OilView® Quick-Check
User Manual

May 2015

Contents

Introduction

How To Use This Manual

This manual describes the operation of OilView® Quick-Check instrument and software.

Manual Conventions

These conventions are used throughout this manual to call attention to the adjacent text:

Note: The Note paragraph indicates special comments or instructions.

Caution: The Caution paragraph alerts you to actions that could have an effect on the equipment or the collected data.

Warning! **The Warning paragraph warns you of actions that could cause serious injury or death.**

OilView® Quick-Check Disclaimer

The OilView® Quick-Check instrumentation and software aids the user in diagnosing oil lubricating and machine wear problems. Because of the complexities of real-world problems, there are no claims or guarantees that OilView® Quick-Check will correctly solve all of the problems encountered. Questionable results should be sent to a reputable oil analysis laboratory for a more comprehensive analysis than OilView® Quick-Check is able to perform.

All results must be considered as advisory information only and should be weighted carefully by the personnel who are responsible for maintenance actions which are taken. MJR Technologies LLC does not accept any liability with regard to the actions performed or omitted by those using this equipment.

The user is responsible for the safety of personnel and machinery. The user should consult their safety department for the recommended methods of handling, storing, and ventilating volatile and lubricating materials.

Electrostatic Discharge or Other Harsh Environments

In unusually harsh operating environments, operation of this product may require reset and/or restart of the function in progress. This user recoverable condition should be readily apparent to the user and will not result in product damage. Such a condition is intended and normal. Any questions regarding proper operation of this product should be directed to MJR Technologies LLC.

Quick Start

Calibration

1. Turn power on.

2. Following instructions on device display, plug clean test grid into device.

3. Unplug grid and fill to first offset with Calibration Fluid 220.

4. Plug grid into device.

5. Unplug grid.

6. Following instructions on device display, plug clean test grid into device.

7. Unplug grid and fill to first offset with Calibration Fluid 300.

8. Plug grid into device. Device should now be calibrated.

Test

1. Following instructions on device display, plug clean test grid into device.

2. Unplug grid and attach undiluted sample.

3. Plug grid into device, observe dielectric reading.

4. Unplug grid.

5. Dilute sample.

6. Plug grid into device.

7. At test completion, analyze/record results.

8. Unplug Grid.

Setup

Oil Compatibility Chart

The following table lists various oils that can and cannot be tested using the OilView® Quick-Check Analyzer.

Oil Type	Test	Notes
Mineral oil	Yes	
Polyalphaolephin (PAO)	Yes	
Synthetic hydrocarbon (SHC)	Yes	
Polyol ester (POE)	Yes	Dielectric extrapolation
Diester	Yes	Dielectric extrapolation
Polyalkalene glycol (PAG)	Yes	Dielectric extrapolation
Perfluorinated ether (PFE)	Yes	Incorrect water estimate. Dielectric extrapolation
Phosphate ester (PhE)	Yes	Need special grid. Dielectric extrapolation
Transformer oils	Maybe	Requirements may exceed device sensitivity
Liquid hydrocarbon fuels	Maybe	Requirements may exceed device sensitivity
Bunker fuels	Yes	
Water/oil emulsions	No	Water shorts out test grid
Grease	Yes	Test dissolved grease sample
Fluids with dielectric > 16.0	No	Exceeds device range

Since the sensor grid has no sensitivity above a dielectric value of 16, high dielectric fluids cannot be tested. Most mineral oils have a dielectric of 2 to 3, most synthetics have a dielectric of 2 to 7, water has a dielectric of 78, and conductive materials like metals have infinite dielectric. It is necessary to extrapolate rather than interpolate for oils outside the range of the calibration fluids. The dielectric will not be accurate, but results will be repeatable and sufficient for difference comparisons.

> *Warning!* **Consult your Safety department, be aware of flammability characteristics and skin contact restrictions for solvents and oils.**

Sensor Curing

When the OilView® Quick-Check Analyzer is first unpacked, it will be necessary to "cure" the sensing grid. As delivered, the grid may contain air in the interstitial space between fibers in the substrate. It is necessary to "cure" the grid by allowing clean oil to stand in the sensor for a few hours. The oil will displace the air pockets and the sensor is then ready for use. If this is not done, the first few calibrations taken with the sensor will be offset by the low dielectric constant of the air relative to oil.

> *Caution:* Never expose a new sensor to water or water contaminated oil before it is "cured."

OilView® Quick-Check Initial Hardware Setup

Place the OilView® Quick-Check Analyzer on a flat, horizontal surface. To utilize the provided PC software, connect the OilView® Quick-Check Analyzer's Port to the computer's COM1 or COM2 serial communication (RS232) port.

host computer

to COM1 or COM2

to port 1

OilView Analyzer

electromagnet

fuse holder

On/Off switch
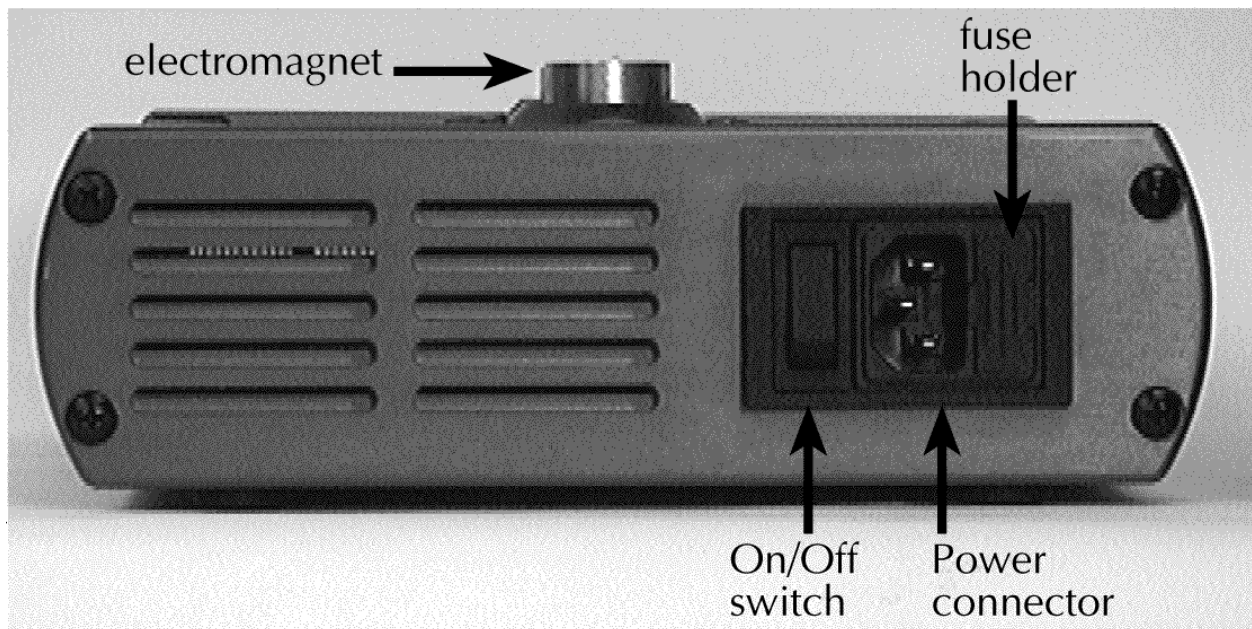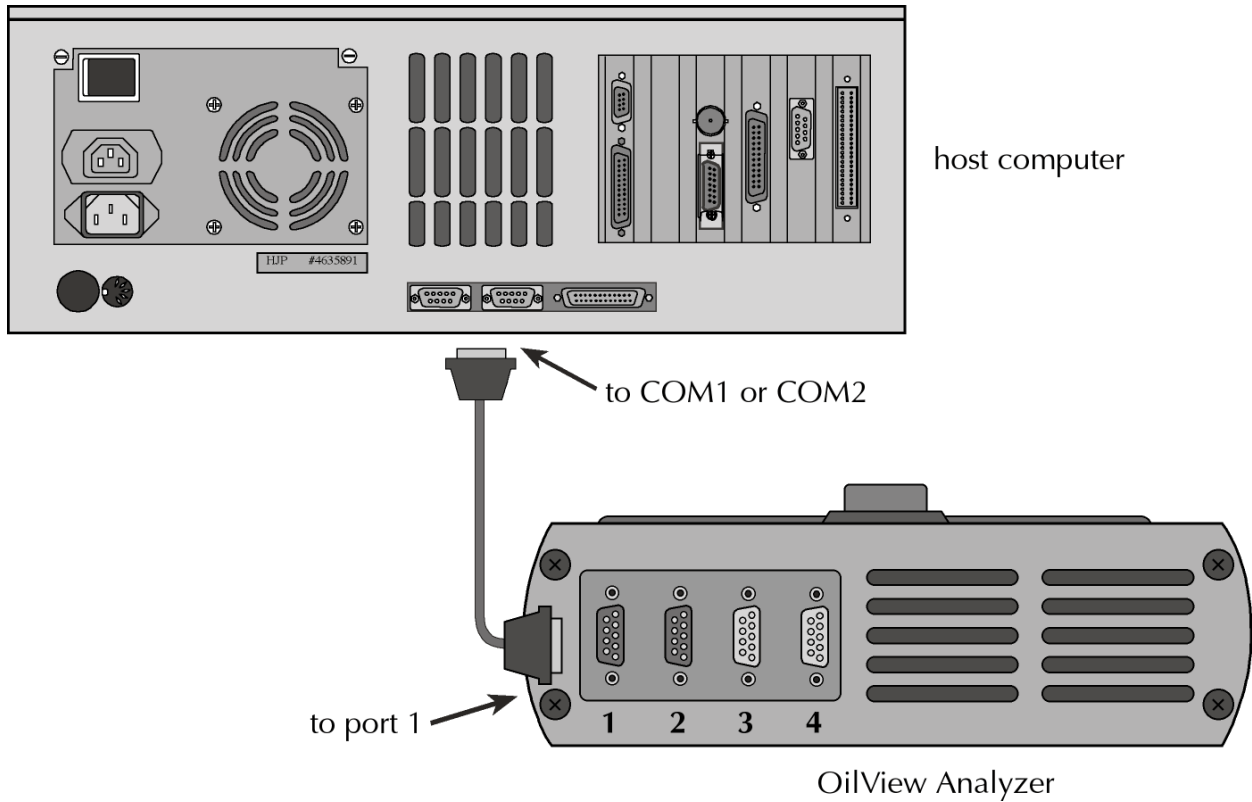
Power connector

After connecting the interface cable, plug the 110/220 volt power cable into the OilView® Quick-Check Analyzer unit and into a 110/220 volt outlet, and then turn the unit on. The analyzer should give a three-tone output and display the OilView® Quick-Check copyright message on its LCD screen.

Caution: The sensing grid should never be exposed directly to water.

Note: Because the OilView® Quick-Check Analyzer is extremely sensitive to moisture, it should be used where humidity and temperature are relatively constant. For best results, the humidity should be low and the temperature should be nearly constant.

Note: The OilView® Quick-Check Analyzer should be turned on before use, allowed to warm up for a few minutes, and should not be turned off until after all tests have been completed. Before analyzing oils, the OilView® Quick-Check Analyzer should be operated through one entire test sequence to preheat the electromagnet.

Note: If necessary, the fuse (next to the power connector) can be replaced with a standard 2-amp fuse.

