aerospace
climate control
electromechanical
filtration
fluid & gas handling
hydraulics
pneumatics
process control
sealing & shielding

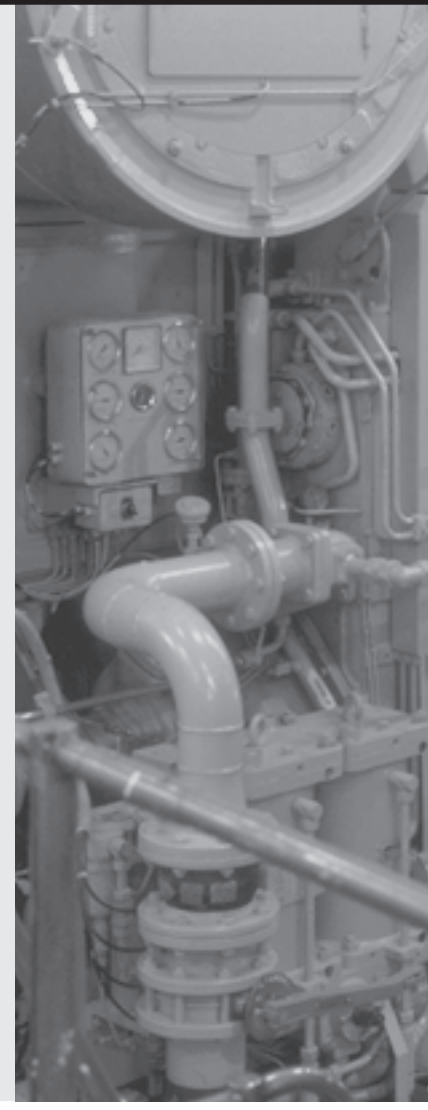
Oil Test Centre

Instruction Manual

Parker

ENGINEERING YOUR SUCCESS.

Oil Test Centre



Contents

A Manual

MANUAL

Specifications

The Kittiwake Oil Test Centre: NATO Approved Metal Case For Marine Use (above), Portable Industrial Roller Case Option (Below)

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

Unheated Viscometer

Console

Unheated Viscometer

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

Range:
15 - 500 cSt at 40°C (lube oils SAE 5 through SAE 50)

Test time:

Viscosity at 40°C:	1 minute (unheated)
Repeat test:	maximum 30 seconds
Cleaning:	1 minute

Calculations:

Viscosity at 40°C	(unheated but corrected to 40°C)
Density variation	(0.8 to 1.0)
Variable Viscosity	Index(25 to 250)
SAE Grade	(% within each SAE band)
Viscosity at 100°C	(unheated but corrected to 100°C)

Accuracy:
Typically with +/- 2%(15 - 320 cSt) or +/- 2 cSt

Power:
110 to 250 VAC

Correlation:
IP 71

Water in Oil Test

Range:	**Mode**
Standard Cell *(blue)*	
0 - 2.5% and 0-1%	**4**
PPM Cell *(Silver / Green)*	
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% & 0-1%]
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)

Sampling of Lube Oils

Sampling 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 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.

Spare Parts:

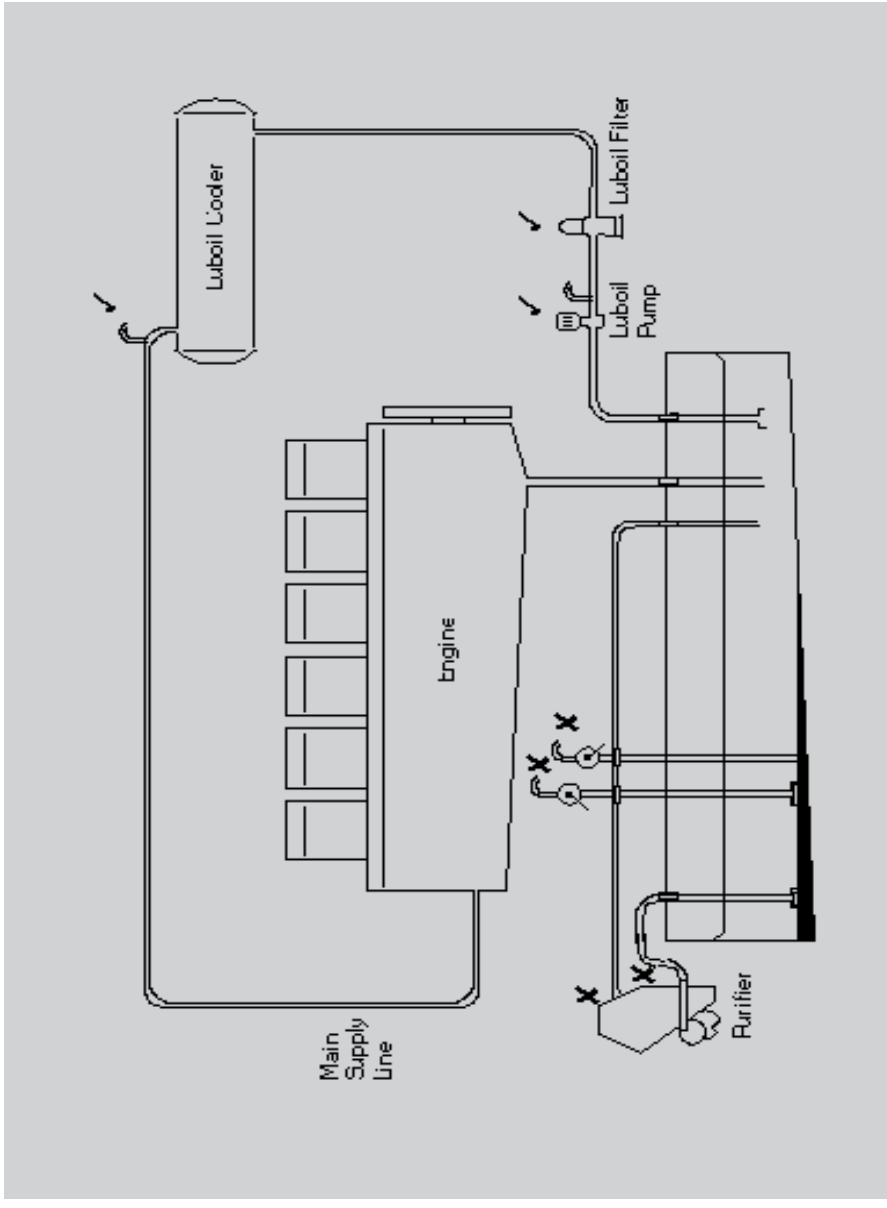
Kittiwake supply sampling equipment as follows:

