

# Fuel & Oil Cleanliness Analyser

## User Manual



March 2018

V1.02

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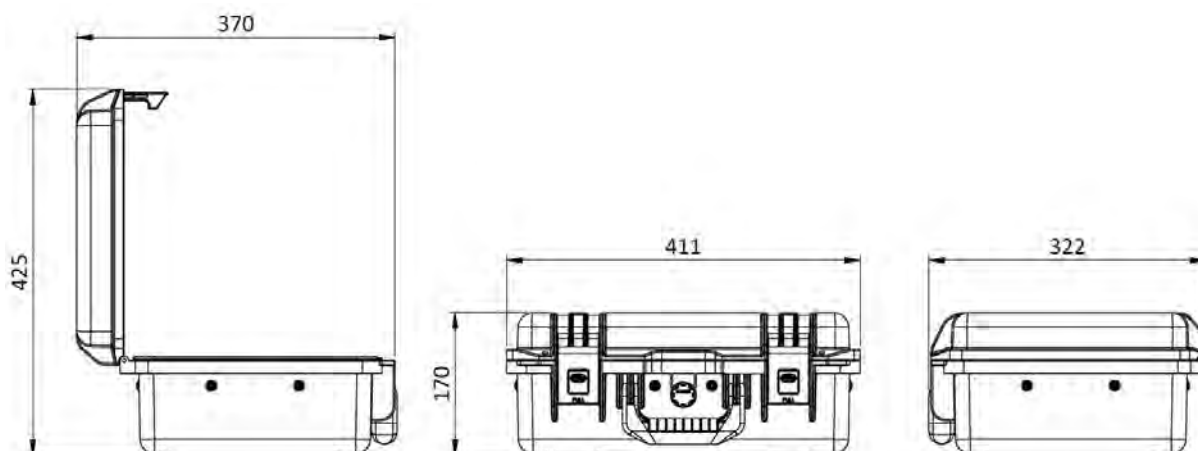
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## Specifications

Specification	Detail
Dimensions	(w)411 mm x (d)322 mm x (h)170 mm
Weight	6.85 kg
Finish	Black HPX resin
Nominal Battery Voltage	15.0 VDC
Charge Voltage	16.8 VDC
Capacity	5.2 Ah
Charge time	2 hours (80%) 5 hours (100%)
Run time	Up to 8 hours (depending on fluid viscosity)
Modes of operation	Tank sampling Bottle sampling (1000ml minimum sample bottle recommended)
Cleanliness standards	ISO 4406, NAS 1638, SAE AS4059
Pump type	Gear pump
Duty cycle	Continuous
Viscosity range	1-320 cSt (1-300 cSt with High Pressure device)
Fluid compatibility	Diesel & oil (hydraulic, lubrication, mineral, synthetic)
Fluid temperature	-10 to 55°C (oils) -10 to 50°C (diesel)
Connections	1604 minimess test points, with 0.6m long 8mm tubing
Pressure	2.5 bar max (up to 350 bar with optional High Pressure device)
Operating temperature	0°C to +50°C
Environment	Lid closed – IP67 Lid open – IP54
Maximum humidity	97% relative humidity, non-condensing
Certification	Factory calibration certificate CE declaration
Verification frequency	12 months recommended
PC requirements	Windows/Mac (with USB port), spreadsheet software (e.g. MS Excel)



## Typical Applications

Typical fuel applications include:

- Test rigs
- Emergency standby power generation
- Diesel fuel systems
- Automotive Industry
- Marine and offshore technology
- Bulk fuel storage depots
- Fuel polishing systems
- Tank cleaning equipment

Typical oil applications include:

- Mining / Heavy industry
- Wind power
- Process technology
- Railway
- Lifting and materials handling
- Hydraulic and mechanical presses
- Construction equipment

## Health, Safety & Environmental Considerations

- This equipment should only be used for its intended purpose by competent and authorised persons, inappropriate use could cause serious injury or death.
- Prolonged contact with oil can cause damage to the skin. Appropriate PPE (personal protective equipment) should be worn when operating the unit e.g. protective gloves, safety glasses, safety shoes etc. Always observe local health and safety requirements.
- The unit should only be used on a flat, even surface and be attended at all times.
- Do not operate switches with wet hands.
- The unit must always be disconnected from the mains supply before carrying out any routine maintenance or repairs.
- Electrical cables and tubes should be checked for any signs of damage before starting the unit.
- Ensure a spill kit is available in case of any accidental spills.
- Used samples must be disposed of in accordance with local environmental requirements.

## Basic Description

Whether on-site or in the laboratory, the range of self-contained fuel and oil cleanliness analysers will provide instant readings to allow you to fully understand the condition of your oils and fuels.

Samples from fuel and oil tanks or sample bottles can be analysed quickly and accurately, thereby minimising the frequency of laboratory analysis. This pro-active maintenance approach is ideal for sites with multiple storage tanks, thereby making the range of analysers the ultimate in survey and diagnostic equipment.

Built-in data logging allows for data to be transferred to a USB stick and displayed in a graphical format using spreadsheet software for trend analysis. By identifying the fluids cleanliness code, the user can be alerted to the need for corrective action.

Connection to a Windows PC/Tablet enables the user to chart cleanliness data in real-time, using the software provided on the USB stick.

## Best Efficiency

During the process of taking fuel or oil samples it is easy to agitate and aerate the samples which when passed through the analysers can lead to inaccurate results. It is recommended to either let the sample sit for a couple of hours or to use a sample pump to draw out the air under negative pressure. It is advisable to use a sample bottle size of at least 1000ml to mitigate aeration problems.

## Precautionary Measures

- The portable analysers are designed for diesel fuel, hydraulic oils and lubrication oils only.
- It is not to be used for highly volatile fluids, such as gasoline, paint thinners etc.

### CAUTION - DO NOT USE THE UNIT WITH THE FOLLOWING FLUIDS:

Fluids not to be used	Related dangers
Gasoline	Fire / Explosion
Inflammable liquids with PM <55°C	Fire / Explosion
Water	Oxidation
Corrosive chemicals	Oxidation / Injury to persons
Solvents	Fire / Explosion / Damage to gaskets

## Component Identification



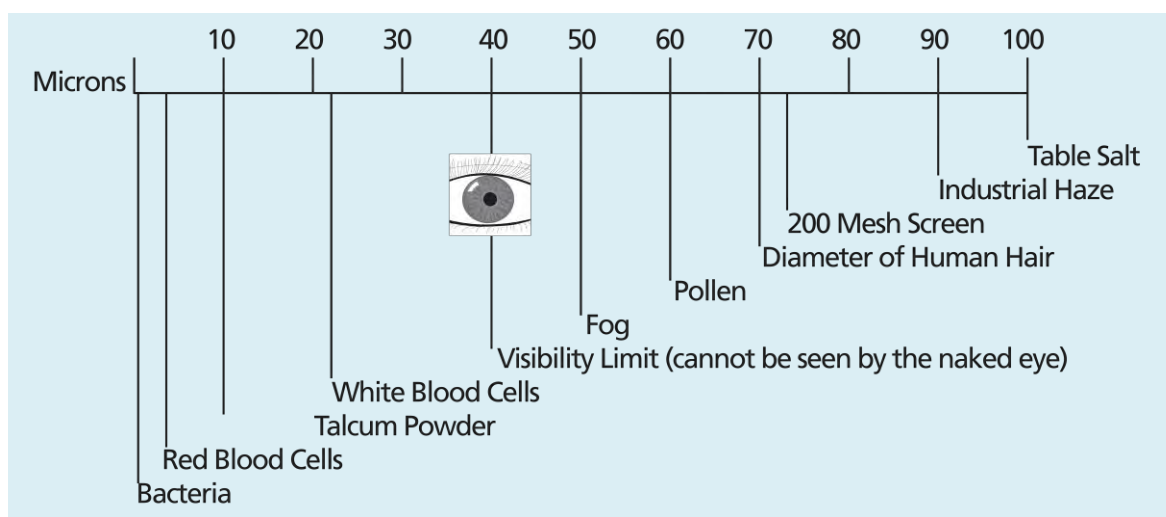
Key:

1.) Charging port	6.) Power / menu button
2.) USB port	7.) Pump on / off button
3.) LCD Display	8.) Pump priming button
4.) Return / Outlet (Minimess Test Point)	9.) Start / stop datalogging
5.) Suction / Inlet (Minimess Test Point)	

## Operational Guidelines

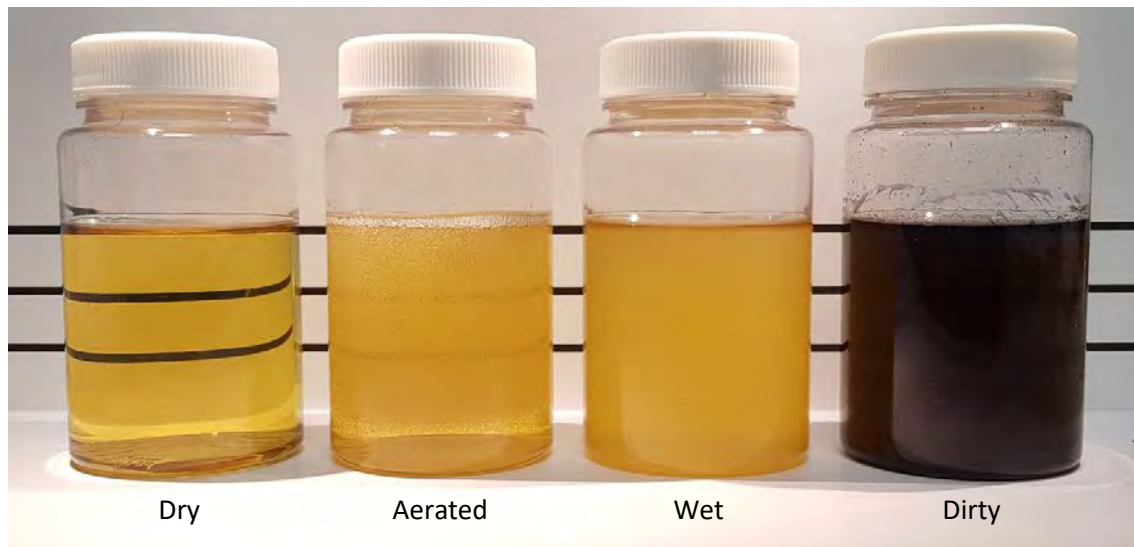
To get the most accurate results from the portable analysers follow the below as a guide:

- When pulling a fresh fluid sample, try to avoid agitation and aeration. It may be beneficial to let the sample sit, allowing air to rise out. The higher the fluids viscosity the longer it will need to sit, this process can be sped up by warming the fluid, therefore reducing the viscosity.
- Portable analysers are designed to detect particulate and water contamination the eye can't see. Carry out a visual inspection of the sample before passing it through the analyser. If particles of dirt are visible, or the sample is hazy indicating high water contamination it is safe to assume the sample is out of specification and requires cleaning.  
Passing highly contaminated samples through the unit can blind the particle counter or damage moisture sensors.



