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APPLICATION NOTE

Measuring Water Concentration with the FluidScan: Get the Best Results with These 5 Simple Tips

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Routinely monitoring water concentration in your oil is an important part of your oil condition monitoring program. Water can enter the oil as a result of environmental conditions, condensation from cooler areas of the equipment and/or compromised seal integrity. Ideally, water remains in its dissolved state, dispersed molecule-by-molecule throughout the oil. Once the oil reaches its saturation point, the water then becomes dispersed as microscopic droplets throughout the oil create an emulsion where the oil appears cloudy or foggy. As the water concentration increases in a water/oil emulsion, the water eventually collects in the oil as free water. Typically, mineral oils and PAO synthetics have a specific gravity less than 1.0 which makes water heavier than the oil; therefore, the free water starts to collect at the bottom of the tank or sump. Elevated levels of moisture in the oil can lead to changes in the hydrodynamic film, oxidation, accelerated wear and possibly even bearing damage from hydrogen embrittlement and/or cavitation.

The FluidScan can be a powerful tool to use on-site. Here are a few tips to implement to enhance your experience:

TIP 1

Know what to Expect Based on the Lubricant Type

Hydraulic fluids, turbine oils and other industrial oils can hold as much as 200 to 600 ppm of water (0.02 to 0.06 percent) in the dissolved state depending on the temperature and length of time in-service. Older oils can hold three to four times more water in the dissolved state than new oil. This is due to the polar by-products forming from the oil oxidizing, holding on to the water molecules and keeping them in solution.

Crankcase oils tend to have this same tendency as they are highly additized with polar additives that tend to hold water in solution.

Turbine oils, which are not as highly additized, tend to have a lower saturation point so we see free water form more quickly. Therefore, turbine oils tend to have lower alarm limits and we need to monitor them a little more closely.

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Polyalkylene Glycols (PAGs) will show high moisture ppm values due to their hydrophilic nature. Values in the 1,000's of ppm are not uncommon. For best results, do not add a user fluid with a previously opened container of PAG oil. To get a reliable reference value, ask the third-party lab to analyze for water using the Karl Fischer oven method (ASTM D6304 Method C) or VaporPro (ASTM D7546). If some other method is used, the additives in a PAG oil can skew the results.

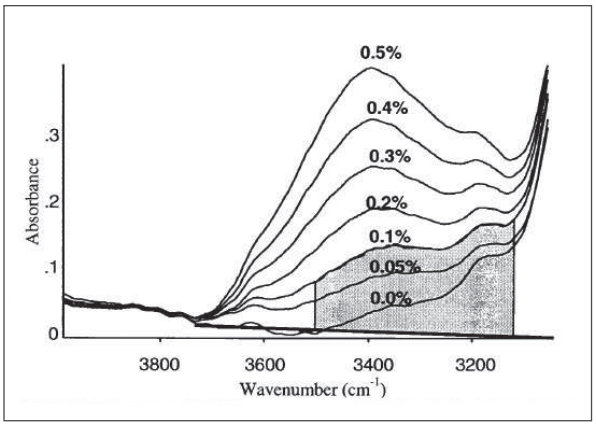


Fig. 1 Measurement for Water according to ASTM E2412.

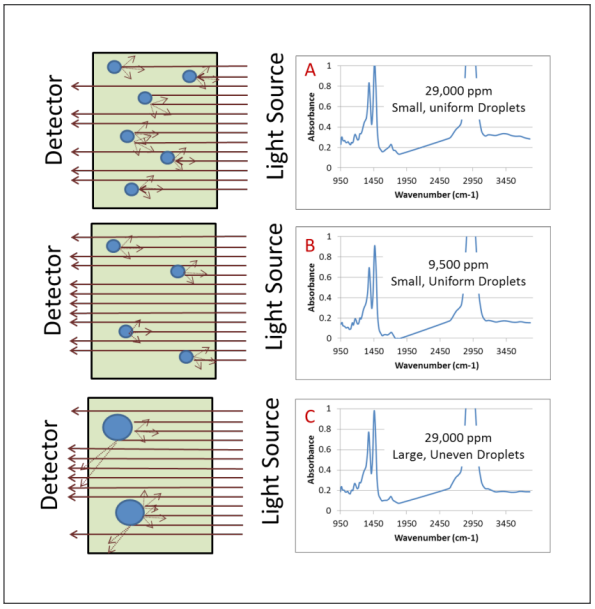


Fig. 2 Measurement for Total Water on the FluidScan after a sample has been homogenized.

