



Pall Corporation

# OPERATING INSTRUCTIONS

## Pall® PCM500 Series Portable Fluid Cleanliness Monitor



## PREFACE

The Pall PCM500 On-line Fluid Monitor has been developed to provide accurate and continuous information on the cleanliness of aqueous solutions, hydraulic fluids and circulatory lubrication system fluids. Fluid contamination levels monitored are then converted to the widely used contamination codes: ISO4406, SAE AS4059 table 1 (NAS 1638) and AS4059 table 2. The result data can be exported to Flash Drive, Printer, PC, PLC or network device..

The self-contained unit provides a portable fluid contamination monitor that can be used with a range of fluids, including mineral oils and aqueous solutions. Fluid change procedures are included in this manual and these help ensure the PCM500 monitor is adequately flushed prior to testing on an alternative fluid application.

The contents of these operating instructions should be read before attempting any aspects of installation, operation or maintenance.

The product has been tested and quality controlled in accordance with Pall standard procedures. The customer should carefully inspect the product and ensure it is not damaged and or unsuitable for use. It is the user's responsibility to check actual operating conditions to ensure the PCM500 monitor is compatible with the application and is operated within local safety codes.

### NOTICE TO USERS

The PCM500 user manual is provided to assist users in maximising the benefits of the PCM500 portable fluid cleanliness monitor.

As part of the continuous improvement process that Pall adopt in the development of technology and satisfying customer requirements, this information or procedure may be subject to change.

Pall welcomes feedback from users who should contact their designated Pall Service Centre.

Please note the PCM500 is shipped to users with, a protective fluid, Rust veto NTP 32, which is miscible in both aqueous liquids and oils. Please ensure the unit is flushed out before running tests. The unit should be run for at least three full test cycles on the system fluid before performing a reliable test.



**Important:** Some fluids may react with Rust Veto to create gels, which can result in functional issues within the PCM500. One example is Mono Ethylene Glycol (MEG).

Please check with Pall if there is doubt over the compatibility of test sample and Rust Veto transit fluid.



**Important:**

If the equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.



**Important:**

The PCM500W model is fitted with a sensor to measure water content in oil and produce a % relative humidity or PPM value.

Do not use with water bearing fluids or permanent damage will occur.

## Contents

Section 1	Describes the environmental, mechanical and electrical aspects of the PCM500 monitor to include product specifications.
Section 2	Inspection, packaging and guidance note
Section 3	Description of the PCM500 monitors main items
Section 4	PCM500 principle of operation
Section 5	Pre-check and connection of the PCM500 to a fluid system
Section 6	General operation of the PCM500 monitor, including communications to peripheral devices.
Section 7	Provides communication protocol for PLC control through RS232 Com port
Section 8	Details the fluid change procedure
Section 9	Describes the PCM500 monitor function codes, possible causes and corrective actions.
Section 10	Spare parts list
Section 11	Covers the disposal of equipment
Appendix A	Details the <b>Pall</b> PCM500 series worldwide aftermarket and calibration service.
Appendix B	Details the Mesh Screen Manifold exchange procedure

<b>MANUAL PART NUMBER</b>	<b>ISSUE</b>	<b>DATE</b>
<b>MA-PCM500</b>	<b>2.00</b>	<b>January 2017</b>



Pall Corporation

**PALL MACHINERY AND EQUIPMENT**  
A DIVISION OF PALL EUROPE LTD.

**EC DECLARATION OF CONFORMITY**

PRODUCT DESCRIPTION: Portable Cleanliness Monitor  
PRODUCT PART NUMBER: PCM500 and PCM500W  
SERIAL NUMBER: SEE NAMEPLATE

On behalf of Pall Machinery and Equipment division of Pall Europe Ltd, We hereby declare that the above product complies with the following transposed harmonised standards:-

