FLUITEC INTERNATIONAL
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RULER®

CE320

Operation and Instruction Manual

Rev.. F-3.7

IMPORTANT NOTE

The RULER® is designed to quickly detect the oxidative health from lubricants and provides information which is complementary to existing oil analysis techniques. Fluitec International does not offer recommendations to Customers as to when lubricants or fluids should be changed. Fluitec International does not accept liability for any decisions regarding the use of RULER® data. Decisions regarding oil changes or additive replenishments is the sole responsibility of the Customer. Customers should always establish their own criteria taking into account other important factors that affects the fluid's integrity.

Today the RULER® & R-DMS© has been implemented by Industries worldwide contributing to oil monitoring and changeout programs.
Fluitec would like to thank you for purchasing the RULER® products. We hope you find the RULER® Product to be an enhancement tool in your oil condition monitoring program.

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1 Introduction

The RULER® provides measurement of the oxidative resistance levels for mineral and synthetic hydrocarbon oils, ester based and biodegradable oils. With the ability to monitor antioxidant levels, the RULER®/RDMS© System can quantify antioxidant levels of incoming and stored supplies, as well as additive depletion in used oils. RULER® can be used to help determine proactively oil change intervals, and to extend change intervals through timely antioxidant additive replenishments. It can be used to detect certain abnormal operating conditions prior to equipment failure when depletion rates change abruptly.

The RULER® uses voltammetric techniques to measure the amount of antioxidants in new and used oil, controlled by the microcomputer in the instrument. To use this technique, however, all the user has to know is how to properly set up and conduct a test.

This manual provides important information regarding safety, technical reference, installation requirements, operating condition specifications, users facility resource requirements, and operating instructions. In addition this manual should be used in conjunction with applicable published laboratory procedures. Information on these procedures is given below in section 1.2

1.2 Recommended Resources and Publications

American Society for Testing and Materials (ASTM)
100 Barr Harbor Drive
West Conshohocken, Pennsylvania 19428-2959
Tel: 610.832.9500 / Fax: 610.832.9555
http://www.astm.org e-mail:service@astm.org

ASTM Publications:

ASTM D-6224 - *Standard Practice for In-Service Monitoring of Lubricating Oil for Auxiliary Power Plant Equipment*

ASTM D-4378 – Standard Practice for In-Service Monitoring of Lubricating oils for Steam and Gas turbines

ASTM D-6810 - *Standard Test Method for Measurement of Hindered Phenolic Antioxidant Content In Turbine Oils by Linear Sweep Voltammetry.*

ASTM D-6971 - *Standard Test Method for Measurement of Hindered Phenolic and Aromatic Amine Antioxidant Content In Turbine Oils by Linear Sweep Voltammetry*

1.3 Features and Benefits

- Compact and completely portable palm unit
- Easy to use software Powered by Windows® CE
- Easy to operate super flex touch screen controls
- 320 x 240 pixels LCD back lighted touch screen
- Touch screen with Automatic contrast temperature compensation
- Unit can store sample data for over 100 tests
- Easy Communication via RS 232 communication port/link to Personal Computers
- Long Life Lithium-Ion battery with Backup reserve
- Integrated charge status and low-battery indicator with
- Intelligent fast charge
- Custom durable Screw-on probe for test solution vials
- Palm unit equipped with Intel, Strong Arm SA 1100, 190 MHz, 32 bit RISC processor
- Memory: 16 Meg DRAM and 16 Meg of NAND Memory
- Fully tested for harsh and industrial environment

1.4 Specifications

Model:	CE 320
Electrical specs:	Circuitry designed to optimize the use of voltammetry in a 0.0 – 1.7 Volt range for lubricants
Power Supply:	1 rechargeable Lithium-ion battery pack, with Separate rechargeable Lithium-manganese backup battery
AC Adaptor:	120 VAC – 60 Hz or 220 VAC – 50/60 Hz

Environmental:	Sealed meets IP67 (Immersion), MIL-STD-810E method 506.3 procedure (Rain) and method 512.3 procedure 1 (immersion) Withstand electrostatic Charge (meets EN61000-4-2)
Temperature Range:	-30°C to +50 °C / -22° F to +122°F
Unit dimensions:	2.36"H x 4.08"W x 9.74"L
Weight:	1.5 lbs (840 g)
Approval:	FCC, Class A, CE certification
Shock Resistant:	meets MIL-STD-810E method 561.4 procedure 4, CEI 68-2-32 method 1

2 Safety Information and Warning

2.1 Important User Safety Information

Safety Consideration. The Use of this equipment may involve hazardous materials and operations. This manual does not purport the address all of the safety problems associated with the use of the equipment. It is the responsibility of any user of this equipment to investigate, research and establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

Equipment Modifications and Replacement Parts. Any modification or alteration of this equipment from that of factory specifications is not recommended voids the manufacturer warranty, product safety, performance specifications, and/or certifications whether specified or implied, and may result in personal injury and/or property loss. Replacement parts must be O.E.M. exact replacement equipment. Please refer to section 7.2.

Do not drop or place the RULER® instrument or probe in a hazardous location. Careless handling or misuse can damage this precision electronic device. Always keep the probe in its protective vial when not in use.

2.2 Chemical Information RULER® test solutions

The RULER® Instrument uses patented techniques and formulations, referred to as RULER® Solutions. RULER® Solutions are designed for specified applications and should be used only as directed in this manual.

Do not use the RULER® instrument with any other solvents or solutions. Probe damage could results from using non-specified solvents.

The RULER® Solutions are Acetone and Alcohol based solutions (flammable). As with all flammable solvents, the user should take precautions not to expose the solutions, or their vapors, to open flame or spark. General safety information on hazardous solutions:

- Keep away from heat, sparks, open flames and other sources of ignition
- Do not smoke
- Keep vials closed
- Use with proper ventilation, preferably in a hood
- Irritant – May cause eye irritation and transient injury; may also cause irritation to skin, digestive system, and respiratory tract
- Avoid inhalation of vapors
- Wash any possible exposed areas thoroughly after handling

After completing RULER® test procedures, observe the same precautions in the disposal of used RULER® Solutions as with other shop solvents. Use appropriate hand and eye protection when handling solvents. RULER® Solutions are flammable. Do not use near fire or flame.
We also recommend reading and consulting the Material Safety Data Sheet (MSDS) information provided with the test solutions.