- Wet diesel/oil samples above saturation point will cause moisture sensors to lock out, if this happens run the unit on dry diesel/oil for up to an hour until readings start to fall.
- Keep the suction and discharge hoses clean, stored in an air tight bag and regularly check the suction strainer to ensure accuracy of samples and unrestricted flow.
- Avoid running the unit dry for longer than 30 seconds to prevent damage to the pump gears. The priming button will allow the fluid circuit to bypass the sensors, significantly reducing the time taken to prime the pump.

- Erratic or high counts are often caused by a high water content, an aerated sample or blockage/reduced flow. A dark sample, such as engine oil with high carbon contamination can stop the laser light penetrating the fluid sample and prevent the particle counter from seeing anything. Always visually inspect the fluid sample before passing it through the unit.



- When sampling from a bottle it's advisable to use a 300-1000ml sample, with the suction tube at the bottom and delivery tube near the top allowing air the rise out faster. Higher viscosity fluids may benefit from a larger sample size.
- The internal gear pump can overheat and shutdown to avoid damage when exposed to fluid viscosities above 320 cSt. Warming a fluid sample will reduce the viscosity and strain on the pump. This will also prolong available battery power.

## Fluid Viscosity

The portable analysers are design to handle a fluid viscosity of up to 320 cSt. It's possible to pass high viscosity oils through the unit if they are preheated as per the below table.

Note that as a pre-heated oil passes though the unit it will cool, therefore increasing its viscosity and strain on the pump.

Temperature °C	Viscosity (cSt)								
	ISO 32	ISO 46	ISO 68	ISO 100	ISO 150	ISO 220	ISO 320	ISO 460	ISO 680
10.0	161	262	442	711	1185	1921	2911	4827	8042
12.0	141	227	379	605	1001	1611	2435	3991	6588
14.0	124	198	327	518	850	1358	2048	3318	5427
16.0	109	173	283	446	726	1150	1730	2774	4496
18.0	97	152	246	385	622	979	1469	2331	3745
20.0	86	134	215	334	536	838	1254	1968	3135
22.0	77	118	188	291	464	720	1074	1670	2638
24.0	69	105	166	255	403	621	925	1423	2230
26.0	62	94	147	224	352	538	799	1219	1894
28.0	56	84	130	198	308	469	694	1048	1616
30.0	51	75	116	175	271	409	604	905	1385
32.0	46	68	103	155	239	359	528	784	1192
34.0	42	61	93	139	212	316	464	683	1030
36.0	38	56	83	124	188	279	408	596	894
38.0	35	50	75	111	168	247	361	523	778
40.0	32	46	68	100	150	220	320	460	680
42.0	29	42	62	90	135	196	285	406	596
44.0	27	38	56	82	121	176	254	360	525
46.0	25	35	51	74	109	158	227	320	463
48.0	23	33	47	67	99	142	204	285	411
50.0	21	30	43	62	90	128	183	255	365
52.0	20	28	39	56	82	116	166	228	325
54.0	19	26	36	52	74	105	150	205	291

## Internal Gear Pump

The internal gear pump provides a steady flow for accuracy of results handling fluids up to 320 cSt. Fluids above this viscosity can cause excess motor strain and cause it to overheat. The pump is protected by a thermal switch causing it to shut down at 90°C, preventing thermal degradation of internal components. The pump temperature can be found in the “System Status” menu.

## Battery Charging

The fuel and oil cleanliness analysers are fitted with a li-ion battery, providing up to 8 hours of run time. A charge port on the fascia allows for charging of the battery, which from a complete discharge takes approximately 5 hours (2 hours to reach 80% charge). To maintain the overall life of the battery, avoid complete discharges.



### Battery Charging Unit:

The battery charge unit is designed for indoor use only and should not come into contact with water, dust, oils or grease. To prevent overheating, the product should not be covered whilst in use.

The mains socket should be easily accessible. In the event of operational error, the plug should be immediately removed from the socket.

A fuse protects the product against short circuit and overload. If the fuse needs to be replaced, the same type and size of fuse should always be used.

### Charging Instructions:

It is recommended you connect the charger to the FS9001 and mains socket before switching on the power at the socket. This will reduce the spark that may occur due to the difference in potential between the charger terminals and charge port terminals.

When charging is complete, disconnect the charger from the FS9001 before disconnecting it from the mains.

An LED in the battery charger unit indicates the following status:

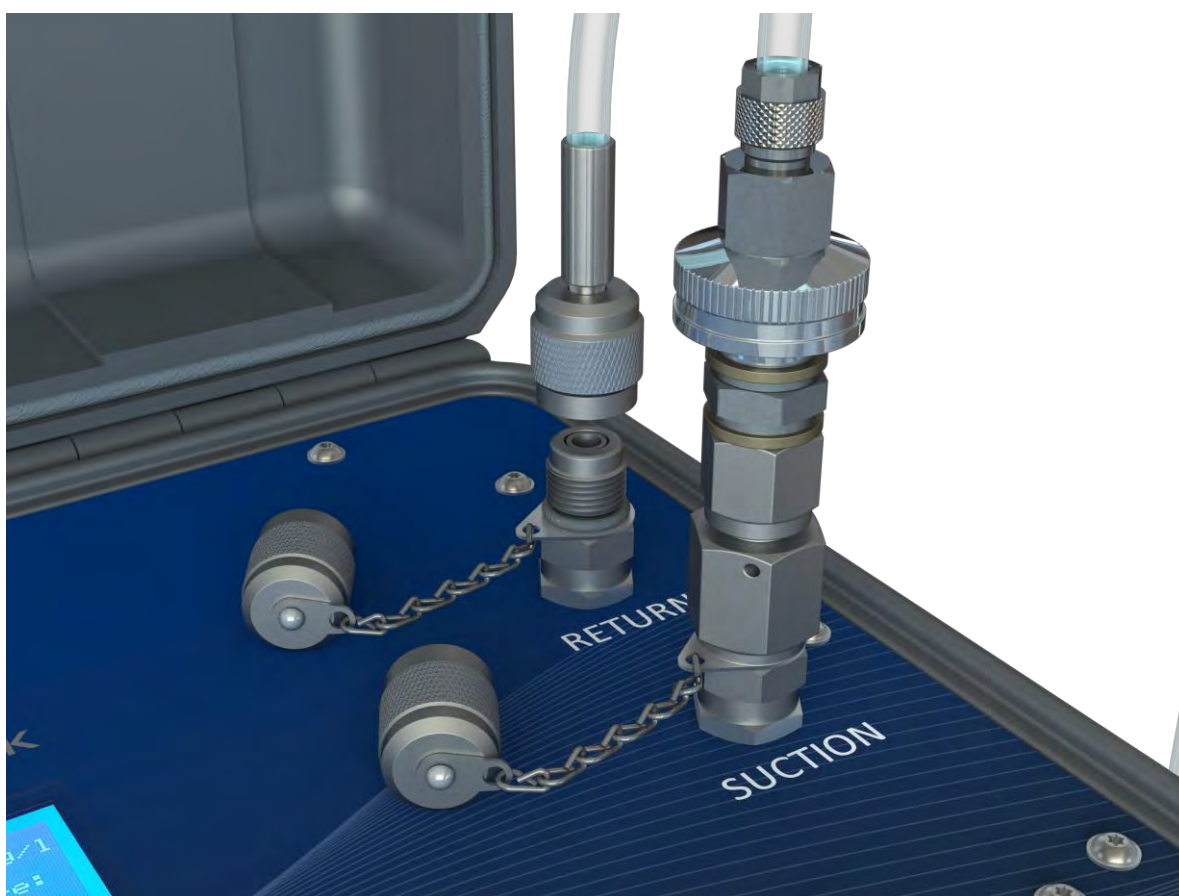
Condition	Description	LED Status
Constant current phase	0-80% charged condition	Orange
Constant voltage phase	80-95% charged condition	Yellow
Charging complete	100% charged condition	Green

## Suction & Return Hose Connections

The portable analysers come equipped with Minimesse Test Points. These seal automatically as the coupling is removed, so the connections won't leak during transit.

To connect the hoses, screw them onto the Minimesse Test Points, hand tight only.

Make sure the hose assembly with the strainer is always used on the suction port.



To disconnect the hoses, unscrew from the Minimesse Test Point. The hose assemblies do not contain a self-seal mechanism and may drip; keep an oil absorbent spill mat ready and store hoses in a clean plastic bag when not in use.