Example Test Session

Calibration

Turn on power to the OilView® Quick-Check unit. After briefly displaying a copyright notice, the unit will enter "Calibration" mode. If connected to the PC software and configured to download calibration data, the most recent calibration will be downloaded and the unit will enter "Test" mode. Calibration mode may still be entered by plugging and unplugging the sensor grid 3 times within 30 seconds of power up. It is recommended that the unit be calibrated daily or when ambient temperature and humidity change. Special care must be taken when calibrating since this will affect all dielectric tests until the next calibration. Best practices for grid cleaning should be followed. Calibration may be verified by testing a calibration fluid or known reference oil.

OilView® Quick-Check Display:
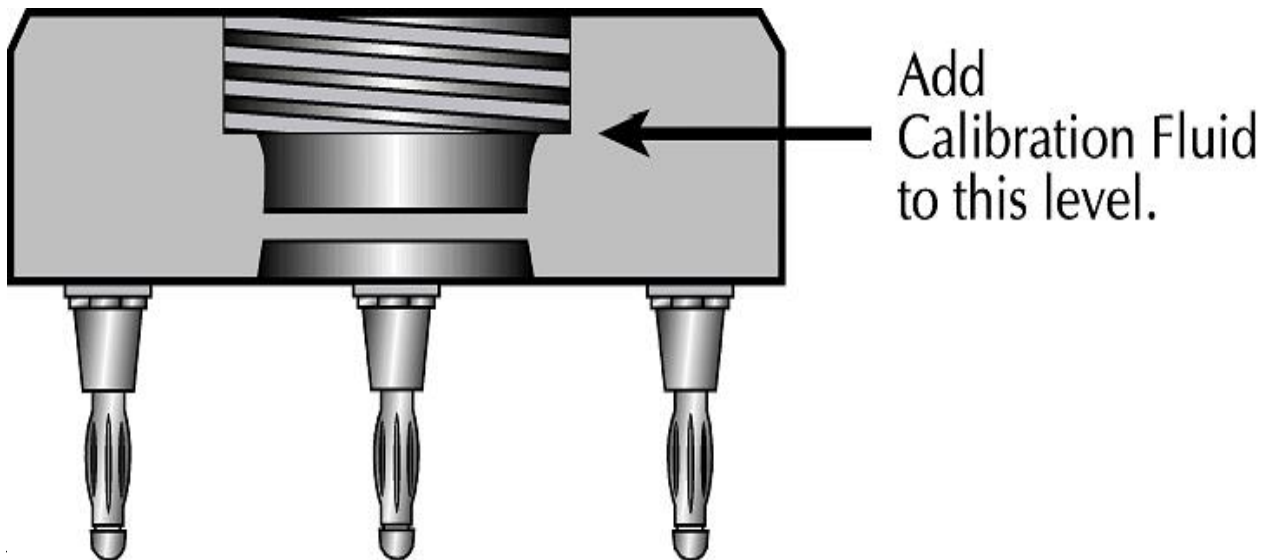
```
Calibrating
Plug Clean Grid
```

After plugging the clean sensor grid into OilView® Quick-Check:

```
Calibrating
Is Clean Unplug
```

Upon unplugging the grid:

```
Calibrating
Test Fluid 220
```

Add fluid 220 to sensor grid, plug into OilView® Quick-Check.

Add Calibration Fluid to this level.

After plugging in grid with Fluid 220:

```
Calibrating
Unplug Grid
```

After unplugging the grid OilView® Quick-Check will display:

```
Calibrating
Plug Clean Grid
```

If a grid is not sufficiently clean, an error tone will sound and the device will display:

```
Calibrating
Unplug Re-Clean
```

After plugging in a clean sensor grid:

```
Calibrating
Is Clean Unplug
```

Upon unplugging the grid:

```
Calibrating
Test Fluid 300
```

Add fluid 300 to sensor grid, plug into OilView® Quick-Check.

```
Calibrating
Finished Unplug
```

After unplugging the grid OilView® Quick-Check will display:

```
Testing
Plug Clean Grid
```

Special Notice

It is especially important to thoroughly clean the sensor before calibrating or verifying. The effects of cross contamination during calibration will affect all of the measurements made until the next calibration. Be sure to clean the grid at least two times using the same calibration fluid that is to be tested. You must wipe the sensor surface completely dry using tissue paper during each cleaning operation.

Keep in mind that Fluids 220 and 300 are very different in dielectric; each one must be completely removed before continuing with the next measurement.

Test

This section describes a typical oil testing session using the OilView® Quick-Check Analyzer system and assumes the grid has been calibrated.

OilView® Quick-Check should display:

```
Testing
Plug Clean Grid
```

Inspect the sensor. If necessary clean according to best practices recommendations and plug into OilView® Quick-Check. Device should display:

```
Testing
Is Clean Unplug
```

Upon unplugging the grid the display will indicate:

```
Testing
Test Neat Oil
```

A "neat" oil sample has not been diluted or otherwise modified. The dielectric of the diluent (kerosene, diesel, lamp oil, etc) will differ from the oil sample, thereby interfering with the determination of the sample dielectric.

Screw the sensor to the bottle.

Vigorously shake the sample bottle after making sure that the cap is screwed on tightly. This must be done to ensure that the contaminants are evenly dispersed in the sample. The bottle should be shaken 15 seconds or until no sediment can be seen on the bottom of the bottle after it has been inverted. In extreme cases, it may be necessary to stir the sediment from the bottom of the bottle using a clean plastic or glass rod before shaking.

Note: This procedure describes shaking the sample bottle and then screwing on the sensor. Some users prefer to shake the sample after the sensor has been screwed onto the bottle. Either method is acceptable as long as the sample is vigorously shaken just before the test.

Plug the sensor into the OilView® Quick-Check Analyzer. Take care to ensure that each of the plugs on the sensor body is fully inserted in the jacks on the face plate of the analyzer.

Upon plugging the grid, the Analyzer will calculate the dielectric:

```
Testing
DIEL 2.31
```

Unplug the sensing grid and shake the bottle. This action stirs the debris that settled onto the grid during the test back into the oil. Then place the bottle bottom down and allow the oil to drain from the sensing grid back into the bottle for a few seconds. After unplugging the grid OilView® Quick-Check will display:

```
Testing
Test Diluted
```

Dilute the sample by adding an equal amount of kerosene, diesel, lamp oil, or other diluent. Vigorously shake the sample bottle after making sure that the cap or sensor grid is screwed on tightly. This must be done to ensure that the contaminants are evenly dispersed in the sample. The bottle should be shaken 15 seconds or until no sediment can be seen on the bottom of the bottle.

OilView® Quick-Check will start to test the sample once the sensor grid is plugged in. The display will indicate:

```
Testing
Testing.. XX
```

The XX is the approximate number of seconds that have elapsed since the start of the test. At completion, final results are displayed along with the previously calculated dielectric.

```
IRON   0 NO LRG
DIEL 2.31 W 0.00
```

The IRON reading is a measure of abnormal wear particles (larger than 5 microns). This value should be trended over time as gearboxes and transmissions will naturally have higher values. The value to the right of IRON is the large contaminant indication. This can be one of several values:

Value	Meaning
NO LRG	No Large Contaminants detected
DROPS	Droplets
LRG FE	Large Ferrous
LF D	Large Ferrous & Droplets
NF	Large Non Ferrous
NF D	Large Non Ferrous & Droplets
LF NF	Large Ferrous & Large Non Ferrous
F NF D	Large Ferrous & Large Non Ferrous & Droplets

Any value other then NO LRG is undesirable and may warrant additional investigation.

At the start of the second line the previously calculated dielectric is redisplayed. The suitability of the oil for future use can be determined by comparing with the dielectric of the reference oil. This comparison is performed automatically by the PC software. The comparison can also be performed manually by subtracting the reference oil dielectric from the sample and multiplying by 100. Oil should be changed before this index reaches 10.

Lastly, the "W" is the % water estimate.

The cycle is complete when the grid is unplugged:

```
Testing
Plug Clean Grid
```

Best Practices

Collecting Oil Samples

The key factor in any oil and machine condition monitoring program is consistency in collecting samples. Any oil monitoring program will probably fail if careful attention is not paid to your sampling technique. Therefore, you must always sample from the same location, in the same manner, and under the same machine conditions.

The location from which the oil is sampled should always be from the same plug, valve, or port. In general, oil should be sampled from a location where the oil is well agitated or flowing. Samples should normally be taken from the return line to the oil compartment *upstream* of any filter. If the oil is sampled on the downstream (outlet side) of a filter, wear debris and particulate contaminants will have been removed by the filter. Keep in mind that the oil compartment or sump will act as a sedimentation "filter".

The manner of collection should always involve a gradual, uniform flow of oil into a clean bottle. Care should always be taken not to take the dregs or the initial spurt of oil when filling from a drain or pressurized line.

Oil should be sampled either just after a machine has been shutdown or (if safe) while the machine is still running. The "when" of sampling is most critical in the cases of lubrication systems with relatively low operating viscosities.

Because the OilView® Quick-Check tests are relatively inexpensive and under your direct control and interpretation, do not hesitate to tailor unconventional sampling techniques to your specific needs. Just remember to apply common sense in correlating your sampling technique and test results to your application.

> *Warning!* **Hot oil may cause severe burns, and used oil should never be allowed to remain on your skin or clothing. Consequently, be extremely cautious when sampling oil from a hot or pressurized system.**
>
> **Never handle very hot oil with a plastic bottle, as the bottle may melt or deform. Use an intermediate, clean metal container to cool the oil, if necessary. If a metal container is used, remember to shake it vigorously before transferring the oil to a plastic bottle.**
>
> **The OilView® Quick-Check Analyzer is designed to work with room-temperature oils. Dielectric will vary with temperature due to thermal expansion of the oil.**
>
> *Warning!* **Follow standard practice procedures for health and safety as established by your safety department when collecting oil samples or handling new and used lube oils, hydraulic fluid, and transformer oils.**

Sampling Hints

A few hints about sampling techniques:

- Do not take the cap off the sample bottle until you are ready to sample. As soon as the sample is taken, replace the cap. This will help to keep dust, moisture, and dirt out of the sample. Do not fill the bottle completely to the top. A partially full bottle allows the contents to be more easily agitated by shaking prior

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to testing, and also allows for easier dilution, if required. For consistent Fe indexes, it is important to fill the sample bottle to the same level each time.

- When drawing oil through a drain plug or valve, do not collect oil during the initial spurt or rush. It may contain metal from the plug threads and it will certainly contain debris that has collected over time around the plug or valve opening. Similarly, don't take the dregs if the oil is being completely drained. However, if you are concerned about water, sample from the initial rush-just remember that the oil sample will not be representative of the bulk of the oil and the data should not be used for trending purposes. A second sample should be taken to determine the bulk oil condition.

- When using a suction pump to draw oil up from a sump through a fill pipe, dipstick tube, or other orifice, do not let the tube contact the bottom of the sump or scrape dirt from the access orifice. Conversely, if you are concerned about free water as opposed to debris, sample near the floor. Always change or clean your sampling tube between samples. Also, remember to keep the sample bottle receptacle on the suction pump clean.

- As a general practice, you would not want to initiate a maintenance action on the basis of an oil sample taken directly from a used oil filter. However, this is where you will find the highest concentration of solid contaminants and large wear debris particles. If the filter is free of metallic debris, it is unlikely that you have had extensive abnormal system wear since the filter was last changed.