TIP 2

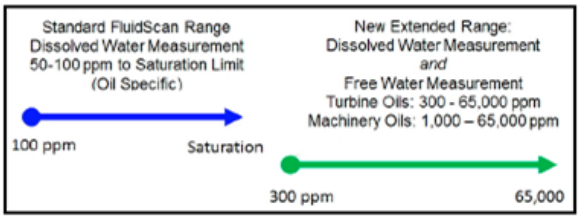
Understand How Water is Reported on the FluidScan

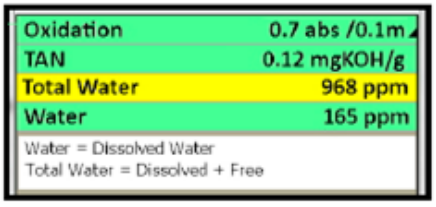
Water can coexist as three phases in an oil sample: dissolved, emulsified, and free water. Dissolved water cannot be seen with your eye. An emulsion in an oil sample can look cloudy or milky. Free water may be seen as discrete water droplets sitting on the bottom of the sample bottle.

Dissolved water is the easiest to measure. The FluidScan detects dissolved water based on a peak in the infrared spectrum. This measurement is displayed as **Water** ppm on the FluidScan. The range of this measurement is 100 ppm – saturation.

If there is an emulsion (cloudy sample) or free water (discrete droplets) present, a homogenizer must be used so that the FluidScan can look at the baseline lift due to light-scattering of the water-oil mixture. This measurement is displayed as **Total Water** ppm (dissolved + free water).

Total Water reads down to 300 ppm on turbine oil and 1000 ppm on all others. This means, if you are dealing with anything less than 300 ppm on Turbine oil, only dissolved water will be detected. This also means, if you are dealing with anything less than 1,000 ppm in all other categories, only dissolved water will be detected. Since we can have all three phases of water present in a sample at the same time, this is an important concept to understand. Further, the **Total Water** ppm result may be larger than the (dissolved) Water measurement if an emulsion or free water is present.





TIP 3

Create New User Fluids

When possible, always create new user fluids. When creating a new user fluid, the FluidScan uses a match routine to automatically select the best calibrations to use. The FluidScan also baselines the new user fluid results against the measured spectrum. You should always check the TAN, TBN, and water values and make any necessary adjustments.

If you have access to a third-party lab, use this Karl Fischer and TAN/TBN titration result as to adjust the reference value of the user fluid. We recommend Karl Fischer oven method (ASTM D6304 Method C) or VaporPro (ASTM D7546) to minimize additive interferences.

- For a new, clean oil the KF result should be representative of the dissolved water in the sample, so use this KF result as the **Water** ppm reference value.
- For a new, clean oil without any emulsion or free water presence, you can adjust the **Total Water** value (if reported for that substance ID) to be equal to **Water** reference value.

If you do not have access to a third-party lab, *know your oil*. For most oil types, excluding PAGs, the water in a new, clean sample should be low. Confirm the **Water** reference value is consistent with what is expected for that oil type. Then adjust the **Total Water** value (if reported) to be equal to the **Water** reference value.

TIP 4

Edit Factory Fluids

If you do not have a new sample of oil to use as a reference you can still make customizations to a factory fluid. Factory fluids are the 700+ oils that are available in the FluidScan oil library. There is no setup required, but it is possible to customize a factory fluid.

The reported parameters of a factory fluid are based on calibrations developed to correlate with TAN, TBN, and KF laboratory results as obtained by Spectro's in-house lab. You can adjust these values to correlate better against your third-party lab results if needed.

TIP 5

Update Reference Spectrum

A lubricant even sold under the same name may have subtle spectral variations from batch to batch due to the manufacturing process. Regional blend differences can also cause shifts in the infrared spectrum. For this reason, it may be useful to occasionally re-baseline a user fluid or a factory fluid. This can be done by updating the reference spectrum of that substance on the FluidScan device. After updating the reference spectrum, review the reference values for TAN, TBN, and KF to see the effect of the new baseline and make any adjustments as necessary.

Please send any questions to lisa.williams@ametek.com. With some initial TLC and proper user setup, the FluidScan is an extremely powerful tool to use on-site for real time results.

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