## Suction Strainer

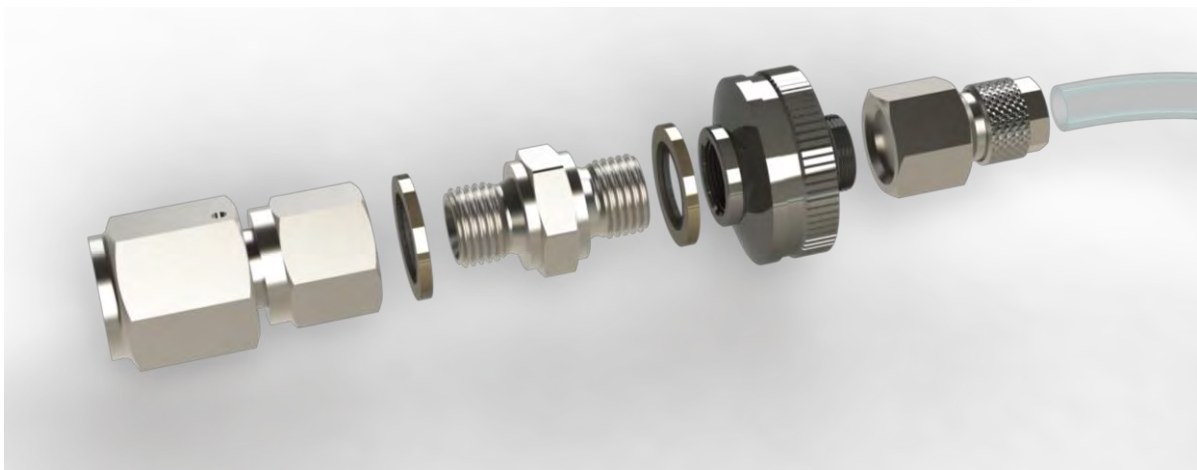
Portable analysers are supplied with a strainer fitted to the suction tube assembly. The inline strainer has a 270 micron mesh and is used for keeping accidental debris from damaging the pump gears or clogging other components.

The strainer must always be used, otherwise the units warranty will become void.

The strainer can be disassembled for cleaning as shown below and should be checked periodically to ensure the flow is unrestricted.

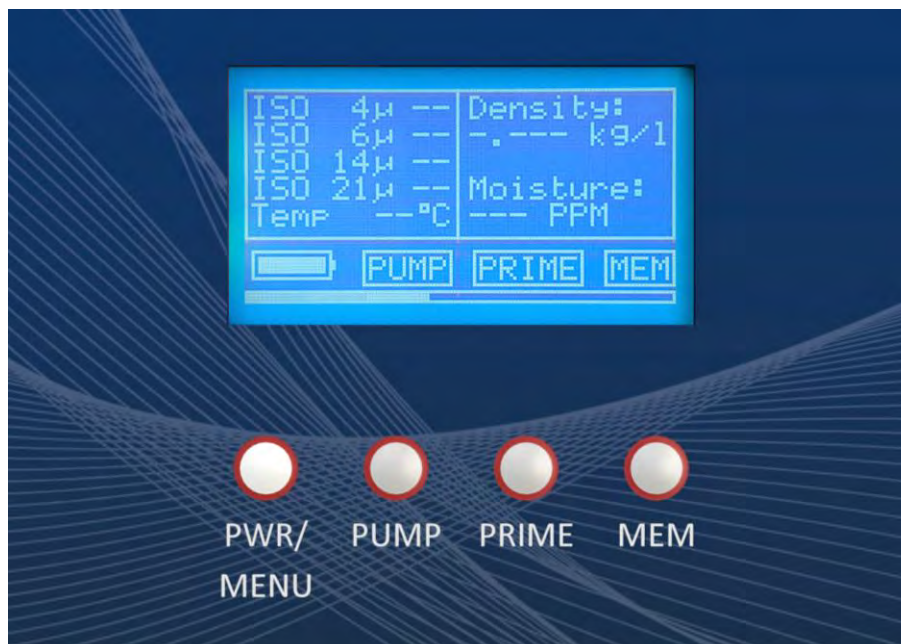


When taking apart the strainer, note the orientation of the mesh for correct reassembly.



## Operating the Unit

### LCD Layout



#### Power On/Off

To power up the unit press and hold “PWR/MENU” button for 2 seconds until the screen illuminates.

To turn off the unit press and hold the “PWR/MENU” button for 5 seconds until the screen switches off.

#### Pump On/Off

To switch on the pump, press the “PUMP” button. On the LCD screen “PUMP” will flash to indicate it’s running. If the pump comes close to it’s thermal limit of 90°C “TEMP” will flash.

#### Priming the Pump

When initially drawing a fluid sample through dry lines the pump will need priming. Once the pump is running press and hold the “PRIME” button until all air has cleared from the lines. Repeat the process to ensure all air has been purged from the system. On the LCD screen “PRIME” will flash to indicate the priming feature is active.

#### Datalogging

The portable analyser has a data logging function which can be activated by pressing the “MEM” button. If data is being logged the “MEM” text on the LCD will continually flash. To stop datalogging press the “MEM” button, the “MEM” text on the screen will stop flashing.

## Battery Indication

The battery indicator shows how much remaining battery life the unit has. It is best to avoid complete battery discharges and keep it topped up. When the battery is low the battery indicator will start to flash. When it becomes critically low a cross will appear, followed by shutting down the unit to protect the battery from damage.

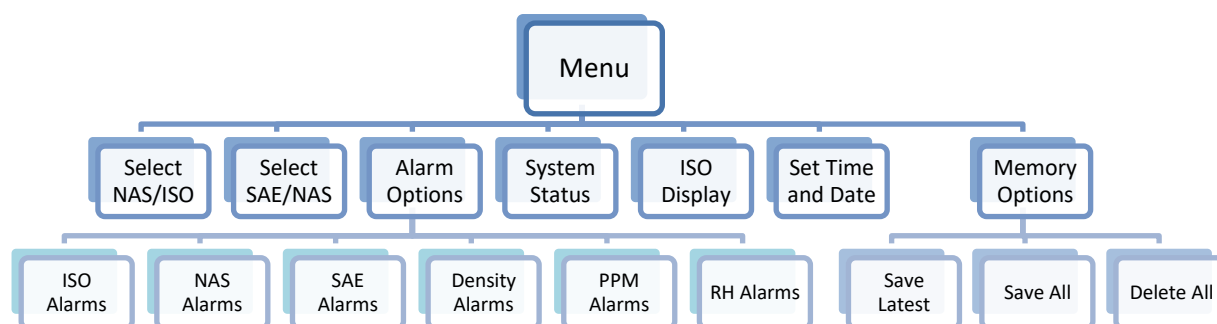


## Polling Bar

At the bottom of the screen is a horizontal bar which indicates when the next set of sensor data will be retrieved. New data will be retrieved every 65 seconds.

## Menu

### Hierarchy



## Switching Between Cleanliness Standards.

The portable analyser can display the fluids cleanliness in ISO 4406, NAS 1638 or SAE AS4059. By default, ISO 4406 is displayed when the unit is powered up.

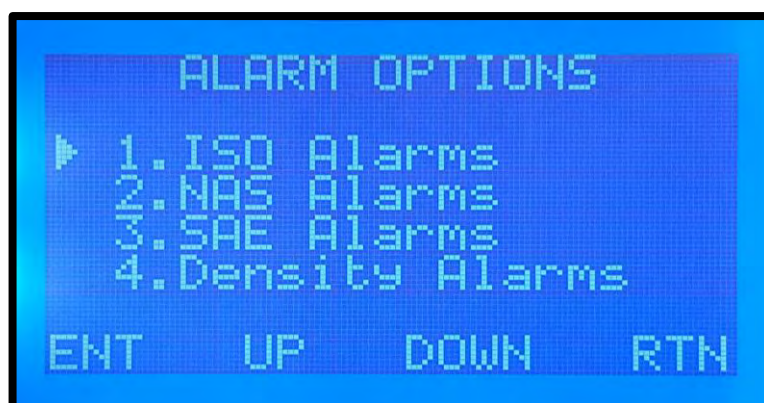
To switch between the available standards, press the “PWR/MENU” button. Use the “PUMP” and

“PRIME” buttons to navigate up and down until the required standard is selected and press the “PWR/MENU” button to activate.



#### Contamination/Cleanliness Alarms

It is possible to set high and low alarm levels for when a fluid sample parameter goes out of range. This can alert the user when reaching the required cleanliness or detecting a spike in contamination.



Alarms for the various categories fall into the following range:

Standard	Minimum Value	Maximum Value
ISO	0	29
NAS	00	>12
SAE	000	>12
Density	0.500	1.500
PPM	0	300
%RH	0	100



### System Status (Error Codes)

If the portable analyser has issues with analysing fluid samples this may be due to an aerated sample or high levels of water or particulate contamination. Each of the sensors can be checked to see if they are communicating correctly and have any error code present.

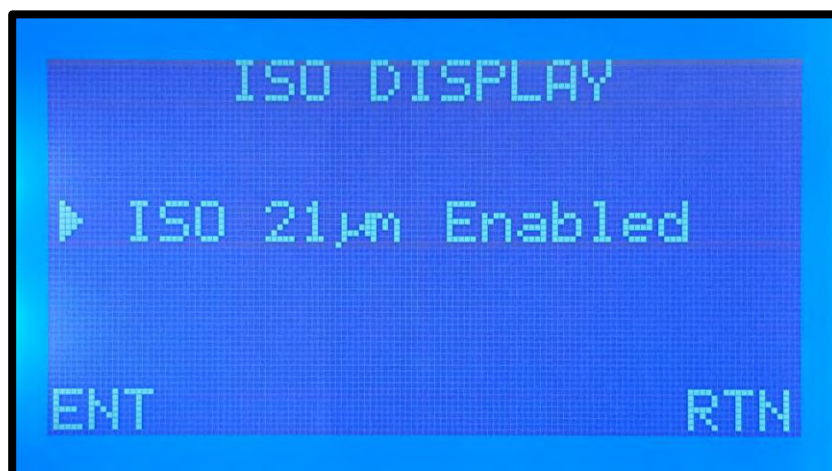
To check the status of the sensors, press the "PWR/MENU" button, scroll down and select "SYSTEM STATUS".