- Take samples just after the equipment has been shut down or, when it is safe, while the equipment is operating. This is most important with less viscous oils as large particles and water will settle out of the oil rapidly. It is extremely important to be consistent with respect to when as well as where you sample.

- Carefully label each sample bottle. The label should minimally identify the oil type, the machine from the which the oil was taken, and the date on which the sample was taken. If a sample is diluted prior to testing, the label should reflect that fact. A sample taken from an unknown source has little value. Mislabeling of samples may lead to unnecessary maintenance actions.

- Over time, some contaminants will agglomerate and cling to the bottle walls, moisture may evaporate, and small ferromagnetic particles may be chemically altered to a non-magnetic form which will not be detected by ferrographic means. Therefore, tests should be conducted within a reasonable time frame.

All OilView® Quick-Check tests should be conducted with the oil at room temperature and with the sample vigorously shaken just before the test.

Cleaning the Sensor Grid

Clean the sensor by carefully wiping the sensing grid dry using a soft tissue paper and a circular (twisting) motion. The grid has been wiped clean when it no longer stains or wets successive clean pieces of tissue. Do not use a water-based cleaner or an abrasive material to clean the grid. Do not allow water-contaminated oil to stand on the grid after a test.

After the grid is wiped clean, apply a few drops of the next oil to be used onto the surface of the grid and wipe it clean and dry. This procedure is intended to "wet out" the surface of the sensor with the next oil, completely removing any trace of the previous oil. Make this double cleaning a standard practice as it prevents cross contamination of samples and is very important to reliable data collection.

Using the supplied bottle of calibration fluid, open the flip-top and add enough fluid to reach the first diameter change in the gasket.

Dilution Of Samples

The OilView® Quick-Check Analyzer's contamination and ferrous indexes are dependent on magnetic and gravitational forces moving contaminants and debris through the oil onto the sensing grid. In order to support the brief test time, oils should be diluted or "cut" with a petroleum solvent such as kerosene, lamp oil, or diesel fuel before testing. This can be done by filling the sample bottle slightly over 1/3 full with oil, adding an equal amount of kerosene, and leaving the rest empty to allow for easy mixing when shaking the sample.

Most mineral and synthetic oils can be diluted with K1 kerosene, diesel fuel, or lamp oil. Some users prefer to use other hydrocarbon solvents such as hexane or heptane. If kerosene does not dissolve a specific type of oil then consider using another solvent. However, make sure that the solvent has a dielectric value of less than 16. For example, most alcohols have a dielectric value greater than 16.

If dilution is impractical samples may still be tested, however, the corresponding reduction in device sensitivity should be noted. The Dielectric is not affected, but Iron, % Water estimate, and Large Contaminant will not perform as with a diluted sample.

> *Note:* When the OilView® Quick-Check Analyzer is being used as a screening tool, a second undiluted sample should be taken in the event the oil is to be sent to an oil lab.

> *Warning!* **Consult your Saftey department, be aware of flammability characteristics and skin contact restrictions for solvents and oils.**

OilView® Quick-Check Analyzer Usage Tips

Procedural consistency and proper techniques are the best way to achieve reliable results from your OilView® Quick-Check analyzer. The following list of procedures has been shown over time to provide the most reliable dielectric measurements and to improve the general repeatability of measurements.

Double-Clean the Grid

Cross-contamination of one test sample affecting the results of a subsequent test can be a significant problem when testing oils of widely differing dielectric values; especially when the oils are not soluble with each other. For this reason, consider testing a 'batch' of oils having similar dielectric (+/- 0.2 dielectric units) before proceeding to a different oil type. Clean the grid two times to prevent cross contamination. In addition to wiping the grid after a test, you should apply a small amount of the next oil to be tested onto the surface of the grid, and thoroughly wipe it a second time. Then return the sensor to the analyzer and test the sample. This procedure is intended to "wet out" the surface of the sensor with the next oil, completely removing any trace of the previous oil or solvent.

Verify Calibration

After initially calibrating your grid using the supplied calibration fluids, verify the calibration by testing a reference oil (dilution will not be necessary). Results should agree within .01 dielectric. This quick test may indicate that the grid needs to be recalibrated, or that an offset should be applied to dielectric results. A dielectric offset will not interfere with the Iron index, water estimate, and large contaminant indication. As a further aid, the PC software will display a chart of calibration history at the completion of calibration or on request from the main menu.

Synthetic Oils

Since synthetic lubricants such as phosphate ester, polyol ester, or diester have vastly different properties from typical mineral oils, extra precautions are necessary to clean away any residual of the synthetic before resuming tests with mineral oils, or vice versa. Once again it is important to do final cleaning using the "next" oil to wipe away any residual surface film on the grid surface and to wipe the sensor dry using tissue paper between cleaning steps.

Sample Temperature

The OilView® Quick-Check Analyzer is designed to work with room-temperature oils. Dielectric will vary with temperature due to thermal expansion of the oil. Observe the following plots for a multi-grade motor oil. Erroneous conclusions could be reached if the dielectric of a hot oil sample is compared to the room temperature dielectric of the reference oil.
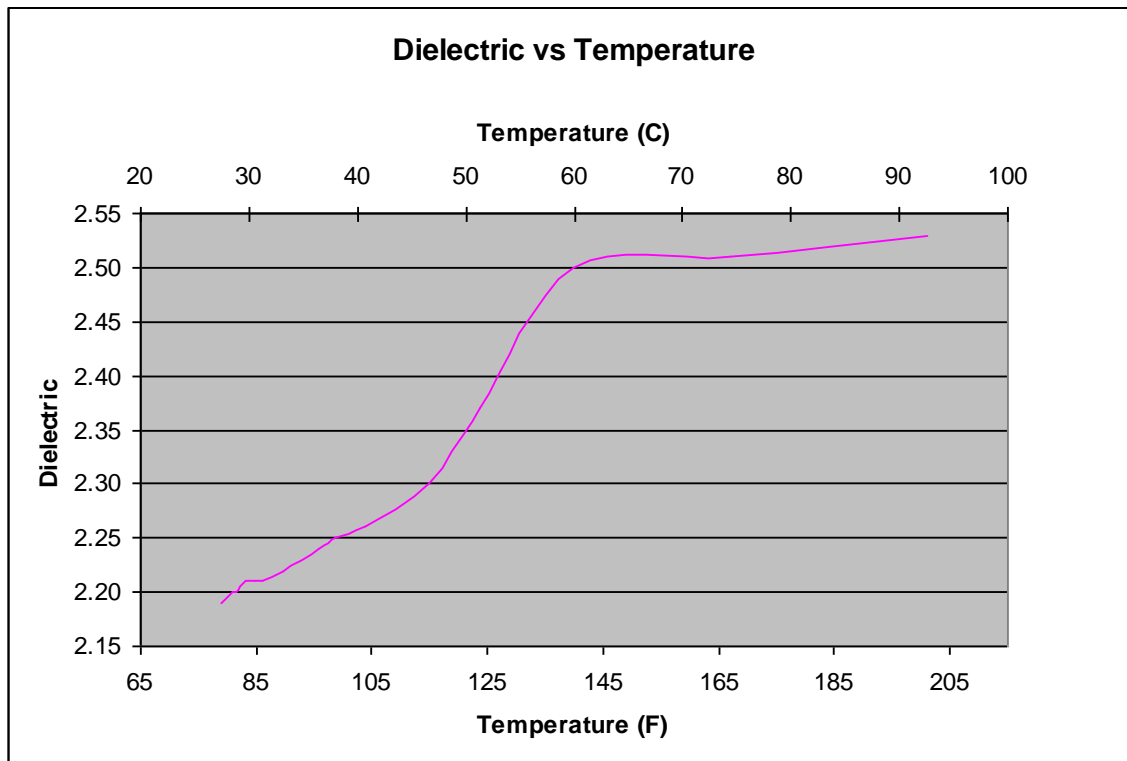
Inserting Test Grid

Observe the sensor grid connections for ground (A), +5V (B), and the serial communications (C). The grid microprocessor will 'lock-up' about 10% of the time if voltage is first applied to the power connection (B) and then the Serial connection (C), or (C) then (B). The Quick-Check will not respond, but should recover if the grid is removed and reinserted. To completely ovoid this problem, use the combinations B-A-C, A-B-C, C-A-B, or A-C-B. Notice that any combination where the ground (A) is first connected is successful.

Applications

Where To Use the OilView® Quick-Check Analyzer

The OilView® Quick-Check Analyzer detects degraded lubricating oil or abnormal wear in lubricated machinery. However, many lubricating oil applications are unique with respect to both oil properties and the machinery in which they are used. The following paragraphs discuss appropriate OilView® Quick-Check Analyzer applications.

Engine Crankcase Oils

The OilView® Quick-Check Analyzer can be used to test crankcase (motor) oils used in reciprocating engines. It is an excellent tool for monitoring oil condition in diesel, gas, and gasoline engines. It has a special value with respect to diesel engines where soot makes any visual determination of oil quality or debris content difficult.

The OilView® Quick-Check Analyzer is sensitive to oxidation-a common mode of oil failure in modern engines. It is sensitive to soot loading in diesels, and will also detect abnormal wear of ferrous parts. The OilView® Quick-Check Analyzer is very sensitive to the presence of either coolant or water in the oil. Oils taken from engines fueled with liquid hydrocarbons (diesel or gasoline) should also be screened for viscosity reduction resulting from fuel dilution.

Turbine and Pump Oils

Oils used in steam turbines and water pumps are prone to contamination with water. In these oils, the OilView® Quick-Check Analyzer will detect water concentrations below 100 ppm. In addition, the OilView® Quick-Check Analyzer will indicate when "free" water (droplets) are present in the oil. Avoiding free water is important because water droplets can disrupt hydrodynamic and elastohydrodynamic lubrication of load-bearing surfaces. The OilView® Quick-Check Analyzer is also sensitive to the corrosive potential of the water. For example, it will give a much higher reading for saltwater contamination than contamination with fresh water.

Gear Oils

The OilView® Quick-Check Analyzer is an excellent tool for monitoring the condition of gear oils. It will detect water and ferrous wear debris. Large "chips" resulting from fatigue wear of gear teeth are very easily detected.

Bearing Lubricating Oils

Many industrial lubrication applications, such as fans, electric motors, and compressors, have oil-lubricated bearings with relatively small oil capacities. Lubricating oil in many of these applications has a relatively long service life and oil analysis is often not applied for reasons of cost. However, OilView® Quick-Check Analyzer testing permits inexpensive monitoring of these oils for contaminants and bearing condition.

Typically, roller element bearings produce easily detectable ferrous debris when failing. This debris is often detectable before any other symptoms of abnormal wear can be seen. Sleeve bearing failure may also be detected if a ferrous shaft is experiencing abnormal wear. Remember that the OilView® Quick-Check Analyzer will only detect gross abnormal wear of babbitt (nonferrous) bearing surfaces. Detection of pending failure of babbitt bearings requires supplemental laboratory testing, or testing with a particle counter.

Hydraulic Oils

The OilView® Quick-Check Analyzer can also be used to screen for water and ferrous debris in nonconductive hydraulic fluids. However, OilView® Quick-Check Analyzer testing of fluids used in precise hydraulic systems should *always* be accompanied by subsequent laser particle counter tests. Cleanliness requirements may exceed device sensitivity.

