Installation and Operating Instructions

for

Drexelbrook Model CM-2 Cut Monitor
Installation and Operating Instructions
for Drexelbrook Model CM-2 Cut Monitor
Water in Oil Indication, Transmission
Using 408-6200 Series Cote-Shield™

Electronics

Typical CM-2 Installation

From Heater Treater

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1.0 Introduction

The instructions in this manual are for Drexelbrook CM-2 transmitters for % water measurement in oil flowing in process piping.

1.1 System Description

Each Drexelbrook CM-2 transmitter consists of a 408-6200 Series two-wire electronic unit with local indication, a 700 Series sensing element (probe), and a 380 Series connecting cable.

The standard electronic unit includes a 24 VDC power supply which allows it to be powered by 120 VAC lines.

In the two-wire configuration, the current supplied to the electronic unit from an external power supply is the same current used for the transmitter output signal. See Figure 1-1.

1.2 Models Available

1.2.1 Electronic Unit

408-6200-1 - Standard electronic unit intended for use with all emulsions.

408-6250-1 - Optional high-sensitivity unit for use with short spans.

408-62X2-1 - Time delay option added.

401-13-21 - 120 VAC/24 VDC power supply in standard unit.

DLM-3000 - Standard digital LCD indicator.

The 408-6200 Series electronic units are available in standard Nema 4X housings.

The standard housing meets the following Nema classifications:

1 General Purpose
2 Drip Tight
3 Weather Resistant
4 Waterproof
5 Dust Tight
12 Industrial use: oil and dust tight

For typical dimensions of the standard housing, see Figure 1-2. Smaller housings are used when the 2 wire configuration is desired. See Figure 1-3.

1.2.2 Sensing Elements

The following sensing elements are included with a CM-2 instrument according to the application requirements. See Section 1.3.5 for detailed specifications. For identification, the last digits of the sensing element model number are stamped into the mounting gland. If you have additional questions about sensing elements, contact the factory or your local representative.

700-201-5 - Rigid 3 terminal sensing element for small pipes.

700-202-23 - Rigid 3 terminal sensing element for larger pipes.

1.2.3 Connecting Cables

The electronic unit and sensing element are connected by a three-terminal coaxial cable, model # 380-XXX-12.
Specifications

Fig. 1-2
Waterproof Housing for Indicating, Line-Powered Cut Monitor

The XXX in the model number indicates the length of the cable in feet. 25 feet is standard, but cut lengths up to 100 feet are available. Cable can also be purchased in bulk lengths with termination kits.

1.3 Technical Specifications

1.3.1 General Specs

A. Output: 4-20 mAdc fully isolated from ground.
   Max. load resistance = 50 (V_supply +15) [ohms]

B. Power Required:
   4 Wire - 120 VAC; 50/60 Hz 1.5 Watts Max (or 230 VAC; 50/60 Hz 1.5 Watts Max)
   *Optional 2 Wire Hookup - 20 to 100 VDC 2.0 Watts Max.

C. Applicability: Any hydrocarbon liquid with consistent dry dielectric constant; homogenized with up to 10% water.

D. Measurement Range: 0-5% water
   *Optional 0-10% water

E. Sensing Element: Single rod sensor with COTESHIELD™ element; to be mounted in standard pipe sizes: 1", 2", 3", 4", 6".

F. Local Indication: Meter calibrated in % water - Digital LCD Standard
   *Optional Analog Indication.

G. Cable Length (Probe to Electronics): 25 feet standard

H. Calibration Signal: A specified level of output, between 20% and 100% F.S., can be selected using an external SPDT switch.

1.3.2 Performance Specs:

A. Accuracy: ± .1% water at standard conditions.

B. Step Response: Less than 1/4 sec. to 90% of final output.
   *Optional 0-30 sec. variable damping.

C. Repeatability: ± .8% span

D. Resolution: .4% span

E. Hysteresis: .4% span

F. Process Temp. Error: ± .2% water/10 F.

G. Ambient Temp. Error: ± .1% span/10 F.

H. Load Regulation: .1% span max. (0-Max. load resistance.)

1.3.3 Environmental Specs

A. Ambient Temp: (-30° to +140° F)

B. Process Temp: (+ 100° to +300° F)

C. Process Press.: 300 PSIG Max.

D. Housing Seal Rating: NEMA 4

1.3.4 Hazard Classification:

A. Sensing Element and Cable: Intrinsically safe for all Groups Div. 1 & 2.
B. Standard Line Powered Electronic Unit:
Non-incendive for Groups C, D, E, F, G,
Div. 2.