BS EN 61010-1: 2010	Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory use. Part 1: General Requirements
BS EN ISO 12100 2010	Safety of Machinery – Risk Assessment
BS EN 61000-6-3: 2007	Electromagnetic Compatibility – Generic Emissions Standard Pt 1 Light Industrial
BS EN 61000-6-2: 2005	Electromagnetic Compatibility – Generic Immunity Standard Pt 2 Industrial Environment
BS EN 61000-3-2 : 2014	Harmonic Current Emissions
BS EN 61000-3-3 : 2008	Voltage Fluctuation and Flicker
BS EN 60529:1992+A2:2013	Degrees of Protection Provided by Enclosures

We declare the products specified above meet the Essential Health and Safety requirements of the EC Machinery Directive 2006/42/EC, the EMC Directive 2004/108/EC, the Low Voltage Directive 2006/95/EC and the Pressure Equipment Directive 2014/68/EU ,designated as Category One and has been manufactured in accordance with conformity assessment Module A “Internal Production Control”.

This product must be regularly serviced by Pall and /or their approved agent for the declaration to remain effective after shipment.

A technical construction file number PCM500 Series for this product is retained at Pall Machinery and Equipment. See below for the person authorised to compile the technical file:

Name: Jamie Collard

Signed: -----

Position: Global M&E Product Engineering Director

Date: 8<sup>th</sup> March 2016

For and on behalf of:  
Pall Machinery and Equipment  
5 Harbourgate Business Park,  
Southampton Road  
Portsmouth. UK  
PO6 4BQ.

## WARNINGS, CAUTIONS AND NOTES

Care must be taken in referring to this manual so as to ensure adherence with all warnings, cautions and important notes. These carry information related to the safety of personnel and the integrity and satisfactory operation of plant.

	<b>WARNINGS: THESE ARE INSTRUCTIONS THAT DRAW ATTENTION TO THE RISK OF INJURY OR DEATH.</b>
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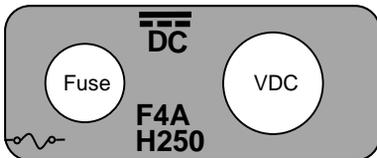
	<b>Cautions: These are instructions that draw attention to the risk of damage to the product, the process, the equipment or the surroundings.</b>
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	<b>Important: These are instructions that draw attention to information that will aid installation, operation or maintenance.</b>
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### Labels affixed to PCM



Caution label attached to Battery cover



Label indicating DC power and Fuse rating



Label indicating refer to manual

## Contents

	Page		
Preface	2	<b>Section 6: PCM500/PCM500W</b>	
Declaration of Conformity	4	<b>Getting Started</b>	
Warnings, Cautions and Notes	5	6.1 General	17
		6.2 System Requirements	17
		6.3 Screen Button Description	18
		6.4 The Screens Flow Chart	19
		6.5 Example Screen	20
		6.6 Start-up Sequence	20
		6.7 Sampling	21
		6.8 Test Point and Fluid Setup	23
		6.9 Code Alarm Set-up	24
		6.10 Data manager Screens	26
		6.11 Tools Screens	28
		<b>Section 7: Interface Protocol – PLC</b>	
		<b>control through DB9 Serial Port</b>	35
		<b>Section 8: PCM500 / PCM500W Fluid</b>	
		<b>Change Procedure</b>	38
		<b>Section 9: PCM500 / PCM500W Function</b>	
		<b>Codes and Corrective Actions</b>	39
		<b>Section 10: PCM500 / PCM500W Spare</b>	
		<b>Parts List</b>	43
		<b>Section 11: PCM500 / PCM500W</b>	
		<b>Cleaning, Maintenance &amp; Disposal of</b>	
		<b>Equipment</b>	44
		Appendix A: Calibration and Aftermarket	
		Services	45
		Appendix B: PCM500/PCM500W Mesh	
		Manifold Exchange procedure	46
		Pall World wide warranty	48
<b>Section 1: PCM500 and PCM500W</b>			
<b>Specification and Requirements</b>			
1.1 General Description	7		
1.2 Fluid Environment	7		
1.3 Ambient Environment	8		
1.4 Electrical Requirements	8		
1.5 Fluid System Connections	8		
1.6 Product Specification	9		
<b>Section 2: PCM500/PCM500W Inspection</b>			
<b>and Packaging.</b>	10		
<b>Section 3: PCM500/PCM500W Description</b>			
<b>of Monitor.</b>	10		
<b>Section 4: PCM500/PCM500W Principles</b>			
<b>of Operation</b>			
4.1 General Principles	11		
4.2 HMI Control Panel	11		
4.3 Test Sampling	11		
4.4 Communication Panel	12		
4.5 Power Schematic	12		
4.5 Battery	13		
<b>Section 5: PCM500/PCM500W</b>			
<b>Connecting the Monitor</b>			
5.1 Connection Options	14		
5.2 Connections	15		
5.2.1 High Pressure Line	15		
5.2.2 Low Pressure Line	15		
5.2.3 Reservoir Sampling	16		
5.2.4 Bottle Sampling	16		
5.3 Operational Checks	17		
5.4 Installation Checks	17		

