

# Vented VW Pressure Transducer 52612499

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# Introduction

**Applications** The vented pressure transducer is designed to monitor changes in water levels. Typical applications include:

- Monitoring water levels in wells and standpipes.
- Monitoring water levels in stilling basins installed in reservoirs.

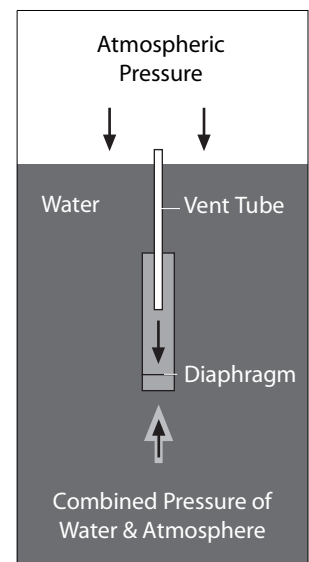
**Theory of Operation** The VW pressure transducer converts water pressure to a frequency signal via a diaphragm and a tensioned steel wire. The pressure transducer is designed so that a change in pressure on the diaphragm causes a change in tension of the wire.

A vent tube communicates atmospheric pressure to the backside of the diaphragm, eliminating the need to compensate the reading for changes in barometric pressure.

When excited by a magnetic coil, the wire vibrates at its natural frequency.

The vibration of the wire in the proximity of the magnetic coil generates a frequency signal that is transmitted to the readout device. The readout device processes the signal and displays a reading.

Calibration factors, which establish a relationship between pressure applied to the diaphragm and the frequency signal returned to the readout device, are used to convert data to the engineering unit required.



# Components

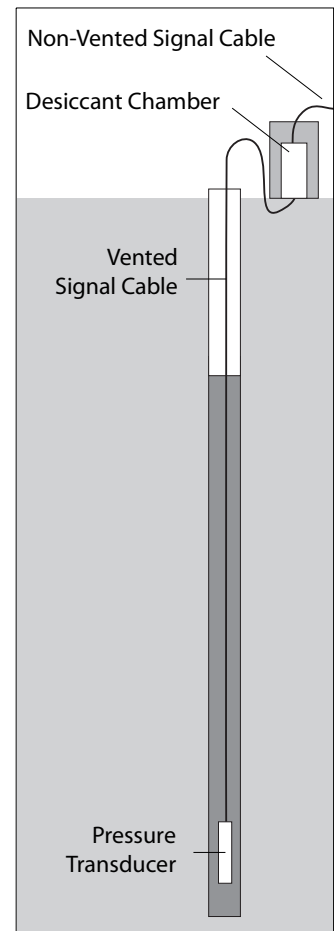
**Overview** The vented pressure transducer system has four main components.

**Non-Vented Signal Cable** runs from the desiccant chamber to the read-out station or data logger. The connection between non-vented cable and vented cable is protected inside desiccant chamber.

**Desiccant Chamber** keeps air in vent tube dry, protecting the transducer from condensation. Desiccant chamber should be protected from weather in a vented enclosure.

**Vented Signal Cable** is connected to non-vented cable inside the desiccant chamber and runs from the desiccant chamber down to the transducer. To keep the vent tube open, you must avoid making tight loops with this cable.

**VW Pressure Transducer** must be installed upright (vertical) with its filter end down. The pressure transducer is quite sensitive, so take care when you handle it.



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# Installation

**Installation Tips**    Read these tips to help ensure a successful installation:

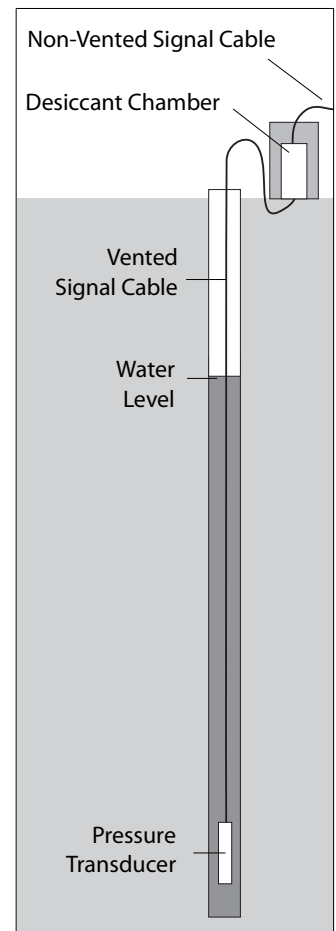
- Transducer**
- Install the transducer in an upright (vertical) position, with its filter end down. Non-vertical installation may cause an offset in the data.
  - Handle the pressure transducer with care. Dropping the transducer is likely to cause damage.
  - Electrical noise from a pump in the same well may interfere with operation of the transducer. Either shut off the pump when you take readings or install the transducer in a different well.