Compressor Oils

Mineral and synthetic oils used in compressors can be tested for moisture contamination, oil breakdown, and mechanical wear. It is normally important to degas the used oil samples taken from refrigerant compressors prior to testing them regardless of what instrumentation is being used. Most often it is *normal* for the used lubricant to contain significant amounts of refrigerant such as ammonia, CFC, or R134A. The ammonia in particular has a significant effect on the OilView® Quick-Check Analyzer sensor since ammonia has a high dielectric just like water.

Electrical Insulating Oils

This screening test evaluates the oil quality and moisture contamination for electrical insulating oils commonly used in transformers and oil filled circuit breakers (OCBs). The OilView® Quick-Check screening test does not replace the need for dissolved gas analysis to detect partial discharge in high voltage transformers.

Fuel Testing

The OilView® Quick-Check Analyzer can be used to test fuel oils such as #2 diesel for water, a common problem that destroys fuel injection pumps. For safety reasons, the OilView® Quick-Check Analyzer should *never* be applied to a highly flammable hydrocarbon liquid such as gasoline.

Synthetic Oils

The OilView® Quick-Check Analyzer can be used to test most synthetic lubricants. Extra care should be taken in cleaning the grid when changing between mineral oils and synthetic lubricants.

Grease

Mechanical wear can be monitored by testing a dissolved sample of the grease.

OilView® Quick-Check Analyzer Detection Limits

Property	Indexes	Lubricant Type	Minimum Detectable Limits
Lube Degradation			
Oxidation	K, C, LC	Most Lubricants	<<10% by FTIR (K, C)
Soot	K, C	Heavy duty diesel	0.4% by TGA
Lube System Contamination			
Water	K, C, W, LC	Hydraulic	<0.01% (K, C, W) 0.06% (LC-Droplets)
Water	K, C, W, LC	Heavy Duty Diesel	<0.2% (K, C, W) 1% to 5% (LC Droplets; Water droplet formation begins when lubricant plus additive is saturated.
Water	K, C, W, LC	Stern Tube Oil (used to lubricate the bearing at the aft end of a marine drive shaft.)	<0.2% (K, C, W)>15% (LC-Droplets)
Water	K, C	Polyol Alkaline Glycol (synthetic lubricant used in R-134a refrigerant compressors)	<0.04% (K, C)
Water	K, C	Perfluorinated Ether (synthetic lubricant used in hard vacuum pumps)	<0.05% (K, C)
Glycol	K, C	Heavy Duty Diesel	<0.2%
Mechanical Wear			
Iron	Fe, W, LC	All	1 ppm >5μ (Fe)<50 ppm >5μ (W)<1 ppm >40μ (LC-Ferrous)
Copper	W, LC	All	50 ppm >5μ (W)<1 ppm >40μ (LC-Nonfer)
Tin	W, LC	All	50 ppm >5μ (W)<1ppm >40μ (LC-Nonfer)
Lead	W	All	50 ppm >5μ (W; Instead of affecting the Water estimate, it may cause a chemical index response due to chemical oxidation of the lead particles. The process of oxidation makes them electrically nonconductive.)

Legend:

"K" the Dielectric constant. "Fe" the ferrous index. "C" the chemical index (calculated in PC software if Reference oil selected). "W" the water estimate. "LC" qualitative "large ferrous" or "large non-ferrous" or "droplets."

Applying the OilView® Quick-Check Analyzer

For clean fresh oils the OilView® Quick-Check Analyzer Iron index and Water estimate should be at or near zero. Dielectric should match prior values for the same reference oil. Variations are possible due to supplier changes in additives and formulation. Increasing values indicate increasing levels of degradation or contamination. These values can be trended over time, manually or by using OilView® Quick-Check software.

Look for increasing values over time. A sharp upward increase in a value is a strong indication of a new or worsening lubrication problem. Do not be hesitant to use a commercial laboratory service if you are having any problem in interpreting an OilView® Quick-Check result.

The following table gives the known minimum contaminant levels that the OilView® Quick-Check Analyzer can detect. If these sensitivities are not adequate for your application you may wish to supplement with lab testing or more sophisticated on site technologies such as particle counting.

Test Results

More information can be obtained from oil testing when test results are trended over time. Lubricant degradation is rarely linear over time. Typically, a petroleum-based lubricating oil contains additives which protect and enhance the lubricating qualities of the base oil. The oil will degrade slowly over time until one or more components of the additive package are exhausted. After that point, the oil will rapidly degrade.

The time to additive exhaustion varies with oil type, the machine type, and changes in the operating environment. In well-sealed, low-temperature applications, a lubricating oil may last for years. In extreme reciprocating engine applications, an oil will degrade after only a few hundred hours of use. Consequently, once you have a knowledge of the "normal" trend of oil degradation in a specific case, abnormal conditions can be detected.

Dielectric Number

This dielectric constant, like boiling point, melting point, viscosity, and refractive index, is a fundamental property of a material. Simply put, dielectric constant measures the resistive, or nonconductive properties of the oil. Contaminants (liquids or solids) settling onto the surface of the sensor grid cause a change in dielectric constant at the oil/grid interface. When oils are oxidized or the water concentration increases, it is reflected in the dielectric number.

Chemical Index

The chemical index is equal to the difference in dielectric between the sample and the reference oil multiplied by 100. This calculation is performed automatically if the PC software is used. An increase in this index indicates that the oil is increasingly able to support electrical conduction due to the presence of polar molecules and/or ions. These conditions typically will lead to increased wear and corrosion.

The most common causes of an increase in this index include:
- thermally accelerated oxidation and nitration,
- soot loading,
- the formation of acids from combustion blow-by in engines, and
- increased moisture content.

This index should be trended over time. Normally, it will be zero. If it is non-zero, the oil is becoming corrosive and frequent testing is in order. If the value continues to rise, it is probable that the oil additive package is exhausted or a contaminant is entering the system. Before condemning the oil, be sure to check that the oil was being compared to the proper reference oil. If desired, retest the reference oil to assure OilView® Quick-Check has been calibrated properly.

If, after verification, a second test gives the same results as the first, consider changing the oil or sending a sample to an oil lab.

The following conditions will cause an increase in the chemical index:
- corrosive products of high-temperature oil oxidation and nitration,
- acids formed from combustion by-products such as sulfuric acid in diesel engines,
- presence of dispersed water or coolant,
- high levels of very fine, suspended particles such as soot, dust, road salt, or fine wear debris.

Note: Remember that a reference sample must be assigned to the sample in order to obtain a chemical index. If a reference is not available, the chemical index will not be given.

% Water Estimate

This estimate is a measure of the level of oil-insoluble contaminants in the oil. Some common contaminants include water, glycol coolants, metallic wear debris, and road dust. This index may also increase if solid additives have been added to the oil. The interplay of water, the oil and its additives, and the operating environment can be extremely complicated and make repeatable results difficult. The additives present in the oil will largely determine the response of the Water Estimate. Turbine oil is engineered to facilitate the coalescence and settling out of water. Multi-grade engine oil attempts to disperse and suspend the water particles. A hot environment will boil off water and a cold one will encourage condensation. The action or inaction of machinery may assist water dispersal or coalescence. Additives will continue to chemically react with the water until they are depleted.

Water particles will not settle onto the sensor grid while the additives are able to disperse and suspend the water particles. The presence of emulsified water will affect the initial dielectric thereby showing lube degradation through the chemical index. The presence of water can be verified with a "crackle test". More accurate results may be obtained from a commercial lab.

The water estimate should normally read near zero. Any positive increase in this value over time indicates increasing levels of contaminants and a laboratory oil test is recommended.

The following conditions will cause an increase in the Water Estimate:
- the presence of insoluble water in the oil. Very high values will be seen if corrosive compounds (such as salts) are present in the water,
- the presence of conductive metal particles in the oil,
- the presence of dirt, grit, or polar hydrocarbons in the oil.

The % Water Estimate for OilView® Quick-Check has been calibrated for a heavy duty diesel engine oil. For other applications the results should be adjusted by multiplying by the following factor:

Application	Multiplier
Polyalkalene glycol (PAG)	1.0
Polyalphaolephin (PAO)	0.5
Turbine & Hydraulic	0.1
Industrial	0.5
Automotive	1.0
Stern Tube	2.0

Ferrous Index (Fe)

The ferromagnetic index is sensitive to conductive, ferromagnetic particles. It increases linearly with *both* particle size and concentration. The index is primarily sensitive to *recent*, *severe* wear of oil-wetted steel and iron parts, because the surfaces of such particles are likely to be conductive. It is an indicator of the condition of the lubricated system. In general, higher index values correspond to higher wear rates.

This index should be near zero. Any positive value indicates ferromagnetic debris. Higher values indicate increasing concentrations and/or particle size. It should be noted that many severe wear particles will not be detected by atomic spectrometry-the standard laboratory analysis for metals in oil. The atomic spectrometers used for oil analysis are not sensitive to particles much larger than 5 to 10 microns in diameter. Severe wear typically produces larger particles. Consequently, even if you are having a spectrometric metals analysis performed by a lab, you should also conduct an OilView® Quick-Check Analyzer test. Atomic spectrometry and OilView® Quick-Check Analyzer testing are complementary rather than redundant.

A full analytical ferrographic examination of the sample by an oil lab is recommended if this index gives a high positive reading.

Large Contaminant Indicator

There are four text outputs for the qualitative assessment reported as "Large Contaminant Indicator."

No Large Indications - indicates that the analyzer did not detect excessively large metal particles or water droplets.

Large Ferrous - indicates that large iron particles, probably much larger than 60 µm were detected. The magnet north/south plots should show upward spikes for tests reporting "Large Ferrous" or "LF."

Large Non-Ferrous - indicates that large (usually much larger than 60 µm) non-ferrous particles, such as copper, aluminum, tin, lead, or chrome, were detected. The magnet off plots should show upward spikes for tests reporting "Large Non-Ferrous" or "NF."

Droplets - indicates that water droplets or similar fluid droplets were detected. All three plots (magnet off/north/south) should show spikes or sharp changes in slope for tests reporting "Droplets" or "D."

   Note: Any Large Contaminant Indication other than "No Large Indications" may indicate a serious problem.

OilView® Quick-Check PC Software

Installation

Insert software CD into CD drive. With Windows Explorer, navigate to CD drive and run the Setup.exe in the root directory. Follow instructions, accepting defaults or changing as desired.