3. Equipment and accessories

- **Component checklist**

RULER® CE 320 instrument with RULER® probe
, RS232 interface and communication cable, 220VAC Power adapter.

- **Accessories**

Micropipetter and tips
RULER® test solutions
Cleaning materials
Carrying case
Operation and Instruction manual

As the RULER® method is a quantitative analysis, a precision micropipetter should be used with your RULER® Instrument. Choose a fixed volume micropipettor, of 50µl, 100µl, or 200µl volumes, appropriate to sample sizes recommended for the oils you are using.

Alcohol cleaning pads and Tissue Wipes are recommended by the manufacturer as high quality materials for cleaning the probe tip. Any abrasive papers or compounds are not recommended for probe cleaning.

4. Unpacking and Installation

4.1 Unpacking

Carefully unpack and place the equipment in a secure location. Ensure that all parts and accessories listed in the previous section are present. Inspect the unit and all accessories for damage. If you find any damage, keep all packing materials and immediately report the damage to the carrier. We will assist you with your claim, if requested. When submitting a claim for shipping damage, request that the carrier inspect the shipping container and equipment. Do not return goods to Fluitec without written authorization.

4.2 Installation

The instructions for preparing the equipment assume that the user is aware of the contents of this document, which lists the warranty conditions and important precautions. Read and understand all instructions and warnings in this manual.
Power: Connect the AC adapter to the gray communication cable. The communication cable has two functions, allowing the RULER to communicate with the PC and charging it's battery as well. Connect the AC adapter to the communication cable by means of a short second cable with a round plug which you can locate at the end of the cable that plugs in the computer. Connect the AC power plug to a properly fused and grounded receptacle with the correct voltage as indicated in section 1.4 or on the information plate of the AC Adapter. *Communication:* Connect the RS232 from the CE320 communication port (COM PORT) to your computer.
Attention: Since the « Com »and « Probe » ports on the Ruler are similar, they are marked as Probe and Com Port. Please make sure that you always plug the gray communication cable in the Com Port

Unit placement:

1. Connect the probe to the probe cable.
2. Connect the RULER® instrument to the communication and charging cable and wait until the rechargeable Lithium-ion battery pack is fully charged. The indicator should light red while charging. Full charge takes approximately 4 hrs. The CE320 intelligent charging system will stop charging and the indicator will light green when the battery is completely recharged.
3. To start the calibration process of the battery, power up the unit, select CTRL/F2, select file , and press "start calibration battery". This process may take 1,5 to 2 days time, for a full calibration of the battery, by leaving the unit connected to the power adaptor.

*4.3. **Getting connected with USB-Serial adapter***

In case you have no Serial Communication Port on your PC, you may have to use a USB/serial adapter for getting connected with the RULER. Follow these steps for proper setup of the communication between the RULER CE320 and your laptop or PC/ Follow the links throughout the steps below for more information on a particular step

1. Install the supplied USB to serial port adapter per the manufacturer's instructions (installing the correct drivers and software) – if you have your own adapter please consult Fluitec in order to avoid communication errors.
2. Install the RDMS software
3. Install the ActiveSync software
4. Install the supplied communication patch file
5. Connect the lemo communication cable to the RULER CE320
6. Connect the lemo communication cable to the USB to serial port adapter
7. Connect the USB connecter of the USB to serial port adapter to your laptop or PC

ActiveSync will begin to communicate

Figure a : COM-PORT connector on the RULER CE320

Figure b: how to connect the communication cable to the AD-adaptor cable

5. RULER Technology - Introduction

5.1 RULER® METHOD

The test can be performed with any lubricant containing at least one antioxidant. The test vial is prepared by mixing an oil sample with a low toxicity solution. Using voltammetric techniques, the RULER® applies a controlled voltage through an electrode inserted into a prepared sample.

As the potential increases the antioxidants become chemically active causing current to increase producing an oxidation wave. In this method, the voltage range of the oxidation wave is related to the identity of the antioxidant, and the peak value indicates the concentration of the antioxidant. The peak value of the oxidation wave is directly related to the concentration of the antioxidants in the sample.

The test results are displayed on the computer screen when the test is completed. The oxidation wave produced is viewed and the values are presented in RULER® Numbers, which can be used to track antioxidant depletion rates.

RULER® Numbers decrease as antioxidants are depleted thus it is possible to track depletion from test to test as degradation occurs. The instrument compares the RULER® Number of a used oil sample with that of a fresh oil sample (Standard) of the same formulation to determine the percentage of the Remaining Useful Life of the used oil.

Through time-series testing, the Remaining Useful Life of a lubricant can be monitored and determinations can be made to predict when rapid changes in the base stock are likely to begin. Based on RULER® results, decisions can be made regarding oil changes or additive reinforcement to extend the useful life of the oil. RULER® levels must be established for a given piece of equipment and used to make proper decisions.

5.2 R-DMS ©, – Ruler Data Management Software

R-DMS©, is a Windows® based software designed for the RULER® CE 320. It allows end-users to download RULER field data from the CE320 field unit to desktop software. With R-DMS©, the user can maintain large databases, trend time-series testing, view multiple tests, and export data to other formats. Please see the accompanying R-DMS©, software manual for details.

6. RULER Instrument

6.1 Features & specifications

The RULER® is a portable oil analysis instrument that can measure the antioxidant levels of oils and lubricants in seconds. It is easy to use; requires less than 0.5 ml of a test sample, and is ideal for field tests, maintenance facilities, and oil analysis laboratories.

6.2 Quick Charge Circuit with Charge Indicator & Communication cable

- The RULER® is powered by a Lithium-ion rechargeable battery pack.
- When the low battery indicator becomes visible, RULER® test results may become inaccurate
- The RULER® instrument is designed with an intelligent quick charging circuit. When the low battery indicator is on, you can continue to operate your instrument only while charging.

The AC adapter connects to the gray communication cable that at the end of the cable plugs in the computer /there is a short second cable with a round plug on it, this is where the AC Adapter plugs into. Once the unit is connected, the recharging circuit will immediately begin a fast charge to the Lithium-ion Battery Pack. Full charge takes approximately 4 hours. The built-in Charge Indicator Light (located on front panel) signifies when the Lithium-ion battery is being charged. The Charge Indicator Light changes from red to green light, when the battery is fully charged. Note: the unit can not be turned off while charging.

