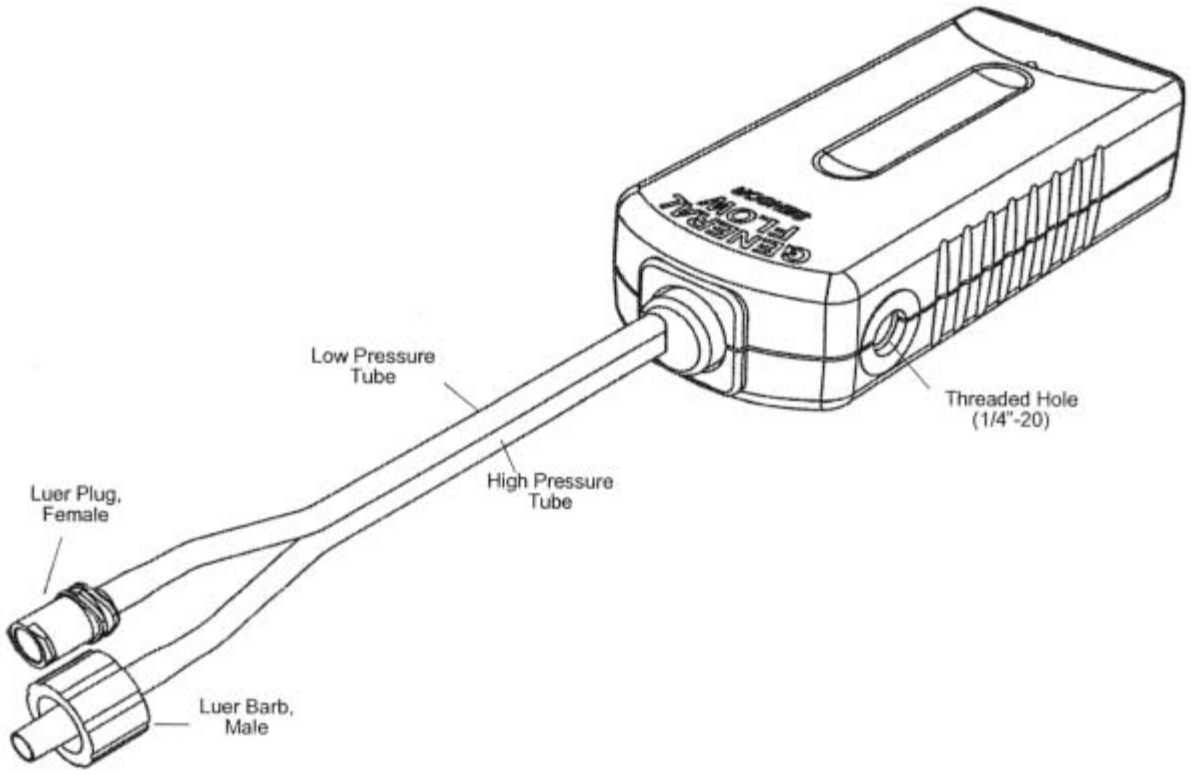
General Flow Sensor



Included	Included
General Flow Sensor	PASPORT Sensor Extension Cable

Required Items
PASCO Interface
PASCO Data Acquisition Software

Accessories used with the sensor	Accessories used with the sensor
Venturi Tube	Pitot Tube

Other	Other
Pressure Tap	Sensor Handles (4 Pack)

Product Description

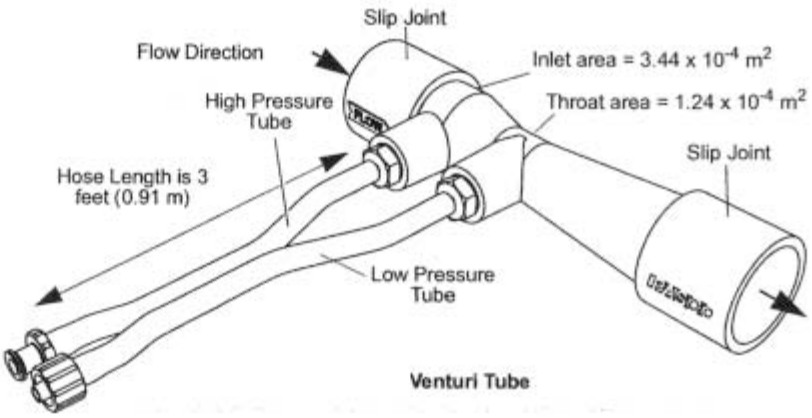
The General Flow Sensor is a versatile device for measuring differential pressure in air or water. It measures the difference in pressure between the two input tubes.

