

## Why choose a Drexelbrook Cut Monitor?

AMETEK Drexelbrook is the world leader in RF Admittance based level measurements. We have been using our patented RF admittance technology for over 20 years to make water cut (BS&W) measurements. Our cut monitor systems are considered the standard at some of the world's largest oil producers, pipelines, and refineries.

What are the Drexelbrook advantages over other products that attempt to mimic our accuracy and reliability?

- Insertion probe advantages – Our probes measure a representative sample, starting at the center of the pipe, which is the preferred sampling location according to API.
- High temperature and pressure ratings - We offer the highest pressure and temperature ratings in the industry. Our probes can handle pressures up to 1500 psi. and temperatures up to 450°F
- Price, Price, Price – Why spend \$15K + for a device when you can get a reliable, accurate measurement for much less?
- Temperature compensated – Transmitter will compensate for the effects of temperature when the water is in liquid state (e.g. 0°C to 100°C at ambient pressure)
- Density compensated – Not affected by changes in density when ordered with the DCM (Density Compensation Module).
- Immunity to paraffin buildup – Our RF Admittance measurement is relatively unaffected by deposits on the pipe and probe.
- Easy to clean – Simply pull the probe, wipe down, and re-insert. No need to take apart spool pieces and tie-off large pipelines.
- Easy to install – Can be configured for NPT or flanged mounting. 4-20 mA can go to any signal processing unit. Can be installed in any pipe size.
- Low maintenance – No gaskets or seals that require routine maintenance.
- No coatings – Our Permaseal sensing element does not require epoxy coatings that wear out and require expensive servicing.
- Durability – Sensing element will not wear out in well fluids that include large amounts of sand.
- Easy to calibrate – Calibration that can be done via onboard keypad or through the 4-20mA loop with our HART software. Comes factory pre-calibrated and requires only one point calibration trim. Competitors require multiple samples and recurring calibration adjustment due to less stable electronics.
- Wide selection of cut ranges – Has 11 pre-set ranges that are within 0-50% with custom ranges as high as 0-80% in heavy oil.
- Not affected by changes in salinity – The RF-Admittance technology is inherently immune to the conductivity changes in the fluid.

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## The Drexelbrook Technology Advantage

### RF Admittance

The Drexelbrook method of using RF Admittance to measure water cut is widely successful because of the large difference between the dielectric constants of oil ( $k \approx 2.3$ ) and water ( $k \approx 80$ ). The sensing element and the pipe wall form the necessary two plates of the concentric capacitor. The system electronics transmit a radio frequency voltage to the sensing element that measures changes in capacitance. As the amount of water in the flowing oil increases, the net dielectric of the fluid increases which causes the capacitance to increase. The onboard electronics can then compute the relationship between capacitance change and water cut. Straightforward, Reliable, Proven.

The Cote-shield circuitry that is part of the RF technology offers several key advantages over other capacitance based devices. The low drift components create the necessary circuit stability to make an accurate water cut measurement. The Cote-shield circuitry that is not affected by temperature induced changes in gland capacitance. We have found that the effects of ambient temperature on competitor's gland capacitance can result in error of approximately 2-3 pF. In lower cut ranges, 0-1% water in oil for example, the entire range of the measurement is only 2-3 pF. The temperature effects on gland capacitance results in an error of 100%. The gland capacitance fluctuations cause additional havoc on the calibration of the device. Users will calibrate their device at 12 noon and then need to recalibrate their device at 8 pm. The Drexelbrook RF Admittance removes this unnecessary maintenance.

### Sensing Element

One of the more common application problems that Drexelbrook has encountered is independent slugs of oil, gas, or water reaching the sensing element. These slugs are usually caused by some form of separation that occurs before it passes through the sensing area of the instrument. The separation is often more critical at water-cuts above 50% where the fluid property differences (density, viscosity, etc...) will cause a portion of the oil/water emulsion to separate into a free water phase. As this occurs, the sensing element is subjected to multiple parallel, and very different, fluids. The separation phenomenon will interfere with the typical cut monitor that requires a pure homogenous mixture in order to make an accurate measurement.

In addition to the advantages of the RF Admittance, the Drexelbrook insertion probe enables it to get a large representative sample of the fluid that other manufacturers can not. The grey colored sensing element show below will extend directly into the process for a minimum of 15 inches. The advantage of this is the capacitive property of the fluid is taken over the entire length of the probe to create an averaging effect. The measurement is now taking a better sample of the fluid over a larger range. Another advantage of the Drexelbrook Permaseal sensing element is its ability to be installed directly into the main process without requiring side-arms or slipstreams.

