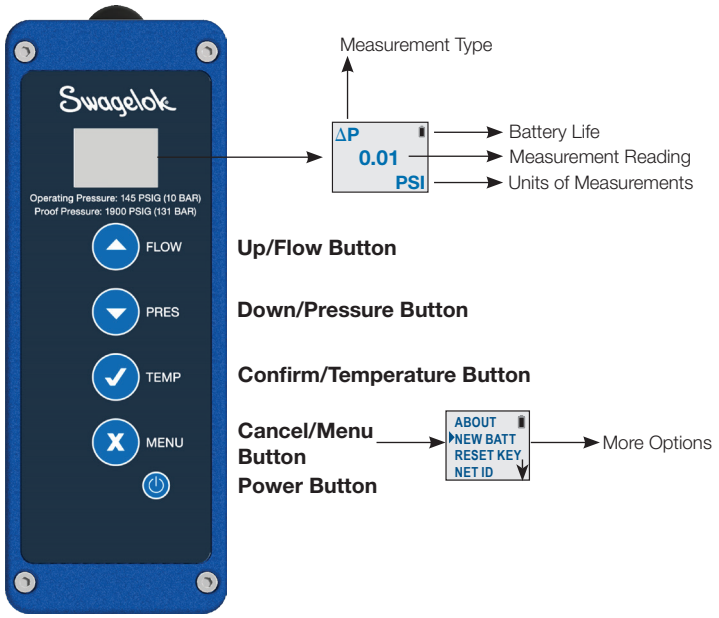
- View local display: A backlit liquid crystal display (LCD) screen is located on the front of the transmitter that displays both transmitter and sensor information. Pressure, temperature, and flow information can be immediately accessed by depressing the corresponding tactile button even while the user is wearing gloves. The electrical properties of the liquid in the LCD changes at extreme high and low temperatures, allowing readings on the display to still be legible at excessive temperatures.

- Built-in security: The transmitter cover features an anti-tamper switch. When the front cover is removed, the Swagelok digital control panel will indicate an alarm alerting users to any potential unwanted access. All data sent wirelessly between the transmitters and the gateway is encrypted.

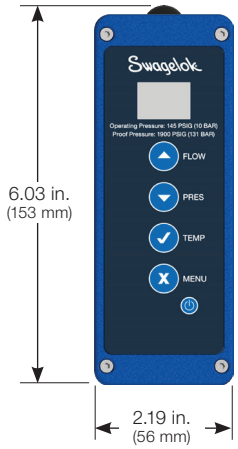
- Replaceable battery: Accessed through the front cover, the lithium-Ion battery can be replaced. For more information on ordering. For more information on ordering a replacement battery, see page 14.

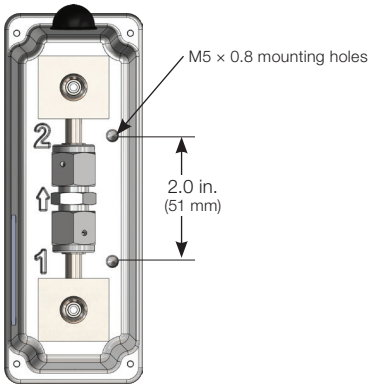
Materials of Construction

Component	Material Grade/ ASTM Specification
Enclosure	Powder Coated Aluminum
Antenna	ABS
Lid Screws	18-8 SS
Keypad	Polyester
Wetted Component	**Material Grade/ASTM Specification**
Restrictor	316/316L SS
Restrictor O-ring	Fluorocarbon FKM
End Connections	316/316L SS
Sensor	316 SS
Sensor O-ring	Fluorocarbon FKM

