KITTIWAKE
monitoring innovation



Power Plant Laboratory

Instruction Manual

Sampling of Lube Oils
Calibration and Maintenance
Console
Heated Viscometer
Unheated Viscometer
Water in Oil
Insolubles Test
TBN Determination
TAN Determination

Power Plant Laboratory

Power Plant Laboratory

A Manual

B User Instructions

A Manual

Specifications

Console

Console

Display:
8 digit LED type

Keyboard:
Membrane type with tactile buttons

Interfaces:
Measuring Cell socket with inductive power circuit and Infra
Red data link. Infra-Red data link on side of unit for viscometer.
RS232 data port on the rear of the console for data download to PC.

Memory:
Capacity to store 256 readings in non volatile storage

Clock:
Realtime clock with internal backup battery

Power:
110 to 240AC 50/60Hz 20VA

Fuse Rating:
2.5A 20mm HRC A/S (T) Ceramic

Heated Viscometer

Heated Viscometer

Operational fluid density:
870kgm^{-3} ≤ ρ ≤ 1000 kgm^{-3}

Range:
20 - 810 cSt at 50°C (ISO Fuel Grades RMA10 to RML55)

20 - 810 cSt at 40°C (lube oils SAE 5 through SAE 50)

Test time:
Heating from 25°C: 10minutes
Viscosity at 40°C: 3 minutes (unheated)
Repeat test: maximum 30 seconds

Calculations:
Viscosity at 50°C or 40°C (heated)
Viscosity at 40°C (unheated, corrected to 40°C)
Viscosity at 100°C (calculated)
Calculated Carbon Aromaticity Index (CCAI)
Density correction from 50°C to 15°C in vacuo
Variable Viscosity Index (for unheated mode)

Accuracy:
Typically with +/- 3%(20 - 450 cSt) or +/- 2 cSt

Power:
110 to 240 VAC 50/60Hz 200VA

Fuse Rating:
2.5A 20mm 250VAC HRC A/S (T) Ceramic

unpainted PPM Cell

Water in Oil Test

Range: **Mode** :
Standard Cell *(blue painted)*
0 - 2.5% & 0 - 1% **4**
PPM Cell
(unpainted/green painted)
0 - 6000 ppm (IP 386) **4.1**
0 - 3000 ppm (IP386) **4.2**

Test time:
3 minutes (10mins 3000ppm)

Accuracy:
Typ. +/- 0.1% [0-2.5%]
Typ. +/- 100 ppm [0-6000 ppm]
Typ. +/- 50 ppm [0-3000 ppm]

Power:
110 to 250 VAC

Correlation:
IP 386

blue painted Cell

Insolubles Test

Range: **Mode:**
0 - 3.5% w/w (IP 316) **2**
0 - 1.75% (Mobil Soot Index) **2.1**

Test time:
20 seconds

Accuracy:
Typically within +/- 0.1 w/w

Power:
110 to 250 VAC

Correlation:
IP 316
Mobil Soot Index

TBN Test

Range: **Mode:**
0 - 100 TBN IP400 **3**

Test time:
2.5 minutes

Accuracy:
Typically within +/- 5% or <2 TBN

Power:
110 to 250 VAC

Correlation:
IP 400

TAN Test

Range: **Mode**
0 - 6 mg KOH TAN **5**
0 - 6 mg KOH TAN IP139 **5.1**
0 - 3 mg KOH TAN IP177 **5.2**

Test time:
2 minutes

Accuracy:
Typically within +/- 0.2 TAN

Power:
110 to 250 VAC

Correlation:
IP 177 (ASTM D 664)
SAE ARP 5088 (modified IP139, ASTM D 974)

Density Meter

Range:
800 to 1010kg/m^3 at 15°C (ISO 8217 Fuel Grades DMA to RML55)

Test time:
Heating from 15°C: 10 minutes.
Repeat test: maximum 30 seconds
Cleaning: 1 minute

Test temperature:
Selectable 50°C or 70°C

Calculations:
Density at 15°C in vacuo, centiPoise to centiStokes Calculated Carbon Aromaticity Index (CCAI)

Accuracy:
Typically with ±0.1%
(800 - 1010kg/m^3)

Power:
110 to 250VAC Autoselected
50/60 Hz 200VA

Fuse rating:
2.5A 20mm 250VAC HRC A/S (T)
Ceramic

Compatibility

Range:
As per ASTM D4740

Test time:
20 minutes (unattended)

Accuracy:
Variation of 1 rating in 20 repeat tests

Power:
110 to 250VAC Autoselected

Fuse rating:
2.5A 20mm 250VAC HBS A/S (T)
Ceramic

Salt/Fresh Water

Test time:
1 hour

Cleaning:
1 minute

Accuracy:
Typically detects 100ppm Salt Contamination

Pour Point

Range:
0^0 - 50^0C Fuel Oils ISO 8217 Grade RMA - RMK

Accuracy:
Typically ±6^0C

Thermometer:
Electronic with 0.1^{0}C resolution

Sampling of Lube Oils

Sampling of Lube Oils

Kittiwake supply all your sampling requirements: bottles, vacuum pumps, tubes and labels. Alternatively, equipment can be obtained direct from the lubricant supplier.

Taking samples

- Sample directly from the top of the main oil supply reservoir. Always take samples from the same point.

- Ensure that the total quantity of oil in circulation is approximately the same during each sampling.

- Purge the sample connection thoroughly until hot oil flows, before taking a sample.

- Draw samples over a period of several minutes into a clean container (sample bottle kits are available for this purpose).

Additional sampling

Hydraulic systems: Middle of main reservoir or system return line. Beware of breaking into high pressure lines.

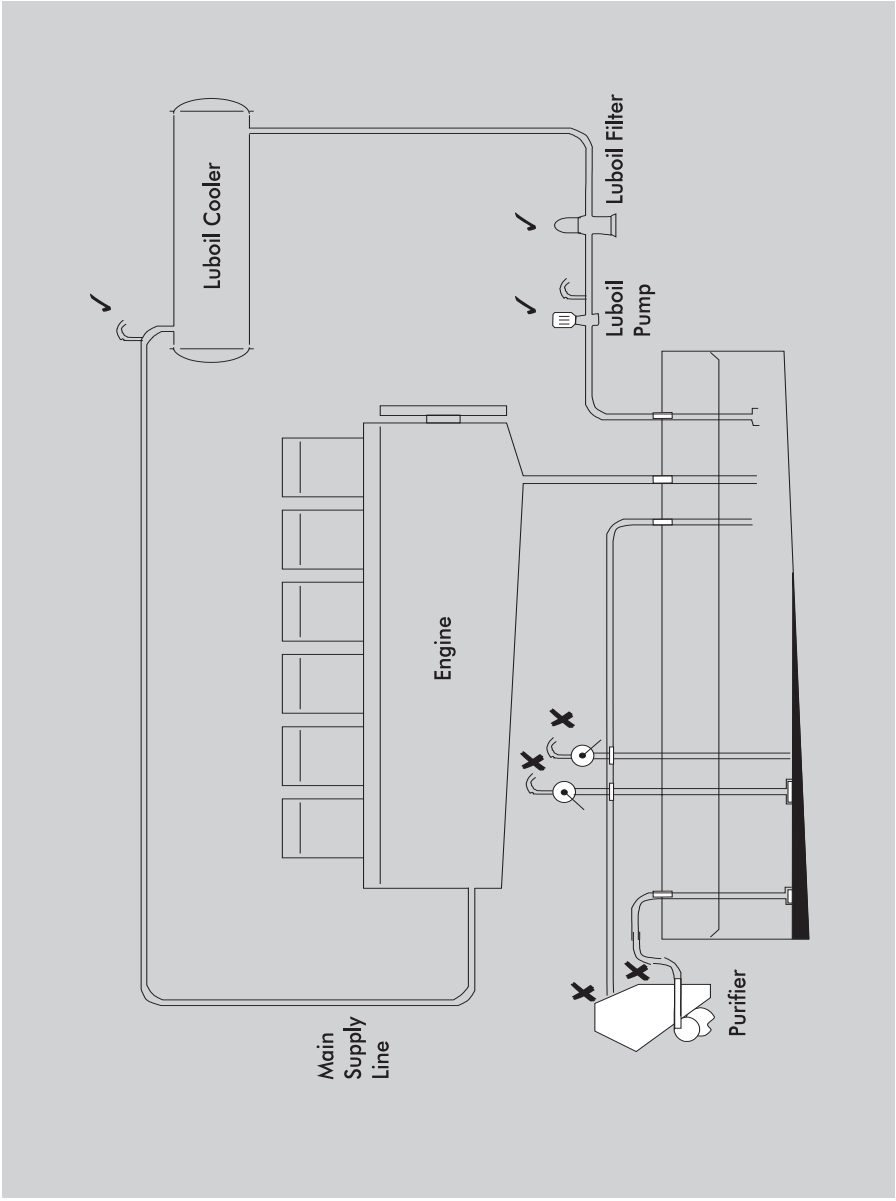
Kittiwake supply the following sampling equipment:

FG-K3207-KW	100ml lubricant sample bottles 450 PVC bottles and caps
FG-K11289	Sample bottle pump
PL-K10215	Sample pump tubing - 15 meters
IH-K11054	Sample bottle labels - 1000 off

Good and bad sampling

✓ *Good sampling*

✘ *Bad sampling*



Calibration and Maintenance

Calibration and Maintenance

Introduction

The ***Power Plant Laboratory (PPL)*** should provide accurate results for many years. It can be calibrated by Kittiwake as part of the operators internal quality control program and it is designed so that parts may be interchanged with precalibrated Kittiwake exchange units. Like most modern electronic test equipment, it should perform within its specifications considerably longer than the suggested calibration interval of 12 to 18 months, but it is important that confidence in the PPL results is regularly established.

Regularly returning the PPL to Kittiwake will ensure good calibration, but this can be expensive or inconvenient, especially when the PPL is operated in the remote areas for which it is designed.

The following describes some general calibration strategies and provides detailed examples of how confidence can be established with the PPL test results.

Calibration Strategies

The PPL is often operated in parallel with less frequent laboratory based oil analysis testing wear metals or other similar parameters.

- Periodically schedule the laboratory to recheck oil samples tested with the PPL.

- Keep known calibration samples of oil to retest on the PPL.

- Try to record and plot the PPL results. It provides very repeatable results and a lot of information when the results are plotted and trended with engine operation.

- Return the PPL to Kittiwake for calibration, or exchange parts with the nearest agent.

Confidence Tests

Viscometer confidence test

Test a known oil sample. If possible use several different viscositys.

" I have no calibration fluids"

When the PPL is first purchased, use it to test typical oil samples. Take longer than normal over these tests. When you are able to obtain repeatable results, record them. Label and store the samples for future use.

"Results within 5%"

Confidence is high. Record and date the test results in a calibration log book. Save a sample for future reference.

"Results repeatable, but outside 5%"

If oil is particularly hot or cold, allow 10 minutes to stabililise.

Try other oil samples, is the percentage error similar? See section on high & low readings.

"The Viscometer readings are erratic"

Tilt the Viscometer smoothly and consistently. Take about 1 second to tilt it. Do not bash it on the table. Do not tilt it slowly.

Is the oil sample temperature stable? Wait a few more minutes if not.

Check that the viscometer moving ball display functions when the Viscometer is tilted in both directions.

Is the viscometer oil temperature consistent?

"Nothing happens when I tilt the Viscometer"

Is the viscometer displaying 'tilt'?

Is the 23mm metal ball in the Viscometer?

Is the Viscometer full of very viscous oil and moved around prior to operation? The ball may be in the middle of the tube moving very slowly! Allow time for the ball to settle, press the Viscometer Reset button.

"The Viscometer readings are consistent, but lower than expected"

Is the Viscometer full with oil to above the V-plate and is all air bled out of the tube?

Retest with another reference or calibration oil.

Has the sample been diluted by solvent cleaner left in the tube?

Check the viscometer oil temperature display, is this correct?

Is there any possibility of fuel dilution in the oil sample?

Could the reference oil sample be wrongly labelled?

Is the correct 23mm metal ball being used?