The image above is for an analyser which measures particulate and water content in %RH. If a sensor is not present, this is shown as "NOT SELECTED". The temperature of the pump is also shown.

### 21µm ISO Code

While the portable analyser will display the standard set of ISO codes by default (4µm/6µm/14µm), there is also the option to activate the 21µm code.



### Set Time and Date

The time and date of the portable analyser can be adjusted, particularly useful for making sure the timestamp on logged data is accurate.



To adjust the time and date enter the menu and select "SET TIME AND DATE", the screen shown above will be displayed. The first set of figures will be flashing and can be adjusted by selecting "UP" or "DOWN". Move to the next figure by selecting "ENT". Once you have completed adjusting the last figure a text box will be displayed confirming to save the new time and date settings.

At any point during the adjustment, selecting "RTN" will take you back to the main menu and cancel any adjustments, retaining the original settings.

## Memory Options

Within the main menu “MEMORY OPTIONS” allows you to transfer logged data to a USB stick for trending and analysing in graphical charts.

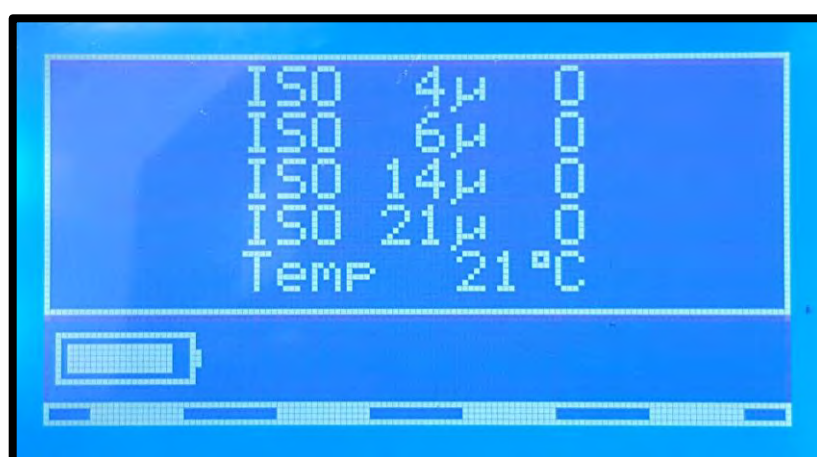


You have the option to either transfer the latest set of recorded data to the USB stock, or all data currently held in memory. It is also possible to delete all data held in memory.

Data from the portable analyser is exported in a CSV file, accepted by most spreadsheet software such as Microsoft Excel. The USB stick provided with the unit contains an Excel spreadsheet which can assist quickly display data in graphical charts.

The portable analysers can hold up to 512 lines of data (approximately 8.5 hrs).

## Connection to PC with ROC Software



When connecting the portable analyser to a PC the scroll bar will change to a dashed line as indicated above.

## Particle Counter – PC9001

### Specifications

Specification	Details
Voltage supply	9 to 33 VDC, 150 mA
Storage temperature	–40 to 85 °C (–40 to 185 °F)
Operating temperature	–10 to 60 °C (–14 to 140 °F)
Altitude limit	2000 m (6562 ft)
Light source	Laser diode, Class I
Particle size/channel	4, 6, 14 and 21 µm (ISO MTD)
Storage/operating humidity	97% relative humidity, non-condensing
Fluid compatibility	Diesel, hydraulic and lubrication oils, mineral, synthetic
Reports	ISO 4406, NAS 1638 and SAE AS4059 cleanliness codes
Wetted materials	Bronze, aluminium (anodized), steel, stainless steel, sapphire, Aflas®
Performance verification	Optional validation certificate available ( $\pm 0.5$ ISO code with ISO MTD at 2.8 mg/L concentration at 100 mL/min)
Reproducibility	$\pm 0.5$ ISO code (minimum concentration ISO MTD 2.8 mg/L, maximum ISO code is 29)

### Calibration

The instrument cannot be calibrated by the user. Contact the manufacturer for instrument verification.

### PC Software Installation

Install the ROC Configuration Utility software to display and trend data to the computer in real-time.

1. Put the utility software disc into the applicable drive on the computer.
2. If the software does not automatically start, find the Setup folder on the disc. Double-click on the setup.exe file.
3. Follow the on-screen prompts to complete the installation.

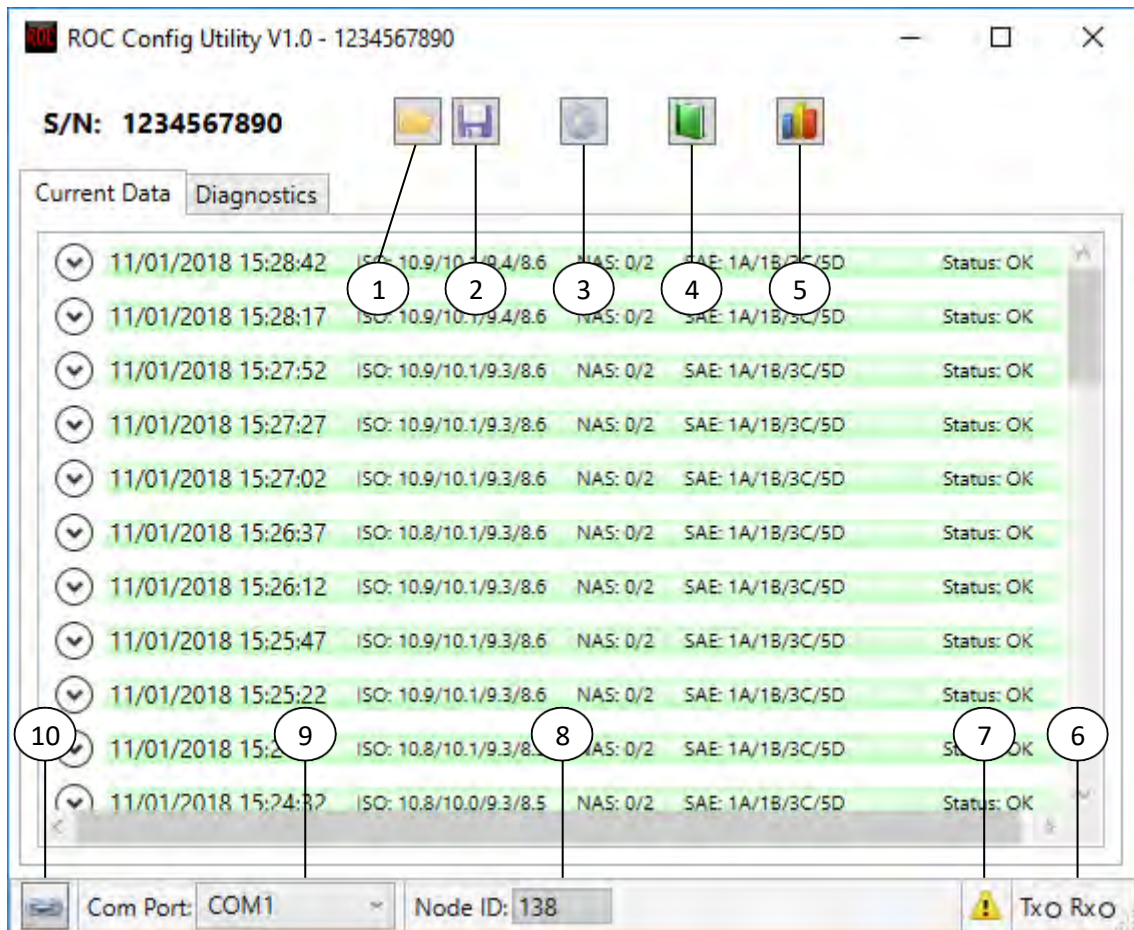
Note: If not already installed it may be necessary to install VCP (Virtual COM Port) drivers for the hardware and software to communicate with each other, this can be obtained from

<http://www.ftdichip.com/Drivers/VCP.htm>

## Operation

### Configuring the Device

- 1.) Open the PC9001 Configuration Utility software. A window opens (see below).
- 2.) Select the communication (COM) port on the computer that is connected to the counter, usually the highest number.
- 3.) Change the Node ID setting to the Node ID of the instrument. The default Node ID setting for new instruments is 138.
- 4.) Click the connect/disconnect button to connect to the counter.



1.) Install settings icon	6.) Transmit and receive indicators
2.) Save settings icon	7.) Error indicator
3.) Edit settings icon	8.) Node ID number
4.) Record data icon	9.) Com Port number
5.) Graph data icon	10.) Connect/disconnect button

## Configuring the Counter

- 1.) From the main screen, select the Edit Settings icon.
- 2.) Select the Counter tab.
- 3.) Make changes to these fields:
  - a. Node ID (138 is the default)
  - b. Sample Period (mm:ss)
  - c. Hold Period (mm:ss)
- 4.) To save the settings to the internal memory of the instrument, select Save Settings to Permanent Flash.

Note: If this option is not selected, the instrument still operates with the new settings. If the power to the instrument is lost, the new settings are lost, and the instrument goes back to the previous settings.
- 5.) Click OK.

## Configuring the Alarms

- 1.) From the main menu, select the Edit Settings icon.
- 2.) Select the Alarms tab.
- 3.) Make changes to these fields:
  - a. Standard (ISO, NAS or SAE)
  - b. Alarm Direction (Clean to Dirty or Dirty to Clean)
  - c. Code Limits (4, 6, 14 or 21  $\mu\text{m}$ ) If NAS is selected as the Standard, only the code limits for 6–14  $\mu\text{m}$  and 14–21  $\mu\text{m}$  will be available.
- 4.) To open the contact when an alarm occurs, select Open Contact on Alarm.
- 5.) To close the contact when an alarm occurs, do not select Open Contact on Alarm.
- 6.) To save the settings to the instrument internal memory, select Save Settings to Permanent Flash.