- Cable**
- Terminate the vented signal cable inside the desiccant chamber. Splice conductors from the vented cable to non vented cable, which exits the desiccant chamber and runs to the read-out station.
  - Maintain a radius of at least 4 inches on any bends in the vented signal cable. Tighter bends can pinch the vent tubing and prevent proper operation.
  - Protect the ends of signal cables so that water cannot enter the cable jacket. Cables should be terminated above ground level.

- Desiccant Chamber**
- Desiccant chamber should be protected from the elements. If you install the chamber in a box, be sure to put holes in the box so that the chamber can “breathe.”
  - An indicator in the desiccant changes color when it is saturated. Replace it with fresh desiccant as soon as possible. The life of the desiccant depends on the environment.
  - Renew desiccant in an oven. Spread out in a single layer on baking sheet. Bake at 210°C or 425°F, for 1 hour, then seal in a glass container while it is still hot.
- If you use another type of desiccant, be sure to check the manufacturer’s instructions. Some types of desiccant cannot be recharged. Others may catch fire.

## Installing in a Monitoring Well

1. Remove filter from end of transducer. Fill cavity with water. Replace filter.
2. Lower the transducer into the well. Position it at the specified depth or just below the depth of maximum drawdown.  
If turbulence is expected, devise a centralizer to keep the transducer stable.
3. Terminate vented cable inside desiccant chamber. Choose a protected location for the chamber, ideally outside the humid environment of the well casing. Any enclosure should be vented and easily accessed for inspections.
4. Terminate signal cable in a dry, protected location.

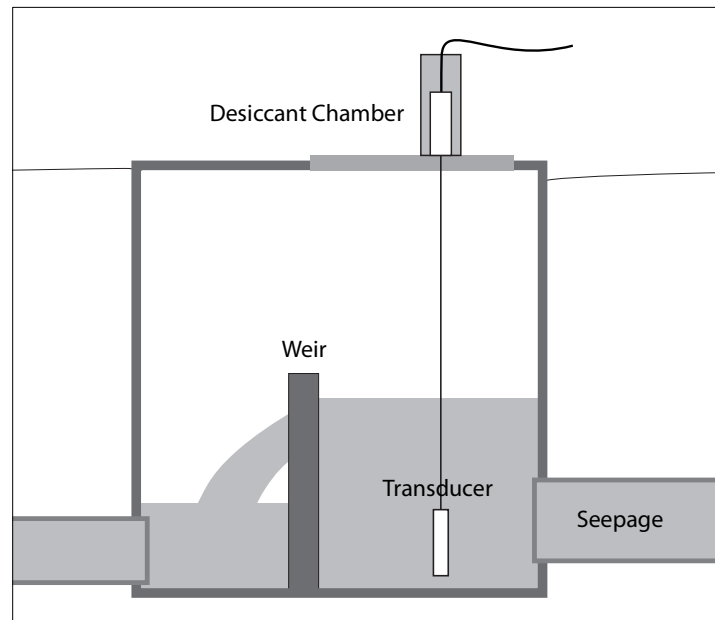


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## Installing in a Stilling Basin or Seepage Weir

The transducer is not suitable for environments in which temperature changes rapidly. However, it can be used at weirs and ponds where water temperature is fairly stable.

1. Remove the filter. Fill the cavity with water, and then replace the filter.
2. Position the transducer away from turbulent areas, such as inlet from pipe and outlet through the V-notch. Install the transducer in an upright position, with its filter end down. Anchor the transducer so that it cannot move.
3. Terminate vented cable inside desiccant chamber. Choose a protected location for the chamber. Ideally, the chamber should be positioned in a less humid environment. Any enclosure should be vented and accessible for inspections.
4. Run non-vented cable from the desiccant chamber to readout station or data logger.
5. Establish a relationship (an offset) between the water level (head of water) reported by the transducer and the actual level of water at the weir.