"The Viscometer readings are consistent, but higher than expected"

Has the previous (high viscosity) oil sample not been cleaned out properly and contaminated the current (low viscosity) sample? This is only an issue when the two oils have very different viscosity's.

Retest with another reference or calibration oil.

Check the viscometer oil temperature display, is this correct?

Could the reference oil sample be wrongly labelled?

Is the correct 23mm metal ball being used?

Water Cell Confidence Test

The Water Test functions by measuring the cell pressure generated by water in the oil sample.

Water Cell basic tests:

- Place the cell on the console and select mode 3. The console should read between 700 and 1400 with the cap removed. The reading may increase slightly when the cell top is screwed on.
- Select Mode 4, press Zero and allow to count to 120. Verify that the console reading goes to 0.0 - 0.03 after the counting has finished.
- A very high or low reading or a reading of zero indicates the pressure transducer is damaged. (Check with another test cell that the console can display a reading).
- The pressure transducer is similar to a human eye. It will last a lifetime and can be gently rubbed. However, if it is pressed with a sharp object or pushed hard with a finger when cleaning the cell, it will break.
- Rolling some paper into a tube and gently pressing this on the pressure transducer will cause the console reading to increase. This provides confidence in the cell electronics and console display.

General calibration:

- Using 25ml of Water Test Reagent, add 50ul of water with micro pipette (1% contamination). Perform the Water Test and expect a result between 0.8% and 1.2%

- Use 20μl (4000ppm) of water in 25ml of Water Test Reagent to calibrate the Low Range 0 to 6000ppm cell.

- Do **not** pour water into the cell and perform a test. This will over-pressurise the transducer and damage the cell.

"The Water Test results are lower than expected"

Check the cap seal for leakage. A sealing ring indent is generally visible in the cap seal.

Has the Calcium Hydride sachet leaked? This should be a dull grey and not white. Repeat the test and check the sachet colour.

Check that the correct test fluid quantity is used. (See Test Method).

It is common for there to be no water in the oil sample.

"The Water Test results are higher than expected"

Check that the correct MCU mode is selected, eg **not** 4.1 Low Range Mode for the 0 - 2.5% test.

Check for correct test fluid quantity

Do **not** clean out the Water Cell with water. This can get trapped in the cap seal and contaminate the next tests.

"The Water Cell cap is hard to remove"

Keep the cap thread well lubricated with a Molybdenum grease, aluminium grease or oil. Try not to use so much that it causes pressure build up when screwing on the lid!

The test chemicals tend to degrease the thread so periodically lubricate the cap to avoid it jamming after a test.'

Insoluble Cell Confidence Test

It is hard to store reference black oil samples as they can 'age', due to the particles dropping out of suspension or tightly bonding to the storage container. However it can be expected that known samples will give a similar reading if shaken well before testing.

Insoluble Cell basic tests:

- Ensure the reagent tube can be inserted into the cell without jamming and that there is no obstructing material within the cell receptacle. See notes on cleaning this cell (page 25)
- Select mode 3 and check that a reading is obtained on the console. Adjust the knob on the side of the cell if necessary.
- Insert a tube with 10ml of Reagent J and check that the console reading can be adjusted between 2000 and 3600.
- Select Mode 2 and check that the reading can be adjusted from at least 0.2 through 0 to 9.9 or '-----'.
- Add a drop of **used** engine oil to the tube. Shake well and allow the bubbles to settle before reading. If the sample gives a reading of 0.6, a second drop added to the tube should give about 1.2 (+/- 0.2) and a third drop about 1.8. This technique can be used to improve the accuracy for low contamination samples. If five drops are added, and the result divided by 5, the test resolution and drop size variation is minimised.
- Better results can be obtained by using a micro pipette set to 30µl (2 x 15µl).

TBN Cell Confidence Test

The TBN Test functions by comparing the cell pressure generated by the new engine oil (Reference Sample), to the cell pressure generated by the used engine oil. As the engine hours build the engine oil TBN will slowly deplete giving a **lower** cell reading. If the engine oil is topped up with new oil the TBN will rise and generate a **higher** cell reading.

TBN Cell basic tests

- Place the cell on the console and select mode 3. The console should read between 700 and 1400 with the cap removed. The reading may increase slightly when the cell top is screwed on.
- A very high or low reading or a reading of zero indicates the pressure transducer is damaged. (Check with another Test Cell that the console can display a reading).
- The pressure transducer will last a lifetime and can be gently rubbed. However, If it is pressed with a sharp object or pushed hard, it will break.

- Rolling some paper into a tube and gently pressing this on the pressure transducer will cause the console reading to increase.
  This provides confidence in the cell electronics and console display.

TBN reference oil

- The result for the Reference Oil is critical to the accuracy of all the future engine oil tests. Check that three repeat tests give the same reading within 5%.
- If possible, save this reference sample for future comparison. Record the reference result for future tests.
- If possible keep a log of engine oil top ups, and also top ups to the oil storage tank.

The cell reading for the used engine oil is higher than the reference reading for the new oil

Check handbook for correct oil test quantity and check that the same amount was used in both the reference and engine oil tests.

Has the RUT oil or reference type changed from that in the engine?

Has the engine been topped up with high TBN oil?

New engine oil could give a slightly higher reading (<5%) due to measurement variations.

New engine oil could give slightly higher reading (<5%) due to

The Calculated TBN is below the alarm limit

Check that the cell cap seal is not damaged

Repeat the test. Is it consistent?

Retest the reference oil. Is the result the same as the original one?

If the reference sample is taken from the 'Ready Use Tank' (RUT) and periodically re-tested has this oil changed? For example a 10 TBN Mil-Spec oil in this tank can be topped up with high TBN commercial oil in an emergency causing the lower TBN oil in the engine to suddenly appear below specification.

Keeping a sample of the new engine oil will avoid variations due to the oil in the RUT but may not be practical with numerous engines to be tested.

The Calculated TBN is above the alarm limit

Check that the quantity of Test Oil is correct.

Repeat the test. Is it consistent?

Retest the reference oil. Is the result within 5% of the original one?

Has the engine been topped up with a higher TBN oil?

Possible contamination from a high TBN cylinder lubricant?

TAN Cell Confidence Test

The Total Acid Number (TAN) Test functions by accurately measuring the colour change caused by acid in the test oil sample. The Reagent D should be slightly alkaline causing its color to be a light *green**. (This can however change in storage to *red** and must be corrected before use.) The TAN Cell remembers this colour when the Zero button is pressed. Adding the Test Oil then changes the reagent color from *green* to *red** if the oil has any TAN. The amount of Reagent E or F required to bring the color back to the start point is used to calculate the TAN of the Test Oil.

TAN Cell basic tests:

- Place the cell on the console in Mode 5. Check that a reading of 1000 to 4000 is obtained with no tube inserted.

- Insert a reagent tube with an alkaline mixture (*green**). Check a reading of less than 100. Press Zero. Check reading is zeroed +/- 10.

- Insert a reagent tube with an acid mixture (*red**). (Add 1 ml TAN oil to the *green** sample tube). Check a reading of higher than 1000.

Reagent D is not green* (i.e. pink/red)

Absorbing Carbon Dioxide can alter the pH or alkalinity of this reagent over time. Add one drop at a time of Reagent E or F (Potassium Hydroxide) to the bottle of Reagent D. Shake after each drop until the colour just changes from *red** to *green*.*

The Reagent E or F can be added to the Reagent D in the sample tube to just turn it *green**, but this is not so easy to do.

Do not overdose the Reagent D. It only has to just turn *green** and should **not** be 'dosed' to obtain dark *blue/green*.*

Reagent D does not turn orange/red when oil is added

The oil sample has no TAN (maybe a TBN oil).

The Test reading does not get back to zero after adding reagent E or F

The test response is logarithmic. If Reagent D was overdosed (too *blue green**) it may be hard to exactly achieve the start point. Acceptable accuracy is obtained when the test reading is reduced to less than 80.

Do not keep adding Reagent E or F beyond this point.

Cleaning the Power Plant Lab and Test Cells

General:

Do **not** use chlorinated, acidic or aromatic solvents, abrasive creams, solvent baths or ultrasonic cleaning.

Cleaning the Viscometer:

- Prepare several sheets of soft tissue paper. Stand Viscometer on end with sliding cap uppermost. Slacken bleed screw and remove the sliding cap. Place cap on some tissue paper.

- Pour out the oil from the Viscometer into a container, using the sieve to catch the metal ball. Place the sieve and ball on some tissue paper.

- Wipe the open end of the Viscometer with tissue paper, then push this into the tube with the cleaning rod. Be careful not to scratch or push the Red Sensors at either ends of the tube.

- Tilt the Viscometer so the screw cap end is uppermost and then unscrew the cap. Wipe this end with tissue paper and then rod this through the Viscometer, pushing the contents into a bin.

- The cleaning can be completed by rodding through more tissue paper.
  A mild solvent cleaner can be used, but this must be dried out thoroughly before the next viscosity test.

Cleaning the Console:

- Disconnect the power lead.

- Wipe console with tissue or a soft rag. A small amount of Reagent A on a cloth will remove marks.

Cleaning the Water Cell:

- Tip contents into a slops bucket.

- Gently wipe out the Cell and cap with soft tissue paper.

Note: Do not press on the pressure transducer. Do not use water to clean this Cell.

Cleaning the TBN Cell:

- Tip contents into a slops bucket. Wipe out the Cell and cap with soft tissue paper.

Note: Do not press on the pressure transducer.

Cleaning the Insolubles Cell:

- Wipe out the tube holder with a soft tissue if fluid is spilled.

Note: For a large spillage leave cell inverted on tissue paper to allow spillage to drain and then wipe clean. Do not use solvents in the tube holder or immerse the cell.

Cleaning the Power Plant Laboratory case:

- Wipe spillage with soft tissue paper.

Storage and Transportation

The PPL case and contents should be stored upright and in a secure position. Prevent exposure to extremes of temperature, humidity and vibration.

- Store reagents upright, away from heat or sources of ignition.

- Remove the reagents before sending back equipment for repair or calibration. Do not send reagents back to Kittiwake or agents.

Bunker Samplers

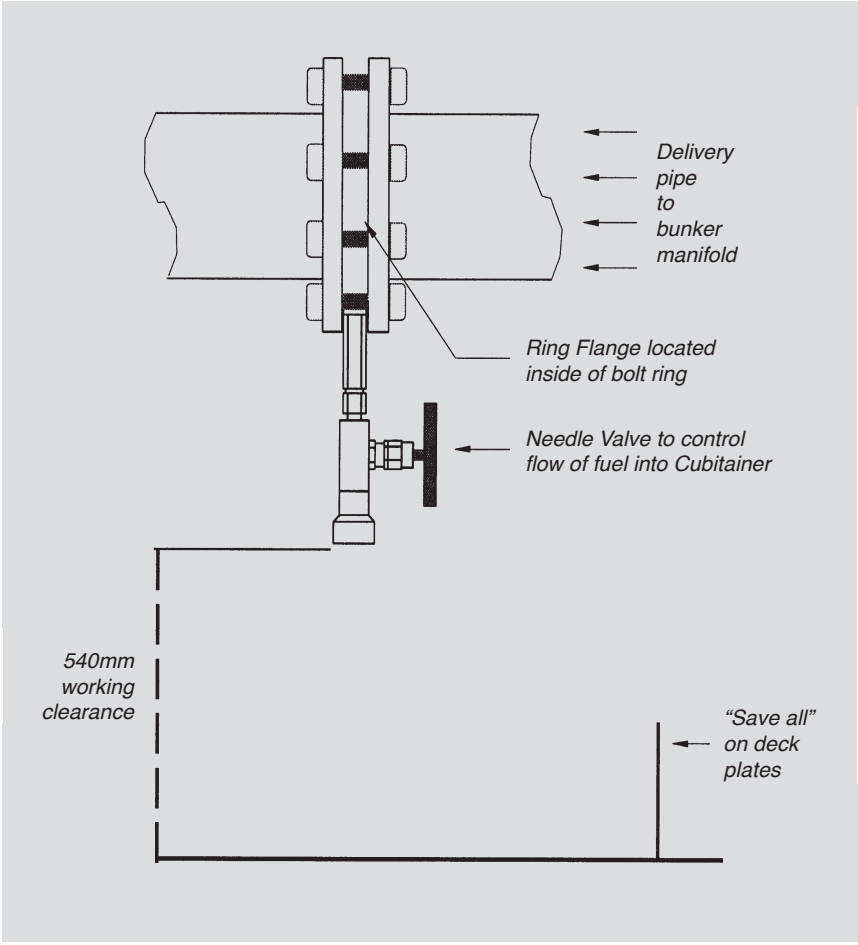
Bunker Samplers

Installation

The ISO fuel specification ISO 8217 refers to the place of custody transfer, which is normally at the vessel's manifold. In other words, at the vessel's end of the bunker delivery hose.