## Section 1: Pall PCM500 and PCM500W Fluid Cleanliness Monitors Specification and Requirements

### 1.1 General Description

The Pall PCM500/PCM500W is specifically developed as a portable diagnostic monitoring device that provides an assessment of system fluid cleanliness. A fixed display/controller allows for simple menu driven input of sample identification, monitor configuration and data output in ISO4406, SAE AS 4059 Table 1 (NAS 1638) or SAE AS 4059 Table 2 formats. The display/controller shows the test results, an option to graph results and this data is automatically stored for subsequent trending and evaluation. The self-contained design provides for a portable fluid contamination monitor that can be used with a range of fluids including mineral oils and aqueous solutions. Note: The PCM500W should not be used for aqueous solutions. Fluid change procedures are included in this manual and these help to ensure the PCM500 monitor is adequately flushed ready for an alternative fluid application

See Pall Datasheet M&EPCM500EN for full technical specification

The full technical specification is given below.

### 1.2 Fluid Environment

Operating Pressure range	0 to 315 bar (4,570 psi) maximum	
Operating Viscosity range	1.5 to 450 Centistokes (30 to 2,200 SUS)	
Operating System	Mineral Oils	10C - 80°C (50°F - 176°F)
Temperature	Water Glycols	10°C - 60°C (50°F - 140°F)
	Water Based Fluid	10°C - 60°C (50°F - 140°F)
	Fuels	10°C - 40°C (50°F - 104°F)
	Industrial Phosphate	
	Esters & Polyesters	10°C - 80°C (50°F - 176°F)



Be aware of possible danger associated with high oil temperatures and exposed metal surfaces of the PCM500

#### Fluid Compatibility

Aqueous solutions within a pH range of 4.0 to 11.0, water glycols, high water based fluids, petroleum based fluids, industrial phosphate esters, mineral oils and synthetic fluids.



Do not use Acetone based fluid.

#### Seals

Fluorocarbon (Viton)



**WARNING: Health and Safety.**

Observe caution when handling fluids and pay attention to instructions of safe use in the Material Safety Data sheet and COSHH regulations.

Wear protective clothing if prescribed; e.g. safety gloves, clothing and footwear.



**Caution: Health and Safety.**

Ensure there is adequate lighting to operate the equipment.

Observe local regulations for factory use.

## Section 1: Pall PCM500 and PCM500W Fluid Cleanliness Monitors Specification and Requirements

### 1.3 Ambient Environment

Operating Temperature range	5°C - 40°C (41°F - 104°F)
Storage Temperature range (Monitor drained of fluid)	-20°C to 55°C ( -4°F to 131°F)
Dust and water protection	IP65 (NEMA 4)
Relative Humidity	95%rh non-condensing
Operating Altitude	<2000 metres