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# Taking Readings

## Reading with Data Loggers

Instructions for reading VW sensors with a Campbell Scientific CR10 can be found at [www.slopeindicator.com](http://www.slopeindicator.com). Go to Support - Tech Notes and click on the link titled "CR10-VW Sensors."

The VW MiniLogger accepts the same connections as the VW Data Recorder. See the VW MiniLogger manual for details.

## Reading with the VW Data Recorder

1. Connect signal cable to the data recorder:

Binding Posts	Wire Colors	
VW	Orange	Red
VW	White & Orange	Black
TEMP	Blue	White
TEMP	White & Blue	Green
SHIELD	Shield	Shield

2. Choose Hz + RTD or Hz + Thermistor.
3. Select the 800-2000 Hz range.
4. The recorder displays a VW reading in Hz and a temperature reading in degrees C.

## Reading with the VWP Indicator

1. Connect signal cable to the jumper #52611950, from the VWP indicator, as shown in the table below.

Clips	Wire Colors		Function
Red	Orange	Red	VW
Red	White & Orange	Black	VW
Black	Blue	White	TEMP
Black	White & Blue	Green	TEMP



2. Read the transducer: Select the 0.8-2.0 kHz range with the Sweep key. Select Hz with the Data key.
3. Read the temperature sensor: Select °C with the Data key. Note that the VWP Indicator reads RTDs only and cannot read thermistors.

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## Reading with the DataMate MP

The DataMate MP allows you to choose engineering units for your readings. However, for ease of data reduction, we recommend that you record readings in Hz. See the DataMate MP manual for directions on programming.

### Manual Mode

1. Connect the DataMate to the sensor (see connection table below).
2. Switch on. Press  (Manual Mode).
3. Scroll through the list to find “Vibrating Wire Hz.”
4. Press  to excite the sensor and display a reading in Hz and a temperature reading in degrees C. Note that this provides readings only for RTDs, not thermistors. A separate setting is available for reading thermistors.

### Connections

The DataMate jumper cable has a universal connector that connects directly to a universal terminal box or to signal cables that are terminated with a universal connector. A bare-wire adapter (BWA) is also supplied with the DataMate. It allows connection to wires of the signal cable as shown below:

Terminals on BWA or Terminal Box	Wire Colors		Function
5	Blue	White	RTD
6	White & Orange	Black	VW
7	White & Blue	Green	RTD
8	Orange	Red	VW
10	Shield	Shield	Shield

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# Data Reduction

**Sensor Calibration Records** Each VW sensor has a unique calibration. Use the sensor serial number to match the sensor with its calibration record.

**Pressure Factors** The calibration lists coefficients that are used in a polynomial expression to linearize the Hz readings and convert them to engineering units.

**Temperature Factors** The calibration record lists the temperature reading at calibration and a sensitivity factor which can be used to calculate a temperature correction, if necessary.

**Calculating Pressure**

1. The calibration factors convert Hz readings to psi.
2. Apply the factors as follows. Apply the factors as follows:

$$\text{Pressure}_{\text{psi}} = (A * F^2) + (B * F) + C$$

Where: F is the reading in Hz and A, B, and C are factors listed on the sensor calibration record

**Calculating Change in Pressure** Subtract the initial pressure from the current pressure:  
Change in Pressure = Current Pressure - Initial Pressure

**Calculating Change in Water Level** Convert the pressure value above to head of water using a multiplier below. Values assume a water temperature of 15.5 °C.

$$\text{Head of Water} = \text{Pressure Reading} \times \text{Multiplier}$$

Starting Unit	Multiplier	Resulting Unit
psi	27.707	inch
	2.3089	feet
	703.77	mm
	0.70377	m

## Correcting for Density of Water (Optional)

This correction is not usually necessary. It is given here for completeness.

Density varies with the temperature and chemistry of the water and affects the pressure reported by the transducer. The table at right shows density changes for pure water. Find the temperature of the water, then divide the head of water by the specific gravity listed for that temperature. For example, at 4°C, 1 psi = 2.3066 feet of water (or 0.70305 meters of water).