The diagrams (Next Page) demonstrate how the water cut measurements can be made incorrectly. The competitor's method takes a sample only over the width of their sensor, typically around 2 inches. Utilizing this approach, any time a slug of water or air passes by the 2" sensing element, the measured water cut of the device will immediately shift. This shift can cause needless alarms and valve actions that are mostly unwarranted. The Drexelbrook solution takes a different approach by extending the sensing range. The extension of the sensing element takes a better sample of the entire fluid and results in a smoother, more accurate, response.

### Temperature Compensation

The dielectric constant of crude oil can change with any changes in temperature. These changes may cause standard cut monitors to change without any variance in water content. The Universal IV Water Cut Monitor measures product temperature internally and calculates a true water cut reading.

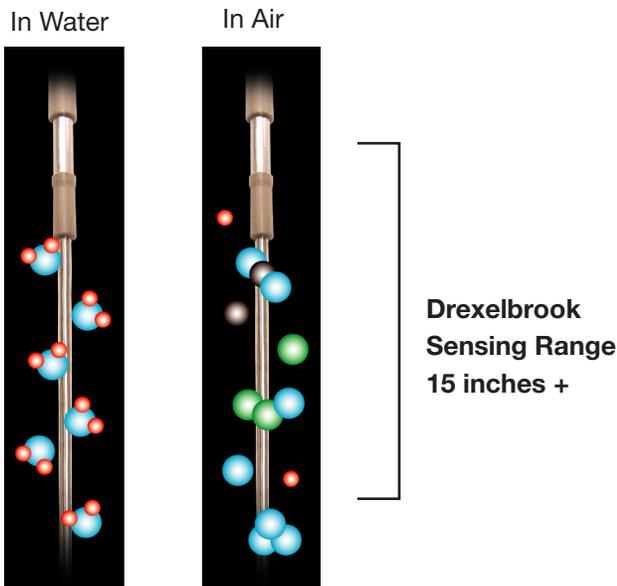
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## Density Compensation

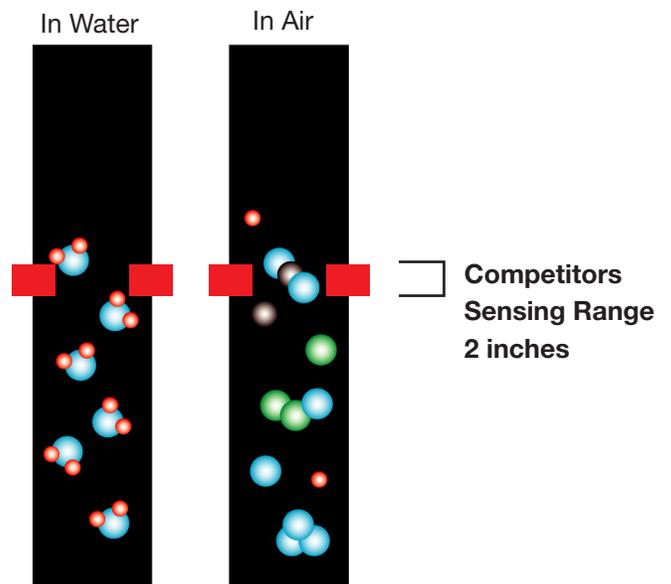
The density or API gravity of crude oil changes due to many factors including temperature, material changes as well as the region and or formation that it is being pulled from. These changes will cause standard cut monitors to mistakenly attribute changes in density to changes in water content if not properly accounted for. The new Drexelbrook UIV CM with Density Compensation utilizes system measured variables such as temperature, flow and density from a customer supplied Coriolis meter and calculates the corrected value for true water content.

## The Sensing Element

### Drexelbrook Standard Permaseal Probe



### Competition



The Drexelbrook sensing element utilizes a PEEK (Poly Ether Ether Keytone) material and stainless steel sensing rod that is extremely durable and does not require epoxy coatings. These epoxy coatings are a maintenance burden because they degrade over time when placed in the turbulent process flow. The picture (R) shows the cracking and erosion of the epoxy coatings. This degradation of the epoxy coating will result in erratic outputs and requires expensive, reoccurring maintenance by field personnel.