6.3 Rechargeable Battery Pack / Replacement

- The RULER® is powered by a special Lithium-ion rechargeable battery pack. The compartment is located in the back of the RULER® instrument
- The recharging must be done when the battery is at a temperature between 0°C (32°F) and 45°C (113°F) to preserve the battery integrity. The built- in Charge Indicator Light goes yellow if the battery is too hot or cold to be charged and the charging system is disabled.
- It is prohibited to open the battery compartment or remove the battery. It is strongly advised for battery problems to contact Fluitec. Liability will be waived when this has not been respected.
- To start the calibration process of the battery, power up the unit, select CTRL/F2, select *file ,* and press "*start calibration battery*". This process may take 1.5 to 2 days time, for a full calibration of the battery, by leaving the unit connected to the power adaptor.

A few tips to make sure you will experiences the maximum benefits from the rechargeable battery

Battery calibration
The CE320 includes a power gauge to monitor the power remaining in the battery at any time (Good, Low, Very low) and the estimated remaining time and percentage.
When calibrated the battery status indicator will flash when the battery reaches the Battery Warning Level. To be operation the Power Gauge needs to be calibrated. This procedure could take up to 20 hours.
A non-calibrated battery does not affect the battery life, nor the charging duration. The calibration only allows the CE320 user to accurately report the remaining capacity of the battery and to enable the Battery Status Indicator to blink when the battery reaches the warning level.

To start the calibration procedure, select ALT+F2. In the next screen select in the menu, File, and Start Calibration.
The result of the calibration will be given at the end of the cycle.

Short term storage
You generally do not have to worry about the battery life time. When turned off with fresh batteries, you can store the CE320 unit for several days without needing to recharge them.
Long term storage

- **For a storage period of a few days or weeks** it is recommended to keep the RULER unit on charge. The main battery will be fully charged, then the charger will go in idle mode. Data and programs will be preserved. If the unit is not on charge, you may lose your programs and data after 1 to 2 weeks.
- Low battery message: after several hours of usage, the main battery will become low. A screen with the message " The main battery very low" will appear when there is still some power to continue to work.
- The level at which it appears is adjustable (control panel – power)
- This message will re-appear from time to time (about four minutes) to remind you to charge the unit.

Backup battery maintenance

- The RULER CE320 unit has a built-in backup battery, allowing you to keep programs and data in the CE320 memory for years without being replaced. Being rechargeable and protected against deep discharge, the backup battery will not need to be replaced during the expected life time of the RULER CE320.
- Even if the battery is too low to power the CE320, enough energy remains to power the memory for weeks without using the backup battery.
- The backup battery is recharged every time you recharge the unit. The backup battery is also recharged from the main battery even if the unit is not charging.
- The backup battery low message will appear when the date is still secure but the backup battery needs to be recharged.

6.4 Automatic Shutoff

If the CE 320 remains inactive for more than 3 minutes, it will turn off automatically. The CE 320 will save the exact status of your application program and data before turning off. (with information from the main screen)

6.5 Connectors

The RULER® instrument is equipped with 2 auxiliary connectors located on the right side of the unit. The connector on top must be used only for connection of the probe cable. The second connector is for communication (RDMS software) and charging purposes only.

6.6 Communication port and cable Interface – COM PORT

The communication and charging cable connects to communication port (COMPORT) of the RULER CE 320 to the RS-232 port of your computer, to provide charging and interface between RULER® and PC (for R-DMS software. Since the Com and Probe ports on the Ruler are similar, they are marked as Probe and Com Port. Please make sure that you always plug the gray communication cable in the Com Port. For USB/Serial adapter see paragr. 4.3

6.7 RULER® Probe

The RULER® probe is a custom electrode made specifically for the RULER® Instrument (Figure 10), based on a 3-electrode sensing system. RULER® Test Vials easily screw onto the probe to minimize the possibility of spilling chemicals.

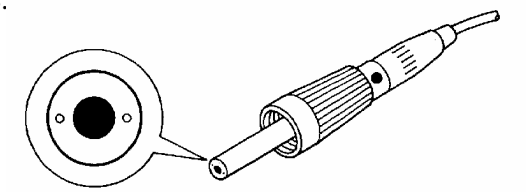


Figure 1: detail of RULER probe

The probe must be wiped clean before and between each test. An alcohol wipe or an unused RULER® Solution (Acetone or Alcohol) may be used to clean the probe. Probe must be dried immediately with a clean lens tissue wipe. The glassy carbon surface should always have a polished look before running a test. A glazed or cloudy look indicates the presence of a chemical film. If the probe tip is not cleaned properly, RULER® readings can be distorted. If the glassy carbon surface appears to be scratched, the probe must be replaced (see chapter J for calibration).

6.8 Probe Handling and RULER Calibration

- Probe condition is a vital part of the Ruler's accuracy. Use caution when cleaning and handling the probe; the RULER® Solutions contain sand, which may cause scratches on the electrode surface. Check the probe tip visually for sand before cleaning, if it appears to have sand on it, rinse the probe tip in a solution vial before wiping it with the alcohol pad
- IMPORTANT: Do not use abrasive filter papers or polishing compounds to clean the probe, wear on surface can change probe sensitivity and accuracy.
- RULER® Instruments are electronically calibrated with the probe supplied by the manufacturer. Fluitec recommends that the RULER® Instrument be calibrated yearly or when the probe needs to be replaced.