> *Note:* PC software is not required for normal operation of the OilView® Quick-Check Analyzer. However, data storage, trending, and reports are useful tools for implementing a successful oil analysis program.
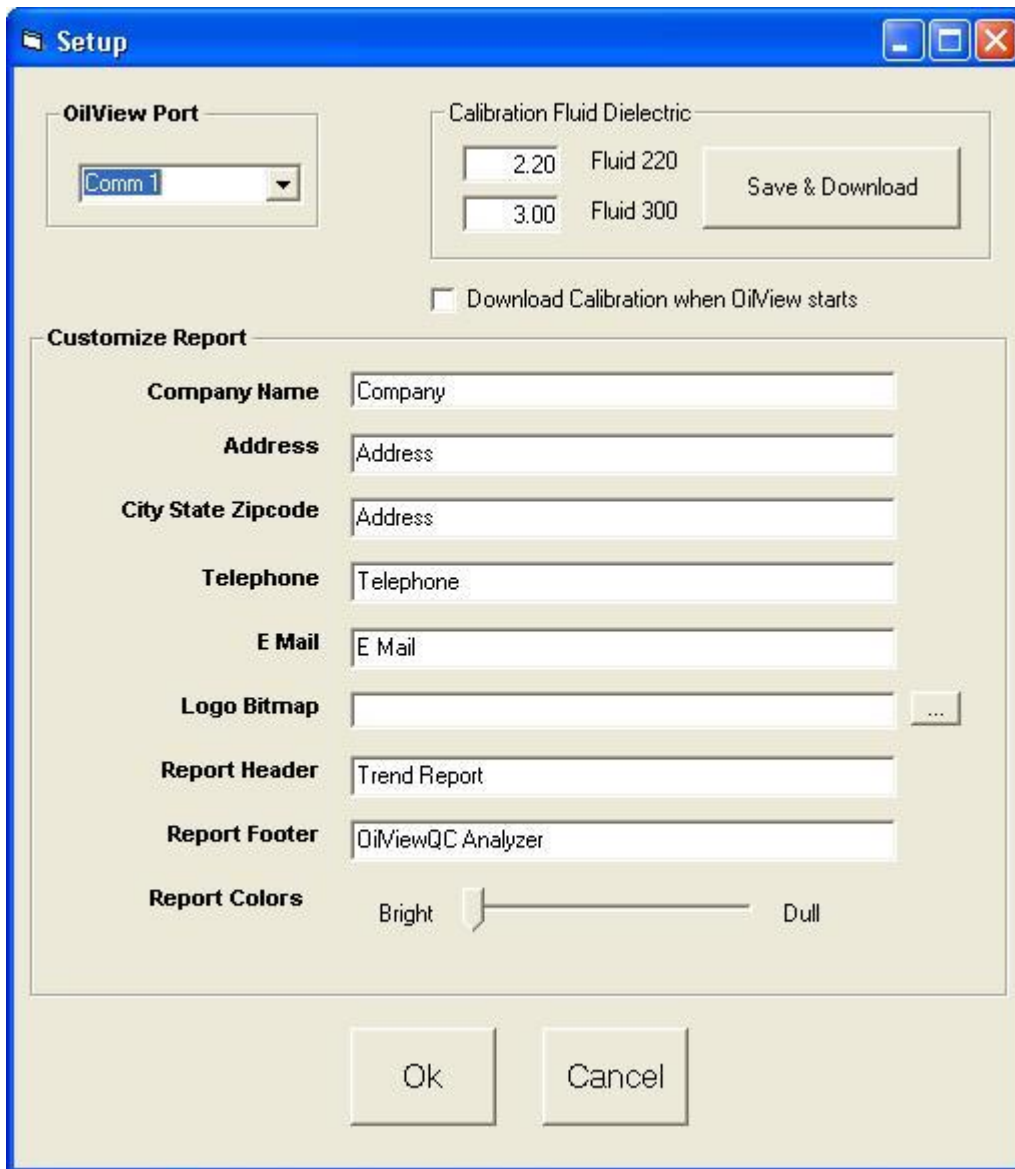
Startup

The first time the OilView® Quick-Check Analyzer software is started on a computer, the user will be prompted to enter the communications port.

The next screen displayed is the setup screen.

Setup Screen

OilView Port

Select PC communications port.

Calibration Fluid Dielectric

The analyzer is supplied with calibration fluids blended for a dielectric of 2.20 and 3.00. These are the default dielectric values that the stand-alone analyzer will use. However, if it is necessary to use other fluids those dielectric

values can be entered and saved by pressing the "Save & Download" button. Whenever the software detects the power up on the OilView® Quick-Check Analyzer the new dielectrics can be downloaded.

## Download Calibration when OilView starts

The software will automatically download the most recent calibration data when a power up of the OilView® Quick-Check Analyzer is sensed. Calibration data affects the dielectric results, but has little effect on other outputs.

> *Note:* The OilView® Quick-Check Analyzer dielectric measurement is extremely sensitive to moisture and temperature. Daily calibration is recommended. However, it may be convenient to use the most recent calibration. The calibration can be verified with a known reference. Offsets may suggest calibration is necessary. Offsets may be mentally applied to results or applied to the reference oil.

Customize Report

Company specific information may be entered in order to customize the supplied report. Of special note, a company logo may be supplied "Logo Bitmap", and the colors may be adjusted with the "Report Colors" slider bar.

Test Time Screen
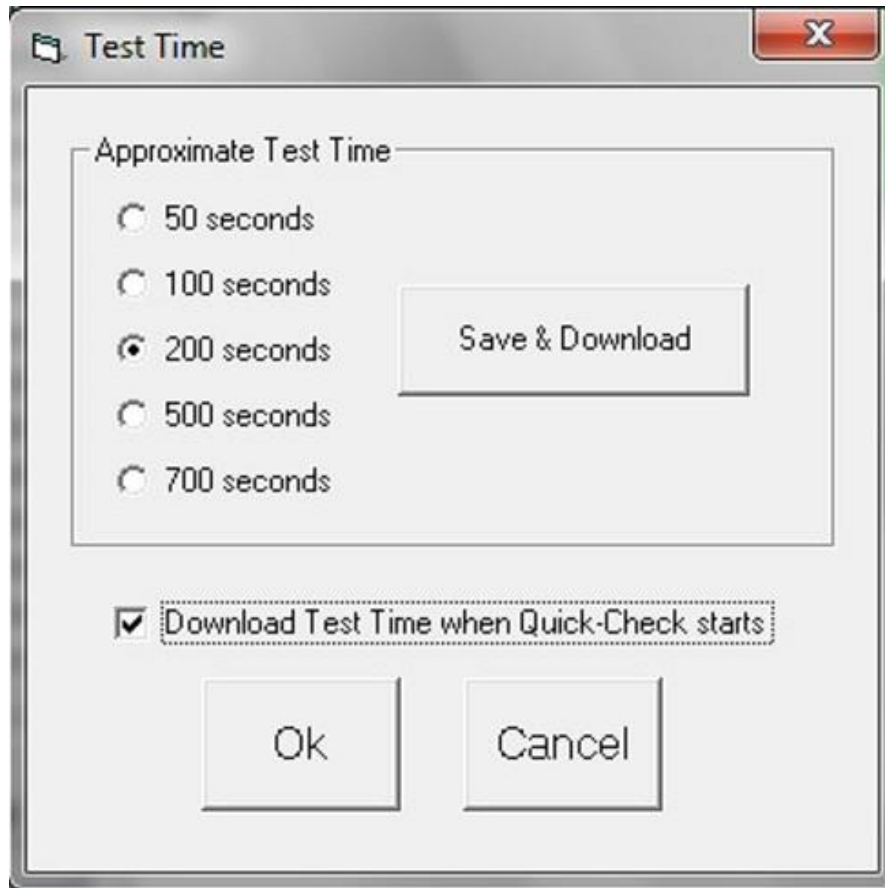
Approximate Test Time

The default test time of 50 seconds should be sufficient for diluted samples. However, if a longer test time is desired or undiluted samples are tested, the test time can be increased.

> *Note:* The Test Time option is hidden on the main menu bar. When the Quick-Check starts the firmware version is checked. If he firmware supports the variable test time option the Test Time item will appear on the menu.

Save and Download

The Save and Download button will immediately download the selected test time. This test time will be used until changed, or if the Quick-Check is restarted. This selection will also be displayed the next time this screen is shown.

Download Test Time when Quick-Check starts

The software will automatically download the most recent test time when a power up of the OilView® Quick-Check Analyzer is sensed.

Database Open Screen
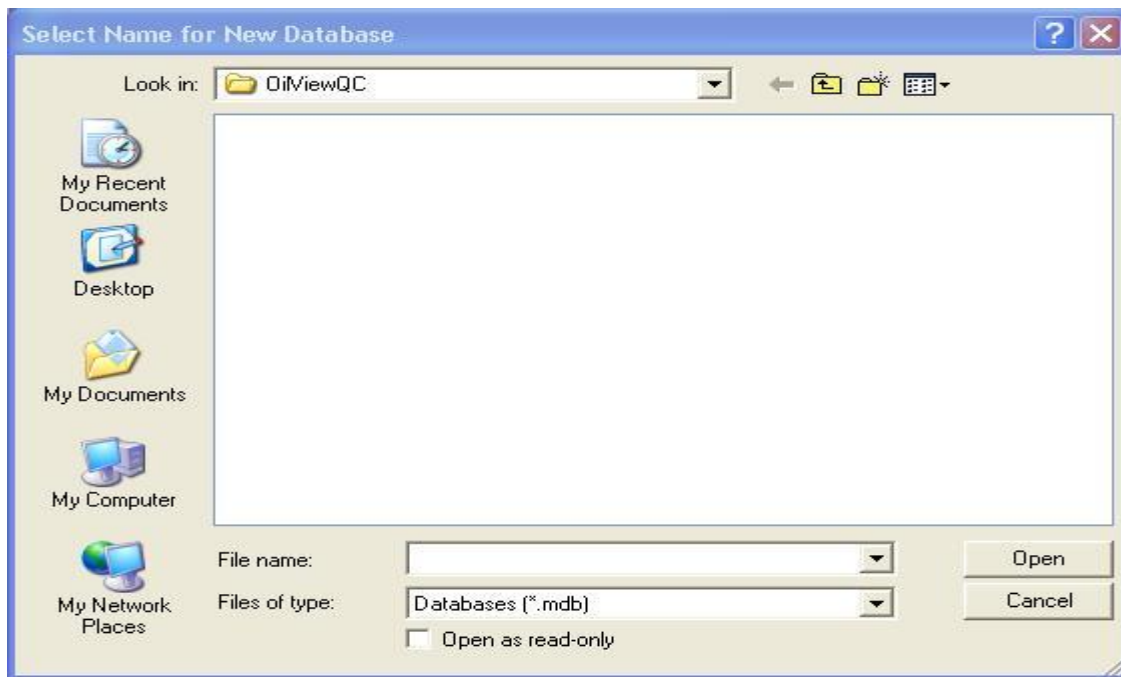
Click the "File name:" field, enter the name of the database you wish to create and select open. Ordinarily, the most recent database will be opened automatically. New databases may be created by selecting "Create New Database" from the "File" dropdown menu.