Note: If this option is not selected, the instrument still operates with the new settings. If the power to the instrument is lost, the new settings are lost, and the instrument goes back to the previous settings.
- 7.) Click OK.

## Configuring General Settings

- 1.) From the main menu, select the Edit Settings icon.
- 2.) Select the General tab.
- 3.) Make changes to these fields.
  - a. Display ISO Codes (All Codes or Highest Code)

- b. Display NAS Codes (All Codes or Highest Code)
  - c. Display SAE Codes (All Codes or Highest Code)
- 4.) To calculate average counts, select Calculate Average Counts and adjust the number of samples.
- 5.) To change the output folder, click the button next to the Log File Output Folder field and select the desired folder. As an option in Windows® Explorer®, move a copy of the output folder into the text box.
- 6.) Click OK.

## Data Management

### Load the Settings

- 1.) From the main menu, select the Load Settings icon.
- 2.) Enter a location and a file name.
- 3.) Click Open.

### Save Settings to a Computer

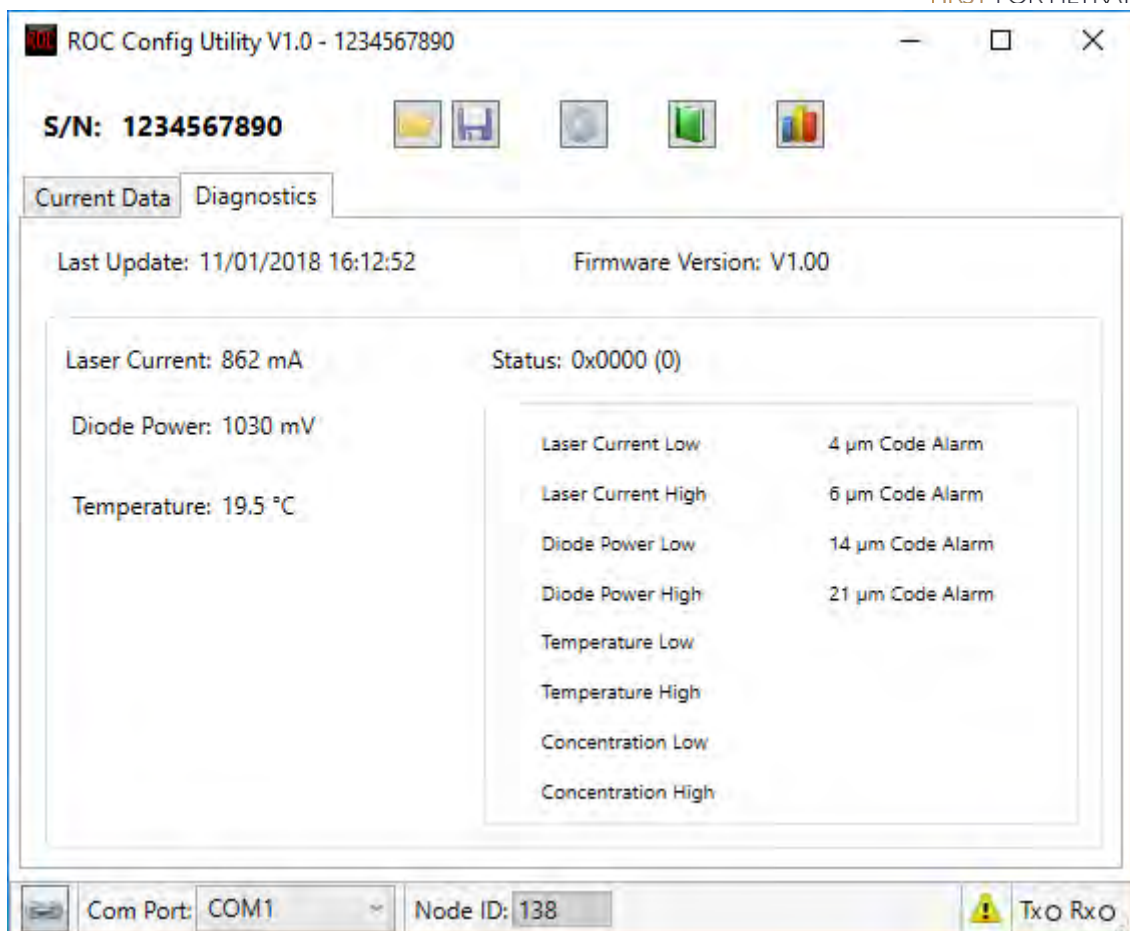
- 1.) From the main menu, select the Save Settings icon.
- 2.) Enter a location and a file name.
- 3.) Click Save.

### View Current Data

- 1.) From the main menu, select the Current Data tab.
- 2.) Click a down arrow (next to each record) to see the particle count data, average particle count data and temperature.
- 3.) To see the errors for an individual data record, move the cursor over the Status text that is located on the right side of the screen. A window opens and shows the error code and a text description of the errors.

### View Diagnostic Data

From the main menu, select the Diagnostics tab. If there is an alarm condition, a red flag is shown (see below).



## Transfer Data

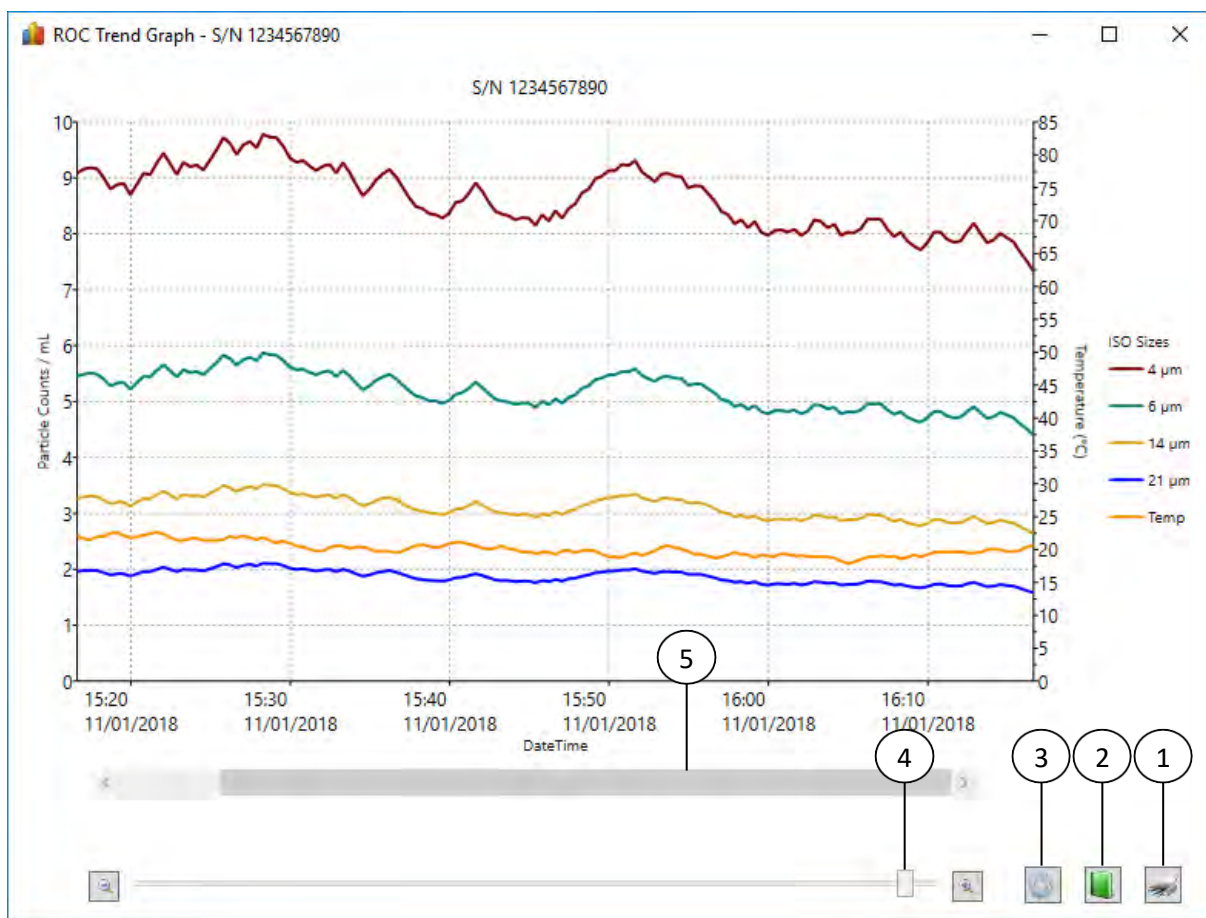
To transfer the collected data to a text file:

- 1.) From the main menu, click the Log Data icon.
- 2.) Enter a unique sample ID.
- 3.) Enter an optional note (up to 255 characters).
- 4.) If necessary, select Log all previously collected results.
- 5.) Click OK.
- 6.) To stop the active collection and transfer of data, click the Log Data icon a second time.