However, it is often more practical to use the sample taken by the supplier at the barge end of the hose.

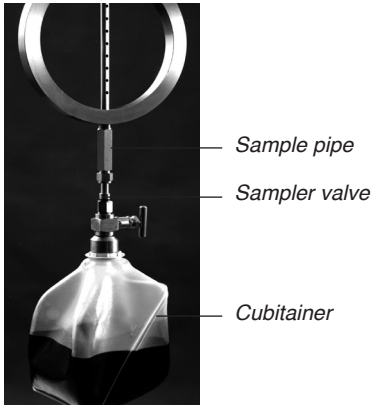
Provided that the sample is witnessed throughout the bunkering, then properly mixed and split, it doesn't matter which end of the delivery hose is used.



Operation

- The tube within the sampler should always be cleaned before use. This can be achieved by removing the tube and simply flushing with a clean distillate fuel.

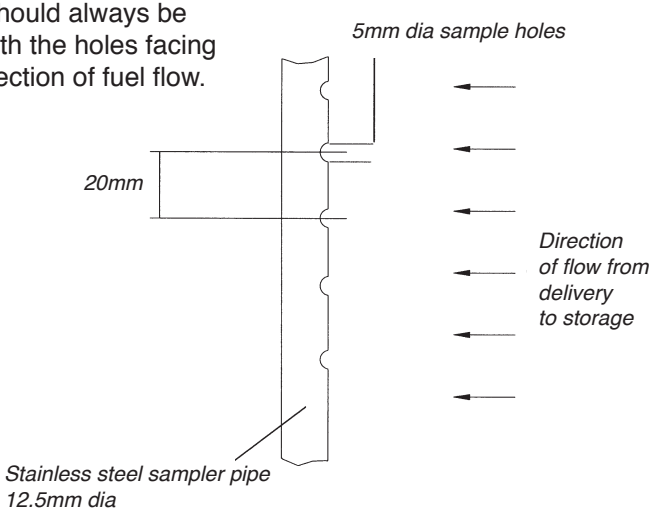
  The use of low flash point solvents for cleaning the sampler is discouraged as contamination of the sample can lead to very expensive mistakes!



Sampler with attached Cubitainer.

- Allow to drain thoroughly before reinstalling.

  The tube should always be installed with the holes facing into the direction of fuel flow.



- When bunkering starts, place a container under the sampler, open the sampler valve fully and flush the sampler with fuel.

- Close the valve and attach a Cubitainer onto the Sampler.

  Adjust the needle valve to give a slow and steady drip.

  Time the fill rate to estimate that it will provide for sufficient sample over the expected delivery period. The sample value can be locked in this position to prevent tampering during delivery.

Sampler in use on a Bunker Barge.

Sampler with valve lock fitted to satisfy PSA guidelines.

- If the Cubitainer fills during the bunkering period, remove it and add a numbered tamper evident cap.
  Place an empty Cubitainer on the sampler and continue to draw a sample.

- Some delivery conditions can cause a vacuum in the line e.g. suddenly stopping the pumps on the barge. Close the sampler valve in these circumstances or the sample will be drawn back into the delivery line.

- On completion of the bunkering, remove and seal the Cubitainer, fully open the sampler valve and allow the sampler to drain.

  Typical bunker suppliers terms state that the 'official' sample will be that taken by the supplier (barge operator). Failure to witness can void claim. Always get the barge operator to witness removal and sealing of the Cubitainer Sample Bottle. If this request is refused or if no witness is provided, then note this in the delivery log.

Kittiwake Cubitainers are available in kits with all ancillary consumables.

If a sample is required for on board testing only, then the sample can be

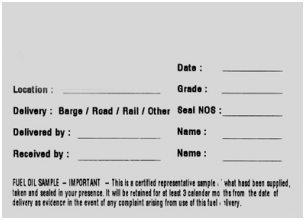
Storing the Sample

- Insert the full Cubitainer into the pourer box and thoroughly mix the contents.

- Select 3 or 4 clean sample bottles.

- Attach the pourer spout and gradually transfer the contents into the sample bottles filling each a little at a time.
  If more than one Cubitainer was used, then transfer a portion of each into the bottles.

- Complete the document labels and attach one to each sample bottle:
  1. Supplier's sample
  2. Vessel's sample
  3. On-site analysis sample
  4. Analysis service sample (optional if on-site analysis indicates a potential problem)


Date : _____

Location : _____ Grade : _____

Delivery : Barge / Road / Rail / Other Seal NOS : _____

Delivered by : _____ Name : _____

Received by : _____ Name : _____

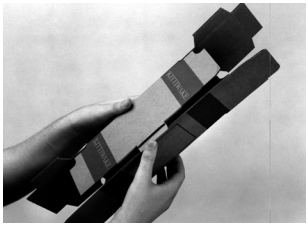
FUEL OIL SAMPLE – IMPORTANT – This is a certified representative sample of what head been supplied, taken and sealed in your presence. It will be retained for at least 3 calender mo ths from the date of delivery as evidence in the event of any complaint arising from use of this fuel following delivery.

Flat Pack Shipping Containers

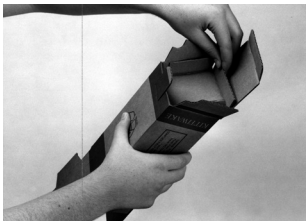
Flat pack shipping containers are provided for transportation of fuel samples. These are tested and approved for use in air transportation. It is **very** important that the correct packaging is used if sending a fuel sample for a laboratory analysis.

Flat pack shipping containers may be assembled in 4 steps as shown below:

- Fold up into a square tube.

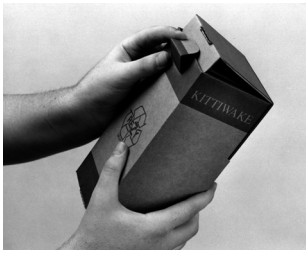


- Assemble base and lock in tab.



- Insert sample bottle, sealed and labelled correctly.

- Close end, label case and store. Ship to laboratory as appropriate.



B User Instructions

POWER PLANT LABORATORY

Console

Console

Intended Use

The Console is designed for use with the Kittiwake range of electronic measuring cells. These include: standard & 6000ppm Water in Oil cell, TBN cell, TAN cell, Insolubles cell. The console is also required to operate the unheated viscometer in order to measure and report the viscosity of oil. These instruction apply to consoles with software version 3.xx

Selecting the Mains Voltage

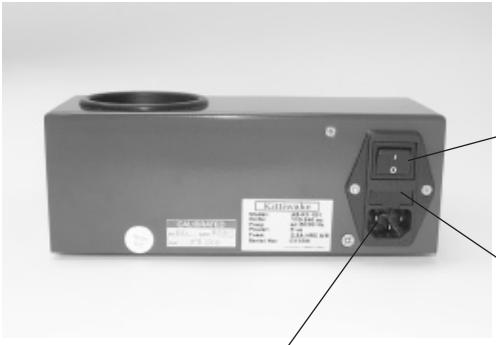
The console auto selects the power supply to suit the mains voltage. No settings are required.

Connecting the Power Supply

- Connect the mains lead into the socket on the rear of the console. Plug the other end of the lead into a suitable **Earthed** mains supply.

- Turn on the mains supply and then turn on the power supply using the switch next to the socket.

- The display will illuminate.



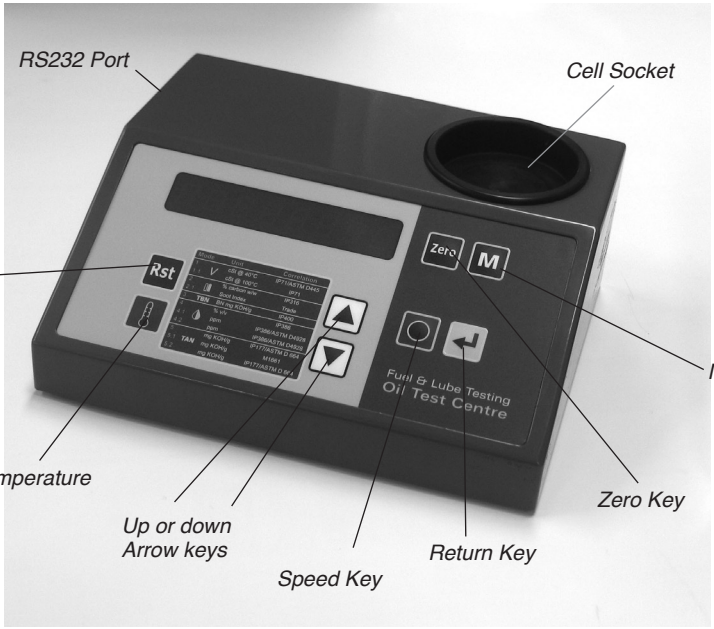
Location

The unit is designed to operate on a flat, level surface such as a workbench. This is essential for accurate and reliable operation.

Controls and Features

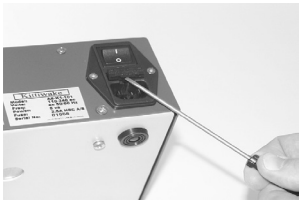
Cell socket:
This socket features our unique inductive coupled power supply. The cells get their power when placed upon the socket via an electromagnetic link. The measurement data is transmitted to the console via an infra red optical link built into the socket. This enables the cells to be designed without wires, batteries or connectors so they are very rugged.

RS232 port:
The console has the ability to log results. These can be downloaded to a PC via a standard RS232 data connection. The Kittiwake download software is required to perform this operation. This is available from Kittiwake at **www.kittiwake.com**



Changing the Fuse

Remove the fuse drawer with a screw driver, replace fuse and reinsert drawer.



Cleaning

Disconnect the power lead. Wipe console with tissue or a soft rag. A small amount of reagent A on a cloth will remove marks.

Note: The console should only be dismantled by a qualified Electrical Technician, if internal cleaning is necessary. If the console is flooded with oil do not apply electrical power.

Maintenance

If the unit fails to power up disconnect the power lead and check the fuses are OK. We have supplied replacment fuses of the correct type in the spares pack. Do not use any other type of fuse.

The Real Time Clock has a battery internal to the console. This should last approximately 5 years and is automatically replaced if the console is returned to the factory for re-calibration and refurbishment. It is not recommended that you replace the battery in normal use, but if the Real Time Clock stops operating and you are using the data logging facility, the battery can be replaced with button cell type CR1620.

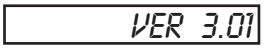
Note: The console should only be dismantled by a qualified Electrical Technician, if battery replacement is necessary.

CAUTION: If the equipment is used in a manner or for a purpose other than that described in this manual then any safety protection may be impaired.

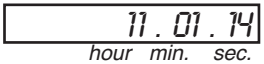
Operation

- Press the Reset key to reset the console.

Note: ***Immediately*** after you reset the console, a number is displayed of the form '3.01'. This is the software version. You may be asked to give this number when requesting technical support.



- The clock will now be displayed. For details on setting the clock, see the section on ***Setting the Date and Time.***



- Press the 'M' mode key. This will display the equipment ID. For information on using this, see the section on ***Setting the Equipment ID and Lubricant Hours.***

- Press 'M' to enter Mode 1. The Mode key is used to select the different type of test to be performed. Repeatedly pressing 'M' will cause the display to cycle through all of the different tests eventually returning to mode 1.