Main Program Window

OilViewQC Monitor - C:\Program Files\OilViewQC\XYZexpress.mdb

File   Edit   Windows   Setup   Help

Sample Data

Sample #	Date	Equip. ID	Unit Usage	Oil Usage	Oil Added	Wear Sev	Contam Sev	Chem Sev	Ref Diel	Chemical Idx	Dielectric	Ferrous Idx	% Water	LCont Droplet	LCont Ferrous	LCont NonFe	Visc %Chn
26	5/19/2004 6:13:36 PM					0	0	55	2.278	-16	2.12	0	0.00	0	0	0	
25	5/19/2004 6:10:20 PM					0	0	55	2.278	-16	2.12	0	0.00	0	0	0	
24	5/19/2004 6:07:17 PM					0	0	55	2.278	-16	2.12	0	0.00	0	0	0	
23	5/19/2004 5:59:33 PM					0	0	85	2.278	-29	1.99	0	0.00	0	0	0	
22	5/19/2004 5:41:37 PM					0	0	55	2.278	-20	2.08	1	0.00	0	0	0	
21	5/19/2004 1:52:53 PM					0	0	0	2.278	-4	2.24	0	0.00	0	0	0	
20	5/6/2004 2:32:03 PM					85	55	85	2.278	29	2.57	5948	0.00	0	1	1	
19	5/6/2004 1:52:45 PM					85	55	0	2.278	38	2.66	8053	0.00	0	1	1	
18	4/30/2004 9:52:45 AM					85	55	0	2.278	2	2.30	5702	0.00	0	1	1	
17	11/29/2004 10:33:18 AM	58492 ENG	7	3	2	85	55	30	2.2	10	2.30	740	0.00	0	1	1	-65
16	4/26/2004 9:53:24 AM		2	0	0	0	0	55	2.278	19	2.47	0	0.00	0	0	0	18
15	4/26/2004 9:51:32 AM	58492 ENG	3	4	5	0	55	85	2.2	106	3.26	4	0.09	1	0	0	
14	4/26/2004 9:48:56 AM		4	0	0	85	55	0	2.278	3	2.31	5719	0.00	0	1	0	
13	4/25/2004 4:13:28 PM		5	0	0	85	55	0	2.278	2	2.30	3342	0.00	1	1	0	
12	1/25/2004 4:01:18 PM	58492 ENG	0	6	0	0	55	85	2.2	146	3.66	1	0.25	1	0	0	
11	4/23/2004 8:56:09 PM	58492 ENG	0	7	0	55	55	85	2.2	157	3.77	3	0.44	1	0	0	

[Delete Sample(s)]   [Recalculate Alarm(s)]   [Export to CSV]   [Export to CSI]

Alarms - Default: Gear/Simple/Other

Equipment Alarm Limit Set
Engine/Unknown
Compressor/Unknown
Gear/Simple/Other
Pump/Unknown

Parameter	Low Alert	High Alert	Low Fault	High Fault
Chemical Idx	5	8	12	14
Ferrous Idx	6	10	15	30
% Water	0	0	0	2

Alarm: [Add] [Delete]
Sample Alarm: [Set] [Clear]
Default Alarm: [Set] [Clear]

Contamination   Chemistry

Reference - Default: Exxon - Terresstic - SHP 320

Supplier	Brand Name	Oil Description	Date	Dielectric	Visc. @ 40
Conklin	Convoy	10W50	1/18/1999	2.272	114.60
Sunoco	Sunvis	932	1/18/1999	2.191	30.60
Sunoco	DX Super C	40	1/18/1999	2.279	148.60
Frick	Refris Oil	2A	1/18/1999	2.300	56.20
Inpro	Synergy	790	1/18/1999	2.884	59.10
D-A Lubricant	Sullair	AWF	4/19/1999	2.387	34.20
Valvoline	Max Life	10W30	12/15/2004	2.200	105.00

Reference: [Add] [Delete]
Sample Reference: [Set] [Clear]
Default Reference: [Set] [Clear]

MJR Technologies LLC
4390 Clearwater Way #602
Lexington KY 40515
859-245-3713
mike@mjrtechnologies.com

Ferrous Idx
814

Status

Available for Test

Calibrating
Is Clean Unplug

Customer

Last Name	First Name	Address	City	State	Zip	Phone	E-Mail
Smith	John	447 Oak Street	Lexington	KY	40513	859-555-1234	JohnSmith@hotmail.com
Technologies LLC	MJR	4390 Clearwater Way #	Lexington	KY	40515	859-245-3713	mike@mjrtechnologies.com

Customer: [Add] [Delete]
Sample Customer: [Set] [Clear]

The default window size and placement may be improved by the user and will be restored in future program executions. For example if there are no Customers for this application, or no interest in Alarm settings, these screens may be closed, minimized, or moved towards the edge of the screen. Windows may be moved by positioning the mouse on the title bar, depressing the left mouse button, and dragging to the desired location. Windows may be resized by selecting the lower right hand corner of the window. Selecting a window will move it to the top of any windows covering it. The "Sample Data" window should figure prominently in any re-layout since the other screen are synchronized with the sample selection. A closed window may be restored by selecting it from the "Windows" menu. Best results are achieved by selecting higher resolution setting for the computer monitor and running the program in full screen mode.

Note: Selections on the "Alarms", "Reference", "Customer", and "Report" windows are synchronized with the current selection on the "Sample Data" window

Sample Data

As tests are completed the results are automatically uploaded and stored in the current database. Calculations will use the current Default Alarm and Default Reference. The "Sample #" defaults to an internal number and may be modified. "Date" will be set to the current date/time and cannot be modified. "Equip. ID" is a unique identifier for that sample point. When a sample with an Equip. ID is selected, prior samples with the same ID are located to populate the "Report" screen. If results are to be exported for a CSI database the "Equip. ID" should match the CSI "Lab Unit ID". "Unit Usage" can be used to report miles, hours, kilometers, etc. "Oil Usage" can record miles/hours oil has been in use, and "Oil Added" can record adds.

"Wear Sev", "Contam Sev", and "Chem Sev" represent the maximum alarm level in that category for the sample. The Ferrous Idx and Large Contaminant Ferrous is used to determine the Wear Severity. Contamination Severity is determined from the % Water Estimate, Large Contaminant Droplets, and Large Contaminant Non Ferrous. The Chemistry Severity is calculated with the Chemical Idx and Visc %Chg. The severity is compatible with the CSI 0 – 100 scale.

> *Note:* You may modify editable fields such as "Sample #", "Equip. ID", "Unit Usage", "Oil Usage", "Oil Added", "Visc 40C", and "Comments".

Note: You may sort the display by any column by clicking the column header. This could be a useful technique for finding and/or grouping results. Subsequent clicks will toggle between ascending and descending order. Sort order reverts to the default "Date descending" next program activation.

Note: Multiple samples may be selected by dragging the mouse. Current selection will be reflected with highlights for the "Sample #" and "Date" fields.

Delete Sample(s)

This will cause the software to generate a confirmation message: "Are you sure you want to DELETE the selected Sample(s)?" If "Yes" is selected the data will be removed from the database.

Recalculate Alarm(s)

Will recalculate alarms for the selected sample(s). A popup window displays "Finished" at completion. Recalculation may become necessary if alarm limits are changed.

Export to CSV

Will write the selected sample(s) to a text file with values separated by comas. This format can be easily manipulated and imported into Excel or Access.

Export to CSI

Use this to write the selected sample(s) to the "Generic" file format for import into CSI software. "Equip. ID" should match the desired "Lab Unit ID" to assure proper data import.

Reference Window

The Reference oil is extremely important. The Chemical and Visc % index readings are relative to a reference sample and will not be correct if the correct Reference is not used. The reference oil sample should be a new oil of the same type and from the same source as the used test oil. If for any reason a known reference oil is not available, it is probably best to conduct your used oil tests without a reference oil or against a previous test from the same machine. In selecting a reference oil, remember that oil suppliers may change additive packages, refineries, and oil sources without notice. Therefore, there is no assurance that a reference sample taken after the fact from a new oil drum can be applied to a test oil that originated from a previous drum-even though the oil is of the same type and from the same supplier.

Reference Add/Delete

Oils can be added to the list of Reference oils by selecting the "Add" key. Enter the required information in each field. You may delete a Reference with the "Delete" key as long as the Reference is not being used by any of the oil samples.

Sample Reference Set/Clear

These buttons only apply to the currently selected sample. As samples are selected in the "Sample Data" window, their corresponding Reference Oil will be selected in the Reference window. To change the Reference for a Sample, select the sample in the "Sample Data" window, select the Reference window and select the desired reference. Press the "Set" button. Pressing the "Clear" button will clear the Reference oil. Either selecting will cause a recalculation of the Alarm levels.

Default Reference Set/Clear

The "Default Reference" will be automatically applied to all future tests. If possible, it may be convenient to group test samples by Reference oil to reduce the need to change this setting. Observe that the current default Reference is displayed in the caption of the Reference window.

Note: You may sort the display by any column by clicking the column header. This could be a useful technique for finding and/or grouping results. Subsequent clicks will toggle between ascending and descending order. Sort order reverts to the default next program activation.

Note: You may change the values in any of the Reference window fields by selecting the desired field and typing the new values.

Alarm Window
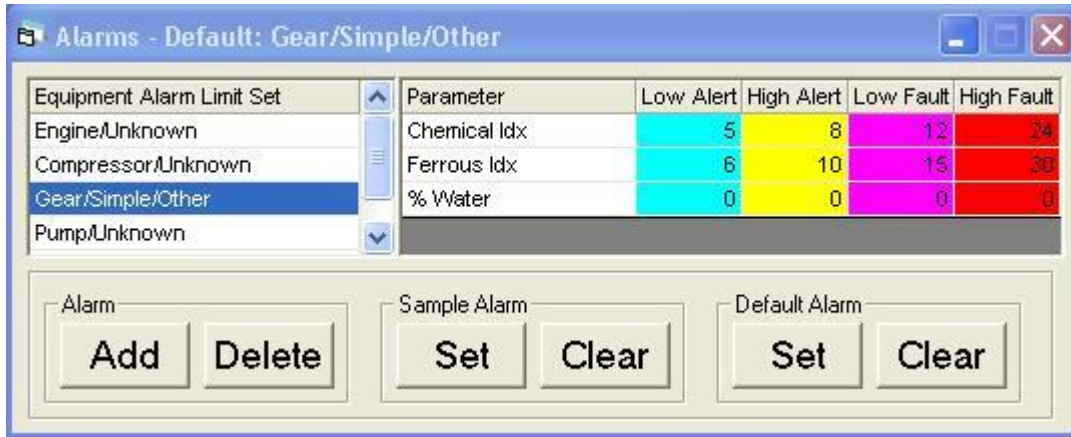
Test results are displayed with colors that correspond to the calculated alarm level. This facilitates a quick assessment of the sample status.

Alarm Add/Delete

Alarms can be added to the list of Alarm Sets by selecting the "Add" key. You may delete an Alarm Set with the "Delete" key as long as the Alarm Set is not being used by any of the oil samples.

Sample Alarm Set/Clear

These buttons only apply to the currently selected sample. As samples are selected in the "Sample Data" window, their corresponding Alarm Set will be selected in the Alarm window. To change the Alarm for a Sample, select the sample in the "Sample Data" window, select the Alarm window and select the desired Alarm Set. Press the "Set" button. Pressing the "Clear" button will clear the Alarm Set. Either selecting will cause a recalculation of the Alarm levels.

Default Alarm Set/Clear

The "Default Alarm" will be automatically applied to all future tests. Observe that the current default Alarm Set is displayed in the caption of the Alarm window.

Note: You may change the values in any of the Alarm window fields by selecting the desired field and typing the new values.