FG-K3-207-KW	100ml lubricant sample bottles 450 PVC bottles and caps
FG-K11289	Sample bottle pump
PL-K10215	Sample pump tubing - 15 meters
FG-K14297-KW	Sample bottle labels - 1000 off

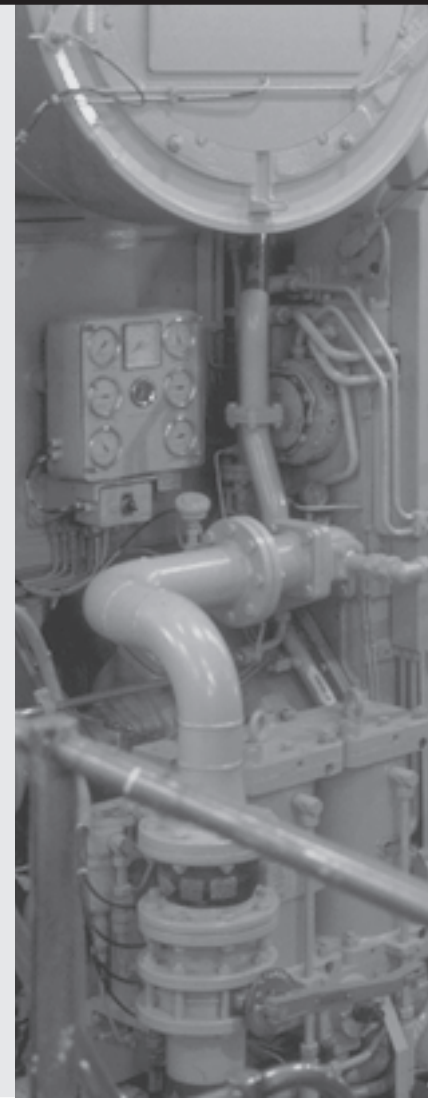
Good and Bad Sampling Practice

✓ *Good sampling*

✘ *Bad sampling*



Calibration and Maintenance



Calibration and Maintenance

Introduction

The ***Oil Test Centre (OTC)*** 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 OTC results is regularly established.

Regularly returning the OTC to Kittiwake will ensure good calibration and is recommended.

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

Calibration Strategies

- The OTC 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 OTC.

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

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

- Return the OTC 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 viscosites.

No calibration fluids

- When the OTC 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 and 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 Ball Bearing 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 viscosites.

- 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. 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 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 20ul (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 console 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 the cell.

- 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 30ml (2 x 15ml).

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.

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?

- 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 thecolor 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 Reagent 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 Oil Test Centre 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.

Note: The console should only be removed by a qualified Electrical Technician if internal cleaning is necessary. If the console is flooded with oil do not apply electrical power. If the console is removed from the OTC lid, a Portable Appliance Test (PAT) should be performed prior to reuse. This will ensure the equipment is electrically safe.

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 Oil Test Centre Case

- Wipe spillage with soft tissue paper.

Storage and Transportation

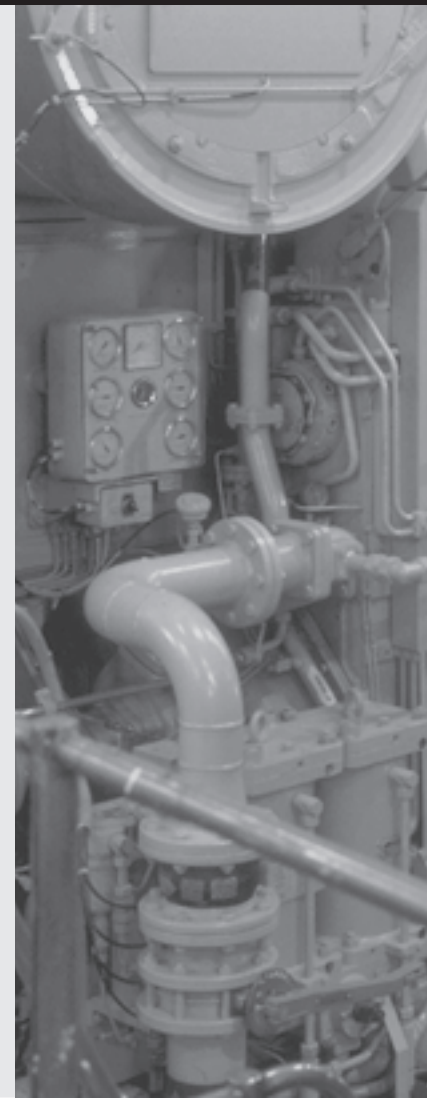
The OTC case and contents should be stored upright and in a secure position. Prevent exposure to extremes of temperature, humidity and vibration.