The General Flow Sensor is designed to work with the Venturi Tube or the Pitot Tube. The Venturi Tube and Pitot Tube attach to the General Flow Sensor by way of a flexible twin tube hose. The connectors on the sensor are reversed from the connectors on the Venturi Tube and Pitot Tube so that they cannot be attached incorrectly.

Using the data acquisition software, the user can select which device is attached to the sensor and what fluid (air or water) is flowing through the device. Once these selections are made, the sensor provides the pressure and the calculated values for flow velocity or volumetric flow (assuming standard temperature and pressure). The units of measure are selectable as metric or non-metric.

Venturi Tube

The General Flow Sensor measures the fluid pressure in two areas of different diameter and calculates the speed from the difference in pressure.



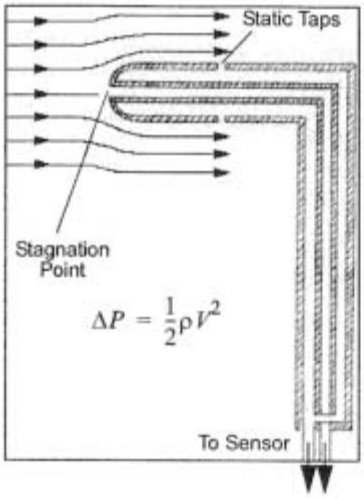
Venturi Tube

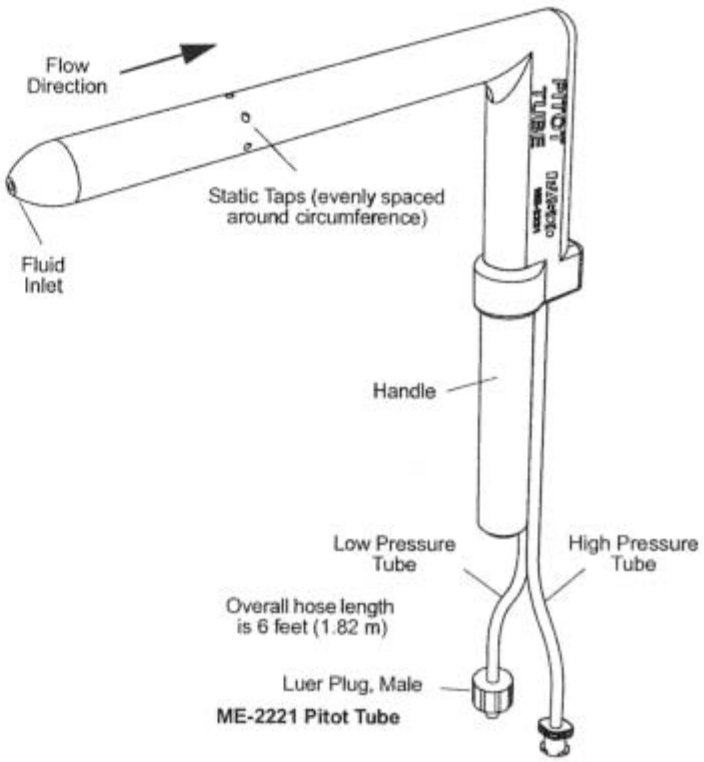
The Venturi Tube is designed to be used with standard 3/4 inch (1.91 cm) diameter polyvinyl chloride (PVC) pipe. The inlet cross-sectional area of the Venturi Tube is 3.44×10^{-4} m^2 (3.44 cm^2) and the throat cross sectional area is 1.24×10^{-4} m^2 (1.24 cm^2).

The plastic used in the Venturi Tube is compatible with standard PVC glues and it is recommended that it be glued into a piping network to measure flow rates. Alternatively, the Venturi Tube may be temporarily placed in a piping network using tape. The hose length is three feet (0.91 m).