Report Window
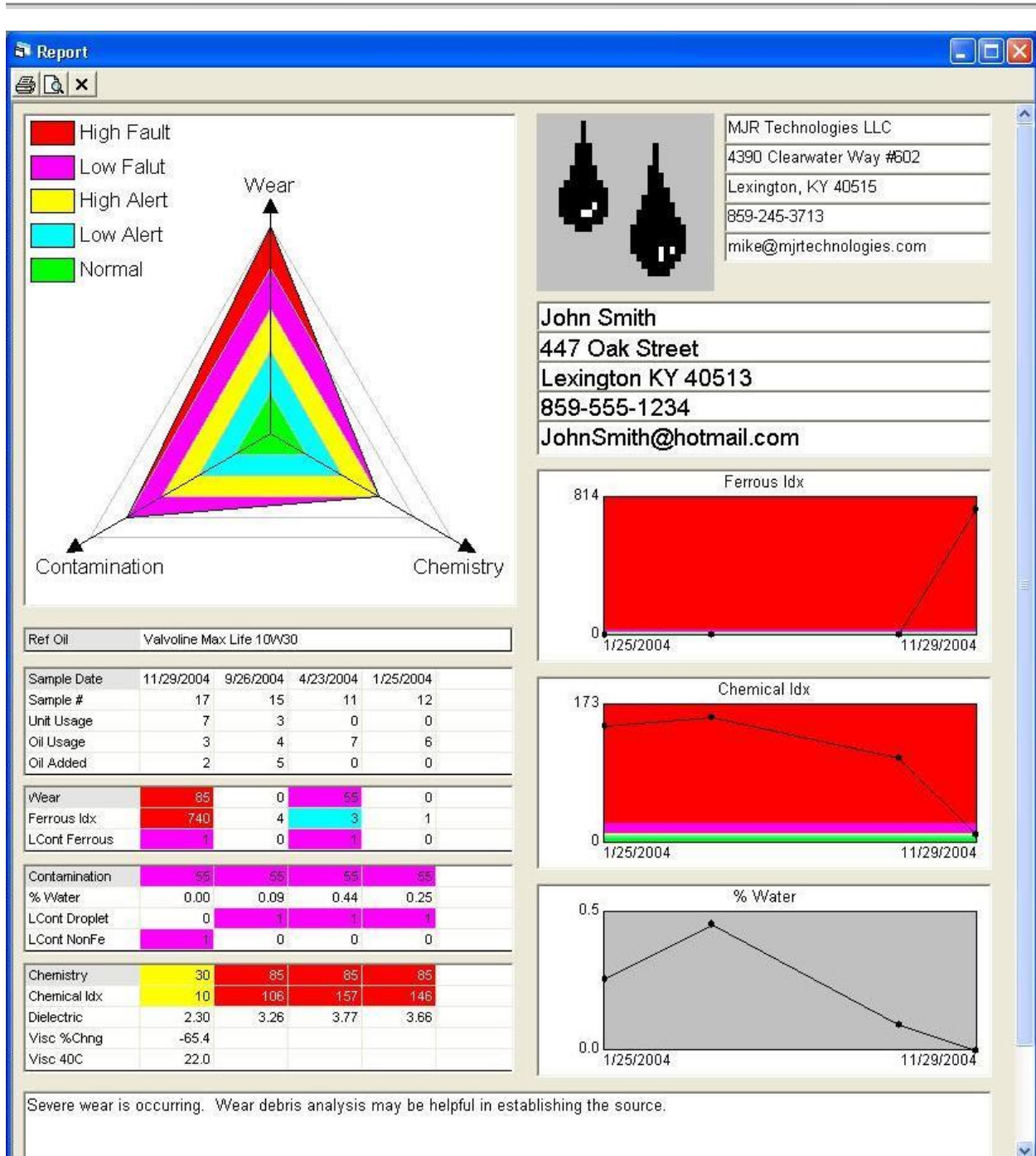
The Report window summarizes test and trend data for a sample. A non-blank "Equip. ID" is required before data can be displayed. Prior samples with a matching "Equip. ID" will be retrieved for historical trending. "Sample #", "Unit Usage", "Oil Usage", "Oil Added", "Visc 40C", and "Comments" for the current sample may be modified by

selecting the field and typing the new values. Customer information may also be modified temporarily, however permanent changes should be make on the Setup or Customer window.

The Report window may be printed or previewed by selecting the appropriate toolbar buttons. The "X" button is used to close the preview mode and return to the Report window.

To create a pdf of the report, go to this site and download the free PDF995 program: http://www.pdf995.com/ This will let you create a pdf by 'printing' (it prompts you for a file name to create) to the pdf995 printer. In the Quick-Check software, select the 'preview' icon on the top of the report window to view the formatted report. The 'print' icon will let you print the report (the pdf995 will need to be set as your default printer).

The shape of the "TriVector" plot is also helpful because it lets you quickly identify areas of concern. For example, a sample with normal wear and contamination readings but bad lube chemistry would appear as below.
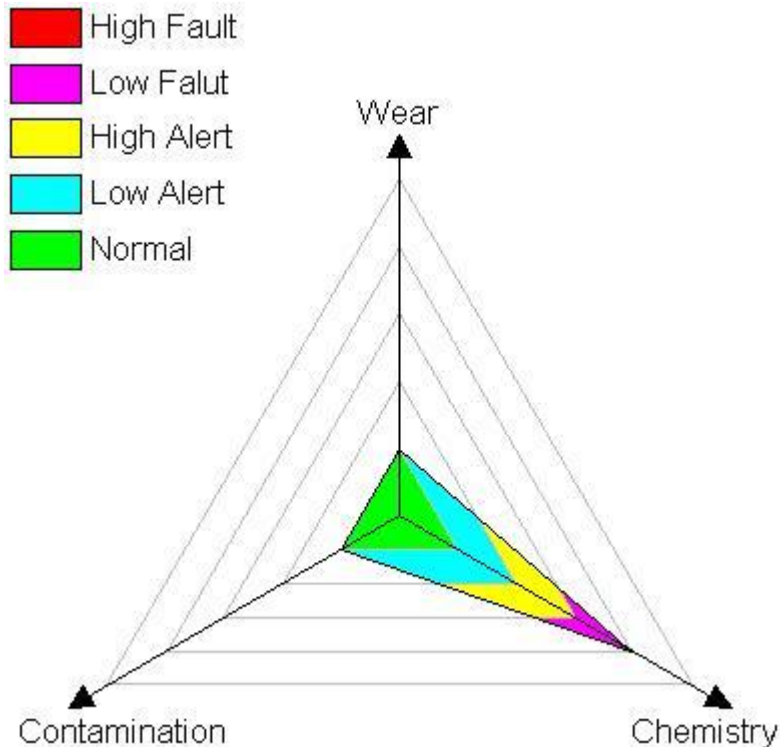
A plot may show high wear but otherwise healthy oil, good oil contaminated with water, or any other combination of problem. It is not unusual for an oil to first experience a Chemistry problem as additives are depleted and soluble contaminants build up. Left uncorrected, the oil problem can develop a Contamination problem, and eventually an abnormal Wear condition.

Customer Window
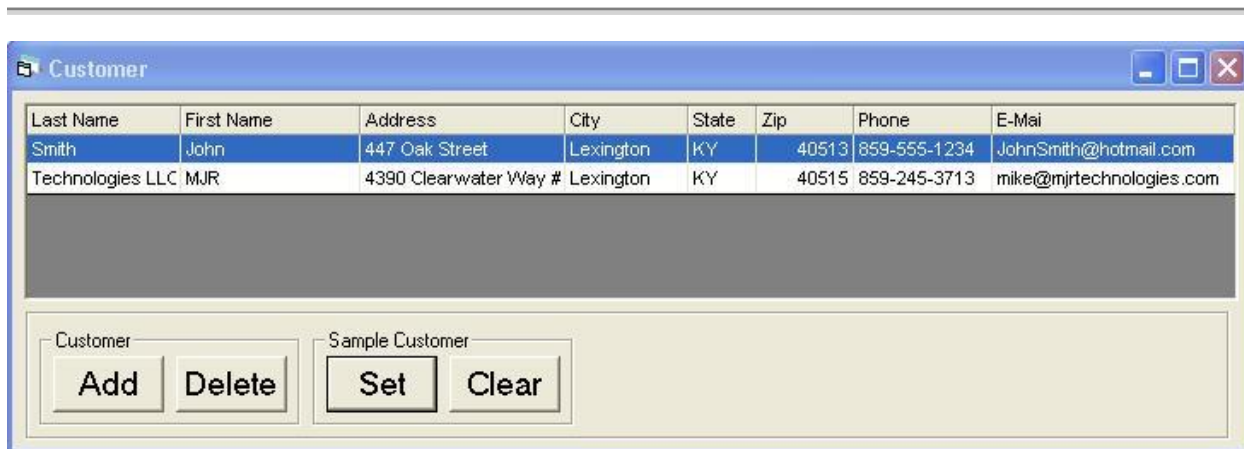
For reporting purposes a customer may be assigned to a sample. If there is no need to assign customers this window can easily be closed, minimized, or moved.

Customer Add/Delete

Customers can be added to the list by selecting the "Add" key. You may delete a Customer with the "Delete" key as long as the Customer is not being used by any of the oil samples.

Sample Customer Set/Clear

These buttons only apply to the currently selected sample. As samples are selected in the "Sample Data" window, their corresponding Customer will be selected in the Customer window. To change the Customer for a Sample, select the sample in the "Sample Data" window, select the Customer window and select the desired Customer. Press the "Set" button. Pressing the "Clear" button will clear the Customer.

Note: You may sort the display by any column by clicking the column header. This could be a useful technique for finding and/or grouping results. Subsequent clicks will toggle between ascending and descending order. Sort order reverts to the default next program activation.

Note: You may change the values in any of the Customer window fields by selecting the desired field and typing the new values.

Status Window
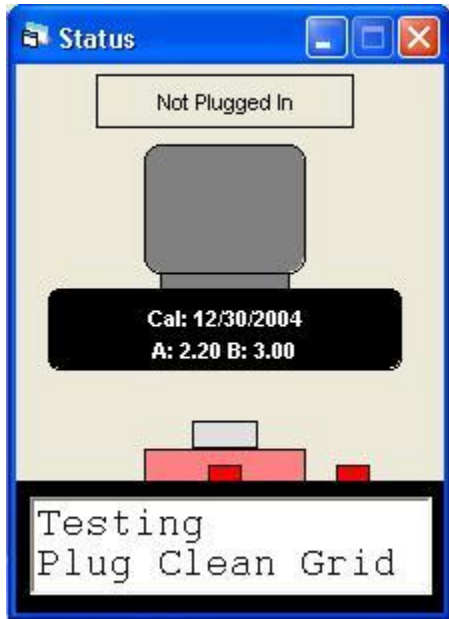
The Status window will reflect the various states and conditions of the OilView® Quick-Check analyzer. The text status may be easier to read then the device display. Also, the Calibration information can easily be verified for correct date and dielectrics. This window is not required for successful operation of the system and may be closed, minimized, or moved if desired.

Cal History

At the completion of calibration a history chart is displayed. The chart may also be displayed by selecting 'Cal History' from the main menu. A 'frequency' (see appendix for explanation) and suggested error band for the 220 and 300 fluids is graphed. The suggested limit is based on the median value for all previous calibrations. A data point near or beyond the suggested limit does not necessary mean that the calibration is incorrect. However, verification is advisable.

Note: Five calibrations are required before a chart will be displayed.

Note: Incorrect calibration will not interfere with the units' ability to detect wear and contamination. However, the 'Chemical Idx' and 'Chem Sev' will be incorrect.

Note: Temperature, humidity, grid cleanliness, switching grids, grid wear, etc can affect calibrations. Calibration fluids may also become contaminated as air replaces the fluid.