C. *Optional 2 Wire Electronic Unit:
Intrinsically safe for Groups C, D, E, F, G,
Div. 1 & 2 when supplied from an intrin-
sically safe power source.

1.3.5 Sensing Elements

<table>
<thead>
<tr>
<th>Mod. #</th>
<th>Std. Mat. of Construction</th>
<th>OD &amp; Mtg.</th>
<th>Press. &amp; Temp Limits</th>
<th>Pipe Size</th>
<th>Insertion Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>700-201-5</td>
<td>TFE &amp; SS Rod</td>
<td>Rod 1/4&quot; OD 3/4&quot; NPT</td>
<td>500 psi @ 300°F</td>
<td>1&quot; Sched 40</td>
<td>18.7&quot;</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2&quot; Sched 40</td>
<td>28.1&quot;</td>
</tr>
<tr>
<td>700-202-23</td>
<td>TFE &amp; SS Rod</td>
<td>Rod 1/2&quot; OD 1 1/2&quot; NPT</td>
<td>500 psi @ 300°F</td>
<td>3&quot; Sched 40</td>
<td>29&quot;</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4&quot; Sched 40</td>
<td>32.1&quot;</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>6&quot; Sched 40</td>
<td>38.4&quot;</td>
</tr>
</tbody>
</table>

1.3.6 Three-Terminal Cable

General Purpose 380-XXX-12: .51" OD at
largest point, 160°F temp limit.
2.0 Theory of Operation

2.1 Basic Principal

Since water has a dielectric (K) of 80 at room temperature, while most petroleum materials are in the 2-2.9 range, the addition of high "K" water molecules to a low "K" petroleum compound raises the total dielectric constant enough to be a useful indication of just how much water is actually present. The ability to measure water content of oil electrically is based on just this phenomenon.

An instrument that will produce a constant RF voltage (Figure 2-1) and monitor how much RF current flows, will produce higher current for high "K" samples, than for low "K" samples. The only limit to how minute a change in dielectric constant can be measured, is the resolution and more importantly, the stability of the equipment used to make the measurement.

In order to measure the dielectric constant (K) of a material, it must be incorporated into some kind of a capacitor, and uniformly distributed between 2 electrodes or "plates" which are well insulated from each other. In the case of liquids, it has been traditional to use "concentric" capacitors in the measurement of dielectric constant. The capacitance of a truly concentric cell is:

\[ C = \frac{7.37 K}{\log \frac{D_2}{D_1}} \]

and this is the capacitance for each active foot of cell.

A variable in the cell itself is centering and parallelism. If the center rod is misaligned, the deviation from theoretical capacitance value is shown in Figure 2-A. The larger the ratio of pipe to rod diameter, the greater the misalignment necessary to produce a given % error.

The pipe itself will be at ground potential, so it can be connected into the process without being insulated from the rest of the piping, and so no external changes can affect the signal. When bringing the rod connection out through the pipe, it must be insulated and sealed.

One of the most important considerations to the stability of the "K" measurement is the type of connection made between the electronic unit and the capacitance cell. Since the cable capacitance and the capacitance of the pressure seal on the probe are directly parallel to, and therefore add to the capacitance of the cell.
Eccentricity (Pipe Diameters)

Capacitance vs Eccentricity for Variations in Diameter Ratio

Graph 2-A

Itself, any variation in capacitance due to changing ambient temperature which affects the cable or the gland, will cause variation in the overall capacitance measured.

If the connecting wire which we are trying to protect from ambient influences, is surrounded by a shield which is driven by an independent but absolutely identical voltage, we now have equal potential across the insulation of the coaxial cable and the gland seal. This means that no current can flow in those insulating materials. Therefore, it no longer matters what the capacitance or the capacitance change of these two items happens to be. Without any current flow through those materials, they cannot add any noise capacitance to the center rod to ground measurement in the cell.

Process temperature variation is the biggest single source of error in a cut monitor. But let’s look at the problem carefully. If we are monitoring the output of a heater-treater, a lot of effort goes into controlling the temperature at which it operates. If the outlet piping is insulated just past the capacitance cell, we are controlling the temperature for the cut monitor as well.