Try this:

Mode 1 – Viscometer test
Mode 2 – Insolubles test
Mode 3 – TBN test
Mode 4 – Water in oil test
Mode 5 – TAN test

The operation of each mode is described in the section for that test. Some of the modes have extra options such as reporting the results in a different manner. These are accessed using the arrow keys and are described in the section on each test.

Data Logging

The console will store up to 250 result sets in non volatile memory. When the limit is exceeded the storage buffer will wrap around and the oldest Result Sets will then start to be overwritten.The results set includes:

Equipment ID
Lubricant hours
Test Type
Test Time
Date

The console connects to a PC via a standard 9 way D type RS232 cable. Kittiwake software on the PC controls the upload process.

- When the console displays a result in any mode, press the return key to log data.

- The display flashes “stor(e)” next to the result.
- Pressing the return key again will confirm that the result set is to be stored. Any other key will cancel the store operation.

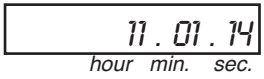
Uploading the Results

- Connect a standard 9 way RS232 serial cable between the console and an IBM PC. Start up the Kittiwake software on the PC.
- Select the correct Comm. port (1 to 4).
- Select Upload.
- Press the Mode button to enter Mode 1 and normal operation.

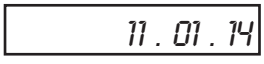
- The Console will automatically select Mode 6 (Upload Mode) and transmit the results to the PC. These results can then be selected and stored in the PC Access Database.

Setting the Date and Time

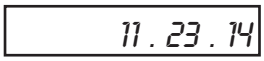
- Press the Reset button.



- Press the Temperature key to select the required digits.



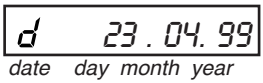
- Use the Arrow keys to select the correct number.



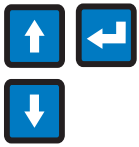
- Use the Return key to update the new value.

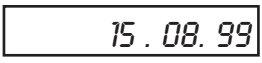
- Repeat asnecessary, press the Temperature key to skip to next digit or date display.

- When the time display is updated, pressing the Temperature key will cycle to the date display (preceded by “d”).



- Use the Arrow and Return keys to select and update the date.

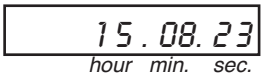




- Press the Mode button twice to enter Mode 1 and normal

Setting the Equipment ID and Lubricant Hours

- Press the Reset button. (the time is displayed).

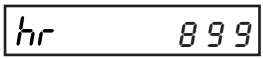


- Press the Mode button.

- Use the Arrow keys and Speed key to select the Equipment ID number [0 to 999].

- Press the Return key to store the ID and select the Lubricant Hours.

- Use the Arrow keys and Speed key to select the Lubricant Hours [0 -9999].



- Press the Return key to store the hours and redisplay the ID.

- Press the Mode button to enter Mode 1 and normal operation.

- The ID and hours will now be saved with all result sets until they are altered.

- When different equipment is tested or the hours change, repeat the above steps.

Error Codes

The console runs through a self check routine for the principal functions every time it is switched on. Additionally the system is programmed to display a number of error messages should a problem occur during use.

Each error has been assigned a unique code and this code may be interpreted using the table below:

Console Error Codes

Error	Description	Action
01	Self test failure	Return to Kittiwake
02	Cell or link failure	Try another cell to check link
05	Ambient temperature out of range	Move to warmer or cooler area
08	Overpressure	Slack off cap, try another cell to check for damaged transducer
10	Insolubles out of range (high)	Oil too dirty
12	Keypad failure	Return to Kittiwake
13	Internal errors	Return to Kittiwake
-----	Unstable reading, console Out of Limits, or cell not on.	
	Remove cell, undo cap to release excess pressure	

Heated Viscometer

Heated Viscometer

Intended use

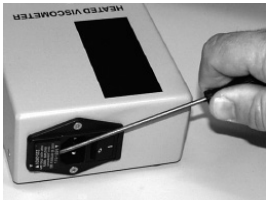
The Viscometer is designed to measure the viscosity of oil either room temperature or warmed to 40°C or 50 °C, and with a density of between 870 kgm^{-3} and 1000 kgm^{-3} (inclusive).

Note: these instruction apply to viscometers with software version 2.xx

Setting the mains voltage

Before connecting the power supply to the mains check that the correct supply voltage is selected. Failure to do this may damage the instrument.

To change supply voltage



Remove fuse box using a screwdriver.

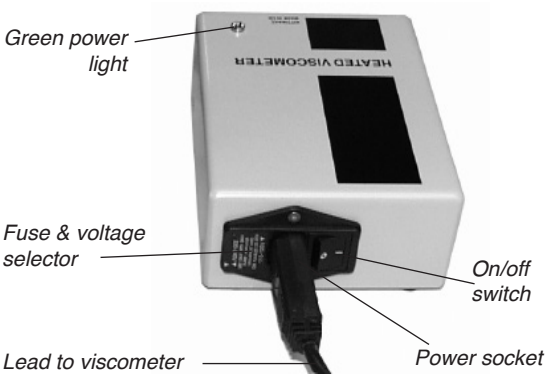
Select correct voltage supply.

Replace box, ensuring white arrows are aligned.

Connecting the power supply

- Connect the yellow power supply lead to the viscometer and lock into place using by rotating the outer collar.
- Connect the mains lead into the socket on the side of the power supply, checking the correct mains voltage is selected. Plug the other end of the lead into the mains supply.
- Turn on the mains power and then turn on the power supply using the switch next to the socket, the green light should come on and the viscometer display should illuminate.

Connect lead to viscometer.



Location

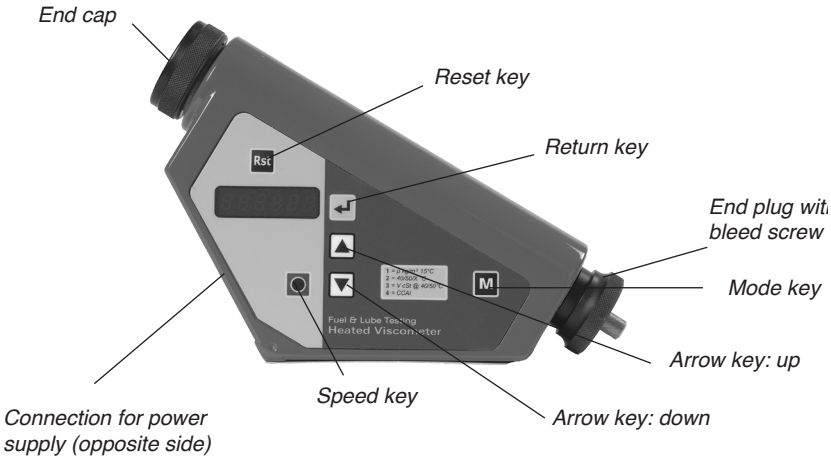
The unit is designed to operate on a flat level surface such as a workbench. This is essential for accurate and reliable operation. Make sure the viscometer can be rocked back and forward without obstruction in one clean movement.

Make sure the power supply is located towards the rear of the workbench where the cable cannot be caught during operation.

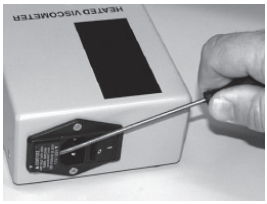
Controls and Features

The instrument measures viscosity by timing the descent of a metal ball through the internal tube. The instrument is designed to easily 'TILT' from side to side allowing the ball to fall under gravity, measurements are taking in both direction to compensate for the workbench being slightly out of level.

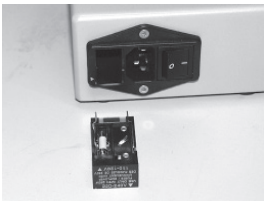
There is an internal circuit that controls the heating of the oil to allow measurements to be taken on higher viscosity oil. The display will request a 'TILT' for measurement only when the temperature is stable to ensure accurate results. The processing circuitry compensates for the temperature of the oil and allows display of Centistokes adjusted to 40,50 or 100 °C. There is a calculator feature, which allows the reading to be adjusted for Density and Viscosity Index for improved accuracy and to display the CCAI.



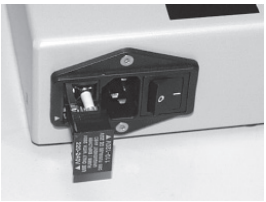
To change fuse



Remove fuse box using a screwdriver.



Carefully remove and replace fuse.



Replace box, ensuring white arrows are aligned to correct voltage supply.

Cleaning After Use

After a measurement is taken the inside of the measuring chamber must be clean of any residual oil, If any is left is could affect the accuracy of the next result. It is also essential to ensure there are no foreign bodies, grit, pieces of tissue etc. inside the tube, as they will affect the motion of the metal ball.

- Turn off the power supply and disconnect the yellow lead from the viscometer. Carefully open the end cap to empty the oil out of the tube. **CAUTION: The oil may be hot (50 °C).**

- Using the sieve supplied to catch the metal ball, tip the oil out into a container.

- Using the rod supplied push a wad of clean tissue down the centre of the tube ensuring all remaining oil is cleaned out. Replace the metal ball into the tube and fit end caps for safe keeping.

General Cleaning and Maintenance

Make sure the power supply is disconnected from the mains. Wipe down the instrument with a clean dry soft cloth. Do not immerse in water, if necessary to remove stubborn marks use a cloth soaked in warm soapy water.

If the unit fails to power up disconnect the power lead and check the fuse is OK. We have supplied replacement fuses of the correct type in the spares pack. Do not use any other type of fuse. There are no other user serviceable parts inside the unit, if the unit still does not operate return to the supplier for repair.

Note: If the equipment is used in a manner or for a purpose other than that described above then any safety protection may be impaired.

General Operation

- Use Reset key to initialise operation.
- Use Mode key to select Viscometer functions.
- Use Arrow keys to change values.
- Speed key toggles on/off. Used for rapid slewing of values.

Filling with oil

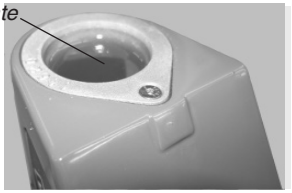
- Support Viscometer vertically, slacken bleed valve, then pull out the sliding plug. Ensure Viscometer tube is clear, clean and contains the metal ball.
- Fill the tube with the oil sample to just above the V-plate. Slowly push in and rotate the plug with the valve open until all air is expelled. Do not use excess force.
- Loosely fit the bleed valve and place the Viscometer in an upright position. Leave to stand for 5mins
- Tighten the bleed valve and wipe off excess oil from the plug. Place Viscometer back on its base and connect the power cable. The Viscometer is now ready for use but do not tilt yet.

Note: If air is not fuly expelled from the unit, it may affect results

Slacken bleed valve and remove end plug.

Fill the tube with oil to just above the edge of the V-plate.

V-plate



Slowly push in and rotate the end cap until all air is expelled. Tighten the bleed valve.

Taking a Measurement

- Use Reset key to initialise operation.

- Use Arrow keys to toggle display and select the temperature required with the Return key.

- Temperature display flashes as Viscometer heats the oil. Degree [°] symbol flashes until the oil temperature stabilises.

- Tilt Viscometer when prompted.
  When oil temperature is stable, the display will show Viscosity at 40° or 50°C as selected.

- Wait for tilt prompt before taking repeat readings.

- Use Arrow keys to toggle display of cSt from 40° or 50° to 100°C.

Rst

2 00

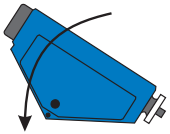
Unheated Lube Oil (correct up to 40°C) 2 00

Heated Lube Oil (to 40°C) 2 40

Heated Fuel Oil (to 50°C) 2 50

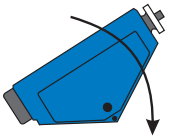
Display flashes XX.X°

Temperature stabilises 40.0°



tilt

125.4cS



tilt

indicator cSt at 100°C 12.54cS

Improving Accuracy in Heated Mode

- Take several readings over a longer period of time until readings stabilise.