## Create a Graph

The user can open multiple graphs and compare the previously collected data. Each time a new graph window is opened, it shows the current data. The user can then open a log file to graph the previously collected data and compare it to the current data or another log file. To create a graph of the data:

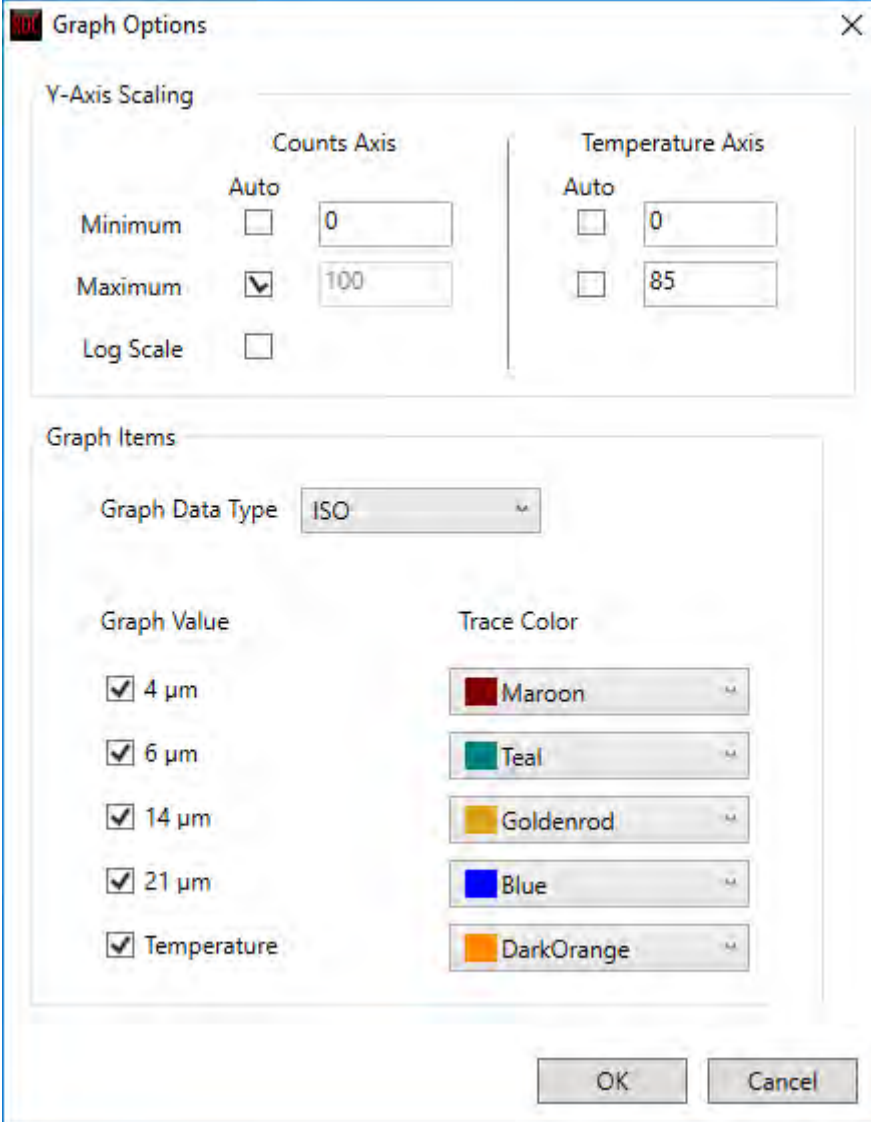
- 1.) From the main menu, select the Graph Data icon. A window opens (see below).
- 2.) To open multiple graphs and compare the collected data, click the Graph Data icon for each graph.



1.) Print graph	4.) Zoom bar
2.) Load data from file	5.) Scroll bar
3.) Graph settings	

## Changing Graph Options

- 1.) From the main menu, select the Graph settings icon. A window opens (see below).
- 2.) Make the applicable changes and then click OK.

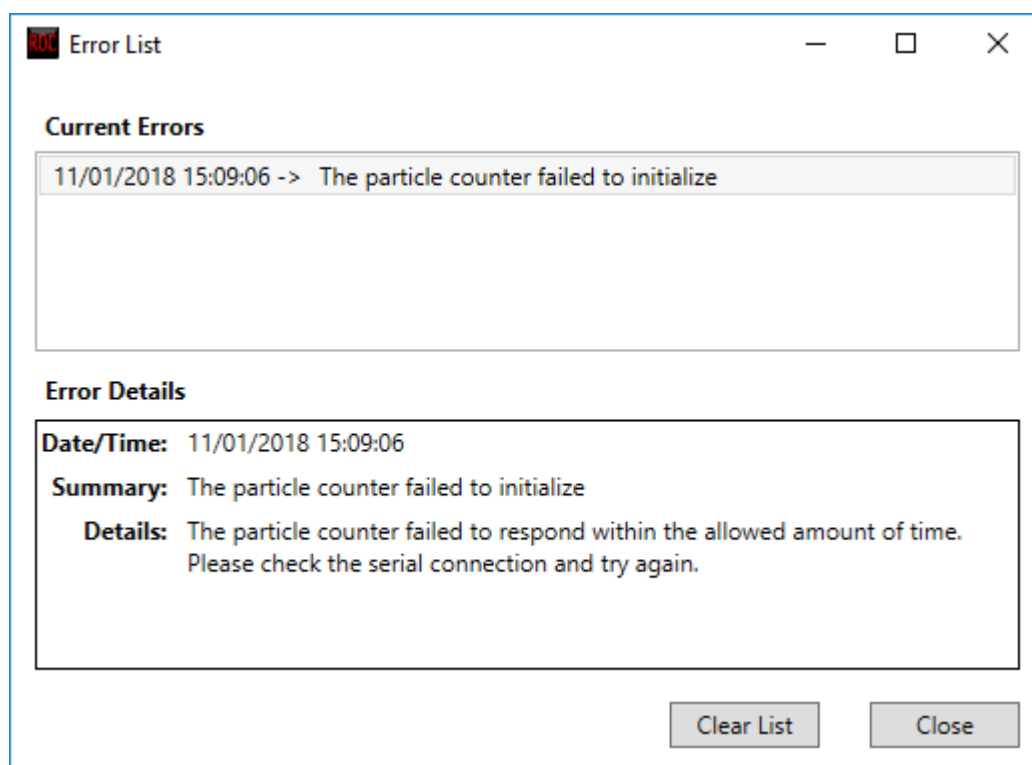


Option	Description
Counts Axis	Selects the particle count for the Y-Axis scaling.
Temperature Axis	Selects the temperature for the Y-Axis scaling.
Graph Data Type	Selects the type of particle count data (ISO, NAS or SAE) to graph.
Graph Value	Selects the traces to show.
Trace Colour	Selects the colour of the graph traces.

## Error Indicator

When an error occurs, an exclamation point appears on the main menu of the ROC Configuration Utility.

- 1.) Double-click on the exclamation point. A window opens (see below).
- 2.) Click on a current error. Details are shown in the lower section of the window.
- 3.) To remove the list of errors in the window, click Clear List. This removes the error indicator from the main screen.

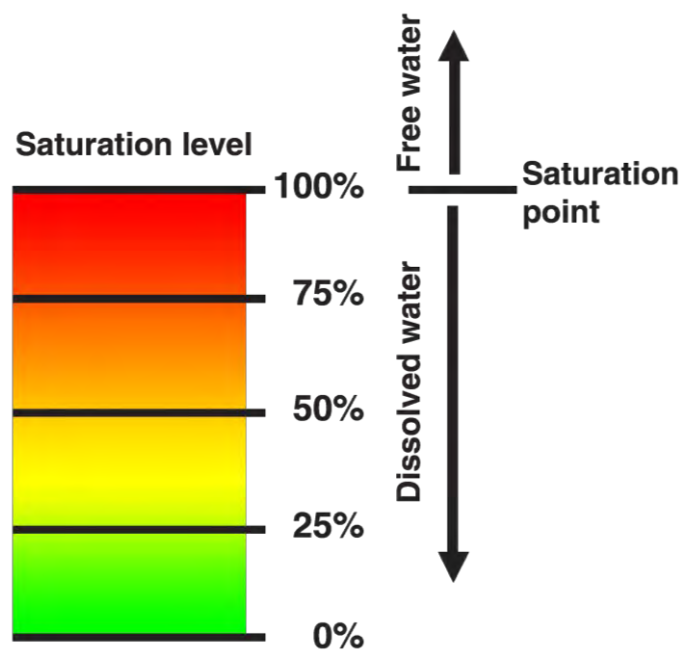


## Water Sensor – % Saturation (RH)

The –RH option incorporates a sensor into the fluid circuit which measures water saturation as a percentage.

The RH sensor measures water content relative to the saturation point of the liquid and outputs the degree of saturation in the range 0-100%. A reading of 0% would indicate a fluid free of water, while a reading of 100% would indicate a fluid that is saturated with water (see diagram below). The capacitance sensor absorbs water molecules from the fluid which change its capacitance value, that capacitance value is directly proportional to the saturation level of the fluid.

Since the effects of free water are more harmful than those of dissolved water, water levels should be maintained well below the saturation point. However, even dissolved water can cause damage, therefore every reasonable effort should be made to keep the saturation levels as low as possible.



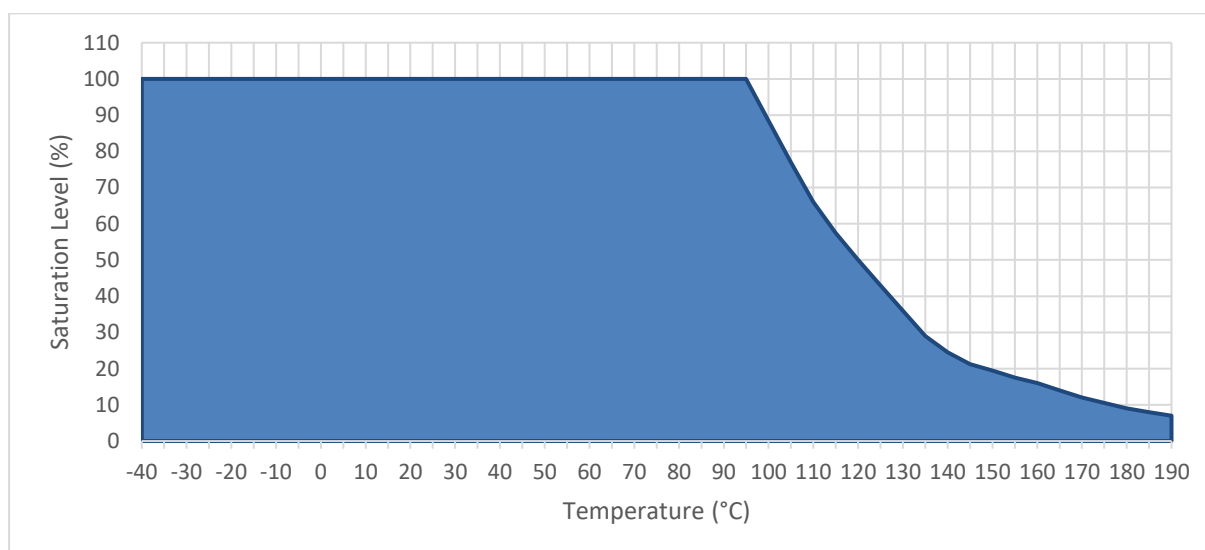
As a guideline we recommend maintaining saturation levels below 45% in all equipment.