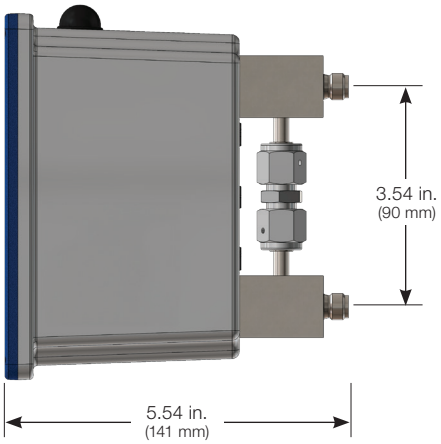


Transmitter Dimensions

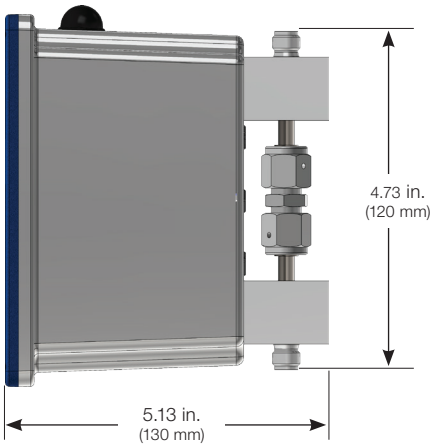




1/4 in. Rear Configuration



1/4 in. Vertical Configuration



Transmitter Ratings and Specifications

Characteristic	Rating
General	
Operating Pressure	0 to 145 psig (0 to 10 bar)
Proof Pressure	1900 psig (130 bar)
Burst Pressure	3500 psig (241 bar)
Electrical Ratings	3.6V 19Ah
Pressure Accuracy	Max ± 0.15%FS Total Error Band (incl pressure and temperature variation): ± 0.7%
Operating Temperature	–4 to 158°F (–20 to 70°C)
Flow Accuracy (Accuracy claims are at calibration point)	Full Scale: ± 7% Accuracy Class: G = 7%, qG = 50%, per VDI/VDE 3513 Sheet 2: 2008①
Max Viscosity (For Liquid Service)	Up to 50 cP
Expected Delta Pressure Between Sensors at Max Flow②	~ 5 psi
Long-Term Stability	Max ± 0.2% Full Scale (per year of service) Limited to max ± 3 mbar
Turn-Down Ratio	10:1
Environment	
Ambient Temperature	-20°C to 70°C
Vibration	IEC-60068-2-6, 10 to 500Hz, 5g
Ingress Protection	IP65, Type 4X
North American Class-Division	Class I Division 1 Groups A, B, C, and D T4
North American Zone (USA)	Class I Zone 0 AEx ia IIC T4 Ga
North American Zone (Canada)	Class I Zone 0 Ex ia IIC T4 Ga X
ATEX (Europe)	II 1 G Ex ia IIC T4 Ga
IECEx (International)	Ex ia IIC T4 Ga
Wireless Compliance	FCC
Communication and Transmission	
Expected Battery Life	Up to 3 years③
Communication Protocol	SmartMesh (default network ID: 1229) with symmetric key encryption
Min Data Transmission Interval	5 seconds
Max Wireless Range	350 ft (unobstructed line-of-sight)
Max Number of Transmitters Per Gateway	40

Standard liter definition: Standard conditions (std liters/min std liters/h nitrogen flow ranges) are defined as 14.7 psia (1.01 bar) at 60°F (15°C)

① In accordance with VDI/VDE 3513 Sheet 2: 2008, accuracy class is effectively equivalent to permissible error above q_G = 50%.
where:
G = Constant permissible error in percent of measured value above q_G
q_G = Flow limit value in percent of full scale
Above q_G, the permissible error is constant. Below q_G, the permissible error increases toward lower flow rates inversely proportional.
In sizing a restrictor, q_G = 50% allows for the greatest accuracy above 50% of the full scale. For assistance with PTF restrictor selection, contact your authorized Swagelok sales and service representative. Fluid media, temperature, pressure, viscosity, and density also must be considered in selecting a transmitter.

② Delta pressure determined under factory calibration conditions as listed below. If product is used under different conditions, delta pressure may be different at max flow.

③ Three-year battery life was calculated under the following conditions: 20C ambient temperature, 30 second data transmission interval, screen on only during initial setup. Variables such as ambient temperature, screen usage, and transmission rate will directly impact the battery life of the device.

Calibration and Testing

Every Swagelok wireless transmitter is factory calibrated to its flow range and accuracy specification using nitrogen. Calibration takes place at full scale flow, with 30 psig (2.0 bar) inlet and ambient temperature of 70°F (20°C).

Transmitter Options

Porting Configurations

- Rear-ported – 1/4 in. (6 mm) Swagelok® tube fitting end connections
- Vertically-ported – 1/4 in. (6 mm) Swagelok tube fitting end connections

Flow Range

Swagelok transmitters can measure the following flow ranges with a 10:1 turndown ratio. The full-scale flow is determined by the installed restrictor orifice diameter.