**WARNING: Do not use the PCM500 Series Monitor in an explosive atmosphere**

### 1.4 Electrical

External Mains Power Supply Unit (PSU) Accessory	Input 100 – 240 VAC (Auto Ranging) Frequency 50 – 60 Hz Single Phase. Output 48V DC
Input Fuse	Quick Blow, 4A 5x20mm (250V)
Optional Mains Supply Unit	Input 100 – 240 VAC (Auto Ranging) Frequency 50 – 60 Hz Single Phase. Output 24VDC
Internal Battery	12VDC Lithium Ion rechargeable.
Battery Life	Typically 35 - 40 samples depending on cleanliness levels & oil viscosity
Communications	USB 1 (Data Download or Printer or WiFi) USB 2 (PLC control of PCM) USB 3 (Data Download or Printer or WiFi) Ethernet Cat5 (Remote control ) RS232C (PLC Control) Voltage Free Contacts (Alarm output – contact rating 1 Amp @ 24VDC)

### 1.5 Fluid Connections

Inlet – 2 options	<b>High Pressure:</b> Hose end ¼” BSP female swivel fitting with Metric, Imperial or NPT Test Point connector.. <b>Low Pressure:</b> Hose direct coupled on ¼” BSP female swivel fitting. Sampling stalk (for bottle sampling)
Outlet	M10 male fitted to 6mm OD. Clear plastic hose, with straight adapter and cap.

**Section 1: Pall PCM500 and PCM500W Fluid  
Cleanliness Monitors  
Specification and Requirements**

**1.6 Product Specification**

Weight	11 Kg (24 lb)
Dimensions	400 x 260 x 250 mm (15.75" x 10.2" x 10")
Monitoring range ISO4406	11/9/7 to 23/21/17
Monitoring range SAE AS4059F Table 1 (NAS1638)	6-14µm & 14-21µm Class 1 to 12
Monitoring range SAE AS4059F Table 2	>4µm;; >6µm;; >14µm;; >21µm Class 1 to 12
Accuracy	±1/2 ISO4406 Code
Water-in-Oil (PCM500W only) %rh. (PPM switchable but requires C1, C2, C3 & C4 fluid constant input. Contact PALL representative).	± 2% at 5 to 95%rh (non-condensing) 0 to 100% full range
Enclosure Material and Flammability	ABS UL94 V-0
Enclosure Gasket Seals	Silicone Rubber
Noise Level	<70 dBA

**Foreseen misuse of equipment**

Within this manual are cautions and warnings to highlight potential dangers associated with operation of the PCM500. Here are a few points of note on misuse of the equipment.

A danger to the user can arise from connecting the PCM500 to a pressured system above the working limit, and / or, using an incorrect high-pressure connection.

Damage to the PCM500 can occur from using incompatible fluids.

A danger to the user and damage to the PCM500 can be from an incorrect mains voltage supply.

## Section 2: Pall PCM500 and PCM500W Fluid Cleanliness Monitors

### 2.1 Inspection and Packaging

The PCM500 is shipped in a transportation case. Use this case for re-shipping the PCM. Visually inspect the case for signs of external damage that may have occurred during shipping and bring any damage to the attention of the shipper.

Inspect the interior of the case for damage to the contents as listed below. Compare the contents of the case with the shipping papers to assure all the content is present. If any items are missing, contact Pall or an approved agent.

The PCM500 package comprises of:

- Integrated PCM500 series monitor with sample hoses
- Power supply unit
- Mains power lead
- PCM500 series Operating Instructions on USB Stick
- PCM500 series Quick Reference Guide
- Fluid Sampling stalk
- High Pressure test point connector (Choice of Minimes, Imperial or NPT)
- Certificate of Conformity
- Certificate of Calibration Verification
- Packing note checklist

The instruments' specific serial number and calibration/service record sheet is also included. It is important to keep this in a safe place and return them with the unit for future annual service requirements.



**Caution: Health and Safety.**  
Ensure there is adequate lighting to operate the equipment.  
Observe local regulations for factory use.

## Section 3: Pall PCM500 and PCM500W Fluid Cleanliness Monitors

### 3.1 Description of the Monitor

The PCM500 is designed and built for light Industrial use while maintaining aesthetic and user friendly ergonomics. See section 1 for full specification. The materials are selected to meet the various fluid and environmental conditions that the PCM500 is likely to be subjected during operation.

As a self-contained unit, including sampling hose and adapters, the user is able to connect the PCM500 on-line or sample fluid directly from a system reservoir without breaking lines thereby avoiding extraneous contamination.