- 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.

B User Instructions

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 permanently fixed to the lid of the Oil Test Centre (OTC). This includes a cradle for the viscometer. **It is essential for accurate operation the lid is removed from the OTC case and placed on a flat level and stable surface.**

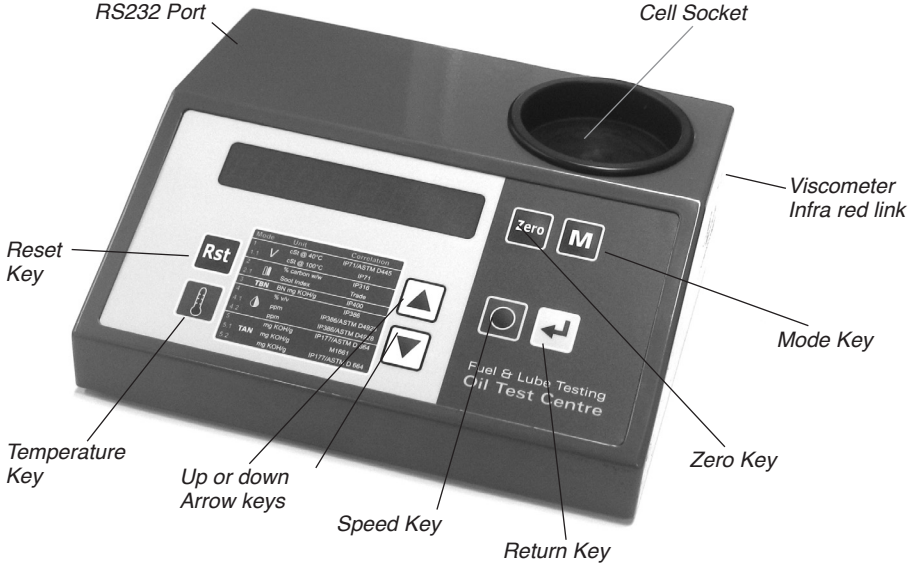
Controls and Features

The console is the central control unit for the Oil Test Centre and is needed to operate all of the tests. It includes some unique features, making it suitable for use in harsh environments.

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.

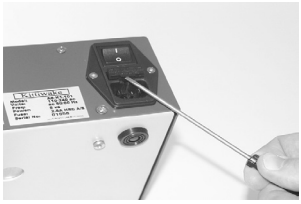
Viscometer Link
The viscometer is also designed to be rugged. The measurement data is transmitted via a data link on the side of the console, so that no wires or connectors are needed. Power is supplied by a standard 9v battery mounted inside the viscometer.

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. If the console is removed from the OTC lid a Portable Appliance Test (PAT) should be performed prior to reuse. This will ensure the equipment is electrically safe.

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 realtime 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. If the console is removed from the OTC lid a Portable Appliance Test (PAT) should be performed prior to reuse. This will ensure the equipment is electrically safe.

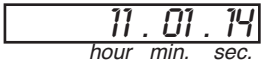
If the equipment is used in a manner or for a purpose other than that described in this manual then any safety protection may be impaired.

Operation

- Press the Reset key to reset the console.

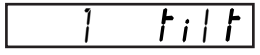
Note: ***Immediately*** after you reset the console, a number is displayed of the form '3.01'. This is the software version. You may be asked to give this number when requesting technical support.

- 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 OTC Results

- Connect a standard 9 way RS232 serial cable between the console and an IBM PC. Start up the Kittiwake software on the PC.

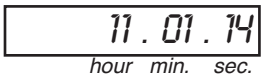
- Select the correct Comm. port (1 to 4). Select Upload.

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

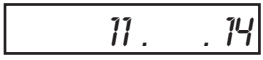
- The OTC will automatically select Mode 6 (Upload Mode) and transmit the results to the PC. These results can then be selected and stored in the PC Access Database.

Setting the Date and Time

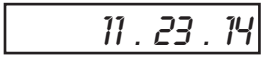
- Press the Reset button.



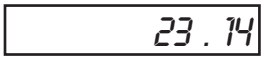
- Press the Temperature key to select the required digits.



- Use the Arrow keys to select the correct number.



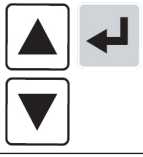
- Use the Return key to update the new value.

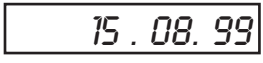


- Repeat as necessary, press the Temperature key to skip to next digit or date display.

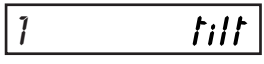
- When the time display is updated, pressing the Temperature key will cycle to the date display (preceded by “d”).

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



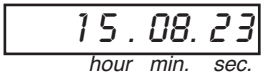


- Press the Mode button twice to enter Mode 1 and normal operation.



Setting the Equipment ID and Lubricant Hours

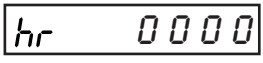
- Press the Reset button. (the time is displayed).