7. Instrument Controls

7.1 RULER® Instrument.

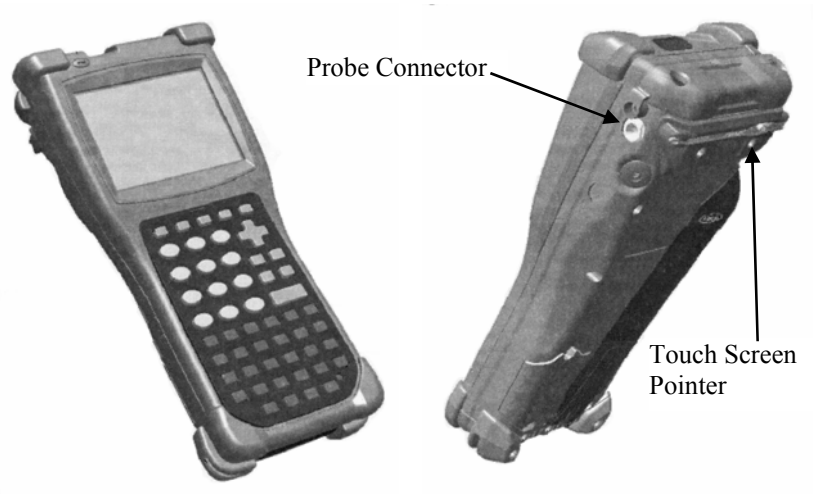


Figure 2: Front and Back of RULER CE320

7.2 RULER Instrument.

This section outlines how to perform some of the basic functions of the RULER instrument

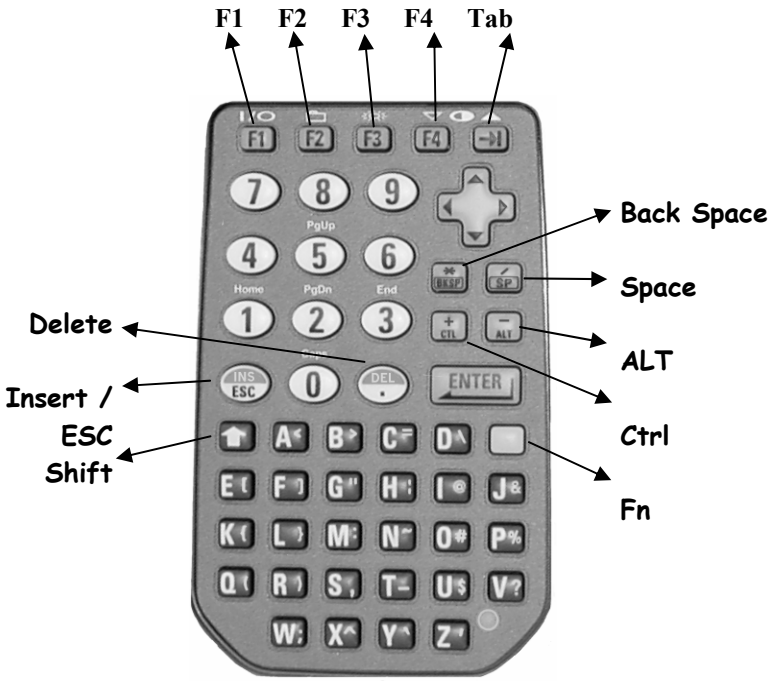


Figure 3: The RULER keypad

Function keys

F1: Power ON / Start Communication

Fn+F1: Power OFF

Fn+F2: Switch to Windows CE

ALT+Tab: To return to main screen

Fn+F3: To turn display backlight ON/OFF

Fn+F4: To decrease display contrast

Fn+Tab: To Increase display contrast

F1+0+9: To Re-Boot Instrument

NOTE: To Re-Boot Instrument, you must simultaneously press and hold F1, 0 and 9 for at least 4 seconds or until Re-Booting begins

8. RULER Operation

8.1. RULER® Terminology

- ***Standard Measurement***

In order to evaluate the percent of a given antioxidant remaining relative to new oil, RULER® requires information about the characteristics of the test solution with fresh oil. The Standard is a measurement of fresh oil mixed with an appropriate RULER® Solution. This measurement gives you a RULER® STANDARD Number (100 percent antioxidant concentration) that indicates the original concentration of antioxidants for the oil being tested.

Because of the importance of comparing a used oil sample to its Standard, RULER® procedures includes Standard oil measurement as an essential building block for the data bases used for filing test results. The term "*Standard*" will be used in this manner in the RULER®/R-DMS system. This is important since antioxidant concentration varies in all brands and blends of lubricants. Standards readings should be updated whenever new batches of lubricants are used, or in the case of partial mixtures between new and used lubricants. Consequently it is possible to detect increases above the 100% additive concentration level when comparing fresh oils to mixtures of the same brand. Save the higher value and use it as the Standard for that lubricant in service.

- ***Used Oil Measurement***

Used Oil measurement is a measurement of a used oil mixed with an appropriate RULER® Solution. This measurement will provide RULER® numbers that reflect the concentration of antioxidant remaining in used oils. RULER® numbers will decrease as antioxidants are depleted. Both the waveform and the RULER® measurement values can be viewed on the Main Screen and can be stored in the instrument's database for future reference. Time-series testing produces trend analysis of the oil condition and will contribute to proactive maintenance programs. R-DMS can be used to perform trend analysis.

Fluitec International does not offer recommendations to Customers as to when lubricants or fluids should be changed. Fluitec International does not accept liability for any decisions regarding the use of RULER® data. Decisions regarding oil changes or additive replenishments are the sole responsibility of the Customer. Customers should always establish their own criteria taking into account other important factors that affect the fluid's integrity.

9. Sample Testing

9.1 Start Up

When the RULER® is first turned on the main screen is displayed (fig.4). This screen displays the Sample information, the standard if one has been chosen and the test type.

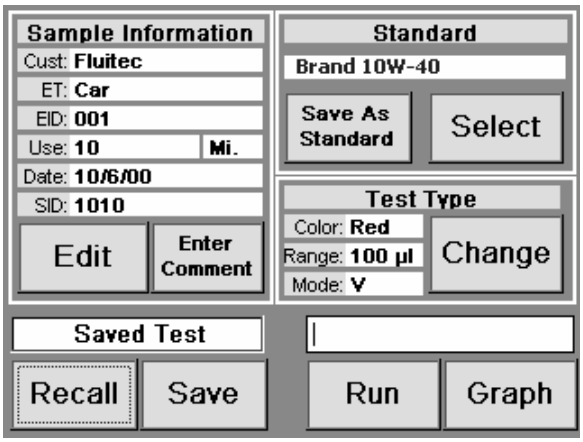


Figure 4: The main screen

9.2 Sample Information

9.2.1 Entering Sample Information

To add or change the sample information click on the EDIT button on the main screen. The screen in figure 5 appears. Enter the information as you would like it to appear for the test.