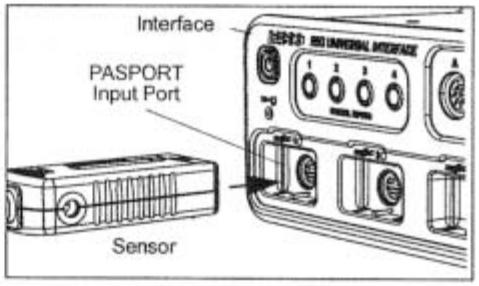
Pitot Tube

The Pitot Tube is designed to measure flow velocity in open channels. The Pitot Tube has a detachable handle attached to a 1/4"-20 nut.The overall hose length is 6 feet (1.82 m). The tube with the male luer plug is for low pressure measurement and the other tube is for high pressure measurement.





Quick Start



- Plug the General Flow Sensor into one of the PASPORT input ports of a PASCO interface (such as the 850 Universal Interface, Xplorer GLX, or SPARK Science Learning System). Or, connect the sensor to the PASPORT Sensor Extension Cable and then connect the cable to an input port.
- Connect an accessory such as the Venturi Tube or the Pitot Tube to the General Flow Sensor.
- Start the PASCO data acquisition software
  Select the type of fluid (air or water). Set up a data display in the software.
- Click "Record"  , press the  button on the GLX, or touch 'Start' to begin recording data.

> • **SETUP:** For more information on setting up the software and recording data, refer to the end of this document or the User's Guide and online help for the data acquisition software.

Specifications

The pressure sensing element used in this sensor will provide accuracy of ±2.5% of the full scale reading (50 kilopascal) at temperatures between 0 and 85 degrees C. This implies accuracy within ±1.25 kPa. Better accuracy may be attained by doing a calibration of the sensor at the temperature of use and maintaining the sensor in a stable position.

For low flow Venturi measurements at a rate of 1 standard cubic foot per minute (SCFM), the measured value of P_{diff} was approximately 11 pascals (Pa) and the theoretical P_{diff} was 6 Pa. These are uncorrected values with a baseline noise level of approximately 3 Pa. Repeatability is excellent with a variation within the noise band.

Item	Value
Range:	0 to 50 kPa Differential Pressure
Accuracy:	±2.5% of Full Scale (at 50 kPa)
• Venturi Tube in Water	±2.1 gallons per minute (gpm)
• Venturi Tube in Air	±2.5 scfm
Repeatability:	0.25% of Full Scale (at 50 kPa)
Resolution:	0.02% of Full Scale

General Flow Sensor with the Venturi Tube and Pitot Tube

Item	Value with Venturi Tube	Value with Pitot Tube
Range - Water:	0 to 0.00530 m^3/s (0 to 84 gpm)	0 to 9.98 m/s (0 to 22.3 miles per hour)
Range - Air:	0 to 0.0488 m^3/s (0 to 773 gpm)	0 to 92.1 m/s (0 to 206 mph)

Critical Use Considerations

Maximum Operating Pressure

Do not subject the sensor to gauge pressures greater than 29 pounds per square inch (psi) or 200 kilopascals (kPa) as permanent damage will occur. Do not use the sensor to measure flow in systems pressurized to more than 29 psi. Note that municipal water systems normally exceed this value.

Maximum Differential Pressure

The maximum differential operating pressure between the high pressure and low pressure input is 7.25 psi or 50 kPa. Differential pressures greater than 7.25 psi may result in permanent damage to the sensor causing inaccurate measurement.

High Pressure/Low Pressure Reversal

Operation of the sensor with reversed pressure applied (the pressure applied to the low pressure port is higher than the pressure applied to the high pressure port) may result in permanent damage to the sensor.

Changing Fluid Use

Care must be taken when changing from measurement in liquids to measurement in gases. It is normal for small amounts of liquid to migrate into the hoses during use. This may be minimized by insuring that the hoses are tightly attached to the sensor prior to introducing liquids to the system. The large diameter of the venturi and pitot tube hoses minimizes capillary flow. Placing a high point in the hoses above the fluid level in the systems will also help limit fluid migration.