Suppose the measured temperature is 16°C. To correct the head of water value, we would divide 2.3066 ft of water by 0.99897 to obtain a corrected head of 2.3089 feet of water ( or 0.70377 meters of water).

°C	Specific Gravity	°C	Specific Gravity
0	0.99987	26	0.99681
2	0.99997	28	0.99626
4	1.00000	30	0.99567
6	0.999997	32	0.99505
8	0.99988	34	0.99440
10	0.99973	36	0.99371
12	0.99952	38	0.99299
14	0.99927	40	0.99224
16	0.99897	42	0.99147
18	0.99862	44	0.99066
20	0.99823	46	0.98982
22	0.99780	48	0.98896
24	0.99732	50	0.98807

## Temperature Effects

As temperature increases, the transducer outputs a lower frequency for a given pressure. The effect is normally not an issue, and we suggest that corrections be applied only if there are large changes in temperature, or if it is apparent that temperature is seriously affecting readings.

The sensor calibration record provides information that allows you to calculate a temperature correction.

1. Find “T\_Cal and “m” on the sensor calibration record.
2. Calculate the temperature correction:

$$\text{Temp Correction in psi} = (T\_Cal - T\_Now) \times m$$

Where:

T-Cal = Reading from the temperature sensor at calibration

T\_Now = Current reading from the temperature sensor.

m = psi per °C .

3. Add the correction value to the pressure value

$$\text{Pressure}_{\text{Corrected}} = \text{Pressure Reading} + \text{Temp Correction}$$

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# Acceptance Tests

**Introduction** The main purpose of an acceptance test is to provide reasonable assurance that a sensor is functioning properly. Unless you have access to sophisticated test facilities and calibration equipment, acceptance tests should not be expected to achieve the accuracy and precision of the calibration data provided on the sensor calibration record.

**In-Water Pressure Check** This test is conducted in a water-filled borehole or well. There are many variables that can degrade the accuracy of the test, including positioning errors, the specific gravity of water at each depth, temperature of the transducer at each depth, etc. You can correct for these, but the real purpose of the test is to verify that the transducer gives you roughly the reading that you would expect.

1. Mark signal cable at two places, one at a shallow depth and the other at a deeper depth. Measure the distance between the two marks.
2. Pull the filter off, fill the cavity with clean water, and replace the filter.
3. Place the pressure transducer into the water, making sure that water has not drained out of the filter cavity. Lower the transducer to the shallow mark on the signal cable. Clamp the cable in position and wait at least 30 minutes for the transducer to adjust to the temperature of the water.
4. Connect the signal cable to the readout device. Make sure that the vent tube is open to atmosphere. Record the frequency reading and the temperature reading at the shallow depth.
5. Lower the transducer to the deeper mark. Again, clamp the cable and allow the transducer to adjust to temperature at that depth. Record the frequency reading and the temperature reading.
6. Convert the frequency readings to units of pressure by applying calibration factors. Calculate temperature corrections, if temperatures are different at the two depths.
7. Subtract the shallow reading from the deep reading and convert the pressure to feet or meters of liquid head. This should be equivalent to the distance between the two marks.

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# Diagnostics

**Introduction** Perform the tests below to check the sensor and cable.

**No Reading** Set your handheld multimeter to a low-ohm range (5k ohm).

- Measure the resistance between the two VW wires (orange and white-and-orange). A normal reading should be about 300 ohms. If the reading is very high or infinite, the coil is damaged (or the cable is severed). If the reading is very low, the cable may have been crushed and a short has developed.
- Measure the resistance between the temperature sensor wires (blue and white). Thermistors should read about 3000 ohms. RTDs should read about 2000 ohms. If the reading is very high or infinite, the temperature device is damaged (or the cable is severed). If the reading is very low, the cable may have been crushed and a short has developed.