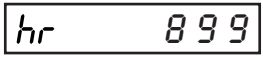
- Press the Mode button.

- 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.

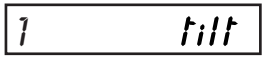


- Use the Arrow keys and Speed key to select the Lubricant Hours [0 -9999].



- 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

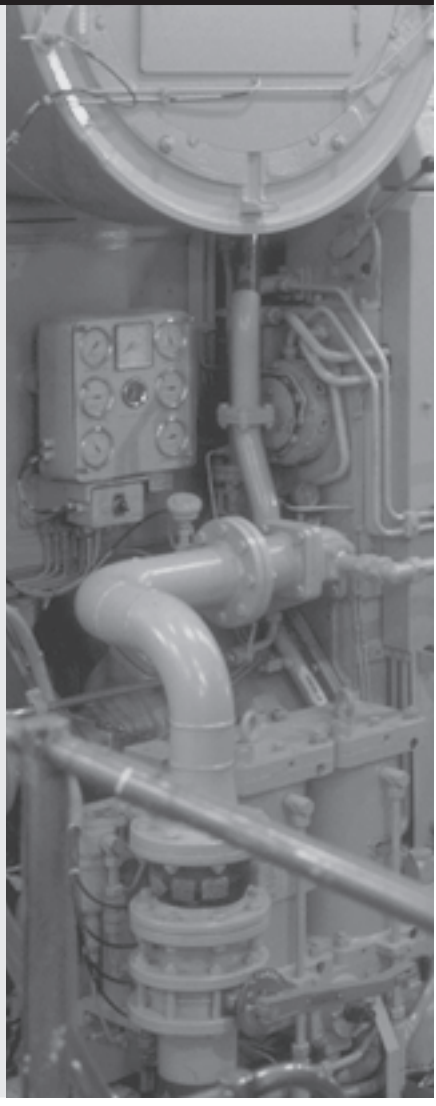
The console runs through a self check routine for the principal functions every time it is switched on. Additionally the system is programmed to display a number of error messages should a problem occur during use.

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

Console Error Codes

Code	Error
1	Self test failure (if persistent, contact your Kittiwake representative)
2	OTC cell failure (if persistent, contact your Kittiwake representative)
3	The viscosity of the oil being tested is too low
4	The viscosity of the oil being tested is too high
5	Ambient temperature is outside of the specified range
6	Viscometer test time is too long
7	Oil in the viscometer is too hot/too cold
8	Water test pressure is too great
9	TBN test pressure is outside of required range
10	Insoluble contents reading is outside of required range
11	Zone lookup out of range, if persistent, contact your Kittiwake representative
12	Keypad failure, if persistent, contact your Kittiwake representative
13	TAN reading is outside of required range

Heated Viscometer



Heated Viscometer

Intended Use

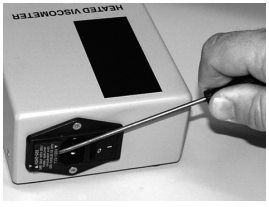
The Viscometer is designed to measure the viscosity of oil either room temperature or warmed to 40°C or 50 °C, and with a density of between 870 kgm^{-3} and 1000 kgm^{-3} (inclusive).

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.

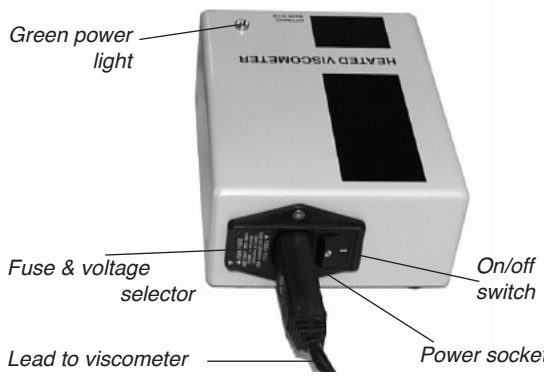
Connecting the Power Supply

- 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 and the Viscometer display should illuminate.

Connect lead to viscometer.



Location

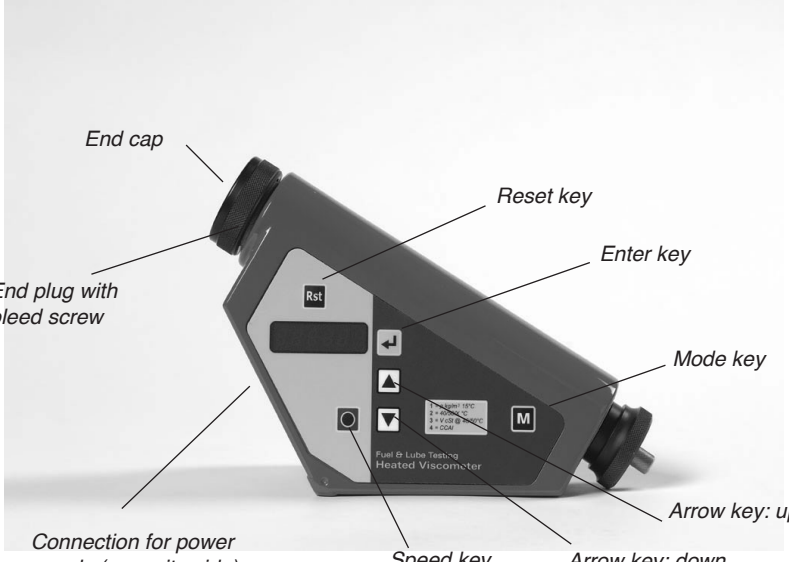
The unit is designed to operate on a flat level surface such as a workbench. This is essential for accurate and reliable operation. Make sure the viscometer can be rocked back and forward without obstruction in one clean movement.