Restrictor Size	Orifice Diameter, in. (mm)	Flow Measurement Ratings			
		Nitrogen, slpm	**Nitrogen,** scfm	**Water,** ccm	**Water,** gpm
-0045	0.0045 (0.11)	0.02 to 0.2	0.0007 to 0.007	–	–
-0096	0.0096 (0.24)	0.1 to 1.0	0.003 to 0.03	–	–
-0211	0.0211 (0.54)	0.5 to 5.0	0.02 to 0.2	37.9 to 379	0.01 to 0.1
-0421	0.0421 (1.07)	2.0 to 20	0.07 to 0.7	151.4 to 1514	0.04 to 0.4
-0803	0.0803 (2.04)	8.0 to 80	0.3 to 3.0	643.5 to 6435	0.17 to 1.7
-1061	0.1061 (2.69)	14 to 140	0.5 to 5.0	1135.6 to 11356	0.3 to 3

Flow Considerations – Selecting a Restrictor

Selecting the appropriate restrictor to measure flow accurately depends on several system variables:

- Fluid type (gas or liquid)
- Fluid specific gravity
- Fluid temperature (gas only)
- Fluid pressure (gas only)

Unlike traditional rotameters that often use an air or water scale to give a general indication of flow, PTF transmitters can be sized to accurately calculate flow based on the above variables. It is recommended to match the restrictor size to the maximum calculated flow for the fluid.

While estimates of specific gravity and system flow are often sufficient, process conditions may vary over time, and it may be necessary to increase or decrease the size of the restrictor orifice. For information on ordering additional restrictor fittings, see page 13.

When restrictor calculations indicate there is an option to use several different size restrictors, it is recommended to select a restrictor where the maximum expected flow value falls within the middle of the flow range for the restrictor. See below for examples of how to calculate the appropriate restrictor based on your system parameters.

User max flow =
Swagelok calibrated max flow × $F_{gas\ or\ liquid}$

$$F_{gas} = F_T \times F_P \times F_G$$
$$F_{liquid} = F_L$$

F = Flow sizing correction factor (F_{gas} or F_{liquid})
F_T = Temperature ratio
F_P = Pressure ratio
F_G or F_L = Fluid density ratio
SG = Specific gravity

User Application Temperature °C (°F)	F_T
–20 (-4)	1.08
–10 (-14)	1.06
0 (32)	1.04
10 (50)	1.02
20 (68)	1.00
40 (104)	0.97
60 (140)	0.94
70 (158)	0.92

User System Pressure psig	F_P
10	0.69
20	0.86
30	1.00
40	1.12
60	1.33
80	1.52
100	1.68
120	1.83
145	2.00

Gas	F_G	Specific Gravity
Air	0.98	1.00
Argon	0.84	1.38
Ethane	0.97	1.038
Ethylene	1.00	0.969
Helium	2.65	0.138
Hydrogen	1.18	0.696
Methane	1.32	0.554
Nitrogen	1.00	0.967
Propane	0.80	1.523
Propylene	0.82	1.453

Liquid	F_L	Specific Gravity
Benzene	1.06	0.884
Ethanol	1.12	0.794
Pentane	1.26	0.631
Toluene	1.07	0.872
Water	1.00	1

To calculate your own F_G or F_L:

$F_{G/L}$ is the square root of specific gravity ratios between the calibration gas (nitrogen = 0.97) and the user's gas. To calculate your own $F_{G/L}$, use the appropriate equation below.

$$F_G = \sqrt{\frac{0.97}{SG}} \qquad F_L = \sqrt{\frac{1}{SG}}$$

Example Restrictor Orifice Size Calculations

$$\textit{Swagelok calibrated orifice flow} = \textit{User Max Flow} \times F_{\textit{gas or liquid}}$$

Example 1: Gas

User is running a mixture that is mostly propane, so they've decided to use that as the system media because it will be close enough. Under typical conditions, the system pressure is 40 psig (2 .7 bar), and the transmitter is in a heated enclosure that is regulated to 140°F (60°C). The stream will run at a constant flow rate of 2 to 3 slpm. The user selected the 5 slpm restrictor as the likely "best fit" but now will do the calculation to ensure proper orifice size.

$$F_{gas} = F_T \times F_P \times F_G$$

From the provided tables, the user inputs the correction factors for temperature, pressure, and media to get F_{gas}.

$$F_{gas} = 0.94 \times 1.12 \times 0.80 = \mathbf{0.84}$$

Now the user divides their user max flow by F_{gas}.