NOTE: The water sensor option is ONLY applicable to mineral oils; it does not provide an accurate reading when used with diesel fuel.

## Sensor Specifications

Specification	Details
Fluid type	Oil
Measurement range	0-100%
Measurement temperature range	0-100°C
Measurement accuracy	±3%
Operating pressure	-0.5 to 50 bar
Voltage supply	1-32 VDC
Power consumption	30-60 mA
Output	4-20 mA
Protection type	IP67
Recalibration	Intervals depend on use, recommended annually

## Sensor Working Range



The graph shows the permitted working range for RH sensor. If the sensor is operated permanently outside the range indicated in blue, lasting damage can occur to the sensor element.

If the fluid sample contains free water, it should not be passed through the portable analyser.

## Water Sensor – Parts Per Million (PPM)

The –PPM option incorporates a water moisture sensor into the fluid circuit of the portable analyser.

The sensor offers real time measurement of absolute water content in ppm (parts per million) and outputs a value up to the fluids saturation point.

As per BS EN 590 diesel fuel should contain no more than 200ppm (0.02%) of water.

The sensor is calibrated specifically for use with diesel fuel, use with other fluid types will provide inaccurate readings.

Note: If the fluid sample contains free water or has a water content of above 300ppm (cloudy/hazy appearance) it should not be passed through the portable analyser. Samples above 300ppm will cause the sensor to lock out. If this occurs, clean dry diesel (<100ppm) will need to be flushed through the unit for 15 minutes to 2 hours (depending on level of exposure), where the readings will gradually fall back within its normal operating range.

### Specifications

Specification	Details
Fluid type	Diesel
Measurement range - water content	0-300 ppm
Measurement temperature range	0-50°C
Measurement accuracy	Less than 10% of limit of measurement range accessible
Operating pressure	Vacuum to 300 bar
Voltage supply	18-28 VDC
Power consumption	30-70 mA
Output	4-20 mA
Protection type	IP65
Recalibration	Intervals depend on use, recommended annually

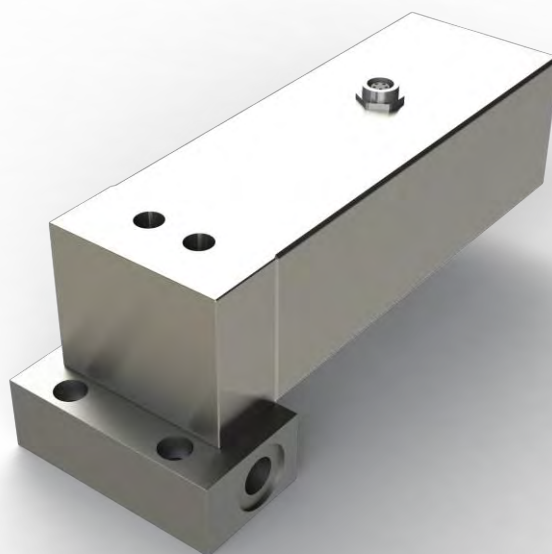
## Density Sensor

The density sensor works on the vibrating tube measuring principle for continuous determination of fluid density or concentration. The fluid to be measured passes through an oscillating element in the form of a bent tube, excited electromagnetically by an excitation coil. As the liquid changes density, the natural frequency of the oscillating elements also changes.

To ensure accurate density readings the fluid should be clean. Contaminant in the form of water or solids may cause a higher than expected reading, while an aerated fluid sample will cause lower than expected readings.

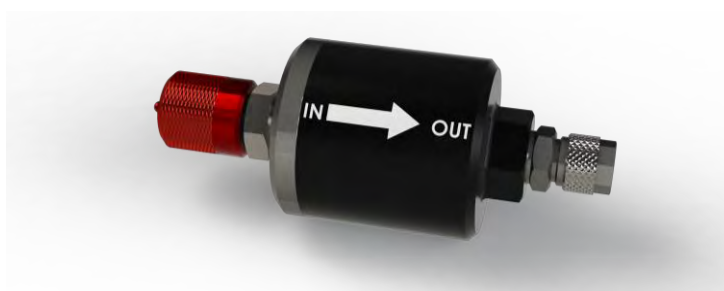
## Specifications

Specification	Details
Accuracy	$\pm 1 \text{ kg/m}^3$
Repeatability	$0.1 \text{ kg/m}^3$
Measuring density range	500 to $1500 \text{ kg/m}^3$
Operating temperature	0°C to 70°C (0°C to 50°C for diesel)
Operating pressure	6 bar



## High-Pressure Device (HP)

The –HP option allows the portable analyser to sample directly from a high-pressure line with a maximum allowable inlet pressure of 350 bar, reducing this down to 2.5 bar at the outlet. The High-Pressure Device has a working viscosity range of 1-300 cSt.



The High-Pressure Device can be purchased separately and used with existing LCD based portable analysers by connecting it to the end of the suction tubing as shown below.



While the High-Pressure Device feeds the portable analyser with fluid pressurised to 2.5 bar, the pump must be switched on to maintain a steady flowrate.

Fluid passing out of the discharge/outlet tube should be fed into a suitably sized sample container for disposal or emptying back into the fluid reservoir.

## Troubleshooting

### General Operational Errors

Problem	Possible Cause	Solution
Unit will not switch on.	Fully discharged battery.	Connect to the mains and fully charge the unit.
Unit will not prime.	Internal tubing/pump gears are dry. High viscosity fluids. Restriction in the suction/discharge lines.	Press and hold the prime button to bypass the sensors, reducing flow restriction. Raise the height of the fluid sample to gravity assist. Check the hoses and strainer for blockages.
Pumps switches off.	Thermal shutdown of pump.	Check the “system status” in the menu for pump temperature (shutdown at 90°C) and try reducing any restrictions or fluid viscosity.
Pump will not start.	Thermal pump protection. Unit has been left containing high viscosity fluids.	If “TEMP” is show on the screen leave for a few minutes to allow pump to cool. Place the unit in a warm environment to reduce fluid viscosity.

### Particle Counting

#### PC9001 Status Alarm Codes

The below table gives the hexadecimal codes for the PC9001 particle counter which are shown on the LCD’s “system status” display found within the main menu.

Note: Combination alarms can occur which make up other hexadecimal codes (e.g., a displayed hexadecimal code value of 006 would be a combination of 002 and 004).

Hexadecimal Code	Description
000	There are no alarm conditions
001	The laser current is low
002	The laser current is high
004	The photodiode power is low
008	The photodiode power is high
010	The temperature is low
020	The temperature is high
040	The concentration is low
080	The concentration is high
100	There is a 4 µm code alarm
200	There is a 6 µm code alarm
400	There is a 14 µm code alarm
800	There is a 21 µm code alarm

## Errors & Corrective Actions

Problem	Possible Cause	Solution
Laser current is high (Code 002)	Possible blockage in the counter/fluid circuit, air bubbles in the fluid or highly contaminated fluid	Check there is adequate flow rate going through the unit (approximately 100ml/min)
		Check/clean the suction strainer for any contamination
		Shine a bright light (such as a phones LED torch) though the suction tubing to check for the presence of minute air bubbles
		Draw out air from the fluid under vacuum
		Let the fluid sample sit in a warm environment for a couple of hours (for high viscosity fluids leave overnight)
Photodiode power is low (Code 004)	See above	See above
Concentration is high (Code 080)	Fluid sample is very dirty, has high levels of water or aerated	Dirty fluid samples which have visible contaminants should not be passed though the unit as filtration is clearly required
		A hazy fluid sample is often an indication of high moisture content and requires filtration. Caution should be taken when passing wet samples though the unit as the moisture sensors can become temporarily locked out or permanently damaged when the fluid is above its saturation point
		Draw out air from the fluid under vacuum
		Let the fluid sample sit in a warm environment for a couple of hours (for high viscosity fluids leave overnight)
High particle count (especially at 14 & 21 $\mu$ m)	Agitation of fluid leading to entrained air in the sample	Draw out air from the fluid under vacuum
		Let the fluid sample sit in a warm environment for a couple of hours (for high viscosity fluids leave overnight)
Contamination codes dropped to near zero	A blockage in the flow path	Check there is adequate flow rate going through the unit (approximately 100ml/min)
		Check/clean the suction strainer for any contamination
Erratic count levels	Unstable sample	Shine a bright light (such as a phones LED torch) though the suction tubing to check for the presence of minute air bubbles
		Draw out air from the fluid under vacuum
		Let the fluid sample sit in a warm environment for a couple of hours (for high viscosity fluids leave overnight)
Software not connecting to unit	Driver issue	Check drivers have been installed (see Windows Device Manager) <a href="http://www.ftdichip.com/Drivers/VCP.htm">http://www.ftdichip.com/Drivers/VCP.htm</a>
		From the ROC software always connect to the highest COM Port (Node ID 138)
		Contact technical support for remote assistance

## Water Sensor - % Saturation (RH)

The most common fault with RH sensors is displaying high readings at around 100% where the value will not come down. This is known as sensor lockout and occurs from exposure to a fluid sample where the water content is above the oils saturation point.