The PCM500 cleanliness monitor provides numerous display functions to assist the user at all stages of operation and provides function codes to warn of any problems with both the PCM500 and system fluid.

1. HMI (display/controller)
2. Communication Ports
3. Robust case with carry handle.
4. Integral 12VDC battery
5. Printer storage compartment
6. Last Chance Filter Housing
7. Hose Storage
8. Mesh Screen block
9. Power input and Fuse



## Section 4: Pall PCM500 and PCM500W Series Fluid Cleanliness Monitor

### Principles of Operation

#### 4.1 General Principles

Upon starting a test sequence the PCM500 will self-prime and perform internal checks on the sample fluid condition. This is an automatic part of the test. After approximately 30 seconds the PCM500 will begin the analysis. The screen will display a progressive time bar for the duration of the sampling period and each stage in the monitoring cycle is indicated above the progress bar.

During analysis the sample fluid is presented to two mesh screens in a specified sequence. which capture contamination that is larger than mesh pore size. Particle concentrations are measured and computed for each specific mesh.

The sample data is constantly analysed to identify any excessive variance in temperature, viscosity, and pressure to ensure results are not spurious. The PCM500 will advise the user by function codes, if any excessive variance occurs.

#### 4.2 HMI Control Panel



There are three light emitting diodes (LED) to indicate PCM500 operational status and two soft-touch control buttons.

#### BUTTONS:

- START/STOP/REPEAT (test) 
- ON /OFF 

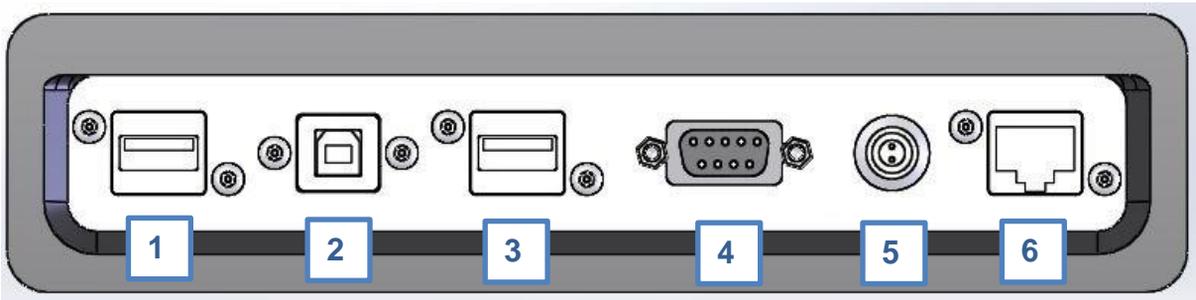
The test Start/Stop button is active on release. The ON button is active on release but OFF requires pressing for 2 -

Blue LED		Green LED		Red	Description
On	Off	Flash	On	On	
x					External power connected and battery in charge mode.
	x				No external power (battery only)
		x			PCM500 On - Operational / Standby
			x		Test in Progress
				x	On Boot Up sequence and if Hardware/Sampling problem detected

#### 4.3 Test sampling

The HMI LCD display is designed to provide clear viewing of the screen menus and test data. The test sample sequence is initiated by use of the primary function keys. In edit mode a keyboard is displayed on the screen, which enables users to enter, or edit data including sample points and fluid types.

## 4.4 Communications Panel



1	USB-A Socket 1	Result download from memory, Printer or WiFi connection.
2	USB-B Socket	PLC control of PCM500 (See section 7)
3	USB-A Socket 2	Result download from memory, Printer or WiFi connection
4	DB9 Female	PLC control (RS232) (See section 7)
5	2-Pin Socket	Voltage free contact. Relay
6	RJ45 Cat5	Ethernet 10/100 base

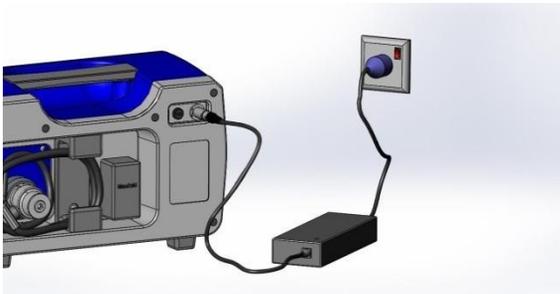
### Screen indication of valid port connection



A row of five small boxes in the bottom right corner of the display screen indicates when a port connection is active.