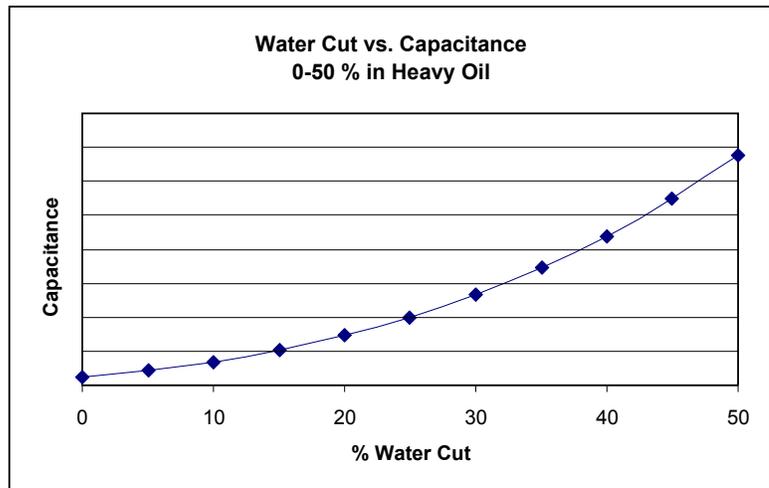
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## Limitations of the Drexelbrook Cut Monitor

The items listed below are some of the negative comments that we have heard about the Drexelbrook Cut Monitor.

### Your cut monitor is limited only to the linear region.

**This is FALSE.** It is a common misconception from our customers that the capacitive instruments are limited to the linear segment of the capacitance vs. water-cut response curve. This was true on some of our older products, but the advancements in micro-processing have eliminated this problem. The capacitance instruments are able to extend into the non-linear range through the use of strapping tables. Our device uses 13 calibration points that creates an excellent fit to the non-linear region of the curve. The graph shows the data points from a typical strapping table that tracks the changing water cut through a non-linear capacitance response.



### The cut monitor lacks integral relay contacts.

This is partially True. A number of competitors offer devices that have a relay contact built into their electronics.

**However,** Drexelbrook DOES offer a relay option on the density compensation option and the ability to close-couple relay contacts with their standard electronics. Since most cut monitors are being fed into a PLC based system that contains relay outputs, why pay for this capability in the primary instrument? Also, the 4-20mA output is the industry standard that can be fed to any loop powered device such as a PLC. Running additional power to the primary instrument to drive the relays is an inefficient and very expensive approach.

### It cannot measure up to 100%.

This is True. The limitations on the ranges of the cut monitor are based on the physical limits of capacitive technology. As the measurement becomes water continuous, the fluid becomes conductive and creates an electrical short to ground. The short to ground, which is equivalent to an infinite capacitance, completely obscures the dielectric information. Our technology is limited to 0-50% in light oil and 0-80% in heavy oil. These limits are generally set by the transition point from oil continuous to water continuous.

**However,** the capacitance measurement is excellent in the oil continuous phase of water cut. The range limitations on the Drexelbrook cut monitor will handle a majority of the applications in the field. If the customer requires a device with 0-100% capabilities, we will kindly refer them to our competitors, with the note that they will be paying three to four times the price for a device that can measure in that range.

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## Sample Applications

### Bakersfield, California

One of the world's largest oil companies purchased 108 Drexelbrook cut monitors to replace their existing devices. Facilities engineers at were looking to find a new solution to eliminate the recurring maintenance that was required for cut monitors on their Automatic Well Testers. The cut monitors at the AWTs measured between 0 and 80% in Heavy Oil with large amounts of sand and entrained gas. The engineers conducted a thorough cost benefit analysis and found that they spent over \$150,000 per year on corrective and preventative maintenance for the existing instruments at the AWTs. The study found that:

- Over 1,400 hours were spent responding to false alarms and performing calibration every year
- Old technology drifted by 20%
- Competitors sensing element required annual re-coatings of epoxy insulation

The study concluded that the total cost to retrofit the entire 108 cut monitors with Drexelbrook instruments was \$284,000, resulting in a payback of 1.9 years. The study also recognized the additional benefit of improved steam injection efficiency for their heavy oil applications. The improvements in steam injection efficiency will directly increase the life and profitability of each well. The financial benefits of the improved efficiency will exceed the maintenance reductions used to justify this project.

### Alberta, Canada

One of Canada's largest pipelines uses over 120 cut monitors for custody transfer, detection of water slugs, and protection of equipment. The pipeline handles various pipe sizes with both heavy and light oil in the 0-1% water cut range. The pipeline chose Drexelbrook as their sole supplier to replace their legacy products that were no longer being supported by the OEM.



*Drexelbrook installation coming off the AWT and then fed back to the manifold.*