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

Controls and Features

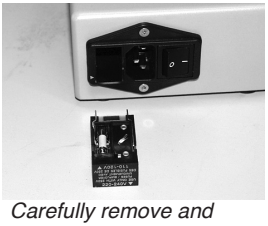
The instrument measures viscosity by timing the descent of a metal ball through the internal tube. The instrument is designed to easily 'TILT' from side to side allowing the ball to fall under gravity, measurements are taking in both direction to compensate for the workbench being slightly out of level.

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

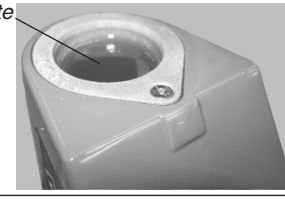
Rst

M

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

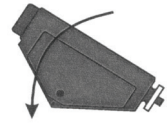
Unheated Lube Oil (correct up to 40°C) 2 00

Heated Lube Oil (to 40°C) 2 40

Heated Fuel Oil (to 50°C) 2 50

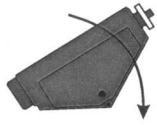
Display flashes XX.X°

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.

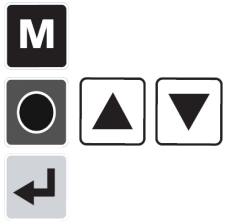
Improving accuracy in Unheated Mode with Multigrade or Synthetic Oils

- 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.

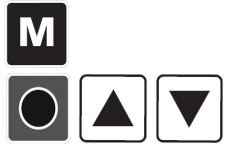
- Press Return key in Mode 5 to recalculate cSt. corrected to 40°C.



1c .900 *Density = 0.9*

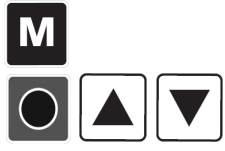
5 XXX

125.4cS



1c .900 *Density = 0.9*

1c .992 *Density = 0.992*



5 100 *Viscosity Index = 100*

5 126 *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').

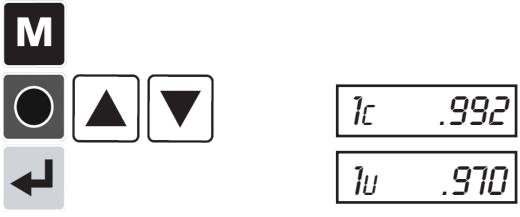
- Select Mode 3 and display the last recorded Viscosity. Alter this if necessary using the Speed and Arrow keys.

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


M
1c .900


1u .970

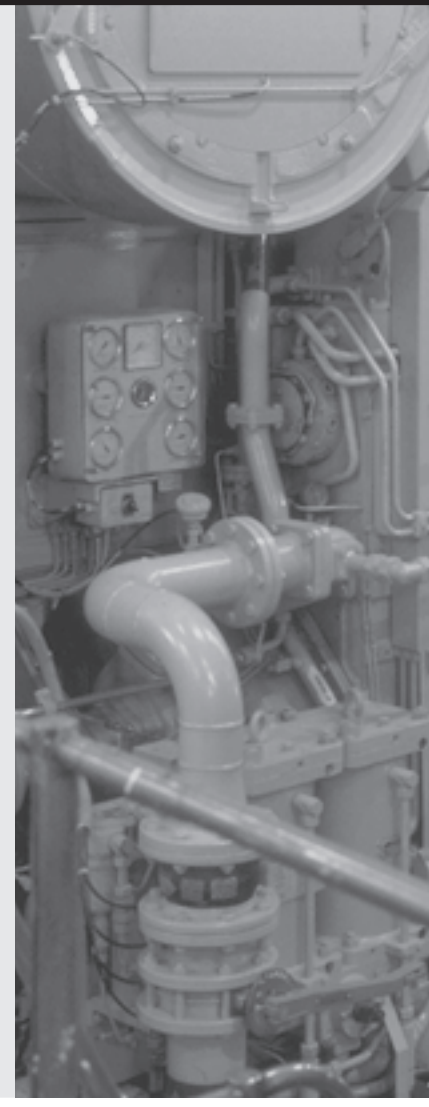

1c .992


M
1c .992
1u .970


M
3 133
3 147


M
4 864

Unheated Viscometer



Unheated Viscometer

Intended Use

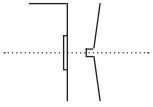
The Viscometer is designed to measure the viscosity of oil at room temperature, and with a density of between 870 kgm^{-3} and 1000 kgm^{-3} (inclusive).

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.

During testing, make sure the viscometer is 100mm from the console with the Infra Red link in approximate alignment.

Keep the Viscometer 100mm from the console with the Infra-Red link in approximate alignment.