After fluid use, hoses from the Venturi or Pitot Tube should be carefully blown clear of any migrated fluid and dried prior to use measuring a gas such as air. Fluid left in the line may obstruct flow causing inaccurate measurement. Fluid may also vaporize during use causing inaccurate measurement of flow.

Setup and Use of the General Flow Sensor

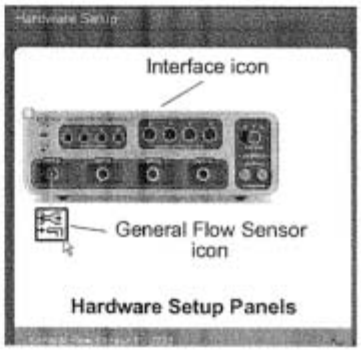
Connect the Sensor

Connect tubes from either the Venturi Tube (ME-2220) or the Pitot Tube (ME-2221) to the General Flow Sensor. Be sure that connections are sealed prior to the introduction of any liquids to the system.

Plug the General Flow Sensor PS-2222 into a PASPORT input port on a PASPORT-compatible interface, and turn on the interface. (Check the PASCO web site for compatible interfaces.) If you are using a computer, make sure that the interface is connected to the computer and turned on.

Prepare the PASCO Capstone Data Acquisition Software

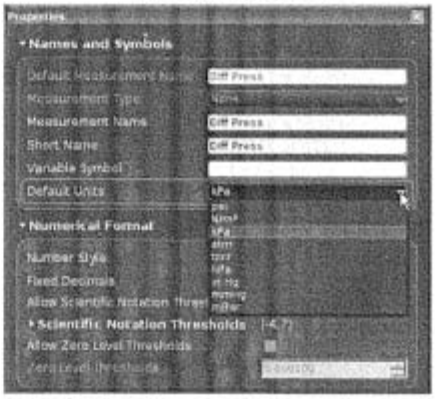
- In the PASCO Capstone software, click the "Hardware Setup" icon in the Tools palette to open the "Hardware Setup" panel. Confirm that the General Flow Sensor icon appears with the interface's icon.



Hardware Setup Panels

- Click the "Data Summary" icon in the Tools palette to open the "Data Summary" panel. The panel lists the sensor's measurements (for example, Differential Pressure (Diff Press kPa)).
- To select the units of measure or make other changes to the measurement properties, select the parameter in the Sensor Data Summary panel, and then click the "Properties" icon (shaped like a gear) to open the Properties panel. To change units, click "Names and Symbols". Both metric and non-metric units are selectable.
- In the event that a fluid other than air or water is used, input appropriate values for density in the user input values in the PASCO Capstone software.

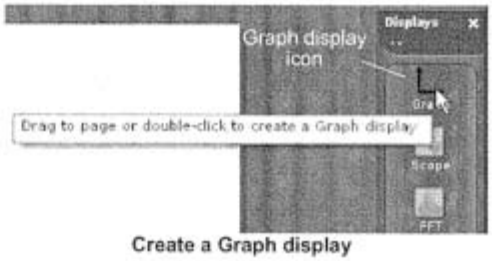

Data Summary Panel



Sensor Measurement Properties

Set Up a Data Display

- Set up a data display. For example, drag the Graph icon from the Displays palette onto the workbook page, or double-click the icon to create a Graph display.



Create a Graph display

- Set up the Graph display to show one of the sensor's measurements on the vertical axis. For example, click the "Select Measurement" menu button on the vertical axis and pick "Diff Press (kPa)" from the menu. "Time (s)" automatically shows on the horizontal axis.

Zeroing the Sensor

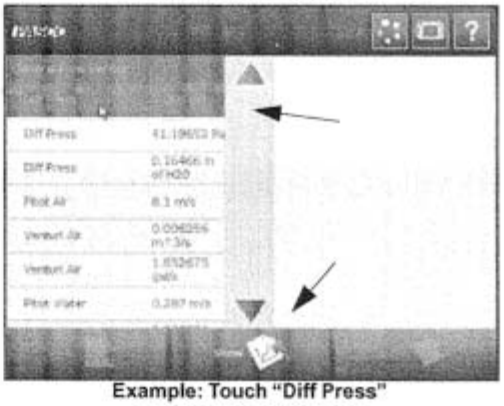
Prior to measurement the sensor should be placed in its operational position, any fluids to be used should be introduced to the system and hoses should be restrained. Immediately prior to a data run the unit should be zeroed using the PASCO Capstone software zero function. Zero drift can occur due to temperature, position or hose placement changes.