The electronic unit (Figure 2-1) has a stable oscillator driving a bridge circuit which brings inherent thermal and electrical stability to the measurement. In addition to providing the stable RF voltage source and the bridge used to measure the amount of RF current going into the cell, the electronic unit also provides the guard potential which makes the connections to the cell completely immune to ambient influences. The principal of the electronic guard is also used within the electronic unit in order to shield the adjustments and any other connections to the measuring circuit from the outside world.

In applications with high paraffin content, it is quite common to pull the cells out for periodic cleaning. Because of its large air gap and metallic surfaces, the Drexelbrook capacitance cell will not require removal of paraffin for intervals roughly five times as long as conventional water-in-oil detectors. Cleaning the probe requires shutting down the line the probe is in for a few minutes; long enough to unscrew the probe, wipe it and the pipe I.D., then screw it back into the line. If the probe is mounted vertically downward, it isn’t even necessary to drain the line.

The standard, 120 VAC unit contains a resistor network which may be switched into the output loop in place of the transmitter to produce a synthetic output signal for calibration or test. Three terminals are connected to an external SPDT switch to select the “calibrate” or “run” mode.

2.2 Sensing Elements

The necessary change of input capacitance is provided by a sensing element or “probe” which is mounted in a pipe carrying the oil to be monitored.
Theory

Sensing elements vary in length depending on the size pipe employed. Knowing the pipe size, the factory will select the correct sensing element for the application. Figure 2-2.

All Drexelbrook cut monitors are based on a probe which produces 15 pF when mounted in an empty pipe of the specified size. Centering is crucial, since substantial deviations from concentricity will cause the air capacitance to be higher than 15 pF and cause the CM-2 to read high water %.

2.3 Cables

The Drexelbrook CM-2 Cut Monitors use a three terminal coaxial cable to connect the sensing element to the electronic unit. The center wire of the cable carries the change in capacitance signal from the probe to the electronic unit, while the coaxial shield is driven at guard potential (sometimes called Cote-Shield™). The purpose of the shield is to eliminate any capacitance from the center wire to ground. As a result, the cable capacitance does not interfere with the capacitance signals from the probe. There is no need for the electronic unit to "zero out" the cable capacitance in order to get a reliable reading. The shield also prevents output errors due to changes in cable capacitance caused by temperature. See Figure 2-3.

Fig. 2-2
CM-2 Sensing Element

Fig. 2-3
Typical Coax Cable
3.0 Installation

3.1 Unpacking

Carefully remove the contents of the carton and check each item against the packing list before destroying any packing material. If there is any shortage or damage, report it immediately to the factory.

3.2 Mounting the Electronics

The 408-6200 Series transmitter was designed for field mounting, but it should be mounted in a location as free as possible from vibration, corrosive atmospheres, and any possibility of mechanical damage. For convenience at start-up and observation purposes, mount the instrument in a reasonably accessible location. Ambient temperatures should be between -40°F and 140°F (−40° and 60°C). See Figure 3-1.

3.3 Mounting the Sensing Element

The mounting location for the sensing element (probe) is determined by the piping in which the "cut" is to be measured.

The following sensing element mounting and installation instructions should be followed so that the equipment will operate properly and accurately:

---

**Fig. 3-1**

*Typical Mounting Dimensions*

A. Mount the sensing element vertically in a pipe carrying the oil upward. The probe should be mounted as near to the center of the pipe as possible to optimize accuracy.

---

**Fig. 3-2**

*Mounting the Sensing Element*
Installation

B. The sensor should be upstream from any valves to keep the oil pressure as high and constant as possible. Figure 3-2.

C. Do not take a sensing element apart or loosen the packing glands.

D. Tighten the sensing element with the wrench flats nearest the mounting threads.

3.4 Wiring the Electronic Unit

The signal connections are made to the terminal strip(s) on the backplate or chassis (depending on the type of unit power). Due to the low power consumption of the instrument, the wiring need only be light gauge. See Figure 3-3 for proper connections.

![Fig. 3-3 Power and Signal Wiring](image)

The cable from the sensing element is connected to the terminal strip on the instrument chassis. See Figure 3-4. The cable connections are center wire (CW), ground (gnd), and shield (SH).

Only coaxial cables supplied by Drexelbrook Engineering Company should be used to connect the transmitter to the sensing element. Use of other cables can result in unstable calibration.