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 taken in both direction to compensate for the workbench being slightly out of

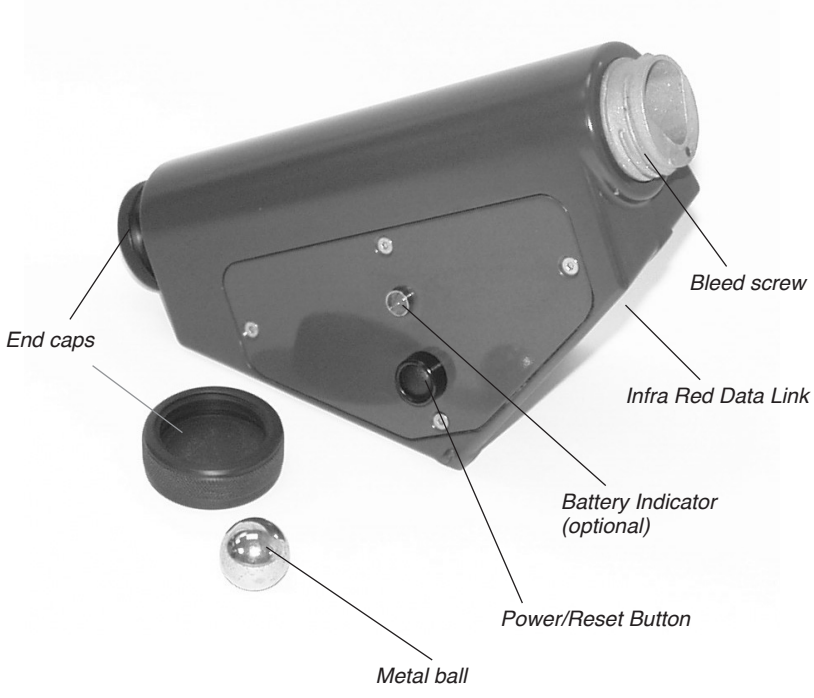
The unheated Viscometer is powered by a 9volt battery. This should be changed if the operation becomes erratic.

Note: Later viscometers have a battery indicator above the Power/Reset button which illuminates when the button is pressed –

Green –	Battery is OK
Red –	Battery is low – change battery now
Not lit –	Press button again to restart viscometer or the battery is flat so change battery.

To replace the battery see the section on “Changing the battery”

The Unheated viscometer operates in conjunction with the OTC console. The data on ball speed and oil temperature is sent by an Infra Red Data Link.



Filling the Viscometer

- Support the Viscometer vertically. Open the vent screw and remove the push in end cap.

- Ensure that the ball is in the tube, then fill the tube with oil to just above the edge of the V-plate. Slowly push in and rotate the end cap until all air is expelled. Do not use excess force. Retighten the vent screw and clean off excess oil.

Using the Viscometer

- Place the Viscometer with the Power/Reset button outermost. Keep the Viscometer about 100mm (4”) from the console with the Infra-Red link in approximate alignmen. If the oil temperature is much hotter or colder then the Viscometer, better accuracy is obtained by taking several readings over a period of 5 minutes until they stabalise.

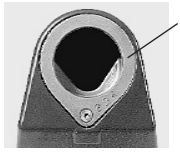
- Select Mode 1, viscosity. The display will show: 
Press the Viscometer Power/Reset button to power the electronics.

- Tilt the Viscometer smoothly.
The ball movement will be displayed during operation.

- When the ball has travelled through the oil sample, the display will show  . Tilt the Viscometer over again. The ball movement will again be displayed.

- When complete, the display will give an average of the two readings in cSt at 40°C. To repeat the viscosity measurement, press the Viscometer Power/Reset button and repeat the tilting procedure.

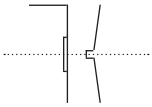
Fill the tube with oil to just above the edge of the V-plate.



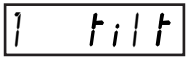
Slowly push in and rotate the end cap until all air is expelled. Retighten the vent screw.

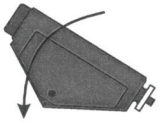
(Gloves not shown for clarity)

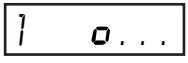
Keep the Viscometer 100mm from the console with the Infra-Red link in approximate alignment.

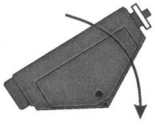


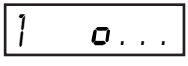
M











Checking the oil Temperature

It is also possible to check the temperature of the oil sample after a test. Press the Temperature button to display the oil temperature.

Note: The viscosity reading is always corrected to 40°C or 100°C irrespective of the oil or ambient temperature.

Checking the SAE Range

The Viscometer will calculate the SAE range for the oil sample as well as the viscosity (cSt). After completing a test, press the Temperature button twice to display the SAE range.
Press the Temperature button again to return to the cSt display.

Improving the Accuracy

The Viscometer can be used on oils that have viscosity indexes or densities that differ from normal monograde engine oils.

- Take a Viscosity reading.

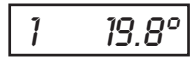
- Press the Return key to enter density function. (Default Density is 900 Kg/m^3). The range is 800 - 999 Kg/m^3 . Select the approximate density using the Speed and Arrow keys.

- Press the Return key to enter Viscosity Index Function. Select the approximate Viscosity Index using the Speed and Arrow keys (Default Index is 100).

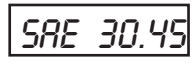
- Press the Return key. The viscosity reading is now corrected to a Density of 0.99 and a Viscosity Index of 140. Further readings will use these values until Mode is cycled, or console is reset.

Calculating Viscosity at 100°C

Obtain the reading corrected to 40°C as normal. Press the Up arrow key to select Mode 1.1. This displays cSt at 100°C. The calculation uses either the default VI or the VI as entered above in section 'Improving the accuracy'. The reading is less accurate than at 40°C, but provides a useful correlation.