$$\text{Swagelok calibrated orifice flow} = \textit{User Max Flow} \times F_{gas}$$
$$\text{Swagelok calibrated orifice flow} = 3 \text{ slpm} \times 0.84 = \mathbf{3.57 \text{ slpm nitrogen}}$$

To determine which Swagelok calibrated orifice to use, the user will need to refer to the flow range table on page 10. Upon review, the user sees that the 3.57 slpm nitrogen falls in between two ranges, the 0.5 to 5.0 and the 2.0 to 20 range. The 3.57 slpm nitrogen falls more in the middle of the 0.5 to 5.0 range so this would be the recommended restrictor size to choose. The selected flow range aligns with the restrictor size of **0211**.

Example 2: Liquid

User is running pentane through a sample stream. Under typical conditions, the system pressure is 100 psig (6.8 bar), and the transmitter is typically at 70 to 86°F (20 to 30°C). The stream will run at flow rates between 1 to 1.5 lpm. The user will calculate for which Swagelok calibrated orifice to choose for their system.

$$F_{liquid} = F_L$$

Since it's a liquid, the user inputs the correction factor for media only.

$$F_{liquid} = \mathbf{1.26}$$

Now the user divides their user max flow by F_{liquid}

$$\textit{Swagelok calibrated orifice flow} = \textit{User Max Flow} \times F_{liquid}$$
$$\textit{Swagelok calibrated orifice flow} = 1.5 \textit{ lpm} \times 1.26 = \mathbf{1.19 \text{ lpm water}}$$

To determine which Swagelok calibrated orifice to use, the user will once again refer to the flow range table on page 10. Upon review, the user sees that the 1.19 lpm water falls in between two ranges, the 0.17 to 1.7 and the 0.3 to 3 range. The 1.19 lpm water falls more in the middle of the 0.17 to 1.7 range so this would be the recommended restrictor size to choose. The selected flow range aligns with the restrictor size of **0803**. Note: When a calculation indicates that two possible restrictor sizes can be used, for best accuracy, choose the restrictor size that equates to a flow in the top half of the flow range for that restrictor.

Ordering Information

Transmitter

Each Swagelok PTF transmitter is factory calibrated to the restrictor of your choice. To construct the proper transmitter part number, use the restrictor sizing information above and select the appropriate orifice size for your application. The restrictor orifice size is denoted in the transmitter part number as shown below.

Ordering Information for Transmitters

1		2		3	4		5
SS	-	PTF	-	S4	R	-	1061

1 Material
SS = 316 stainless steel

2 Component
PTF = PTF

3 End Connection
S4 = 1/4 in. Swagelok
S6M = 6 mm Swagelok

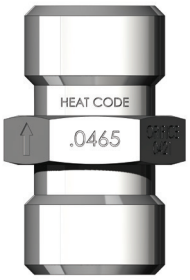
4 Configuration
V = Vertical
R = Rear

5 Restrictor Size
BLND = Blind Orifice
BT = Bore Through Orifice
0045 = 0.0045 in. (0.11 mm)
0096 = 0.0096 in. (0.24 mm)
0211 = 0.0211 in. (0.54 mm)
0421 = 0.0421 in. (1.07 mm)
0803 = 0.0803 in. (2.04 mm)
1061 = 0.1061 in. (2.7 mm)

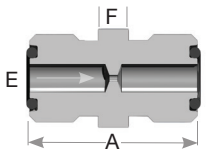
Restrictors

Restrictors are marked on the hex flat with the following information.

- Flow direction
- Calibration value
- Nominal orifice size



One restrictor is included with each transmitter. Should additional orifice sizes be required, additional restrictor kits can be ordered using the part numbers below.



VCO Size in.	Ordering Number	Dimensions, in. (mm) A	Dimensions, in. (mm) E	Dimensions, in. (mm) F, in.
1/4	SS-PTF-REST-0045-KIT	1.065 (27.1)	0.0045 (0.11)	5/8
	SS-PTF-REST-0096-KIT		0.0096 (0.24)	
	SS-PTF-REST-0211-KIT		0.0211 (0.54)	
	SS-PTF-REST-0421-KIT		0.0421 (1.07)	
	SS-PTF-REST-0803-KIT		0.0803 (2.04)	
	SS-PTF-REST-1061-KIT		0.1061 (2.70)	
	SS-PTF-REST-BLND-KIT		—	
	SS-PTF-REST-BT-KIT		0.1800 (4.57)	