SPARKvue Setup

- When SPARKvue starts up, it shows the Home Screen for a moment, and then shows a screen that lists the parameters for the General Flow Sensor, such as "Diff Press" in "psi", "Pa", and "in of Hg".

SPARK SLS screen for the General Flow Sensor

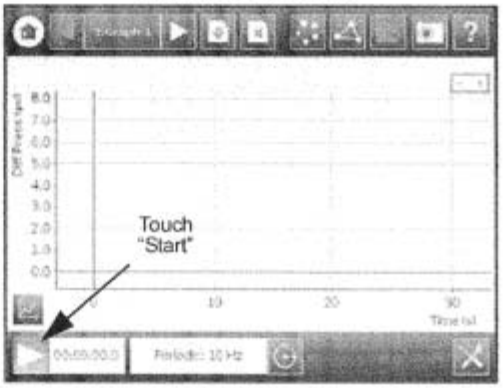
- Select a parameter to display on a graph. For example, touch "Diff Press psi" and then touch "Show. A graph display of Diff Press (psi) versus Time (s) opens.



Example: Touch "Diff Press" and then touch "Show"

- Touch the Start ( ) button to begin recording data.
- Touch the Stop ( ) button to end data recording.

SETUP: For more information on setting up the data acquisition software and recording data, refer to the User's Guide and the online help for the software.

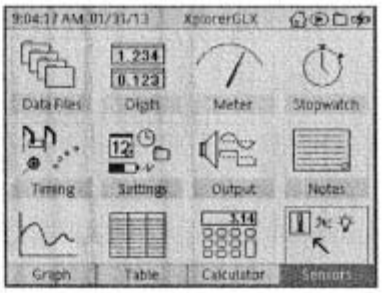


Graph Display

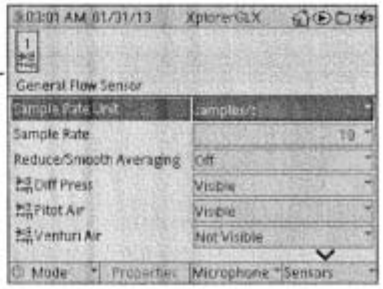
Xplorer GLX Setup

Make sure that the Xplorer GLX is turned on, and insert the General Flow Sensor into one of the PASPORT input ports at the top of the GLX.

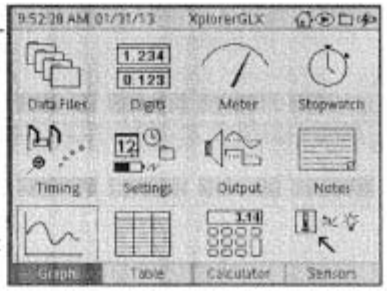
- In the GLX Home screen, use the cursor buttons to highlight "Sensors" and then press the "Checkmark" button.



- In the General Flow Sensor screen, use the "Up" and "Down" cursor buttons to select a choice such as "Pitot Air" and then press the "Checkmark" button to change the selection from "Visible" to Not Visible", or *vice versa*.



- Press the "Home" button to return to the Home screen, and use the cursor buttons to select a display. Press the "Checkmark" button to open your display choice.