Caution: Before using Intrinsic Safety Barriers, read the manufacturers instructions for barrier operation. Barriers supplied by Drexelbrook

![Fig. 3-4 Sensing Element Wiring to the Electronic Unit](image)

Engineering Company, and prewired to the power supply, have already been tested for proper operation. See Figure 3-5.

The 408-6200 has a built-in current limiter which holds the signal current to a maximum of 35 mA.

![Fig. 3-5 Typical Intrinsic Safety Barrier](image)
3.5 Sensing Element Connections

The cable connections to the sensing element are shown in Figure 3-6. Do not connect the cable to the sensing element until after the sensor has been installed in the pipe and the conduit housing has been screwed on securely.

![Diagram of cable connections]

Fig. 3-6
Cable Connections to the Sensing Element
4.0 Calibration

4.1 Controls and Adjustments

Note: All Drexelbrook cut monitors are calibrated to the expected capacitance values, and the adjustments are sealed. If calibration is necessary due to a misaligned probe, only the fine zero adjust should be changed to produce the correct reading after checking water content of a sample. Do not change other adjustments unless a rigorous calibration program can be accomplished.

4.1.1 Zero & Span Controls

There are four main controls on the chassis front panel. They are the Step Zero, Fine Zero, Step Span and Fine Span controls. See Figure 4-1.

![Step Zero, Fine Zero, Step Span, Fine Span Controls](image)

**Fig. 4-1**
Zero and Span Controls

The Step Zero and Fine Zero controls work together to provide continuous adjustment of the minimum current point. Each Step Zero position advances the minimum current point approximately 60 pF, while the Fine Zero provides continuous adjustment between each step.

Note: Under normal circumstances, the interaction between zero and span should be less than 1% of span. If this interaction becomes greater than 1%, consult the factory for assistance.

The Step Span and Fine Span controls also work together to provide continuous adjustment of the change in capacitance required to produce full scale current. The Fine Span provides continuous adjustment between the Step Span positions.

4.1.2 Time Delay Control

Time delay or adjustable damping is available as an option. See Figure 4-2. It is a RC time constant circuit that is variable over a range of zero to 30 seconds. For most applications requiring damping, five or ten seconds is usually sufficient. Calibration of the transmitter is done with the time delay turned off.

![Time Delay Control](image)

**Fig. 4-2**
Time Delay (adjustable damping) Control

After calibration is complete, the time delay can be added, without affecting the calibration, by turning the control knob clockwise. Occasionally, when the time delay is first turned on, there is a temporary upset in the transmitter output until the circuit settles out.

4.2 Start-Up

Before applying power to the instrument, be sure that the input power is correct for the particular instrument. Check all wiring connections, observing polarity of the output loop.

Caution: Explosionproof Installations in Hazardous Areas: Before the housing cover is removed to calibrate the instrument, the area must be checked and known to be nonhazardous. When calibration is complete, the housing cover must be re-placed. Each lead from the explosionproof case must be equipped with an approved seal fitting.

4.3 Calibration Procedures

Note: Your transmitter has been precalibrated at the factory, do not alter adjustments, unless it is known to be out of calibration.
4.3.1 Trimming the Calibration

If calibration agrees with sample tests, within ± 2.5% H₂O, the calibration may be trimmed using this procedure. If it deviates by more than ± 2.5% H₂O, the 4.3.2 procedure is required.

A. Read and record output at the time a sample is pulled from the pipe which surrounds the probe.

B. Check moisture content of sample with centrifuge.

C. If reading deviates from sample by less than 1.5% H₂O, note present reading on transmitter and adjust “fine zero” only - until reading is increased or decreased by amount of deviation.

D. If reading deviates by more than 1.5% H₂O, adjust “fine span” only - until present reading is increased or decreased by amount of deviation.

E. Repeat steps A & B to verify calibration.

4.3.2 Full Calibration Procedure

Before starting the calibration procedure, the following equipment will be necessary:

A. API spec. centrifuge

B. Pressure sampling bomb - 500 mL min. (only for product running above 150°F).

C. Drexelbrook model 401-6-81 capacitance box (and instruction manual 401-18-20-LM, Section III).

D. Temperature stabilization bath.

Before attempting to calibrate:

A. Read and record output from transmitter with fairly wet but consistent product flowing. (If reading is erratic and/or below zero %, there are probably significant gas bubbles in the line, or falling pressure may be allowing water to flash to steam. Correct the condition or relocate the probe.)