Ordering Information for Restrictors

1	2	3	4	5
SS	- PTF	- REST	- 1061	- KIT

1 Material
SS = 316 stainless steel

2 Component
PTF = PTF

3 Restrictor
REST = Restrictor

4 Restrictor Size
BLND = Blind Orifice
BT = Bore Through Orifice
0045 = 0.0045 in. (0.11 mm)
0096 = 0.0096 in. (0.24 mm)
0211 = 0.0211 in. (0.54 mm)
0421 = 0.0421 in. (1.07 mm)
0803 = 0.0803 in. (2.04 mm)
1061 = 0.1061 in. (2.7 mm)

5 Kit
KIT = Kit

Ordering Information for Battery

MS - PTF - BKIT

Battery Shipping Specifications

Each transmitter is shipped with a non-rechargeable D-cell lithium battery in the enclosure assembly. A replacement kit is available that includes a lithium battery that is shipped alone. Shipment of lithium metal batteries is aligned with shipping standards established by U.S. DOT (Department of Transportation) and IATA (International Air Transport Association). Declaration and labeling requirements are met in respect to UN 3090 (Li metal battery shipped alone) and UN 3091 (Li metal battery in assembly).

The transmitter battery is located inside the housing and is a nonrechargeable D-cell lithium battery. The battery can be replaced by removing the four screws on the transmitter lid that is connected to the rear enclosure. Once the lid is open, remove the retention screws and plate to disconnect the battery and place the new battery in the enclosure. Lastly, reinstall the transmitter in the system and reset the battery indicator.

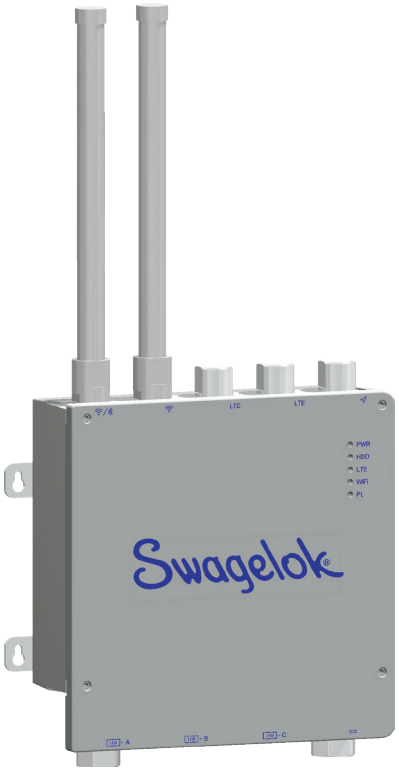
Note: Detailed instructions can be found in the battery replacement section of the Swagelok *Remote Monitoring System Installation, Operation, and Maintenance* Manual, MS-13-347.