Care

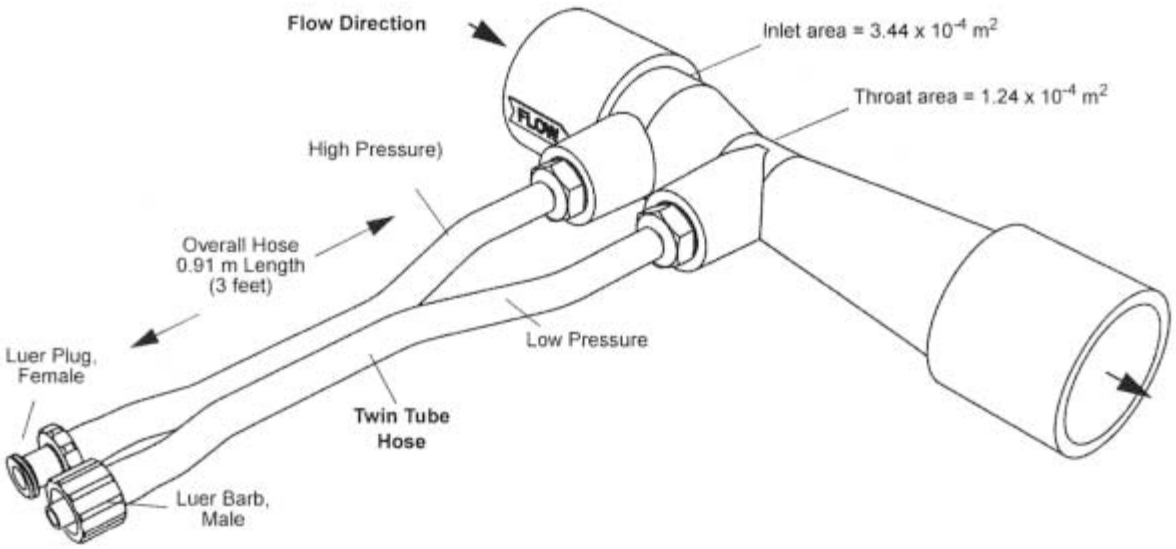
After use with fluids, care should be taken to remove all fluid from the hoses that attach the sensor to the Venturi Tube or the Pitot Tube. Fluids left in the hoses may migrate into the sensor and cause damage over time.

Suggested Laboratory Activities

Visit the PASCO Web site at www.pasco.com and enter PS-2222 in the Search window. Click the User Resources tab to see the Downloads menu for the downloadable suggested activity write-ups. Activities may be similar to the following:

- Derivation of the Venturi Pressure Velocity Relationship
- Pump Delivery Studies - Measure fluid velocity as a function of pump speed and working head
- Measurement of Velocity and Pressure Losses in Piping Networks (when used with the PS-2107 Absolute Pressure Sensor and the ME-2224 Pressure Tap)
- Measurement of Velocity and Pressure Losses in Valves (when used with the PS-2107 Absolute Pressure Sensor and the ME-2224 Pressure Tap)

Venturi Tube



Required Items
General Flow Sensor
PASCO Interface
PASCO Data Acquisition Software

Product Description

The Venturi Tube is designed to work with the General Flow Sensor. The Venturi Tube connects to the General Flow Sensor by way of a flexible twin tube hose. The connectors on the General Flow Sensor are reversed from the connectors on the Venturi Tube so that they cannot be attached incorrectly.

The General Flow Sensor is a versatile differential pressure measuring device. It measures the difference in pressure between the two input tubes.

The Venturi Tube is designed to be used with standard Schedule 40 polyvinyl chloride (PVC) pipe. The open ends of the Venturi Tube have an inside diameter of approximately 2.69 cm (1.05 in). The inlet cross sectional area of the Venturi Tube is 3.44×10^{-4} m^2 and the throat cross sectional area is 1.24×10^{-4} m^2.

The plastic used in the Venturi Tube is compatible with standard PVC glues and the Venturi Tube may be glued into a piping network to measure flow rates. Alternatively, the Venturi Tube may be temporarily placed in a piping network using tape. The overall hose length is 0.91 m (three ft.).

Using the PASCO data acquisition software, the user can select the accessory that is attached to the sensor and what fluid is flowing through the accessory. Once these selections are made, the sensor provides the calculated values for flow velocity or volumetric flow (assuming standard temperature and pressure). The units of measure are selectable as metric or non-metric.

General Flow Sensor with the Venturi Tube

Item	Value with Venturi Tube
Accuracy - Water	±2.1 gallons per minute (gpm)
Accuracy - Air	±2.5 scfm
Range - Water:	0 to 0.00530 m^3/s (0 to 84 gpm)
Range - Air:	0 to 0.0488 m^3/s (0 to 102 gpm)

Setup and Use with the General Flow Sensor

Connect the Sensor

Connect tubes from the Venturi Tube to the General Flow Sensor. Insure that connections are tightly sealed prior to the introduction of any liquids to the system.