**Unstable Reading** Set your handheld multimeter to a high range (10 or 20 M ohm).

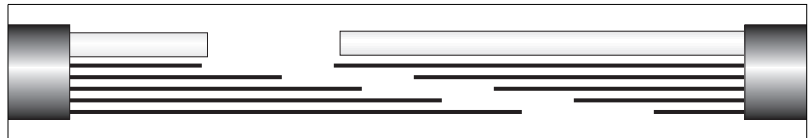
- Measure the resistance between a VW wire and a Temp wire. The reading should be infinite or out of range.
- Measure the resistance between any of the colored wires and the drain (shield) wire. The reading should be infinite or out of range.
- Measure the resistance between the shield wires of two installed VW sensors. Wires must be disconnected from data logger or terminal box to make this test. The reading should be very high or infinite. A lower reading indicates the presence of a ground loop.
- Other sources of unstable readings are electrical noise from nearby power lines, radio transmitters, or motors. Also, over ranged or shocked instruments can exhibit this problem.

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# Splicing Vented Signal Cable

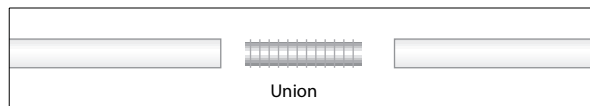
**Introduction** If you have a choice, consider splicing the non-vented signal cable rather than the vented cable. If you must splice the vented cable, you should have splice kit #50614415, a soldering iron, solder, and a heated blower.

**Prepare Wires** Strip back 3 or more inches of cable jacket and cut conductors different lengths to minimize the overall diameter of the splice. Strip about 0.3 inches of insulation from each conductor.



**Splice Wires and Tubing**

1. Slide large cold-shrink insulator onto cable.
2. Cut short lengths of heat shrink tubing to cover each splice and slide onto wires.
3. Solder wires using rosin-core solder. Hold wires with clamps or a soldering jig. Solder drain wires, too. Crimp connectors may be supplied in the kit. You may use these if you cannot solder.
4. Apply oxidation inhibitor to wires, if specified.
5. Slide heat shrink tubing over soldered wires and apply heat.
6. Push tubing ends onto brass union.



7. Wrap mastic pad around splices. It is important to make the diameter of the wrap as small and even as possible. Wrap rubber tape over spliced areas from cable jacket to cable jacket.

**Release Cold Shrink Insulator**

1. Coat wrapped area with grease.
2. Center cold-shrink insulator over wrapped area.
3. Hold cold shrink insulator in position and pull on the release tab to unwind the supporting core of the insulator. You must pull and unwind (counter clockwise) at the same time.
4. The cold shrink insulator collapses onto the spliced area to complete the splice.

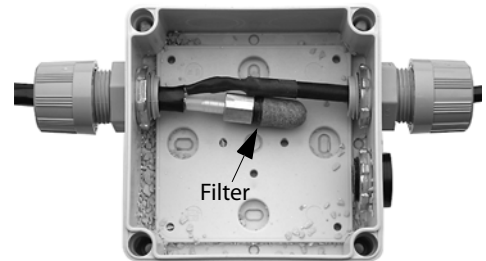
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# Terminating Vented Signal Cable

**Overview** Vented signal cable runs between the transducer and the dessicant chamber. The vent tube must be terminated inside the dessicant chamber to prevent the entry of moisture. The signal conductors of the vented cable are connected to non-vented cable which then exits the dessicant chamber and runs to the readout station or data logger.

## Open Desiccant Chamber

1. Remove the lid by unscrewing the four retaining screws. Pour desiccant into airtight container.
2. Loosen gland seals and push out of the way.
3. Cut out old splice and remove filter from vent tube.
4. Loosen cable glands and pull cable out of chamber.



## Prepare Cable Ends

1. Cut vented cable to the proper length. Strip the jacket back about two inches to expose conductors and vent tube. Strip about 0.5 inch of insulation from each conductor.
2. Cut off the exposed vent tube so about 1 inch remains.
3. Strip 1.5-inches of the jacket on the non-vented cable. Strip about 0.5 inch of insulation from each conductor.
4. Slide cables through cable glands and into dessicant chamber. You may need to slide components of cable glands onto cables first. Some lubrication may be required.

## Splice Cables

1. Insert small filter into the vent tube. You may have to soften the vent tube with a little heat.
2. Identify matching conductors and twist ends together. Secure with wire nuts or solder.
3. Wrap spliced cables with electrical tape.

## Assemble Chamber

4. Fill the chamber with desiccant and screw the lid.