System Component Details – Gateway

Description

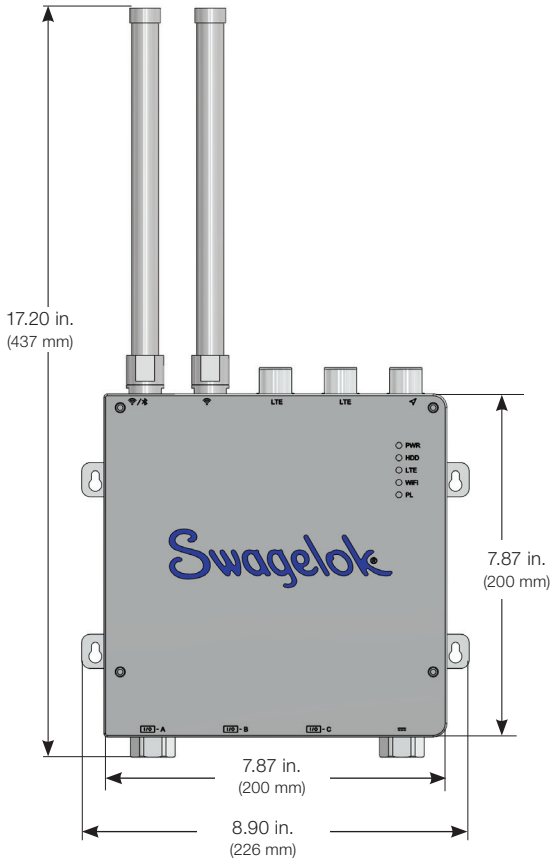
Gateway

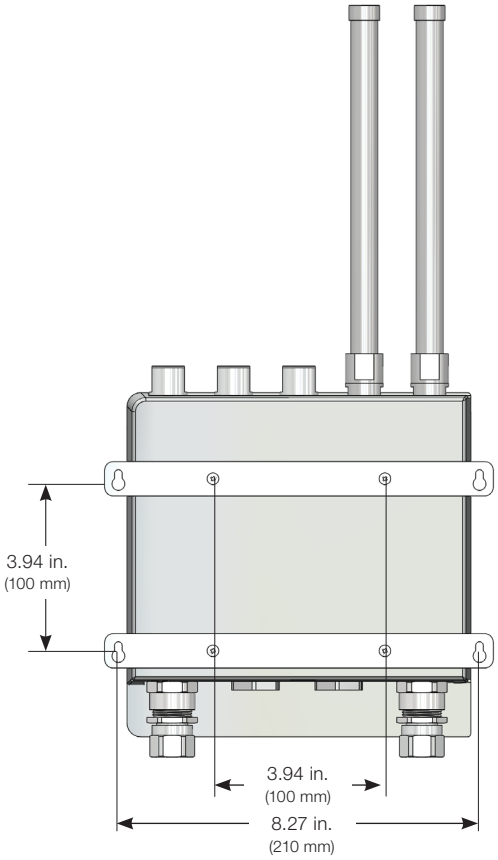
The gateway gathers all of the data from your fluid system's wireless transmitters. It was designed with both ease of use and security in mind. Using the SmartMesh® IP communication protocol, your system data is compiled in a database (SQL format), which can be accessed by your facility's internal network using RestAPI or Modbus TCP/IP protocols.

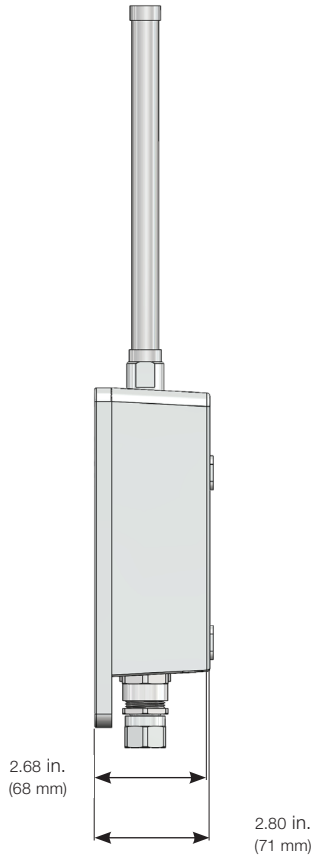


- **Simple setup:** The gateway is easy for anyone to set up—minimal IT skills or extensive wiring is required. Included with the gateway are two antennas which require simple assembly. The gateway also requires a separate power supply, power cables, and ethernet cable(s) for installation. Reference the Swagelok *Remote Monitoring System Installation, Operation, and Maintenance* Manual, MS-13-347 for step-by-step instructions of the set-up process along with the required power supply specifications. Up to 40 transmitter devices can be connected to the gateway once it is installed.
- **Mesh network:** By utilizing the SmartMesh® IP communication protocol, transmitters can connect to one another from a distance of up to 350 ft. apart. This mesh Wi-Fi network uses a daisy-chain-type connection between transmitters to extend the reach of your gateway. And, if a single transmitter goes offline, other transmitters will automatically search for another connection.
- **Built-in security:** The gateway features a tamper-resistant physical design, which sends an alert if the case is opened. All data sent wirelessly between the transmitters and the gateway is encrypted. Consolidated data from the transmitters that resides on the gateway is relayed to a DCS or data historian via ethernet cables connected to your internal and secure network.

Gateway Dimensions







Gateway Components: Gateway, antenna (two included, assembly required); required but not included: power supply, power cables, and Ethernet cable(s)

Power Requirements: Power supply, power requirement 10~36 VDC (30-watt minimum rating)

Power Cables: Appropriate cables and/or conduit should be selected for C1D2 applications; the input terminal block should be installed to 12-22AWG wires with 8 mm conductor insulation stripped. The field wiring cable should be rated greater than 90°C.

