VW
Temperature Sensor
52631599

This equipment should be installed, maintained, and operated by technically qualified personnel. Any errors or omissions in data, or the interpretation of data, are not the responsibility of Durham Geo-Enterprises Inc. The information herein is subject to change without notification.

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Introduction

Applications

The VW temperature sensor is used to monitor the heat of hydration in mass concrete.

Operation

The VW temperature sensor consists of a stainless steel body, a wire held in tension within the body, an electromagnetic coil, and signal cable.

The body of the sensor expands and contracts with changes in temperature, increasing or decreasing the tension of the wire inside the body.

When a readout is connected to the sensor, it sends an electric pulse to coil, which plucks the wire and causes it to vibrate at its natural frequency. A second coil picks up the vibration and returns a frequency to the readout. The frequency reading is converted to units of temperature by applying calibration factors.

Installation Suggestions

Sensor

- Handle the sensor carefully. Never let vibrators make contact with the sensor or the cable.
- When a temperature sensor is mounted in a particularly vulnerable position, consider spraying the area with marker paint, covering the gauge with a protective wire mesh, or placing some non-structural steel to protect the gauge. Damage is most likely to occur when the reinforcing gauge is lifted and then placed and also when the tremie pipe places the cement.

Signal Cable

- Mark cables before installation to help you identify the sensor and cable at the end of the installation process. Add extra identification marks at locations where the cable is vulnerable or must be spliced. This precaution may make it possible to reconnect a bundle of broken cables. Also add extra marks toward the end of the cable, where excess cable length may be cut off.
- Start with the sensor farthest from the readout station and run the cable along the reinforcement, picking up cables from other sensors along the way. Use nylon cable ties to strap the cables to the reinforcement at least every 300 to 400 mm.
- Run cables along the underside of any reinforcements gain some protection from the poured concrete and the use of vibrators. Never run cables diagonally or unsupported through the reinforcement.
- Leave sufficient slack in the cables where there is likely to be any movement in the reinforcement. Check that slack cable cannot be damaged.
- Protect the cables where they exit the concrete with a short length of conduit.

Taking Readings

Reading with Data Loggers

Instructions for reading VW sensors with a Campbell Scientific CR10 can be found at 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
RTD/Therm	Blue	White
RTD/Therm	White & Blue	Green
SHIELD	Shield	Shield

2. Choose Hz + RTD or Hz + Thermistor.
3. Select the 1200-1700 Hz range.
4. The recorder displays a VW reading in Hz and a RTD/Therm reading in degrees C.

Reading with the VWP Indicator

1. Use jumper #52611950 which is supplied with the indicator.
2. Connect the clips of the jumper to signal cable from the sensor, as shown in the table below.

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

3. Read the VW sensor: Select the 0.8-2.0 kHz range with the Sweep key. Select Hz with the Data key.
4. Read the RTD: Select °C with the Data key. Note that the VWP Indicator cannot read thermistors.

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 VW reading in Hz and a RTD reading in degrees C. Note that another setting will show readings for 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/Therm
6	White & Orange	Black	VW
7	White & Blue	Green	RTD/Therm
8	Orange	Red	VW
10	Shield	Shield	Shield

Data Reduction

Serial Numbers & Calibration Records

Each VW sensor has a unique calibration. Use the sensor serial number to match the sensor with its calibration record. There are two alternate data reduction methods; be sure to match the sensor to the method.

METHOD A - Five factors

Calibration Factors

The calibration record lists coefficients that are used in a polynomial expression to linearize the Hz readings and convert them to engineering units. The VW temperature sensor lists five factors, A, B, C, D, and E, which are used to convert the Hz reading to degrees C.

Converting Hz to Degrees C

Apply the calibration factors as shown in the equation below:

$$\text{Temperature} = (A \times F^4) + (B \times F^3) + C \times F^2) + (D \times F) + E$$

Where:

Temperature is in Degrees C,

A, B, C, D, and E are factors on the sensor calibration record,

Example

The Hz reading is 1284.6. What is the temperature in degrees C?

1. Find the sensor calibration record and identify the five factors: A, B, C, D, and E.
2. Apply the calibration factors to find the answer of 60 degrees C.

	Factor	Hz Reading	Value
A	1.6224 x 10E-1	12844.4^4	316.4954
B	-4.56464 x 10E-7	12844.4^3	-967.6321
C	6.8648 x 10E-4	12844.4^2	1132.8273
D	-328319 x 10E-1	12844.4	-421.6929
E	-1.18733 x 10E-3		-0.001187
Temperature in degrees C			59.99

METHOD B - Three factors

Calibration Factors

The calibration record lists coefficients that are used in a polynomial expression to linearize the Hz readings and convert them to engineering units. The VW temperature sensor lists three factors, A, B, C which are used to convert the Hz reading to degrees C.

Converting Hz to Degrees C

Apply the calibration factors as shown in the equation below:

Temperature $= (A \times F^2) + (B \times F) + C$

Where:

Temperature is in Degrees C,

A, B, and C are factors on the sensor calibration record,

F is the Hz reading from the sensor.

Example

The Hz reading is 2240.11. What is the temperature in degrees C?

1. Find the sensor calibration record and identify the three factors: A, B and C.
2. Apply the calibration factors to find the answer of 60 degrees C.

	Factor	Hz Reading	Value
A	3.66391×10^{-5}	2240.11^2	183.8584
B	-1.55501×10^{-2}	2240.11	-34.8339
C	-1.20283×10^{2}		-120.283
Temperature in degrees C			28.74

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 RTD/Thermistor 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 an RTD/Thermistor 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.