Correct Reading for Density

The Mode 1 Density value (kg/m^3 at 15°C in vacuo) used by the Viscometer will default at: 0.900 for 0°- 40°C operation and to 0.990 for 50°C Fuel Oil operation

- Select Mode 1.
  Use Speed and Arrow keys to input the oil Density (i.e. Density at 15° in vacuo).

- Select Mode 5 to recalculate cSt. value and press return.

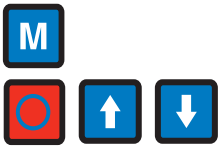
Improving Accuracy in Unheated Mode with Multigrade or Synthetic Oils

- Follow 'Taking a measurement' on the previous page to obtain a reading in cSt. corrected to 40°C.

- Select Mode 1.
  Use Speed and Arrow keys to input the oil Density (i.e. density at 15° in vacuo).
  The Density of many Synthetic Oils is nearer to 1.0 than 0.9.

- Select Mode 5.
  Enter the approximate Viscosity Index (VI).
  The VI of Multigrade Oils will be higher than the default VI of 100.

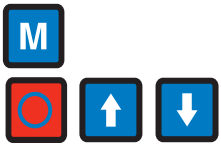
- Press Return key in Mode 5 to recalculate cSt. corrected to 40°C.



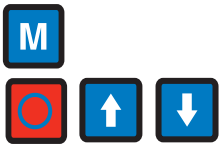
1C .900	*Density = 0.9*

S XXX	

125.4CS	



1C .900	*Density = 0.9*
1C .992	*Density = 0.992*



S 100	*Viscosity Index = 100*
S 126	*Viscosity Index = 126*

132.5CS	

Correcting the Density from 50° to 15° in vacuo

The small [c] in Mode 1 [1c] indicates the reading is as 15°C in vacuo. Sometimes you may be given the reading at 50°C in air and this will need to be corrected.

- Select Mode 1 Density at 15°C in vacuo.

- Press Return to enter the reading at 50°C in air.
  (This is indicated by the [u] for uncorrected [1u]).
  Use the Speed and Arrow keys to enter the reading.

- Press Return and the uncorrected reading is automatically corrected to 15°C in vacuo. This value will then be used by the Viscometer for all other calculations.

Calculated Carbon Aromaticity Index (CCAI)

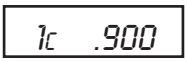
- Select Mode 1.

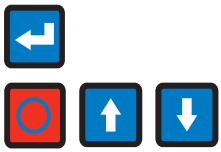
  Use Speed and Arrow keys to enter the Density.

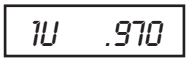
  Use the Return key to toggle between Corrected and Uncorrected Density (see 'Correcting the Density').

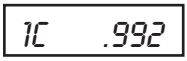
- Select Mode 3 and display the last recorded Viscosity.
  Alter this if necessary using the Speed and Arrow keys.

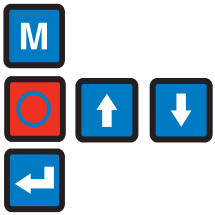
- Select Mode 4 to calculate CCAI for this Density and Viscosity.

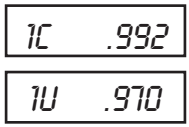

1c .900

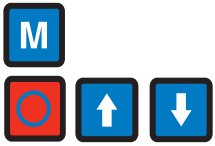


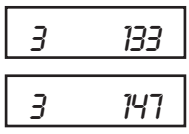

1U .970


1C .992




1C .992
1U .970




3 133
3 147


4 864

Water in Oil Test

Water in Oil Test 0 - 2.5%

- Select Mode 4, Water in Oil 0 - 2.5% (Standard Cell)
  The display will read as shown.

  Note: Different Cells are required for the 2.5% and ppm ranges.

- Place the Cell on a level surface and remove the end cap.
  Add Reagent A up to the internal lip (20ml).
  Add 5ml of the test oil using the syringe provided.

- Cut the Reagent B sachet along the dotted line.
  Pinch ends inwards to form a thin boat and place upright in the cell.
  Do not spill. Replace the cap tightly.

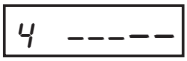
  CAUTION: Take care not to inhale the powder and avoid contact with the eyes.

- Place the cell on the console and allow reading to stabilise.
  Press the Zero button to zero the reading and start the test.

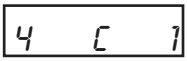
- Remove the cell from the console and shake until the display reaches 120, then replace on the console.

  Note: The test will not work unless shaken very thoroughly, especially in cold temperatures.

- The display will read directly in % water contamination in oil sample (0 - 2.5% range)

% v/v 

(Gloves not shown for clarity)



% v/v 

Water in Oil Test (Reagent B) 0-6000 ppm

Silver Cell

- Select Mode 4, Water in Oil 0 - 2.5% (Standard Cell)
  The display will read as shown.

  Press the Up Arrow to select Mode 4.1 (the correct Mode for using the PPM Water Cell).

  Note: Use the Arrow keys to toggle between Modes before the test starts Different Cells are required for the 2.5% and ppm ranges.

- Place the Cell on a level surface and remove the end cap.
  Add Reagent A up to the internal lip (20ml).
  Add 5ml of the test oil using the syringe provided.

- Cut the Reagent B sachet along the dotted line.
  Pinch ends inwards to form a thin boat and place upright in the cell. **Do not spill.** Replace the cap tightly.

  CAUTION: Take care not to inhale the powder and avoid contact with the eyes!

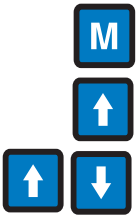
- Place the cell on the console and allow reading to stabilise.
  Press the Zero button to zero the reading and start the test.

- Remove the cell from the console and shake until the display reaches 120, then replace on the console.

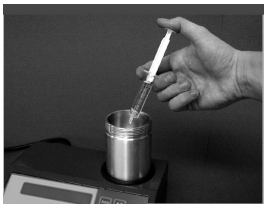
  Note: The test will not work unless shaken very thoroughly, especially in cold temperatures.

- The display will read directly in parts per million water in the oil (6000ppm range) **Note:The two ranges require different cells and it is not possible to toggle between the calibrations.Variation on repeat reading on the 6000ppm cell of +/- 50ppm is quite normal.**

(Gloves not shown for clarity)



0-6000 ppm 4.1 -----



4.1 C 1

ppm 4.1 480

Water in Oil Test (Reagent B) 0-3000 ppm

Silver Cell

Only suitable for oils <120 cSt @ 40°C

To improve the accuracy of the 0-3000 ppm test, it is possible to compensate for the residual water in Reagent A.

Run a 0-3000ppm test as normal, using 25ml of Reagent A. This is 5 times the normal quantity of reagent. Note the result and divide by 5; this will reperesent the residual water in the sample/reagent. When a test is run on a used oil sample, subtract the residual water value from the result to obtain the true water content.

- Select Mode 4. The display will read as shown.
  Pressing the Up Arrow twice will select Mode 4.2 (the correct Mode for using the 0 - 3000 ppm Water Cell).

  Note: Use the Arrow keys to toggle between Modes before the test starts.

- Place the Cell on a level surface and remove the end cap.
  Add 5ml of the Reagent A using the syringe provided.
  Add 20ml of the test oil using the syringe provided (4 x 5ml).

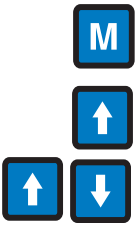
  Note: Note the quantities are different from the other water tests

---

- Cut open the Reagent B sachet as shown.
  Pinch ends inwards to form a thin boat and place upright in the cell. **Do not spill.** Replace the cap tightly.

  CAUTION: Take care not to inhale the powder and avoid contact with eyes!

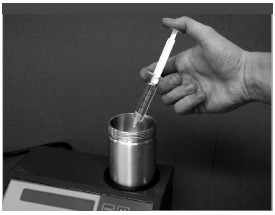
- Place the cell on the console and allow reading to stabilise.
  Press the Zero button to zero the reading and start the test.



% v/v 4 – – – – –

0-3000 ppm 4.2 – – – – –

(Gloves not shown for clarity)



4.2 C 1

- Remove the cell from the console and shake until the display reaches 120, then replace on the console.

  Note: The test will not work unless shaken very thoroughly, especially in cold temperatures.

- Allow the Cell to Stand until the display stops flashing (approximately 8 minutes).

  The reading will stabilise giving the result for the range 0 - 3000 ppm.

Reading flashes until stable *ppm* 4.2 800

Take result when flashing stops *ppm*

Water in Oil Test (EasySHIP) 0 - 1%

- Select Mode 4, Water in Oil 0 - 1% (Standard Cell)
  The display will read as shown.

  Note: Different Cells are required for the 2.5% and ppm ranges.

- Place the Cell on a level surface and remove the end cap.
  Add Reagent A up to the internal lip (20ml).
  Add 5ml of the test oil using the syringe provided.

- Cut or tear the EasySHIP Reagent sachet.Squeeze all of the EasySHIP paste into the cell, ensuring that all of the paste has been emptied into the cell.

- Place the Agitator into the cell. Replace the cap tightly.

- Place the cell on the console and allow reading to stabilise.
  Press the Zero button to zero the reading and start the test.

- Remove the cell from the console and shake until the display reaches 120, then replace on the console.

  Note: The test will not work unless shaken very thoroughly, especially in cold temperatures. EasySHIP Test Reagent must be above 18°c

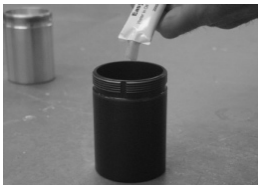
- The display will read directly in % water contamination in oil sample (0 - 1% range)

Extending the test range

To extend the test range to 0 - 2%. Add only 2.5ml of sample oil to the test cell and multiply the on-screen result by a factor of 2. Accuracy may be affected.

% v/v 4 -----

(Gloves not shown for clarity)



4 C 1

% v/v 4 0.33

Water in Oil Test (EasySHIP) 0 - 6000 ppm

Silver Cell

- Select Mode 4, Water in Oil 0 - 2.5% (Standard Cell)
  The display will read as shown. Press the Up Arrow to select Mode 4.1 (the correct Mode for using the PPM Water Cell).

  Note: Use the Arrow keys to toggle between Modes before the test starts Different Cells are required for the 1% and ppm ranges.

- Place the Cell on a level surface and remove the end cap.
  Add Reagent A up to the internal lip (20ml).
  Add 5ml of the test oil using the syringe provided.

- Cut or tear the EasySHIP Reagent sachet.Squeeze all of the EasySHIP paste into the cell, ensuring that all of the paste has been emptied into the cell.

- Place the Agitator into the cell. Replace the cap tightly.

- Place the cell on the console and allow reading to stabilise.
  Press the Zero button to zero the reading and start the test.

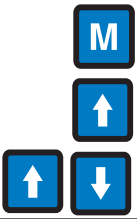
- Remove the cell from the console and shake until the display reaches 120, then replace on the console.

  Note: The test will not work unless shaken vigorously, especially in cold temperatures. EasySHIP Test Reagent must be above 18°c

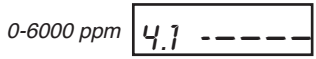
---

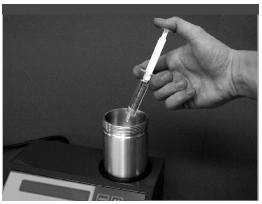
- The display will read directly in parts per million water in the oil (6000ppm range)

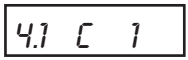
(Gloves not shown for clarity)



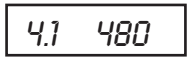
0-6000 ppm







ppm



Water in Oil Test (EasySHIP) 0 – 6000 ppm
Green Cell

- Select Mode 4, Water in Oil 0 - 2.5% (Standard Cell)
  The display will read as shown.
  Press the Up Arrow to select Mode 4.1 (the correct Mode for using the 0 - 6000 ppm Water Cell).

  Note: Use the arrow keys to toggle between modes before the test starts. Different cells are required for the 0 - 2.5% and 0 - 6000 ppm ranges.

- Place the Cell on a level surface and remove the end cap.
  Add 30ml of Reagent A using one of the syringes provided.
  Add 3ml of the test oil using a different syringe.