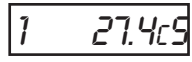


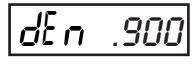
19.8°C

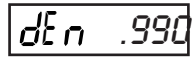


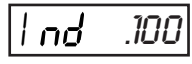
For example:
SAE is 30.45. Oil is in the SAE 30 Band, 45% through the SAE 30 range from low to high viscosity.

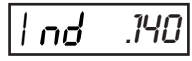
For example:
if using **Mobil** *Jet Oil II, which has a Viscosity Index of 140 and a Density of 0.99*

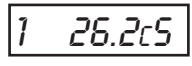


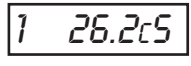


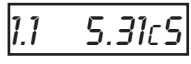












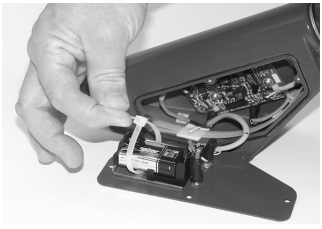
Changing the Battery

Use a 9 volt Alkaline type PP9 battery

- Remove the battery compartment cover using the Allen key supplied.

- Cut the cable tie securing the battery and remove the old battery.

- Fit new battery and secure using a new cable tie. (These are supplied inside the viscometer battery compartment).



- Replace battery compartment cover.

Cleaning after Use

After a measurement is taken, the inside of the measuring chamber must be cleaned of any residual oil, If any is left it 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.

- Carefully open the end cap to empty the oil out of the tube.

- 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

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.

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.

Water in Oil Test

Water in Oil Test (Reagent B) 0 - 2.5%

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

  NB: 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.

  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.

  NB: 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)

(Gloves not shown for clarity)

M

% v/v 4 -----

Zero

4 C 1

% v/v 4 0.33

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 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 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.

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

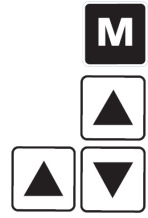
- Place the cell on the console and allow reading to stabilise.
  Press the Zero button to zero the reading and start the test.

- 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.

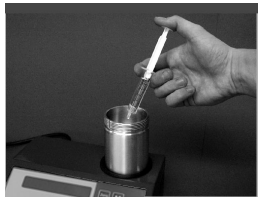
- The display will read directly in:
  Parts per million water in the oil (6000ppm range)

  Note: The two ranges require different cells and it is not possible to toggle between the calibrations. Variation on repeat reading on the 0 - 6000ppm cell of +/- 50ppm is quite normal.



0-6000 ppm 4.1 -----

(Gloves not shown for clarity)



Zero

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).

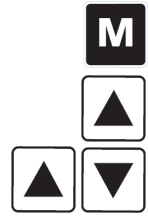
  Note: Note the quantities are different from the other water tests

---

- 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.

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

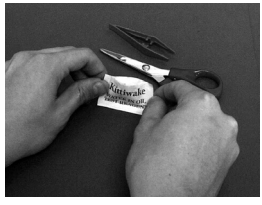
- Place the cell on the console and allow reading to stabilise.
  Press the Zero button to zero the reading and start the test.



% v/v 4 -----

0-3000 ppm 4.2 -----

(Gloves not shown for clarity)



Zero

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 - 2.5% (Standard Cell)
  The display will read as shown.

  NB: 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.

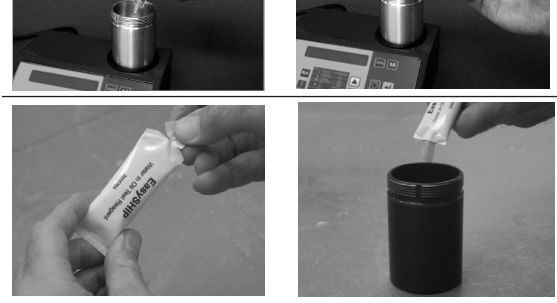
  NB: The test will not work unless shaken vigorously, especially in cold temperatures. EasySHIP Test Reagent must be above 18°C

- The display will read directly in: % 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.

(Gloves not shown for clarity)



Water in Oil Test (EasySHIP) 0 - 6000 ppm
Silver Cell

- Select Mode 4, Water in Oil 0 - 1% (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 - 1% and 0 - 6000 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.

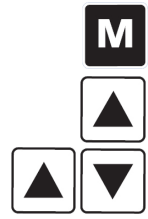
- Place the cell on the console and allow reading to stabilise.
  Press the Zero button to zero the reading and start the test.

- 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.

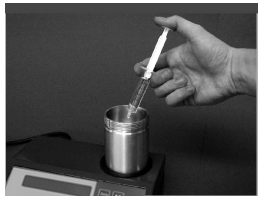
- The display will read directly in:
  Parts per million water in the oil (6000ppm range)

  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 4.1 -----

(Gloves not shown for clarity)



Zero

4.1 C 1

ppm 4.1 480

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

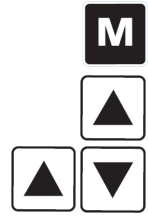
- Cut or tear the EasySHIP Reagent sachet.
  Squeeze all of the EasySHIP paste into the cell, ensuring that all of the paste has been emptied into the cell.
- Place the Agitator into the cell. Replace the cap tightly.

- 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.