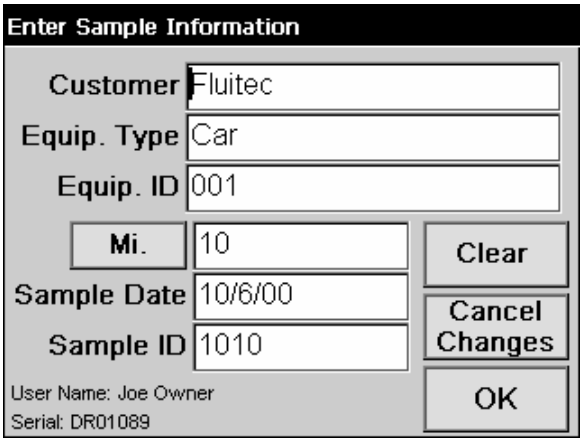


Figure 5: Entering Sample Information

9.2.2 Entering Comments

To associate a note or comment with the test click on ENTER COMMENT. Enter the note or comment in the window that appears and click OK. After a comment has been entered the ENTER COMMENT button will appear as VIEW/EDIT COMMENT.

9.2.3 Change Test Type

To change the Solution color used, the sample size or the mode click on the CHANGE button. The screen in figure 6 will appear.

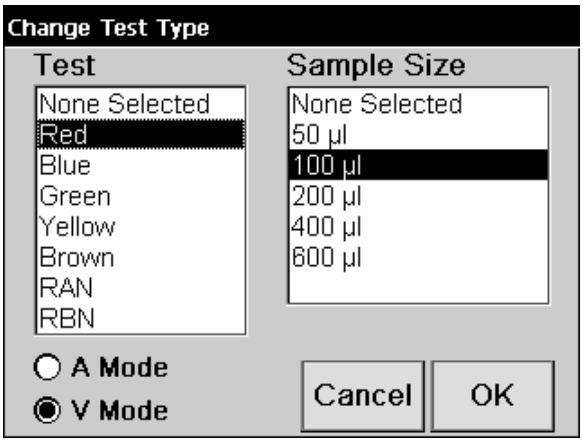


Figure 6: Test Type

Click on the desired solution color, sample size and mode. Click on OK to return to the main screen.

9.2.4 Save and Recall

To save a test after it has been run click on the SAVE button. The test status bar just above the RECALL and SAVE button shows the status of the test currently being viewed. It will indicate if the test is NEW and not yet saved, if it is a SAVED test or CHANGED if the test has been edited and not re-saved.

To recall a test that was previously saved click on the RECALL button. Click on the test that you wish to view and click on OK.

9.2.5 Graphing Results

If you wish to view the graph of the test being displayed, click on the GRAPH button and the graph will appear. See figure 7.

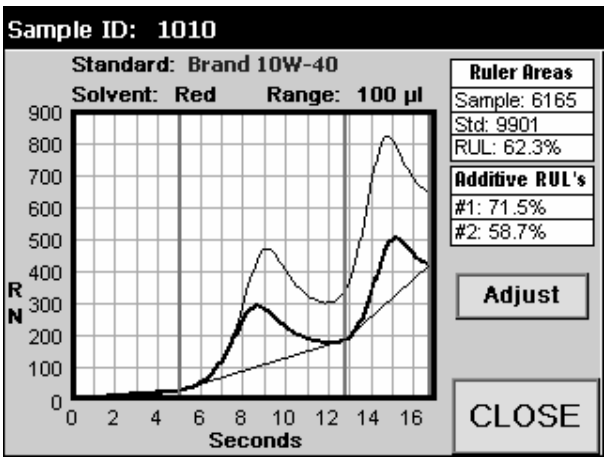


Figure 7: RULER Graph

9.2.6 Running Tests

After the sample information has been entered and the test solution vial has been prepared click on the RUN button to begin a test. Details on how to prepare and run the test are given in the next section.

10. **RULER®** Test Solution and Calibration

10.1 Function of RULER® Solution Vials

In order to optimize the measurement of the antioxidant in a given class of oils several specific test solutions, indicated by different colored caps, have been developed. Information on selection of the appropriate test solutions is given on page 26. This information should be reviewed and the guidance followed, whenever a new oil is being added to the monitoring routine of oil analysis.

RULER® Test Solution Calibration is necessary for the following reasons:

- Voltammetry is sensitive to the medium in which it measures oxidation waves. Each RULER® Test Solution is unique, therefore the software reads and calculates the voltammetric response in the blank test solution and uniformly subtracts it in the testing that follows.
- Varying operating conditions from day to day can be best reckoned with by calibration of the RULER® System at the time of the test session.

Test Solution color: Essential to RULER® operation. This is the Solution Type that the RULER® is currently calibrated for. A Test cannot be run without first calibrating the RULER® for a specific test solution type.

Mode: The Mode refers to the length of the scan or the voltage ramp. Different antioxidants respond to different potentials, and the Mode is chosen accordingly. See the RULER® Solution and Applications Table in Section 1, Page 26 to help in Mode selection. Mode A runs for 11 seconds, and Mode V runs for 17 seconds.

10.2 Test Solution Calibration Procedures

Before any RULER® test can be run the instrument must be calibrated to the solution used. Once calibration for a selected test solution is completed, users can switch from one type of solution to another, without having to repeat calibration. A message including the time the last calibration was performed prompts the user to accept or recalibrate.

1. From the main screen click on the CHANGE button under the Test Type heading. The following window will appear.

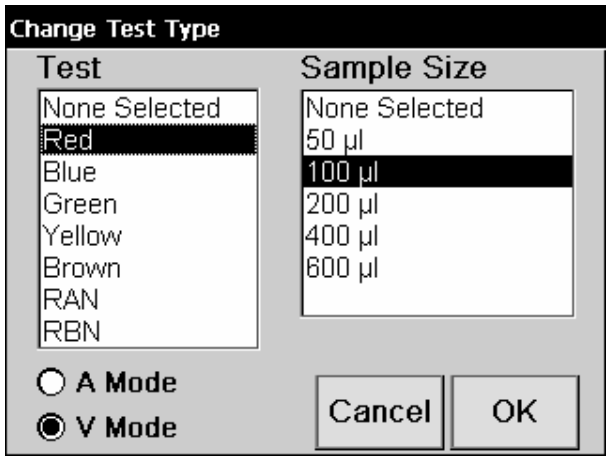


Figure 8: Change Test Type

- Click on the color of the desired test solution
- Click on the sample size
- Click on the mode to be used
- Click OK to save the selection and return to the main screen

2. Clean the Probe tip with an alcohol wipe and dry it with a clean, dry tissue to remove any residues that could distort test results.