  Note: The quantities are different from the other water tests

- Cut or tear the EasySHIP Reagent sachet.
  Squeeze all of the EasySHIP paste into the cell, ensuring that all of the paste has been emptied into the cell.

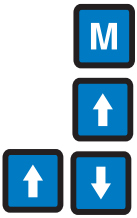
- Place the Agitator into the cell. Replace the cap tightly.

- Place the cell on the console and allow reading to stabilise.
  Press the Zero button to zero the reading and start the test.

- Remove the cell from the console and shake until the display reaches 120, then replace on the console.

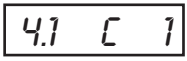
  NB: The test will not work unless shaken vigorously, especially in cold temperatures. EasySHIP Test Reagent must be above 18°C

- The display will read directly in:
  Parts per million water in the oil (6000ppm range)
  Note: The two ranges require different cells and it is not possible to toggle between the calibrations. Variation on repeat reading on the 0 - 6000ppm cell of +/- 50ppm is quite normal.

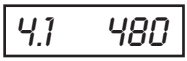


0-6000 ppm

(Gloves not shown for clarity)



ppm



Water in Oil Test (EasySHIP) 0 – 3000 ppm
Green Cell

To improve the accuracy of the 0-3000 ppm test, it is possible to compensate for the residual water in Reagent A.

Run a 0-3000ppm test as normal, using 45ml of Reagent A. This is 10ml more than the normal quantity of reagent. Note the result and divide by 9, then multiply by 7; this will represent the residual water in the sample/ reagent. When a test is run on a used oil sample, subtract the residual water value from the result to obtain the true water content.

- Select Mode 4, Water in Oil 0 - 1% (Standard Cell)
  The display will read as shown.
  Press the Up Arrow twice to select Mode 4.2 (the correct Mode for using the 0 - 3000 ppm Water Cell).

  Note: Use the arrow keys to toggle between modes before the test starts.

- Place the Cell on a level surface and remove the end cap.
  Add 35ml of Reagent A using one of the syringes provided.
  Add 10ml of the test oil using a different syringe.

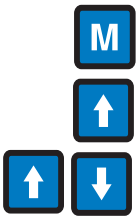
  Note: Note the quantities are different from the other water tests

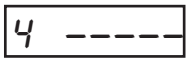
---

- Cut or tear the EasySHIP Reagent sachet.

  Squeeze all of the EasySHIP paste into the cell, ensuring that all of the paste has been emptied into the cell.

- Place the Agitator into the cell. Replace the cap tightly.
- Place the cell on the console and allow reading to stabilise.
  Press the Zero button to zero the reading and start the test.



% v/v 

0-3000 ppm 

(Gloves not shown for clarity)

- Remove the cell from the console and shake until the display reaches 120, then replace on the console.

  Note: The test will not work unless shaken vigorously, especially in cold temperatures. EasySHIP Test Reagent must be above 18°c

---

- Allow the Cell to Stand until the display stops flashing (approximately 8 minutes).
  The reading will stabilise giving the result for the range 0 - 3000 ppm.

Reading flashes until stable *ppm* 4.2 800

Take result when flashing stops *ppm*

Insolubles Test

Insolubles Test

- Select Mode 2 - % Insolubles w/w (IP 316).

  Pressing the Up Arrow will select Mode 2.1 - % Insolubles (Mobil Soot Index).

  Note: It is possible to toggle between Mode 2 and Mode 2.1 (using the Up/Down Arrow keys) as they use the same cell.

- Place the cell onto the console.

  Take the Insolubles tube and fill with Reagent J to the fill line (10ml).

  Gently insert the Insolubles tube into the test cell. A short length of tube will protrude from the test cell.

- Rotate the Zero knob on the side of the cell fully anticlockwise and then slowly clockwise until the reading reaches zero (overshooting reads [- - - -] or 9.9).
  The display will read as shown.

- Shake the oil sample thoroughly.
  Remove a small volume using a disposable pipette provided.
  Return one drop to the oil sample.
  Add the next drop to the test tube*
  Place the cap on the tube and shake until well mixed.
  Allow any bubbles to settle.

  *Better accuracy can be obtained using a micro pipette (30µl drop).

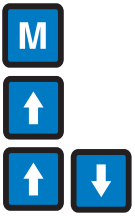
- Return the tube to the Test Cell.
  Fully insert the tube and record the reading once it has stabilised.

- The display will read directly in % insolubles contamination of the oil sample.

  Note: If two calibrations are provided, press the Arrow keys to toggle between the two.

  Mode 2 - % Insolubles w/w by IP316
  Mode 2.1 - % Insolubles by Mobil Soot Index

(Gloves not shown for clarity)



% w/w 2 ----

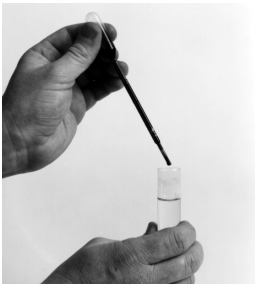
% soot index 2.1 ---

2 X.X

2.1 X.X

2 0.0

2.1 0.0



% w/w 2 18

% soot index 2.1 0.9

TBN Test

TBN Test

Determination of the Reference Value (new oil)

To be undertaken every time new oil is added to the Oil Storage Tanks.

- Select MODE 3 TBN, the display will read as shown:

- Place the cell on a level surface and remove the end cap.
  Shake the bottle of Reagent C and attach the pourer spout.
  Add Reagent C to the TBN Cell until the level reaches the internal lip inside the cell bowl. Add test oil:
  [New Oil TBN 2 - 20] add 10 ml Test Oil
  [New Oil TBN 21 - 40] add 10 ml Test Oil
  [New Oil TBN 41 - 100] add 2.5 ml Test Oil
  Replace end cap and tighten.

- Replace cell on to the console, allow reading to stabilise, then press Zero to zero the reading.
  The display will then start to count 0 -120 over 2 minutes.

- Remove the cell from the console.
  and shake until the display reaches 120.

Note: The test will not work correctly unless the test cell is shaken very thoroughly, especially in cold temperatures.

- Replace the cell onto the console.
  The display will show the **Reference Value** for the **new oil.**
  This will then be used as the **Reference value** for testing used samples of this batch of oil.
  Record this value in your log book for later use.

Determination of the Test Value (used oil)

Routine test procedure for used oils using the **Reference value** from your log book (see earlier in this test procedure).

- Repeat the **Reference Value** Procedure, but with the **same quantity of used test oil** in place of the new reference oil.

- The displayed value will then be used as the **Test Value** for calculating the **used oil** TBN depletion.

(Gloves not shown for clarity)

M

3 -----

Zero

3 C 1

Reference Value

3 XXX

Test Value

3 XXX

Calculating the Used Oil TBN

Example:

New Oil TBN = 40
Reference Value = 140
Test Value = 93

- Start by testing the used oil to get the **Test Value** as described on the previous page.

- Press Enter.

- The display will ask for the **Reference Value,** use the Up/Down/ Speed keys to display this value.

- Press Enter

- The display will ask for the **New Oil TBN**, use the Up/Down/Speed keys to display this value.

- Press Enter to display the **Used Oil TBN**.

mg KOH TBN

TAN Test

TAN Test 0 - 6 mg KOH/g

- Select Mode 5, TAN (IP177).
  Use the Up Arrow to select Mode 5.1, TAN (M6661).

  Note: Both calibrations use the same cell and it is possible to toggle between Mode 5 and Mode 5.1 using the Arrow keys.

- Take the bottle of Reagent D. This should be *blue/green*.
  If it is *red,* add one drop at a time of **Reagent E** until the colour just turns to *green* (see colour reference).
  Place the cell onto the console.
  Take the TAN tube and fill with Reagent D to the fill line (10ml).
  Gently insert the TAN tube into the test cell. A short length of tube will protrude from the test cell

---

- Press the Zero button to zero the reading.

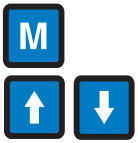
- Shake the oil sample thoroughly. Remove 1ml using a 1ml syringe, and add this to the TAN tube. Replace the cap and shake well (if the oil has any TAN the colour will change to *red*). Allow any bubbles to settle. Return tube to the TAN cell. The reading will be higher than zero if there is any TAN.

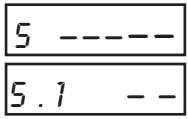
- Carefully fill the1ml syringe with **Reagent E** to the 1ml mark.
  Add 1 drop to the TAN tube.
  Shake and place the tube back in the TAN cell.
  Continue 1 drop at a time until the reading is less than 80 (colour starts to change *red* through *green*).

- Press Return and enter the syringe reading using the Up/Down arrows and the Speed key.
  (The greater the volume of **Reagent E** used, the lower the syringe reading).

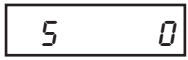
- Press Return and the display will show the TAN.
  Note: Two calibrations are provided.

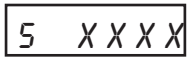
  Mode 5 - IP177 (ASTM D 664) used for all other mineral oils.
  Mode 5.1 - SAE ARP 5088 (modified IP139, ASTM D 974) used for aviation turbine and synthetic oils.
  Toggle between the two by pressing the Arrow keys.

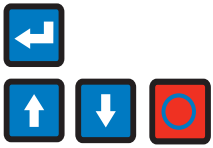


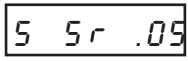


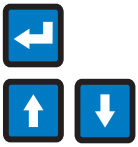
(Gloves not shown for clarity)



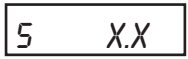




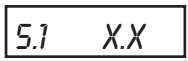




IP177



IP139



TAN Test 0 -3 mg KOH/g

- Select Mode 5, TAN (IP177).
  Use the Up Arrow to select Mode 5.2, TAN.

- Take the bottle of Reagent D. This should be *blue/green*.
  If it is *red,* add one drop at a time of **Reagent F** until the colour just turns to *green* (see colour reference).
  Place the cell onto the console.
  Take the TAN tube and fill with Reagent D to the fill line (10ml).
  Gently insert the TAN tube into the test cell. A short length of tube will protrude from the test cell.

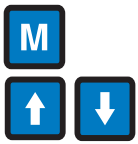
- Press the Zero button to zero the reading.

- Shake the oil sample thoroughly. Remove 1ml using a 1ml syringe, and add this to the TAN tube. Replace the cap and shake well (if the oil has any TAN the colour will change to *red*). Allow any bubbles to settle. Return tube to the TAN cell. The reading will be higher than zero if there is any TAN.

- Fill the 1ml syringe with **Reagent F** to the 1ml mark.
  Add 1 drop to the TAN tube.
  Shake and place the tube back in the TAN cell.
  Continue 1 drop at a time until the reading is less than 80 (colour starts to change *red* through *green*).

- Press Return and enter the syringe reading using the Up/Down arrows and the Speed key.
  (The greater the volume of **Reagent F** used, the lower the syringe reading).

- Press Return and the display will show the TAN (0 to 3 mg KOH/g)).
  Mode 5.2 - IP177 (ASTM D 664).



5 -----

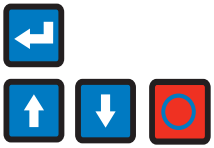
5.1 --

(Gloves not shown for clarity)

5.2 XXXX

5.2 0

5.2 XXXX

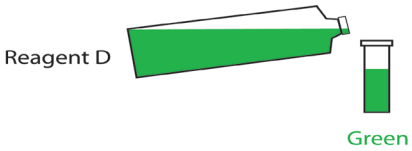


5.25 r .05

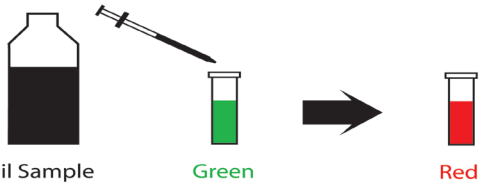
IP177 5.2 X.X

Colour Reference for TAN Tests

Start point
Add Reagent D

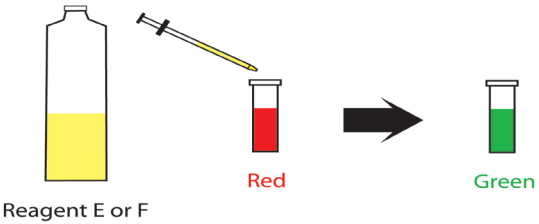


Add the test oil



Add Reagent E
or F drop by drop.