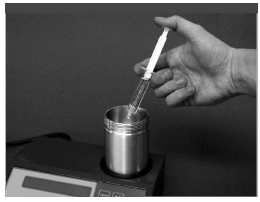
  NB: The test will not work unless shaken vigorously, especially in cold temperatures. EasySHIP Test Reagent must be above 18°C

- 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 4.1 -----

(Gloves not shown for clarity)



Zero

4.1 C 1

ppm 4.1 480

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.

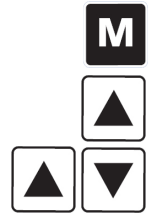
- Place the Cell on a level surface and remove the end cap.
  Add 35ml of Reagent A using one of the syringes provided.
  Add 10ml of the test oil using a different syringe.

  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.

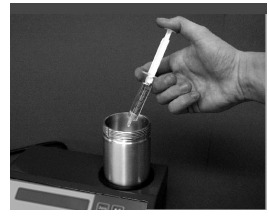
- Place the Agitator into the cell. Replace the cap tightly.
- Place the cell on the console and allow reading to stabilise.
  Press the Zero button to zero the reading and start the test.



% v/v 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 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.

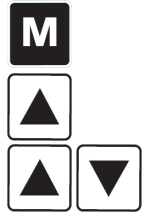
  *Better accuracy can be obtained using a micro pipette (30µl drop).

- 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 -----

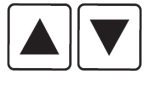
% soot index 2.1 -----

2 X.X

2.1 X.X

2 0.0

2.1 0.0



% w/w 2 1.8

% 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 20 - 40] add 5 ml Test Oil
  [New Oil TBN 40 - 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.

  NB: 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

Zero

Reference Value

●●●●●

Test Value

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.

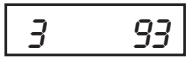
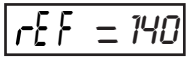
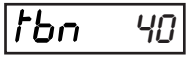
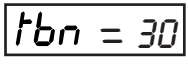
- Press Enter.

- 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).

  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 *from red* through to *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)

M

▲ ▼

5 -----

5.1 -----

5 XXXX

Zero

5 0

5 XXXX

↵

▲ ▼ ●

5 Sr=.05

↵

▲ ▼

IP177 5 X.X

IP139 5.1 X.X

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 from *red* through to *green*).

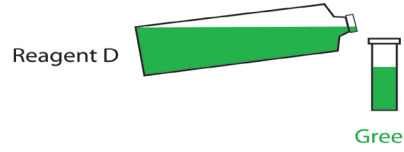
- Press Return and enter the syringe reading using the Up/Down arrows and the Speed key. (The greater the volume of **Reagent F** used, the lower the syringe reading).

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

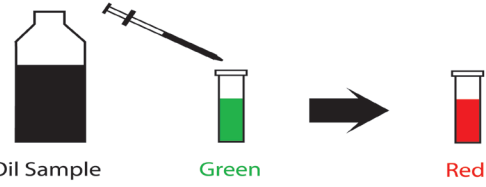
(Gloves not shown for clarity)

Colour Reference for TAN Tests

Start point
Add Reagent D

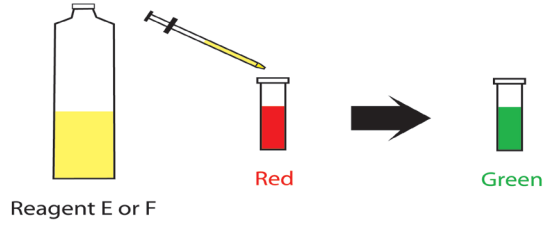


Add the test oil

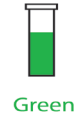


Add Reagent E
or F drop by drop.

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



Finish back at startpoint.



C Health and safety

Operation of the Oil Test Centre

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.

Note: 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

Other Information

Independent Laboratory Report

Saybolt
A CORE LABORATORIES COMPANY
FAST TO THE POINT.

CALIBRATION CERTIFICATE

Report. No: 102/10481-0/08

ROLLING BALL VISCOSIMETER

Manufactor: Kittiwake
Instrument no: 10889
Ref. Oils: Fuel oils

Ref. viscosimeter	Ref. Viscosity (cSt)	Measured Visc. (cSt)	Deviation (cSt)	Acceptable deviation (cSt)
CF-150-570A	18.60	20.4	**1.7**	± 2.3
CF-300-66	173.7	181.0	**7,3**	± 7.8
CF-350-73	383.4	397.1	**13.7**	± 17.3
CF-400-4178	723.4	737.8	**14.4**	± 32.6

DENSITY METER

Manufactor/Model: Kittiwake / AS-K1-301
Instrument no.: 10910
Ref. Oils: Diesel oil (low visc), Fuel Oil (High Visc)
Ref. Densiometer: DMA 45 S1, No.: 252638

Hydrometer no.	Ref. density (g/ml)	Measured Dens. (g/ml)	Deviation (g/ml)	Acceptable deviation (g/ml)
08/189074	0.8560	0.856	**0.000**	± 0.001
07/951066	0.8560	0.856	**0.000**	± 0.001
07/859066	0.9590	0.959	**0.000**	± 0.001

Saybolt Danmark A/S, March 14, 2008

Jan Achmann

APPROVED SAYBOLT

SAYBOLT DANMARK A/S
Fyrtårnvej 11, 2300 Kobenhavn S, Danmark
Tel. +45 3295 3132, Fax +45 3295 3134
Internet: www.saybolt.dk
E-mail: saybolt.denmark@corelab.com

MA-K10368-KW Iss 19

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