Ethernet Cable(s): Low-profile ethernet cable or conduit that is rated for C1D2 application. Cables should ideally have no strain relief plastic molding over the connector so that it can fit through the cable gland.

Gateway Ratings and Specifications

Characteristic	Rating
General	
Dimensions (W x D x H)	7.87 x 7.87 x 2.67 in. (200 x 200 x 68 mm)
Form Factor	Square
Enclosure	Aluminum housing
Mount Options	Wall mount
Weight (Net)	8.16 lb (3.7 kg)
Power Requirement	10 to 36 VDC
Power Consumption	21W (typical)/27W (max.)
System Hardware	
BIOS	AMI UEFI (64 Mbit)
Hardware Security	TPM 2.0
Processor	Intel® Atom® E3950 quad core, 1.6GHz (up to 2GHz)
Memory	8GB of DDR3L, 1600MHz
Graphics Engine	Intel HD Graphics 505
Ethernet	Intel i210-IT GbE, IIEEE802.1AS, 802.3az
LED Indicators	Power, Storage, LTE, Wi-Fi, Programmable LED
Storage	1 x M.2 2242 B-key (SATA signal)
Internal Maintenance Interface	1 x USB 3.0, 1 x USB 2.0, 1 x DP
I/O Interface	
LAN①	2 x RJ45, 10/100/1000 Mbps IEEE 802.3u, 1000 BASE-T Fast Ethernet
Power Connector①	1 x 3-pin terminal block
Cable Gland	4 x 1/2 in. NPT conduit explosive atmosphere cable gland [cable size OD 0.26 to 0.55 in. (6.55 to 14 mm)]
Environment	
Operating Temperature	-40 to 70°C (-40 to 158°F) at 5% to 85% RH with 0.7 m/s airflow
Storage Temperature	-40 to 85°C (-40 to 185°F)
Relative Humidity	10% to 95% RH at 40°C (104°F), noncondensing
Shock Protection	Operating, IEC 60068-2-27, 50G, half sine, 11ms
Vibration Protection	Operating, IEC 60068-2-64, 2Grms, random, 5 ~ 500Hz, 1hr/axis
Ingress Protection	IP66
North American Class-Division	Class I Division 2 Groups A, B, C, and D T4
Wireless Compliance	FCC

① Four I/O cables can be connected simultaneously via the cable gland

Ordering Information for Gateway

MS - SGW - 1

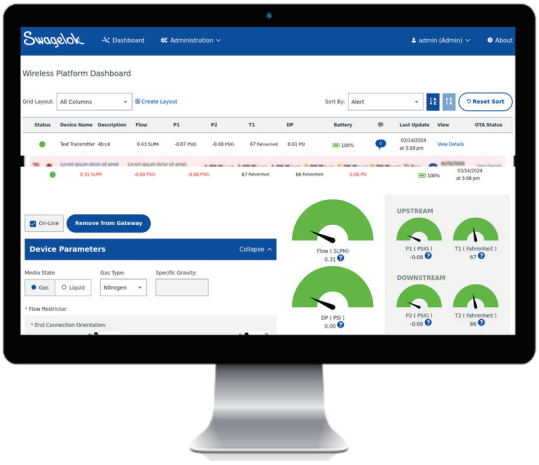
The gateway is required for use with PTF Transmitters. One gateway can connect up to 40 transmitters. For more information regarding the Swagelok gateway use considerations, please see page 20.

System Component Details – Swagelok Digital Control Panel

Description

The hardware of the Swagelok remote monitoring system collects flow, pressure, and temperature data from throughout your fluid system. But it's the built-in software (Swagelok digital control panel) that places it at your fingertips. The Swagelok digital control panel is accessible from any web browser within your facility's secure local network, so there is no software to install or additional license to purchase. It allows you to view your current system data and customize its presentation to meet your needs.

- **View data in real time:** Get flow, pressure, and temperature readings from every transmitter in your fluid system. Your data transmission speed can be customized ranging from every five seconds up to over an hour.
- **Customize units of measurement:** Set units of measurement that are specific to your exact application and region.
- **Improve flow measurement accuracy:** Unlike traditional rotameters that are only calibrated for air or water, your remote monitoring system can provide accurate flow measurements for any media type. Just enter the specific gravity of your liquid or gas in the Swagelok digital control panel, and eliminate the need for flow measurement conversions.
- **Monitor sensor health:** View the connection status, battery life and last update time of each transmitter. The Swagelok digital control panel will also notify you if a transmitter has a low battery or connection issue.
- **Set alarm notifications:** Program high and low threshold limits for each sensor, so your team will be notified of abnormal readings.
- **Set user access:** Control what information a user can view or edit in the Swagelok digital control panel by setting role-based permissions and assigning to a given user.