B. Pull sample from pipe at probe location. (If temperature is above 150°F, use a sampling bomb and stabilize temperature at 150°F, so that no water is lost to evaporation.)

C. Centrifuge sample to determine water percentage.

Now, begin calibration

D. Attach C-box (401-6-81) to electronic unit (Figure 4-3) and detach center wire (blue) at probe conduit.

E. Dial in capacitance which produces the same output as in step A.

F. Read C-box value and add the standing capacitance of the box (Figure II-6 in the C-Box Instruction Manual). Record this value of capacitance which is the output our probe produces for the % water in our sample.

G. Repeat steps A through G for a fairly dry product. (This can be done on another day if necessary.)

H. Data:

<table>
<thead>
<tr>
<th>Capacitance</th>
<th>Actual % Water</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dry Stream</td>
<td>C₀ = (Dry)</td>
</tr>
<tr>
<td></td>
<td>(Oil)</td>
</tr>
<tr>
<td>Wet Stream</td>
<td>C₂ = (Wet)</td>
</tr>
<tr>
<td></td>
<td>(Oil)</td>
</tr>
</tbody>
</table>

Compute capacitance for 0% water (bone dry) in oil.

\[
C₀ = \frac{C₂ - C₀}{(Wet) - (Dry)} = \frac{C₀}{(Oil) - (Oil)}
\]

J. Compute capacitance for full scale output.

\[
C₀ = \frac{C₂ - C₀}{(Wet) - (Dry)} = \frac{C₀}{(Oil) - (Oil)}
\]

Example:

<table>
<thead>
<tr>
<th>Capacitance</th>
<th>Actual % Water</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dry Stream</td>
<td>C₀ = 41.9</td>
</tr>
<tr>
<td></td>
<td>(Dry) = 1.0</td>
</tr>
<tr>
<td></td>
<td>(Oil)</td>
</tr>
<tr>
<td>Wet Stream</td>
<td>C₂ = 51.9</td>
</tr>
<tr>
<td></td>
<td>(Wet) = 7.3</td>
</tr>
<tr>
<td></td>
<td>(Oil)</td>
</tr>
</tbody>
</table>

Full scale moisture = 10%.

\[
C₀ = \frac{C₂ - C₀}{(Wet) - (Dry)} = \frac{C₀}{(Oil) - (Oil)}
\]

\[
= \frac{51.9 - 41.9}{10.0 - 7.3} \times \frac{7.3}{6.3} = 40.3\mu F
\]
D. If necessary, adjust the zero controls for the minimum current calibration and the span controls for the maximum current calibration.

E. Disconnect the calibration standard and reconnect the coax center lead to probe.

Unit is again ready for operation.

When replacing a malfunctioning electronic unit, the replacement chassis can be calibrated on the bench by the preceding method and then installed in the field, providing an equipment length cable is attached to the chassis during the procedure.
Calibration/Operation

\[ C_{\text{max}} = 40.3 + \frac{10.0}{6.3} \times 10.0 = 56.2 \text{pF} \]

Internal C-box Capacitance = 7pF, 50

Dial should read 33.3 for 4mA(0% H₂O) and 49.2 for 20mA(10.0% H₂O)

I. Attach C-box to electronic unit and detach center wire (Blue) at probe conduit.

J. Subtract C-box standing capacitance from \( C_0 \) and dial in this value. Adjust zero to read 0.00% (4mA output).

K. Subtract C-box capacitance from \( C_{\text{max}} \) and dial in this value. Adjust span to read full scale water % (20mA output).

L. Recheck 0% reading, record \( C_{\text{dry}} \) and \( C_{\text{max}} \) for future reference.

M. Detach C-box, reconnect probe and close up box and conduit.

N. If additional accuracy is required, tweak fine zero (only as in section 4.3.1).

4.4 Secondary Calibration Standard

A secondary calibration standard C-box such as Drexelbrook model 401-6-81 can be used to simulate the capacitance of an empty vessel. The following procedure permits recalibration of an instrument without the necessity of a complete calibration effort.

4.4.1 Recording Calibration Data

After initial calibration, do the following:
(Also, see calibration standard instruction manual, Section II).