3. Remove seal and cap of the test solution vial. Insert probe into solution and attach the vial to the threaded probe cap.

4. Place the vial upright in a rack or perforated foam block.

5. Click on the RUN button to start the test solution calibration scan. The test solution calibration is now complete. The RULER® will store the solvent calibration indefinitely and will prompt users with an option to re-calibrate for a test solution every time a test solution, sample size or mode is selected in the ***Test Type*** window.

11. Running a Standard

11.1 The Basis of Comparison

- **Standard:** For each lubricant being monitored, you will need to test a fresh oil of the same batch as the used oil and save the test results as a Standard. Standards will need to be saved with an appropriate name. Standards are the reference oils for comparison with used oils.
- **Select standard:** This field shows the current Standard selected from the database of Standards which you will call up for comparison when running a used oil test (figure 9). Click on SELECT under the Standard heading from the main screen, and the stored Standard can be selected. The list will contain only those Standards that match the calibrated Solvent type, sample amount and Mode used for the test.

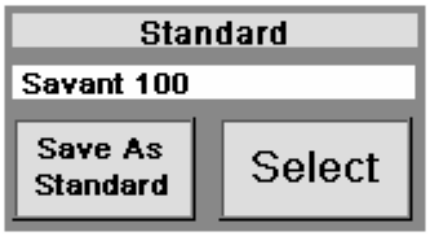
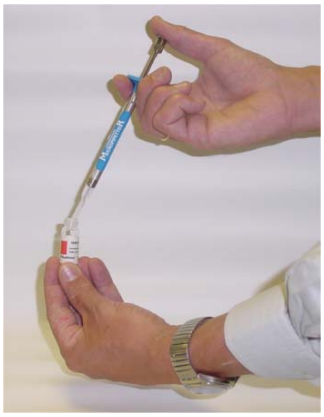


Figure 9: Standard Field

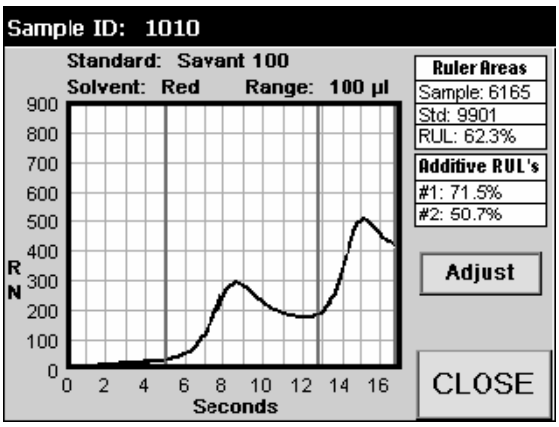
11.2 Oil Testing Procedures -standard



- **Preparing Solution:** Remove seal and cap of the test solution vial. Pipette the appropriate amount of fresh oil sample into the solution.
  - **SOLUTION RED** – 50 µL
  - **SOLUTION GREEN -** 400µl
  - **SOLUTION BLUE** - 400µL
  - **SOLUTION YELLOW -** 400 µL

- **Shaking solution:** Replace cap; shake sample until sand is thoroughly mixed. (15 seconds). Place prepared sample upright in a rack or perforated foam block until the sand settles on bottom with oil, leaving the upper level clear for testing.

- **Run test** : Clean the Probe tip with an alcohol wipe and dry it with a clean, dry tissue to remove any residues that could distort test results.
- Insert probe into solution and Attach the vial to the threaded probe cap. Click RUN, the RULER® will take 11 or 17 seconds to run the test, depending on the Mode being used. Test Results will be displayed on the screen showing the unique characteristic of the oil.



11.3 Saving the Standard

- Click CLOSE to return to the main screen. Click SAVE AS STANDARD

- **Locate the antioxidant peaks:** a message to the right of the graph will prompt the user to locate antioxidant peaks by selecting the valleys before and after the antioxidant peaks. To clear the selected peaks and re-position them, click on START OVER. This removes the previously chosen valleys and allows the user to choose new locations for the peaks.

- **Save standard**: The next step in order to save the graph as a standard, click on the STORE button. The next box that appears requests a New Standard Name. Type in the oil reference name, which provides a complete description of the oil to differentiate it from similar products. Carefully enter Standard names, as they cannot be edited without re-testing the Standard oil and saving it. Click OK.

  NOTE: If a standard already exists with this name it will be overwritten.

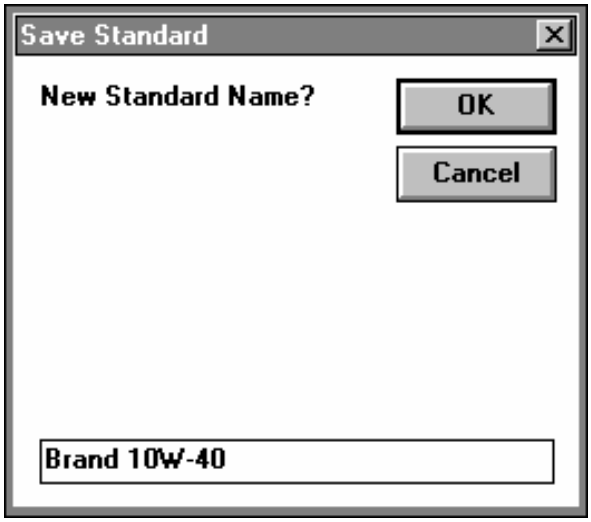


Figure11: Standard Name

12. Running a Used Sample (in-service oil sample)

12.1 Choosing a Standard

Before a used or in-service oil sample is run with the RULER®, a standard oil should be chosen for comparison.

From the main screen under the Standard heading click on SELECT. The following screen appears. Click on the standard you wish to use and click OK.