PTF Gateway Power Supply and Installation Guidelines

Responsibility for Power Supply Installation

It is the end user's responsibility to source, install, and connect the external power supply to Swagelok equipment. The selected power supply must meet the following criteria:

- **Certified for Use in Ordinary Locations:** The power source must be approved for general safety and intended for use in non-hazardous environments.
- **Type Requirements:** Acceptable power supplies include SELV (Safety Extra-Low Voltage) or Class 2 types. Refer to the NEC code for details.
- **Installation Location:** The power supply must be installed outside of any hazardous area—typically within a control panel or protective enclosure—subject to approval by the authority having jurisdiction (AHJ).

Power Supply in Hazardous Locations

If installation within a hazardous area is unavoidable, the power supply must either:

- Be certified for use in that specific hazardous location.
- Be enclosed in a protective housing rated for the applicable hazardous environment, with the final installation method approved by the AHJ.

Wiring and Code Compliance

All wiring must comply with the applicable regional or international electrical codes:

- **United States:** NFPA 70 (National Electrical Code), Articles 500–506
- **Canada:** Section 18 of the Canadian Electrical Code (CEC)
- **European Union / International:** IEC 60079-14, based on area classification

Compliance and Limitations

The end user is solely responsible for ensuring that all power supply components and installation practices comply with local codes, regulations, and safety standards. Swagelok does not provide specific recommendations for field wiring or power supply selection, as we do not control site-specific conditions or installation practices.

Use Considerations

PTF Transmitter

Application Use: The transmitter can be used in any application where traditional rotameters, pressure gauges, and thermocouples are used to measure and track system conditions. The PTF transmitter was designed as a low delta pressure (DP) device. At full flow, the transmitter will have an approximate max DP of 5 psi. Please consider the DP at full flow when designing the transmitter into your system.

Flow Direction: When mounted in the standard configuration of bottom to top, the transmitter measures flow with the bottom port as the inlet (1), and the top port as the outlet (2). Each restrictor is calibrated in the flow direction indicated by the marked flow arrow. The transmitter will work if the restrictor is placed in either direction; however, flow accuracy can be affected when placed in the reverse direction. Match up the flow arrows on the transmitter and restrictor for proper flow direction.

Tare: The PTF transmitter pressure sensors are designed with absolute pressure in mind and may need to be tared to the atmospheric conditions where they are installed in before use. A tare device sets the input that a sensor is reading to near zero, without changing the true zero point. Before installation into the fluid system, use the menu button on the transmitter and navigate to the tare device screen to set the sensors to the atmosphere of the location where the transmitter is being installed. The taring should be done in the location where the transmitter will be installed but before it is connected to pressure.

Filtration: Restrictors contain small orifices that can be clogged with particulate located within fluid streams. Using a filter with an element size smaller than that of the orifice can be used to reduce the chance of orifice blockage.

Gateway

Placement: For best connection to PTF transmitters, it is recommended to install the gateway in an elevated location free from major obstructions.

General Wireless Best Practices

Sensor Placement: Prior to sensor installation, perform a site survey. Test the connection of the transmitter to the gateway, with the transmitter in its operation location, before installing it in the fluid system.

Wireless Signal: A signal is strongest when there is a direct line of sight between the sensor and the gateway; this will provide the greatest range. Try to avoid any obstructions that are known to block signals such as metal structures and thick walls. Elevated gateway and sensor installations are more likely to clear ground level obstructions, allowing for a direct signal. Environmental conditions like humidity or rain may impact the signal strength and connectivity of the system. Refer to Swagelok *Remote Monitoring System Installation, Operation, and Maintenance* Manual, MS-13-347, for additional information.

Safe Product Selection
When selecting a product, the total system design must be considered to ensure safe, trouble-free performance. Function, material compatibility, adequate ratings, proper installation, operation, and maintenance are the responsibilities of the system designer and user.

⚠ WARNING
Do not mix/interchange Swagelok products or components not governed by industrial design standards, including Swagelok tube fitting end connections, with those of other manufacturers.

Warranty Information

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

MS-02-490 RevC, September 2025