Reagent E is 0-6 TAN
Reagent F is 0-3 TAN



Finish back at startpoint.

Density Meter

Density Meter

Intended use

The Density Meter is designed to measure the Density of fuel or lubrication oil either at 50°C or 70 °C.

CAUTION: The Density Meter must not be used for heating any other liquids such as water, cleaning fluids, or any fuels with a low flash point temperature (e.g. gasoline).

Note: These instructions apply to density meters with software version 2.xx

Setting the Mains Voltage

The meter auto selects the heating and power supply to match the supplied mains voltage. This is displayed on the screen at power up.

Connecting the Power Supply

- Connect the mains lead into the socket on the rear of the Density Meter. Plug the other end of the lead into the mains supply.

- Turn on the mains power and then turn on the power supply using the switch next to the socket, density meter display should illuminate showing the mains voltage detected.

Location

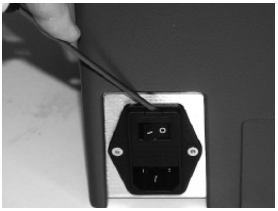
The unit is designed to operate on a flat level surface such as a workbench. The unit when operating contains hot oil heated up to 70 °C It is essential for safe operation that it is on a stable surface with the power cable running backwards from the unit where it cannot be accidentally snagged.

Controls and Features

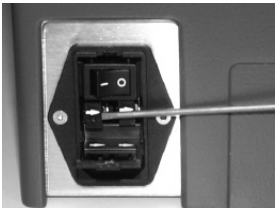
The instrument measures density using a hydrometer dropped in warmed oil. Most oil can be measured at 50 °C but for very viscous oils the units can be set to warm to 70 °C .

There is a calculator feature, which allows the reading to be adjusted to show Density at 15 °C in a vacuum. If the viscosity is known in Cenststokes or Centipoise the calculator will display the CCAI.

To change fuse


Open lid using screwdriver.


Carefully remove fuses.


Replace and secure lid.

Cleaning after Use

- After a measurement is taken, turn off the power supply and disconnect the mains lead from the Density Meter.

- Carefully pour the oil into a container using the pouring spout.

CAUTION: The oil will be hot (up to 70 °C). Pour out the contents carefully. Using the rod supplied use a wad of clean tissue down the centre of the tube ensuring all remaining oil is cleaned out.

General Cleaning

Make sure the power supply is disconnected from the mains. Wipe down the instrument with a clean dry soft cloth. Do not immerse in water, if necessary to remove stubborn marks use a cloth soaked in warm soapy water.

Maintenance

If the unit fails to power up disconnect the power lead and check the fuse is OK. We have supplied replacement fuses of the correct type in the spares pack. Do not use any other type of fuse.
There are no other user serviceable parts inside the unit, if the unit still does not operate return to the supplier for repair.

Note: If the equipment is used in a manner or for a purpose other than that described above then any safety protection may be impaired._

Heating

- Carefully fill Density Meter tube with oil up to the fill line about 10mm from the top.

- Switch ON, press reset.(Unit displays revision and supply voltage). Select heating temperature using UP and DOWN arrows.

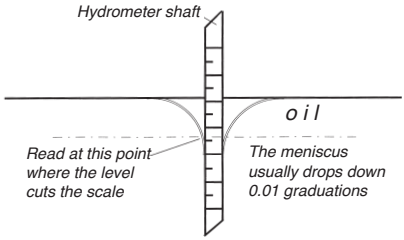
- Press Return to start heating.

- Centigrade digit "°" flashes as the Density Meter heats the oil. Stir the oil occasionally as it heats up with the stirring rod provided. When the temperature stabilises at 50°C the meter is ready for operation, (this takes about 10 minutes).

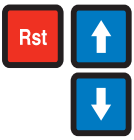
- The meter will display the uncorrected [u] hydrometer reading in Mode 1. Stir the oil thoroughly and gently insert the hydrometer (select an appropriate range for this). Imparting a gentle spin will help

Testing

- Read the hydrometer at the meniscus.
  Use Arrow and Speed keys in Mode 1 to enter the uncorrected [1u] Hydrometer reading at 50°C.



- Press Return.
  Display now shows the Density corrected to 15° [1c] in a vacuum kg/m^3 in vacuo.



38.6°

39.0

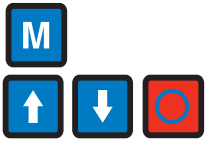
Do not use the hydrometer for stirring the oil.
Be careful with the hydrometers: they are made of glass and will break!

19.3°

50.0°

3 ranges of hydrometers are available:
0.80 - 1.01 Wide range but less discrimination
0.85 - 0.95 Lighter fuels DMA - RMH
0.90 - 1.01 Heavier fuels RMD - RML

1U .980



1U .978

1C .999

Calculating CCAI (Calculated Carbon Aromaticity Index)

- Advance to Mode 2. (Not available with 70º heating).

- The default viscosity is 280, or the last reading entered.
  Use Arrow and Speed keys to enter an Oil Viscosity.
  This is normally entered in centiStokes at 50°C for Fuel Oils.

- Advance to Mode 3. (Not available with 70º heating).
  CCAI value is displayed automatically, using the entered Density and Viscosity values.

- Use Mode key to cycle modes and repeat calculations.

Conversion to centiStokes from centiPoise

- Holding down Speed key in Mode 2 allows entry of Viscosity in centiPoise [P].

- Press Return to display value converted from cP to cSt using the Density entered in Mode 2.

  Note: Corrected Density [1c] can be altered for calculating cSt from cP.

'P' indicates centiPoise option

Viscosity corrected to centiStokes

Compatibility Test

Compatibility Test

Intended Use

The Compatibility Oven is use to pre-heat a sample and then dry sample test paper prior to analysis. It contains chamber heated to 100 °C. It must not be used for heating any other materials.

Note: these instruction apply to compatibility ovens with software version 1.xx

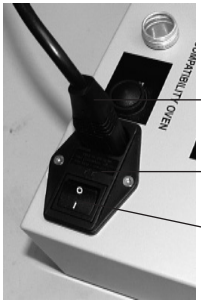
Setting the Mains Voltage

The meter auto selects the heating and power supply to match the supplied mains voltage.

Connecting the Power Supply

- Connect the mains lead into the socket on the side of the power supply.

- Turn on the mains power and then turn on the power supply using the switch next to the socket, the timer display should illuminate.

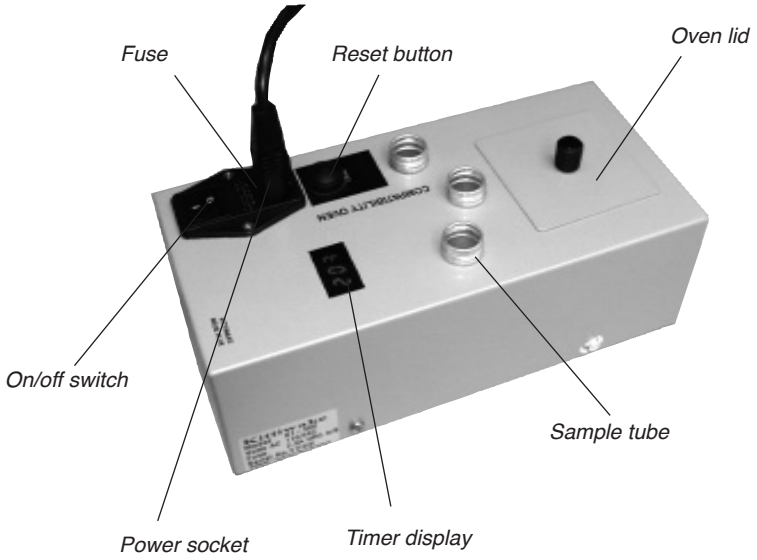


Location

The unit is designed to operate on a flat level surface such as a workbench. The unit when operating contains hot oil heated up to 100 °C It is essential for safe operation that it is on a stable surface with the power cable running

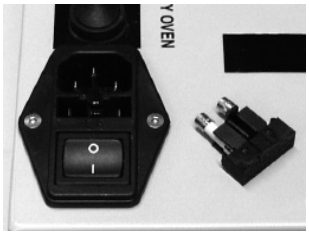
Controls and Features

The instrument is designed to prepare oil sample for performing a visual oil compatability analysis. It automatically controls the oven temperature to 100 °C and has a timer features to allow the preparation time to be measured.



To change fuse

Remove fuse box using a screwdriver.



Replace fuse.

Cleaning After Use

- After a measurement is taken, turn off the power supply and disconnect the mains lead from the Compatibitly oven.

  CAUTION: The oil samples and oven will be hot (up to 100 °C). Handle with care.

- When cool remove the sample tubes and dispose of oil and tube.

General Cleaning

Make sure the power supply is disconnected from the mains. Wipe down the instrument with a clean dry soft cloth. Do not immerse in water, if necessary to remove stubborn marks use a cloth soaked in warm soapy water.

Maintenance

If the unit fails to power up disconnect the power lead and check the fuse is OK. We have supplied replacement fuses of the correct type in the spares pack. Do not use any other type of fuse. There are no other user serviceable parts inside the unit, if the unit still does not operate return to the supplier for repair.

Note: If the equipment is used in a manner or for a purpose other than that described above then any safety protection may be impaired.

Stability of Fuel Oil

- Obtain a representative sample.
  Shake thoroughly just before testing.
  Heat in hot water if necessary to aid pouring.

- Pour a sample of oil into a beaker.
  Transfer about 10ml of oil from the beaker into a sample tube (to a height of about 30mm).

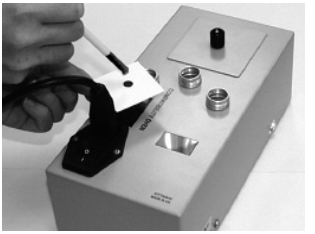
  NB: For equipment setup see 'Timer' section.

- With the unit fully heated to 100^0C, place the tube in one of the preheat holes. Press Reset and allow the timer to count to 20 (takes 20 minutes).

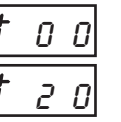
- Stir the oil for 5 seconds with an acetate rod.
  Remove the rod without touching the side of the tube.
  Allow the first drop to fall back in and the second drop to fall onto the centre of the test paper.

- Place the paper in the removable tray section and replace in the oven.
  Press Reset and allow the timer to count to 20.
  During this time the spot will develop and dry.

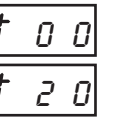
- Remove the paper and compare the spot against the Spot Reference Chart (see following pages).



Unit fully heated



Timer reset to 0 minutes



Compatibility of Fuel Oils

- Repeat the sample preparation procedure used in the 'Stability of Fuel Oil' method (on the previous page), using one tube for each fuel to be tested (fuel A and B).

- With the unit fully heated, place the tubes into two of the preheat holes. Press Reset and allow the timer to count to 5.

- Carefully syringe samples of fuel A and B into a third sample tube in the same ratio as the oils are to be mixed in the bunker tank. Stir to mix well.
- Place the third tube (containing the mixture) in the remaining preheat hole. Press Reset and allow the timer to count to 15.

- Stir the oil for 5 seconds.
  Remove the rod without touching the side of the tube.
  Allow the first drop of oil to fall back and the second drop to fall onto the centre of the test paper.
  A spot may also be made of fuel A and B at this stage, if required.

- Place the paper(s) on the removable tray section. Replace in the oven. Reset and allow the timer to count to 20. Both the mixture and each individual fuel can be tested for stability.

- Remove the paper(s) using the tweezers and compare the spot against the Spot Reference Chart on the next page.