U = USB-A  
 E = Ethernet  
 W = WiFi (Dongle Required)  
 P = Printer (USB lead) B = Printer (Bluetooth)  
 \* = Engineer logged on

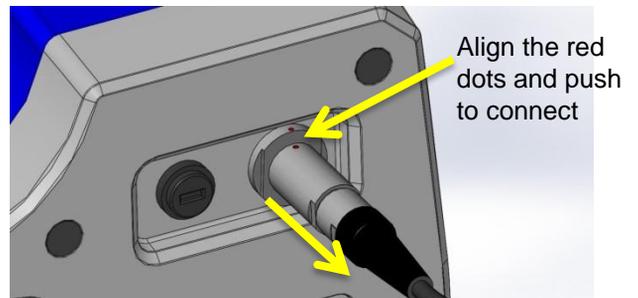
### 4.5 Power Schematic



The PCM500 is normally powered by a battery located in the front of the unit behind a plain panel. This has capacity at full charge to power the monitor for an average of 40 tests (depending on oil viscosity). A power supply unit (PSU), supplied as part of the PCM500 package, allows the monitor to be run from mains power and to charge the battery.

An indication of battery charge can be seen in the lower right corner of the display.

### External Supply



Grip connector outer body and pull straight to disconnect.

### Important:

The PSU cable connection uses a push – pull action on the outer body and both connector and receptacle align through a 'red dot' location mark. DO NOT attempt to remove by rotating the connector.

## 4.5 Battery

### Important:

The monitor should not be operated with the battery pack disconnected. If a power outage occurs on mains supply during testing the battery will maintain power to the PCM to prevent loss of data and allow for a safe shut down.



**WARNING:** Use only battery packs supplied by the manufacturer or Pall agent. Serious damage will occur if a battery of different chemistry or specification is used.

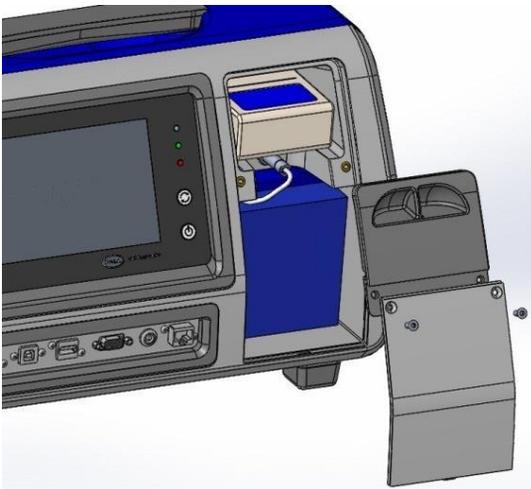
### Important:

If the PCM500 is unused for long periods it is advised to maintain the battery in operational condition by re-charging every 6 to 8 weeks.

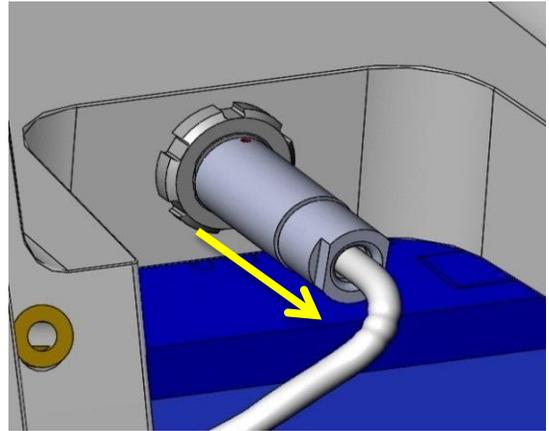
Simply connect the external power pack and ensure the blue LED is on. Allow to charge for a minimum 4 hours.