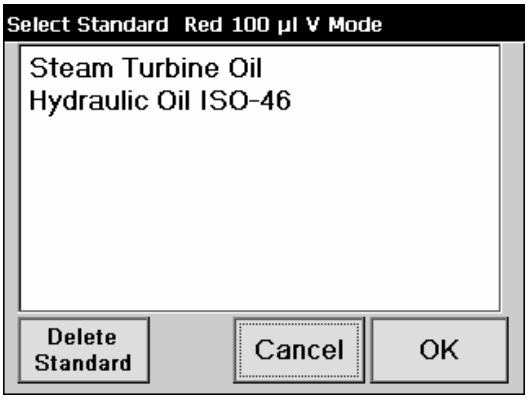


Figure 12: List of Available Standards

You will be returned to the main screen, click on the EDIT button under the Sample Information heading. The following screen will appear:

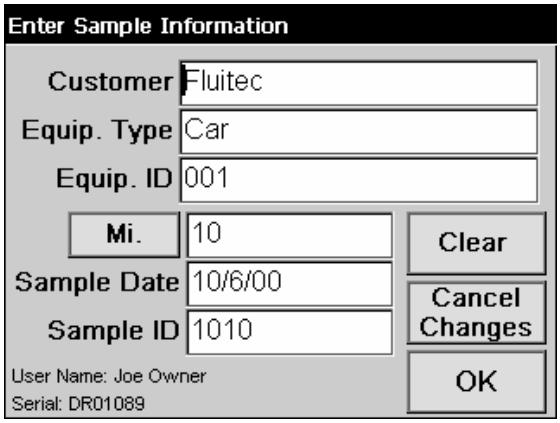
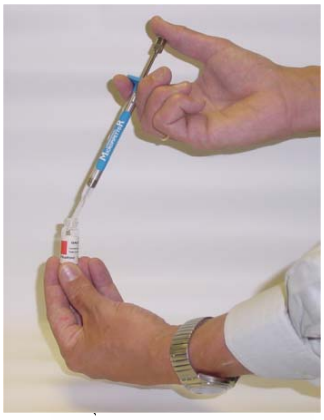


Figure 13: Sample Information

Enter all appropriate information pertaining to the test sample and click OK to return to the main screen.

12.2 Oil Testing Procedures – used oil sample



- **Preparing Solution:** Remove seal and cap of the test solution vial. Pipette the appropriate amount of fresh oil sample into the solution.
  - **SOLUTION RED** – 50 µL
  - **SOLUTION GREEN** - 400µl
  - **SOLUTION BLUE** - 400µL
  - **SOLUTION YELLOW** - 400 µL

- **Shaking solution:** Replace cap; shake sample until sand is thoroughly mixed.
  (15 seconds). Place prepared sample upright in a rack or perforated foam block until the sand settles on bottom with oil, leaving the upper level clear for testing.

- **Run test** : Clean the Probe tip with an alcohol wipe and dry it with a clean, dry tissue to remove any residues that could distort test results.
- Insert probe into solution and
  Attach the vial to the threaded probe cap.
  Click RUN, the RULER® will take 11 or 17 seconds to run the test, depending on the Mode being used. Test Results will be displayed on the screen showing the unique characteristic of the oil.

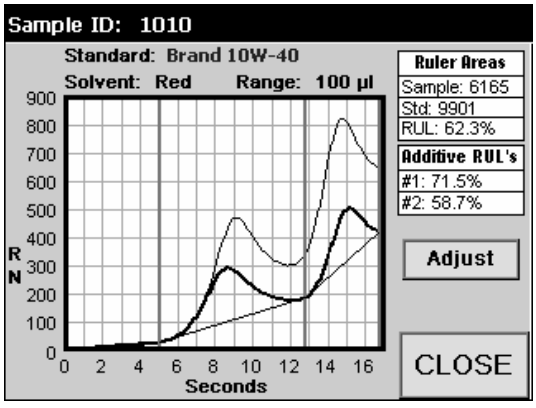


Figure 14: Used Sample with Standard

Click on CLOSE and return to the main screen. Click SAVE to store the test.
A verification window will let you know that the task was completed.

12.3 Interpreting Test Results

When viewing the Graph the RULER® results are presented in two different ways. The first is RULER® area. This measurement takes into account the total antioxidant concentration of the lubricant. The second is the Additive Remaining Useful Life (RUL). This allows the comparison of individual antioxidants within the lubricant.

Ruler Areas
Sample: 6165
Std: 9901
RUL: 62.3%
Additive RUL's
#1: 71.5%
#2: 58.7%

Figure15: Test Results

To enter a comment concerning either the test or lubricant sample, click on the ENTER COMMENT button under the Sample Information heading on the main screen. Type your comment in the field provided and click OK. After a comment has been entered the ENTER COMMENT button changes to VIEW/EDIT COMMENT.

12.4 Recalling a Test

To recall a test click on RECALL from the main screen. A listing of all the stored tests is shown. Select the test that you wish to view and click RECALL. The main screen returns with the information from the test that you selected. To view the graph click on GRAPH.

13. RULER® Test Solutions

13.1 Function of RULER® Test Solutions

- There are several patented test solutions formulated specifically for RULER® analysis. These test solutions are provided in 7-milliliter vials, which attach easily to the RULER® Probe.
- The RULER® Test Solution vials are convenient for field and remote testing. Each vial contains 5 milliliters of solution and one gram of sand. When the vial is shaken, the sand will help separate the oil from the antioxidants and as the sand settles, oil and debris will adhere to the sand and the antioxidants will remain in the solution for testing.
- **Important:** The RULER® method is a quantitative analysis and requires 5 milliliters of solution for a test sample. The use of sand is optional but is helpful when testing heavy weight oils that contain dirt, fuel soot or other contaminants.
- **Shelf life** for RULER® solutions is approximately 1 year from the manufacture date. Refer to label information on solution carton or vial to verify this information.

13.2 Solution Handling and Disposal

The RULER® Solutions are Acetone and Alcohol based solutions (flammable). As with all flammable solvents, the user should take precautions not to expose the solutions, or their vapors, to open flame or spark. It is recommended to work with the RULER® Solutions in a well-ventilated area or under a ventilation hood. After completing RULER® test procedures, observe the same precautions in the disposal of used RULER® Solutions as with other shop solvents. Use appropriate hand and eye protection when handling solvents. MSDS sheets are shipped with every solution order. Please contact Fluitec International to request additional copies of the MSDS sheets.