Unit fully heated

t 0 0

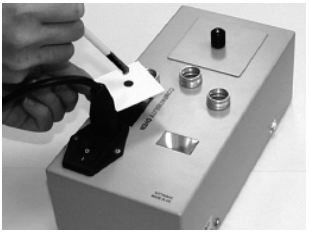
t 0 5

Mixture

Fuel A *Fuel B*

t 0 0

t 1 5

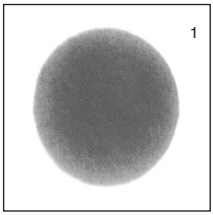


t 0 0

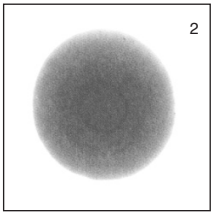
t 2 0

Spot Reference Chart

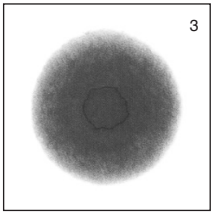
When the dried sample is removed from the oven, it can be compared against the spot reference chart.
Differences in colour, overall darkness, spot size and appearance of outer edges should be ignored. Only the characteristics of the centre ring should be examined when determining compatibility rating.



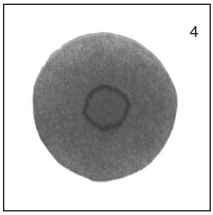
Compatible / stable.



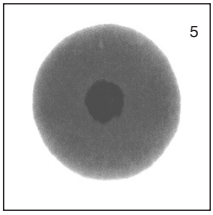
Will deposit some sludge; handle carefully; consider chemical additives; do not overheat; increase purifier; blow down frequency.



As for 2 but increased sludge potential.



Incompatible / unstable.



Incompatible / unstable.

ASTM: D 2781 also used in revised standard ASTM 4740-94.
With acknowledgement to ASTM.

Theory of Operation

Measure stability of pre-blended oils on delivery and storage:

- Test each new bunker fuel.

- Check after purifier.

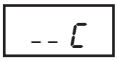
- Check effectiveness of fuel additives used to improve fuel stability.

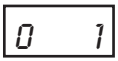
Measure compatibility of two component oils:

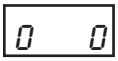
- Test when fuels are mixed on transfer or bunkering.

Timer

The equipment is provided with a small display that will indicate as follows:

- Equipment in heating mode, not yet up to temperature. 

- Equipment heated to 100°C and ready for use, when timer starts to count in 0 - 99. The timer counts in minutes. 

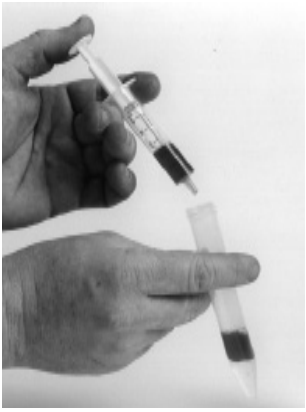
- The timer can be reset by pressing the Reset button. 

Salt/Fresh Water Test

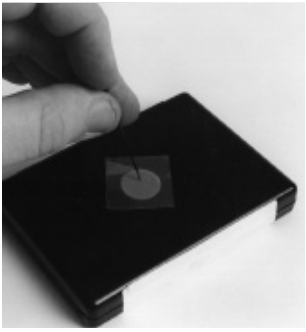
Salt/Fresh Water Test

This test is designed to determine if the water contamination in a fuel or lube oil sample is from a fresh or salt water source. As a guide 1% sea water contamination is associated with 100ppm salt and can easily be detected with this test. Note that salt will continue to contaminate lube oil, even when the original water contamination has been evaporated.

- Add 2ml of Reagent H to the test tube.
- Shake the oil sample and draw off 5ml using the syringe provided. Add this to the test tube, replace the cap and shake vigorously.
- Place the tube upright in **hot** water and allow to stand for 1 hour until the water settles out of the oil sample.

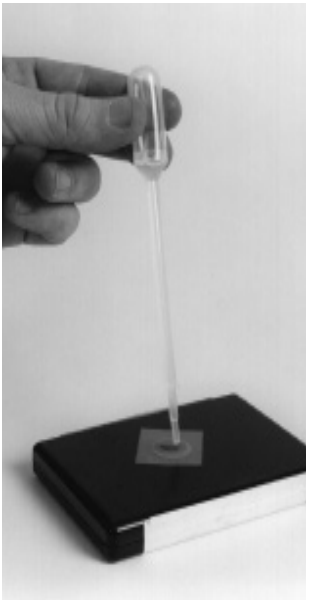


- Take one test pad from the box and replace the lid. Handle the test pads by the edges to avoid contaminating the surfaces with sweat.
- Puncture an area 10mm in diameter 10 to 15 times with the pin provided.



- Flush the pipette with Reagent H. Place the tip in the water layer in the test tube.
- Squeeze the bulb gently and draw off a sample of the water into the pipette.
- Remove the pipette, wipe off any oil and return a few drops of water to the test tube.

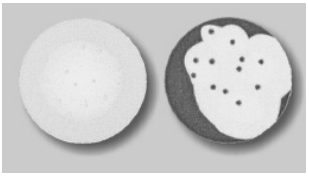
- Place the next drop of water onto the prepared test pad.
- Allow the pad to stand for 5 minutes.



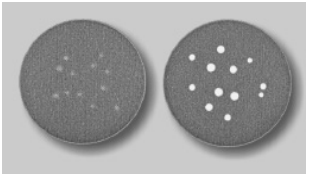
- Examine the pad:

  If a large yellow patch appears, the contamination is **salt water**.

  If there is no yellow colour, or only a very faint yellow patch appears, the contamination is **fresh water**.



Salt Water.



Fresh Water.

- A positive result should always be checked by testing another pad.

Pour Point Test

Pour Point Test

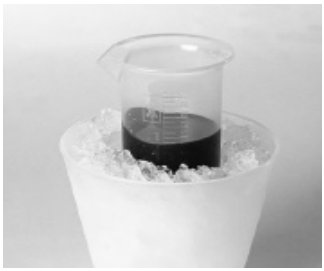
within a few seconds and the oil returned to the cooling medium (refrigerator or ice bath).

Sources of Warm Oil

- The pour point is reached when the oil surface stays in the vertical position when tilted for a period of 5 seconds and does not sag in the beaker.

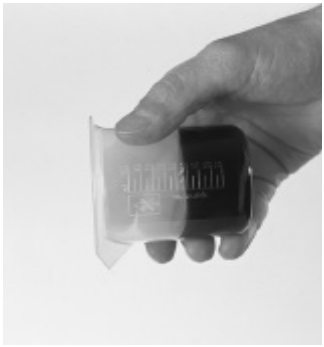
- At this point, insert the thermometer and take the temperature of the oil in the beaker.
  This should be completed within 10 seconds.

  Please refer to manufacturers instructions for operation of the thermometer.



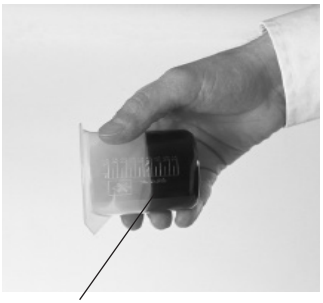
Place the beaker in a bath of crushed ice.

- The pour point is defined as 3°C higher then the temperature at which the fuel in the sample beaker will not flow when tilted for a period not exceeding 5 seconds.



Examine the beaker by holding in a horizontal position.

- Warm the fuel oil sample without stirring to between 40 and 50°C. (Alternatively, take a pre-heated fuel sample directly from the Density Meter or Heated Viscometer.)



Must stay vertical at Pour Point

- Pour 50ml of the sample into a 100ml beaker and either

  a) place the beaker in a domestic refrigerator or

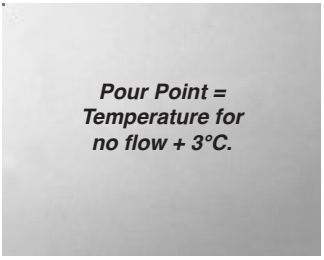
  b) place the beaker in a bath of crushed ice.

  The pour point of most residual fuels is above 0°C, thus for these products there is no need to determine a pour point below this temperature.

Insert the thermometer and take the temperature of the oil in the beaker.

- Inspect the beaker at approximately 5 minute intervals. (Use a watch or the counter on the compatibility tester to time 5 minutes.)

  Examine the beaker by holding in a horizontal position as shown. This process should be completed



C Health and Safety

General Health and Safety Information

Operation of Fuel and Lube Oil Test Equipment

Ensure that:

- The operator is thoroughly familiar with all aspects of the instruction manual.
- The equipment is connected to the correct power supply.
- The equipment is placed on a firm, horizontal surface during use and that it is prevented from sliding.
- The working area is well ventilated and illuminated.
- The equipment is not subjected to damp or liquid spray (e.g. on deck).
- The equipment is never used in a hazardous environment.
- Never smoke while using the equipment or handling any of the Reagents.

Over Pressure Protection

The Water and TBN Cells have been safety tested to more than 20 times working pressure. However it is essential that the operator does not exceed the recommended volumes of reagents or test oils in each cell.

Both Water and TBN Cells are designed to vent excess pressure and prevent spray before the cap can be fully removed. If the cell is operated beyond its design pressure then simply slacken the cap to release the pressure. Hold the cell upright when slackening the cap to prevent any liquid from being sprayed out as the pressure escapes.

The end plug and bleed valve assembly in the Viscometer are designed to slide. If cold oil is left in the Viscometer and allowed to expand, there is danger of an hydraulic lock but damage is prevented by allowing the end plug to be pushed out.

Always therefore clean out the Viscometer after use and never store the Viscometer with the tube full of oil.

Chemicals

Kittiwake have taken care to ensure the safety of Reagents used, but it is imperative that the operator is thoroughly familiar with the individual Material Safety Data Sheets before handling or use of any Reagent.

Liquid Reagents A, C and J:
Have a flash point above 66°C.

Reagent B:
Will react with oxygen and especially water to liberate hydrogen gas.
It is subject to IATA, IMDG transport restrictions.

Reagents D, E and F:
Have flash point below 66°C and are subject to transportation restrictions under IATA and IMDG codes.
Limited quantity exclusions will however apply.
Refer to the individual H&S sheets for specific information.

CAUTION: Never store the equipment without checking that all reagents are sealed tightly and cannot leak. Remove all Reagents before returning the equipment to the manufacturer.

Guide to interpreting MSDS Sheets

Most reports are split into a number of sections, each covering just one aspect of the product and as the same report format is used for many different chemicals, not every entry is appropriate information for Kittiwake Products.The information may not be reproduced in this order but almost all of the information will appear in all Material Safety Data Sheets. The main purpose of this guide is to provide a glossary to most of the specialist terms and acronyms found in Material Safety Data Sheets prepared to the standards of USA, Canada and the EU. They may also be useful in assessing data sheets prepared in other regions.

Product name:	Including Synonyms and government identification codes.
Summary of hazards:	Usually written inunderstandable but precise terms.
Hazardous ingredients:	Individual components which have their own particular hazards.
Physical data:	Colour, density, smell, boiling etc.
Fire and explosion Hazard data:	This describes the flash point, auto ignition temperature and flammability in air. The procedure for fire fighting is covered as are the particular fire and explosion hazards.
Reactivity data:	How product will react when in contact with other materials.
Health hazard information:	Specific health risks covering all methods of exposure to the product.
Emergency first aid:	Detailed advice on first aid measures and guidance on treatment for doctors.
Precautionary measures:	How to avoid the health and fire/ explosion hazards.
Spill and leak procedures:	How to deal with spillages of the product and how to clean up same.

For copies of MSDS sheets, please visit our website at www.kittiwake.com

Kittiwake's testing and analysis products effectively measure, monitor and manage the quality of essential fluids used to maintain and operate capital equipment.

Kittiwake are the world leaders in the design, manufacture and distribution of technically advanced fuel and lubricant test kits, equipment and products.

For more information and your nearest dealer, visit our website at **www.kittiwake.com**

KITTIWAKE
monitoring innovation

Parker Kittiwake
Hydraulic Filter Division Europe
3 - 6 Thorgate Road Littlehampton
West Sussex BN17 7LU United Kingdom
Tel: +44 1903 731470
Fax: +44 1903 731480
Email: kittiwakeinfo@parker.com
Web: www.kittiwake.com www.parker.com

MA-K11152-KW Issue 13