A. Disconnect the coax center wire from the probe rod in the probe conduit. (Be sure that it does not short to anything.)

B. Connect the calibration standard to the instrument in parallel with existing cable, ground to Terminal 7, center wire to 9, and shield to Terminal 8. See Figure 4-3.

C. Adjust the calibration standard until the instrument indicates minimum current (4 mA).

D. Record the value read on the calibration standard and its serial number for later use. Recording the value on the inside of the instrument door is also suggested.

E. Adjust the calibration standard until the instrument produces full scale indication (20 mA).

F. Record the capacitance value as in Step D.

G. Disconnect the calibration standard from the instrument terminals and reconnect the probe.

4.4.2 Recalibration

Whenever it is subsequently desired to check or reset the calibration, or replace the instrument, the C-box set to the value recorded above may be substituted for the probe. This is done as follows:

A. Disconnect the coax center wire from the probe in the probe conduit.

B. Connect the C-box parallel with the existing cable. See Figure 4-3.

C. Set the C-box to the recorded values.
5.3 Checking the Signal Loop.

A. With probe disconnected, disconnect the power from Terminals 1 and 2 and measure the open circuit voltage from the power supply. Voltage should be between 20 and 100 VDC.

B. Connect the signal wires to Terminals 1 and 2. Turn the Step Span and Step Zero to Position #1. Put the Fine Span control completely clockwise and adjust the Fine Zero until 20 mA flows.

C. Measure the voltage between Terminals 1 and 2. Voltage should be between 13 and 100 VDC. If there is less than the minimum 13 volts required, the loop has too much resistance or not enough power supply voltage.

D. If, in Step C above, the voltage is less than 13 VDC, disconnect the power supply and signal wires to the unit. Short the wires that were removed from the power supply (+) and (-) terminals.

E. Measure the resistance between the two wires that were just removed from Terminals 1 and 2 of the electronic unit. The graph below will tell you when the resistance is too large. See Figure 5-5.
5.0 Troubleshooting

5.1 Introduction

The 408-6200 Series instruments are designed to give years of unattended service. No periodic or scheduled maintenance is required.

A spare chassis is recommended for every 10 units so that, in case of a failed unit, a critical application will not be held up while the unit is returned to the factory for repair.

If a difficulty occurs when operating your measurement system, mentally divide the system into its component parts and test each part individually for proper operation.

These troubleshooting procedures should be followed in checking out your system. If attempts to locate the difficulty fail, notify your local factory representative or call the factory direct and ask for the service department.

5.2 Testing the 408-6200 Series Electronic Unit

5.2.1 Operation Check

A. Remove the sensing element and signal wires from the transmitter.

B. Be sure the Fail-Safe link is in the low-level fail-safe position. See Figure 5-1.

C. With a pencil, mark the positions of all the controls on the faceplate in order to return to them.

D. Put the Step Span in Position #1 and the Fine Span in the full clockwise position (most sensitive position). Put the Step Zero in Position #1. See Figure 5-2.

E. Observing polarities, connect a DC milliammeter and DC power supply (20 to 100 volts) in series, and complete the loop by connecting Terminals 1 and 2. See Figure 5-3.

F. Adjust the Fine Zero until the meter reads 0% (4 mA).

G. Turn the Fine Zero one turn clockwise. The output should read between 40% and 70% (10-15 mA).

H. If the difficulty has not been located at this point, proceed to the next checkout procedure.

5.2.2 Drift Check

If the output of a transmitter seems to be drifting, it is important to determine whether the drift is in the transmitter or in the probe. (A properly connected, dry cable never drifts.)

A. Remove the sensing element cable from the transmitter.

B. Without disturbing the dial settings, connect a capacitance standard or an NPO capacitor* across the probe to ground input. Adjust the capacitance standard or select a capacitor value that will bring the unit on scale.

*The capacitor should remain stable with changes in temperature.