13.3 RULER® Test Solutions Application Table

RULER Solution #	Aviation	General	Combust	R&O	TAN
Solution	**Red**	**Green**	**Blue**	**Yellow**	**Black**
Ester Based Turbine Oils	* amines				*
Phosphate Esters		*amines		*phenols	*
Mineral Based Steam & Gas Turbine Oils (R&O)		*amines		*phenols	*
Gear Oils (non-EP oils)		*amines	*		*
Compressor Oils		*ZDDP, amines		*phenols	*
Hydraulic Oils (including biodegradable oils)		*ZDDP, amines		*phenols	*
Gasoline and Diesel Crankcase Oils , Marine oils, gas engine oils			*ZDDP, amines	*phenols	*
Greases		*ZDDP, amines		*phenols	*
Transformer/ insulating oils		*amines		*phenols	*

***** Selection of antioxidants by test solution type is made on the criteria to have the main antioxidant selected as the first peak.
If you have questions on antioxidant selection criteria please contact us via info@fluitec.com, or via contact info at page 1.
Fluitec International does not accept liability for any decisions regarding the use of RULER® data for comparison or qualification of antioxidants, other than related to the RUL-estimation.

RULER and ACCESSORIES LIMITED WARRANTY

As manufacturer, Fluitec International LLP will repair or replace, at its discretion, any products which prove to be defective, in either material or workmanship, for a period of one year for the RULER hand-held computer, and 90 days for its accessories, from date of purchase.
Accessories include: communication cable, AC adapter, measurement probe, probe cable, and pipettor.

This warranty does not cover the misuse, abuse, neglect or damage incurred during shipping or storage, or any modification or servicing by anyone other than a Fluitec International Authorized technical engineer.

Fluitec International LLP cannot be held responsible for any damage caused by the misuse of the RULER CE320 or by any other software or hardware added to the RULER CE320.

Extended warranty

The original purchaser may, at any time during the initial warranty period, extend the warranty through the purchase of the FLUITEC Service Contract. For more information contact Fluitec International.

Servicing

In order to have your product serviced, you must first obtain a Return Material Authorization (RMA) from Fluitec International LLC. You may then return your RULER CE320 instrument, correctly enclosed in its original packaging if possible (or other protected package), to Fluitec International.

RULER Calibration & Servicing

- Fluitec advises to perform a validation and/or evaluation of the RULER instrument annually. The instrument should not go longer than 18 months without being calibrated or the accuracy of the measurements may be compromised.
- Fluitec maintains accurate records of the purchase date and last date calibrated for all instruments sold. Fluitec will contact you by telephone or via mail to inform you that the instrument is due for service.
- If an ISO or other Quality Program requires an earlier calibration, contact Fluitec to request a calibration.
- As this validation and evaluation is performed at our Fluitec technical facilities, customers are required to obtain a Return Material Authorization (RMA)-number, prior to sending their RULER unit back.
- Fluitec manufactures a Reference Oil commercially available for all RULER users, which can be used for an on-site evaluation of the RULER repeatability. Contact a Fluitec representative to receive a quotation.
- To assure an optimum availability and reliability of the RULER technology at your plant, Fluitec has made Service Contracts available. They include the RULER validation, reference oil and validation manual and software updates. For more information regarding the Service Contract, contact Fluitec.

For information on the above items contact Fluitec either through the Fluitec International website, via email at info@fluitec.com or use the physical address below:

N.America:

Fluitec International LLC
1997 Newborn Road
Rutledge, GA 30663
Tel: 706 557 7772
Fax: 706 557 9334

Europe & Rest of the World

Fluitec International
Nieuwbrugstraat, 73
B-1830 Machelen – Belgium
Tel: +32 2 255 76 43
Fax: +32 2 255 76 41

CE CONFORMITY
CE5240, CE5320

The CE5000 meets the 89/336/EEC directive intent for Electromagnetic Compatibility Compliance when used with DAP's accessories.

The compliance was demonstrated to the following specifications as listed in the official Journal of the European Communities:

Emissions:

EN 55022	Radiated & conducted, CLASS B
EN 60555	PART 2 & 3.
CISPR 22	For CLASS B

EN 50082-2:1995, Electromagnetic Immunity:

ENV 50140	Radiated RF electromagnetic field.
ENV 50204	Radiated electromagnetic field from radio telephones.
EN 61000-4-8	Power frequency magnetic field.
EN 61000-4-2	Electrostatic discharge.
EN 61000-4-4	Electrical fast transient/burst.
ENV 50141	Conducted disturbances induced by RF field.

When Barcode Scanner Options Installed

Safety of Laser Product

CEI/IEC 60825-1:1993+A1: 1997 (CLASS 2 Laser product)

US Federal (FDA) Regulation

21 CFR Chapter I, Subpart J, Part 1040.10
Performance Standards for Light Emitting Products
(Class II Laser Product)

14. RULER® Troubleshooting Tips

When	Try
Press the *ON* button, no response. Or Switch pad does not respond.	1. Connect unit to charger. Allow unit to charge for minimum 5 hours, or until the charging indicator turns green. 2. Contact Fluitec.
Unit operates only when connected to charger (AC adaptor).	Contact Fluitec.
Power is on, touch screen does not respond.	Reboot the RULER by simultaneously pressing and holding "9", "0" and F1 keys for 3 seconds (until you hear a long beep).
When communication cable is connected to the ComPort, the RULER unit does not communicate with RDMS.	1. Check connections between communication cable and PC. 2. Turn PC completely OFF, reboot and try again. 3. Reboot instrument and try again. 4. Make sure the R-DMS software is correctly installed 5. Contact Fluitec.
Display seems to be to dark.	Adjust contrast by pressing and holding the blue function key and pressing F4.
Charge indicator does not turn Green after the unit has been charging for minimum 5 hours.	Disconnect unit, power off the instrument, reinsert cable into the ComPort and wait 30 minutes. If the problem persists, contact Fluitec.
After running a test, there does not appear to be a RULER graph (waveform) on the screen. This applies also for irregular looking RULER graphs.	1. Check probe for damages. 2. Assure for a correct cable connection. 3. Check RULER instrument by running a previously ran (standard) oil. 4. If the problem persists, contact Fluitec.
RULER graph shows off-scale reading on all tests.	1. Clean Probe carefully with alcohol or acetone, and rerun test. 2. Reduce sample amount at least by half. 3. If the problem persists, contact Fluitec.