Note: Calibration history is stored in the currently opened database. For continuity, the same database could be used for all calibrations
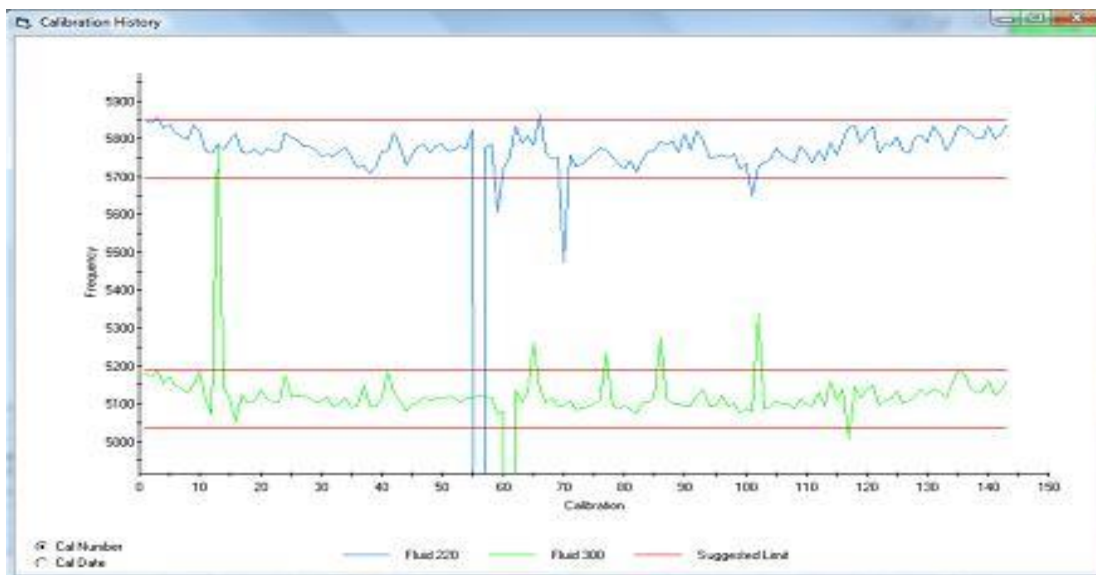
Effects of Calibration Error

Dielectric Calculation
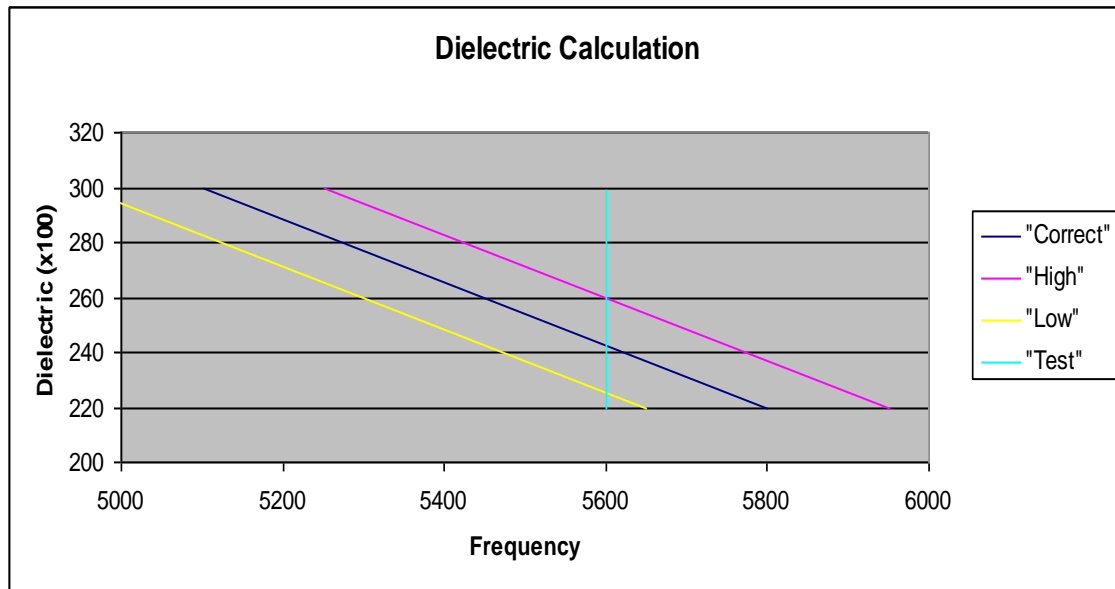
Dielectric is calculated by taking the "Test" frequency and interpolating between the frequencies for the 220 and 300 fluids. For this example, a frequency of 5600 using the "Correct" calibration will result in a dielectric calculation of 2.43. The "High" calibration curve would result in a dielectric of 2.60, and the "Low" calibration would result in a dielectric of 2.26. If unexpected dielectric results are received, the calibration can be verified by testing a reference oil and or re-testing the sample.

Manual Log

If a PC is not available or practical for your application you may wish to manually record test results. An example log sheet is included on the software distribution CD (QuickCheckManualLog.doc). Feel free to modify as required.

Equipment ID		Reference Dielectric		Reference Viscosity	

Date	Unit Usage	Oil Usage	Oil Added	Dielectric	Chem Idx	Fe Idx	% Water	Large Contam	Visc 40 C	Visc % Chg	Comments

Appendix B

Dielectric constant

The dielectric constant is a measure of a materials response to an electric field. The dielectric constant, along with melting point, boiling point, refractive index, and viscosity, is a fundamental property of a material. For simple compounds, these properties correlate well with the dielectric constant. A dielectric constant represents the sum of two different component properties: the polarization, and the dipole moment. Polarization measures the interaction of a molecule at high electric fields so that only the electrons, rather than the entire molecule, can respond to the electric field frequencies. A dipole moment measures the center of gravity of the positive and negative charges in a molecule. By definition, the dielectric of a vacuum is 1.0.

Most lubrication oils will have a dielectric of 2.1 – 2.4. Many synthetic oils have dielectrics in excess of 6. Water has a dielectric of 75 at room temperature. When comparing a sample dielectric with the reference oil, a 0.02 change is negligible and a 0.10 change is large. For example, a 0.10 increase in dielectric could be caused by a 0.6 increase in TAN, or 0.11% water, or some combination of the two. These values will depend on the brand of oil used and can be established in cooperation with a commercial lab. Soot, oxidation, and fuel dilution can also change the dielectric constant.
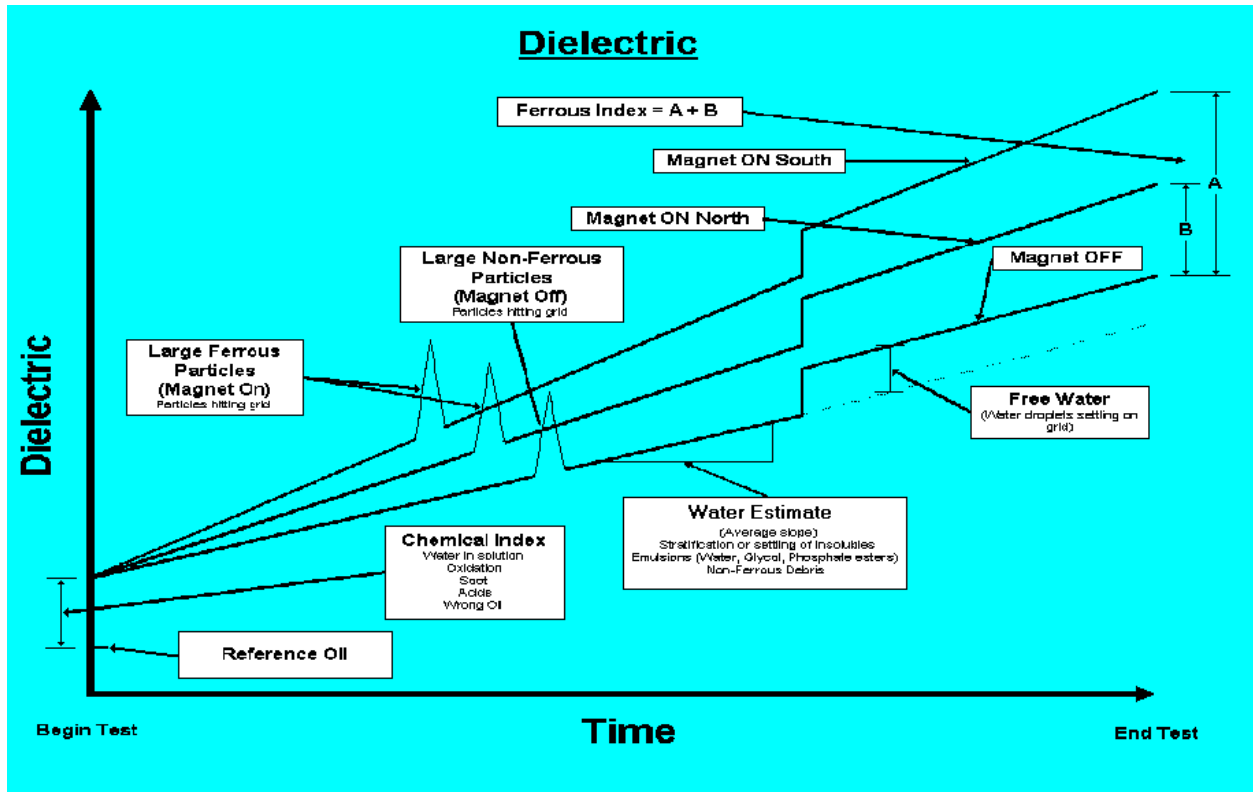
How the Quick-Check works

The Quick-Check measures the dielectric over time as contaminants settle onto the sensing grid. The sensor grid acts as a capacitor in an RC circuit with the oil in the vicinity of the grid as the dielectric medium. A timer/oscillator circuit outputs a frequency that varies with the capacitance. The unit calibration associates the output frequency with the known dielectric of the calibration fluids. Free water will sink to the grid and is easily detected due to the much higher dielectric constant of water. The instrument has a permanent magnet and an electromagnet to facilitate the detection and clarification of ferrous particles. Readings are taken with the electromagnet off, North, and South polarity. This will cause magnetic particles to stand up and lay down, changing the spacing between the grid lines, and resulting in diverging plot lines.

Chemical Index

The chemical index is the change in dielectric between a reference oil and a test sample. Among the factors that may contribute to the chemical index are: soluble water, oxidation of the oil, soot, acids, and wrong oil. Fuel dilution, due to its lower dielectric, can reduce the Chemical index and result in a negative index value. Since contaminants drive the dielectric in the opposite direction of fuel, it is best to rely on viscosity measurements to detect the fuel dilution. A change in dielectric constant of less than 0.02 is considered good. A change of 0.10 is considered extreme.

Large Ferrous Particles

Large ferrous particles are detected as spikes in the dielectric constant during the north and south magnet states.

Dielectric

Ferrous Index = A + B

Magnet ON South

Magnet ON North

Magnet OFF

Large Non-Ferrous
Particles
(Magnet Off)
Particles hitting grid

Large Ferrous
Particles
(Magnet On)
Particles hitting grid

Magnet OFF

Free Water
(Water droplets settling on
grid)

A

B

Dielectric

Chemical Index
Water In solution
Oxidation
Soot
Acids
Wrong Oil

Water Estimate
(Average slope)
Stratification or settling of Insolubles
Emulsions (Water, Glycol, Phosphate esters)
Non-Ferrous Debris

Reference Oil

Begin Test

Time

End Test

Large Non-Ferrous Particles

Large non-ferrous particles are detected as short term spikes in the dielectric constant during the magnet off state.

Water Droplets

Water Droplets are detected as an instantaneous and permanent change in dielectric constant.

Water Estimate

The Water Estimate is derived from the slope of the dielectric over the test interval. This estimate reflects the level of insoluble contaminants in the sample such as water, coolant, and wear particles.

Ferrous Index

The ferrous index is determined at the end of the test. It represents the sum of the difference of dielectric constant between the magnet off state with the magnet north and magnet south states.