C. Observe the reading over a 24-hour period to see if it is stable.
5.5 Checking the Sensing Element Cable

1. DISCONNECT CABLE AT BOTH ENDS. BE SURE ALL TERMINALS ARE STANDING CLEAR.

2. MEASURE RESISTANCE FROM CENTER WIRE TO COTE-SHIELD. RESISTANCE SHOULD BE INFINITY (OPEN CIRCUIT).

3. SHORT PROBE & GROUND TERMINALS TOGETHER AT ONE END.

4. MEASURE RESISTANCE FROM PROBE TO GROUND TERMINALS AT OTHER END. RESISTANCE SHOULD BE NEAR ZERO OHMS (SHORT CIRCUIT).

5. REPEAT STEP 2 FOR COTE-SHIELD AND GROUND TERMINALS.

5.6 Problems and Causes

<table>
<thead>
<tr>
<th>Problem</th>
<th>Possible Causes</th>
<th>Checkout</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Transmitter reads 20 mA or greater even when pipe is not full.</td>
<td>a. Transmitter malfunction [\text{Sec. 5.2.1}] b. Water in probe condulet [\text{Sec. 5.4}] c. Short in cable [\text{Sec. 5.5}] d. Short in probe [\text{Sec. 5.4}] e. Calibration is wrong [\text{Sec. 4.3}]</td>
<td></td>
</tr>
<tr>
<td>2. Transmitter never reaches 20 mA even though the oil is “wetter” than 100% of range.</td>
<td>a. Load resistance too high [\text{Sec. 5.3}] b. Calibration is wrong [\text{Sec. 4.3}] c. Transmitter malfunction [\text{Sec. 5.2.1}]</td>
<td></td>
</tr>
<tr>
<td>3. Transmitter is drifting</td>
<td>a. Moisture in probe gland [\text{Sec. 5.4}] b. Water in probe condulet [\text{Sec. 5.4}] c. Transmitter malfunction [\text{Sec. 5.2.2}] d. Water in cable [\text{Sec. 5.5}] e. Gas in liquid stream [\text{Sec. 3.3, 4.3.2}]</td>
<td></td>
</tr>
</tbody>
</table>
5.4 Checking the Sensing Element

A. With an analog ohmmeter*, check the resistance of the probe-to-ground and shield-to-ground with no liquid on the probe. See Figure 5-6.

*A digital ohmmeter may produce erroneous readings.

Resistance should be infinite. Resistance less than 1 megohm indicates excessive leakage, probably due to condensation or leakage in the conduit, around the gland/packing nut area. (Consult factory.)

B. Check the resistance of the probe-to-ground and shield-to-ground with liquid on the probe. See Figure 5-7. Resistance readings less than 1 megohm indicate that the material is conductive and your Drexelbrook Application Engineer should be consulted.
5.7.3 Field Service

Trained field servicemen are available on a time-plus-expense basis to assist in start-ups, diagnosing difficult application problems, or in-plant training of personnel. Contact the Service Department for further details.

5.7.4 Customer Training

Periodically, Drexelbrook instrument training seminars for customers are held at the factory. These sessions are guided by Drexelbrook engineers and specialists, and provide detailed information on all aspects of level measurement including theory and instrument operation. For more information about these valuable workshops, write to Drexelbrook Engineering, Attention: Communications/Training Group. Or Call direct (215) 674-1234.
5.7 Factory and Field Service Assistance

5.7.1 Telephone Assistance

If you are having difficulty with your Drexelbrook equipment, and attempts to locate the problem have failed, notify your local Drexelbrook representative, or call the factory direct and ask for the service department. Drexelbrook Engineering Company is located at 205 Keith Valley Road, Horsham, PA 19044. The telephone number is (215) 674-1234. To help us solve your problem quickly, please have as much of the following information as possible when you call:

- Instrument Model #
- Probe Model #
- P.O. #
- P.O. & Date
- Cable Length
- Application
- Material being measured
- Temperature
- Pressure
- Agitation
- Brief description of the problem
- Checkout procedures that failed

5.7.2 Equipment

Do not return equipment without first contacting the factory for a return authorization number. Any equipment being returned must include the following information:

- Reason for return
- Return Authorization #
- Original P.O. #
- Drexelbrook order #
- Your company contact
- "Ship To" address

To keep the paperwork in order, please include a purchase order with returned equipment even though it may be coming back for warranty repair. You will not be charged if covered under warranty. Please return your equipment with freight charges prepaid. We regret that we cannot accept collect shipments.

Drexelbrook usually has a stock of reconditioned exchange units available for faster turnaround of a repair order. If you prefer your own unit repaired rather than exchanged, please mark clearly on the return unit, "DO NOT EXCHANGE".

Spare instruments are generally in factory stock. If the application is critical, a spare chassis should be kept on hand.