Sensor lockout is resolved by passing clean, dry oil through the unit until the readings start to come down. This could take 15 minutes, or up to 2 hours depending on the level and duration of exposure to water.

Over time, continued exposure to oil above its saturation point will damage the sensor, causing it to respond slower and shorten its useful life.

## Water Sensor – Parts Per Million (PPM)

Exposing the PPM sensor to diesel above 300ppm will cause sensor lockout. This can be resolved by passing clean, dry diesel (<100 ppm) through the unit until the readings start to come down. This could take 15 minutes, or up to 2 hours depending on the level and duration of exposure to water.

Over time, continued exposure to diesel above 300ppm will damage the sensor, causing it to respond slower and shorten its useful life.

## Density Meter

### Errors & Corrective Actions

Problem	Possible Cause	Solution
Negative measuring error Unstable display	Air locks or gas bubbles inside the transducer	De-aerate the fluid sample Rotate the unit around its axis to try and release any trapped air inside
Positive measuring error Long-term drift	Sedimentation in the transducer	Flush the unit with clean fluid to remove any debris Rotate the unit around its axis to try and release any trapped dirt inside the transducer
Negative measuring error Long-term drift	Corrosion Abrasion	Return to supplier for repair
The display does not change or is too slow	Flow in the transducer is too low or zero	Check for any blockages and that there is flow

## Particle Count and Other Codes

### ISO Codes (ISO4406)

The table below shows the ISO 4406 codes by number of particles per 1 ml of fluid sampled.

ISO 4406 Code	Counts/mL	
	Greater than	Up to/including
0	0	0.01
1	0.01	0.02
2	0.02	0.04
3	0.04	0.08
4	0.08	0.16
5	0.16	0.32
6	0.32	0.64
7	0.64	1.3
8	1.3	2.5
9	2.5	5
10	5	10
11	10	20
12	20	40
13	40	80
14	80	160
15	160	320
16	320	640
17	640	1300
18	1300	2500
19	2500	5000
20	5000	10000
21	10000	20000
22	20000	40000
23	40000	80000
24	80000	160000
25	160000	320000
26	320000	640000
27	640000	1300000
28	1300000	2500000
29	2500000	∞

### NAS Codes (NAS 1638)

Class	Particle Size Range (Particles/100 mL)	
	5 to 15 µm	15 to 25 µm
00	125	22
0	250	44
1	500	89
2	1,000	178
3	2,000	356
4	4,000	712
5	8,000	1,425
6	16,000	2,850
7	32,000	5,700
8	64,000	11,400
9	128,000	22,800
10	256,000	45,600
11	512,000	91,200
12	1,024,000	182,400

### SAE Codes (SAE AS4059)

Size, ISO 4402 calibration, or optical microscope count <sup>1</sup>	Maximum Contamination Limits (Particles/100 mL)					
	> 1 µm	> 5 µm	> 15 µm	> 25 µm	> 50 µm	> 100 µm
Size, ISO 11171 calibration, or electron microscope <sup>2</sup>	> 4 µm(c)	> 6 µm(c)	> 14 µm(c)	> 21 µm(c)	> 38 µm(c)	> 70 µm(c)
Size Code	A	B	C	D	E	F
Class 000	195	76	14	3	1	0
Class 00	390	152	27	5	1	0
Class 0	780	304	54	10	2	0
Class 1	1560	609	109	20	4	1
Class 2	3120	1220	217	39	7	1
Class 3	6250	2430	432	76	13	2
Class 4	12,500	4860	864	152	26	4
Class 5	25,000	9730	1730	306	53	8
Class 6	50,000	19,500	3460	612	106	16
Class 7	100,000	38,900	6920	1220	212	32
Class 8	200,000	77,900	13,900	2450	424	64
Class 9	400,000	156,000	27,700	4900	848	128
Class 10	800,000	311,000	55,400	9800	1700	256
Class 11	1,600,000	623,000	111,000	19,600	3390	512
Class 12	3,200,000	1,250,000	222,000	39,200	6780	1020

<sup>1</sup> Particle size based on the longest dimension.

<sup>2</sup> Particle sized based on the projected area equivalent diameter.

## Conversion between Standards

ISO 4406 Code 4µm / 6µm / 14µm	Mil Std. NAS 1638	Mil Std. 1246A	ACFTD Gravimetric Level mg/L	SAE Level
21/19/16	10			
20/18/15	9			6
19/17/14	8	300		5
18/16/13	7		1	4
17/15/12	6			3
16/14/12		200		
16/14/11	5			2
15/13/10	4		0.1	1
14/12/9	3			0
13/11/8	2			
12/10/8		100		
10/10/7	1			
12/10/6			0.01	
11/9/6				

Cleanliness Standards Conversion

Equivalent ISO 4406 Code (approx.)	NAS Code	Size Range in Microns (µm)				
		5-15	15-25	25-50	50-100	>100
-	00	125	22	4	1	0
-	0	250	44	8	2	0
12/10/7	1	500	89	16	3	1
13/11/8	2	1,000	178	32	6	1
14/12/9	3	2,000	356	63	11	2
15/13/10	4	4,000	712	126	22	4
16/14/11	5	8,000	1,425	253	45	8
17/15/12	6	16,000	2,850	506	90	16
18/16/13	7	32,000	5,700	1,012	190	32
19/17/14	8	64,000	11,400	2,025	360	64
20/18/15	9	128,000	22,800	4,050	720	128
21/19/16	10	256,000	45,600	8,100	1,440	256
22/20/17	11	512,000	91,200	16,200	2,880	512
23/21/18	12	1,024,000	182,400	32,400	5,760	1,020

ISO 4406 vs NAS 1638 Contamination

## Required Cleanliness Codes for Fluid Power Components

Element	Type	ISO 4406 Cleanliness Code
Pump	Piston (slow speed, inline)	22/20/16
	Piston (high speed, variable)	17/15/13
	Gear	19/17/15
	Vane	18/16/14
Valve	Directional	20/18/15
	Pressure control	19/17/14
	Flow control	19/17/14
	Check valve	20/18/15
	Cartridge valve	20/18/15
	Proportional	18/16/13
	Servo valve	16/14/11
Motor	Axial piston	18/16/13
	Radial piston	19/17/13
	Gear	20/18/15
	Vane	19/17/14
Actuator	-	20/18/15
Station Nozzle	Worldwide fuel charter cleanliness standard for fuel delivered	18/16/13

## Spare Parts List

Part Number	Description
FS9V2-CUK	240 VAC battery charger with lead
FS9V2-1604-SUC	1604 suction hose assembly (0.6m long 8mm clear tubing)
FS9V2-1604-DIS	1604 discharge hose assembly (0.6m long 8mm clear tubing) includes strainer and fittings
FS9V2-USB-CABLE	USB lead for PC connection
FS9V2-ILS	Inline strainer for suction hose
FS9V2-CAP	Plastic protection cap for power and USB sockets

## Additional Items

Part Number	Description
FS9STP01	Shoulder strap
OSB-500	Sample bottle (500ml)
OSB-1000	Sample bottle (1000ml)

## Warranty Statement

All products manufactured or distributed by Filtertechnik Ltd are subject to the following, and only the following, Limited Express Warranties, and no others:

For a period of one (1) year from and after the date of delivery of a new Filtertechnik product, Filtertechnik warrants and guarantees only to the original purchaser/user that such a product shall be free from defects of materials and workmanship in the manufacturing process. The warranty period for pumps and motors is specifically limited to ninety (90) days from the date of delivery. A product claimed to be defective must be returned to the place of purchase. Filtertechnik, at its sole option, shall replace the defective product with a comparable new product or repair the defective product. This express warranty shall be inapplicable to any product damaged or impaired by external forces or used for any purpose other than that for which it was originally sold.

THIS IS THE EXTENT OF WARRANTIES AVAILABLE ON THIS PRODUCT. FILTERTECHNIK SHALL HAVE NO LIABILITY WHATSOEVER FOR CONSEQUENTIAL DAMAGES FOLLOWING THE USE OF ANY DEFECTIVE PRODUCT OR BY REASON OF THE FAILURE OF ANY PRODUCT. FILTERTECHNIK SPECIFICALLY DISAVOWS ALL OTHER WARRANTIES, EXPRESS OR IMPLIED INCLUDING, WITHOUT LIMITATION, ALL WARRANTIES OF FITNESS FOR A PARTICULAR PURPOSE (EXCEPT FOR THOSE WHICH APPLY TO PRODUCT OR PART THEREOF THAT IS USED OR BOUGHT FOR USE PRIMARILY FOR PERSONAL, FAMILY OR HOUSEHOLD PURPOSES), WARRANTIES OF DESCRIPTION, WARRANTIES OF MERCHANTABILITY, TRADE USE OR WARRANTIES OF TRADE USAGE.

## EC Declaration of Conformity

**Manufacturer's Name:** Filtertechnik Ltd.

**Manufacturer's Address:** 1 Central Park, Lenton Lane, Nottingham, NG7 2NR

**EC Representative's Name:** N/A

**EC Representative's Address:** N/A

**Equipment Description:** Portable analysers for fuel and oil

**Equipment Model Designation:** FS9V2

### Application of Council Directive:

EMC Directive 2004/108/EEC  
Low Voltage Directive 2006/95/EC  
Batteries Directive 2006/66/EC

### Referenced Standards:

EN61000-6-3: 2001  
EN61000-6-1: 2001  
EN61326-1: 2006  
CISPR 11  
EN60825-1: 2007  
EN61010-1:01

I, the undersigned, hereby declare that the equipment specified above conforms to the above Directive(s) and Standard(s).

**Signature:**



**Printed Name:** Daniel Whittaker

**Title:** Engineering Director

**Date:** 09<sup>th</sup> January 2018