In the event of battery replacement the following procedure should be followed.

1. Ensure the PCM500 is OFF and the external mains power supply disconnected.
2. Remove the two M4x10 hex socket screws from the battery cover and lift out the cover and then the printer storage cover.



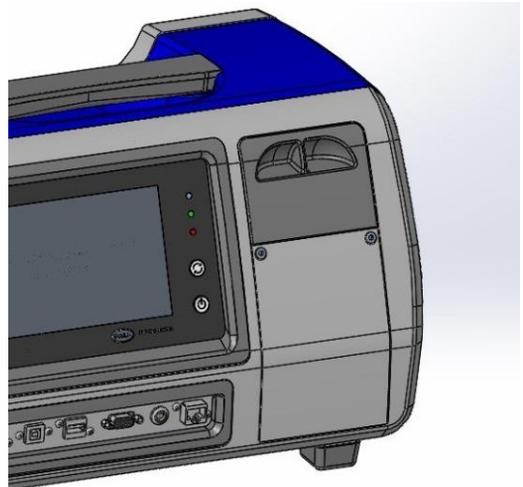
3. Remove the printer, if present, to allow full access to the battery connector



4. The battery connector is removed by pulling straight on the outer body. Do not rotate the connector, otherwise damage will result.

5. When connecting the new battery, align the red dots between connector and receptacle before insertion.

6. Replace the printer and battery covers and fix with the M4 hex socket screws.



## Section 5: Connecting the PCM500

### 5.1 Connection Options

A general checklist for the user before starting is given in section 5.3 and also in the 'Useful information' quick reference card for a PCM500 unit.

PCM500 is configured for two hose operation, inlet and return and these are stored within the rear of the instrument. The high-pressure hose is used for both high and low-pressure sampling. Fluid entering the PCM500 is filtered for contaminant larger than 65µm diameter by a mesh cartridge element (Last Chance Filter). This element is user changeable. In the event of a blocking filter, fluid entering the PCM will be restricted. The PCM will detect a loss of fluid and produce an error code and message on the display.

The sample take-off point in pressure systems should be cleaned of contaminant before connecting the PCM hose and in both high and low pressure sampling modes the return line must be unrestricted and allowed to drain into a waste container or system reservoir.

The PCM500 can be connected in various ways. High-pressure mode is considered to be the most appropriate to achieve representative sampling.

It is important to note that due to the very small bore through the high-pressure connector it must be removed from the inlet hose when sampling below 1 bar pressure. If not, an error may occur through insufficient fluid flow into the PCM.

When sampling a closed system, it is advised to flush the PCM with one test to waste to prevent cross contamination by fluid remaining in the PCM from a previous test.



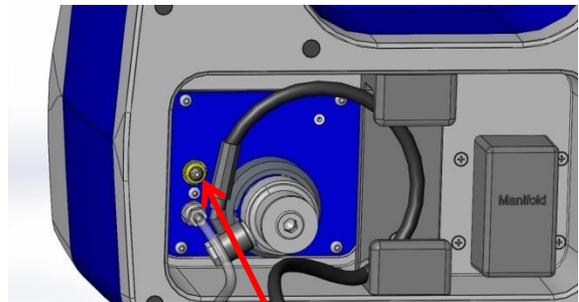
**Caution:**  
Do not position the PCM that makes it difficult to disconnect power.



**Caution:** In the interests of safety, always remove the end cap from the return line before connecting the inlet hose to high-pressure. If the PCM Pressure Reduction Valve does not regulate properly then excess outlet pressure can escape through a relief-valve into the return line.  
**NEVER LEAVE A PCM CONNECTED TO HIGH-PRESSURE WITH THE RETURN LINE CAPPED.**

If the return line is capped or blocked and a fault occurs with the Pressure Reduction Valve, then to prevent damage to the internal circuit a secondary relief valve will exhaust through a diffuser element at the rear of the PCM above the return outlet. It is important, therefore, to be aware of a possible loss of system fluid.

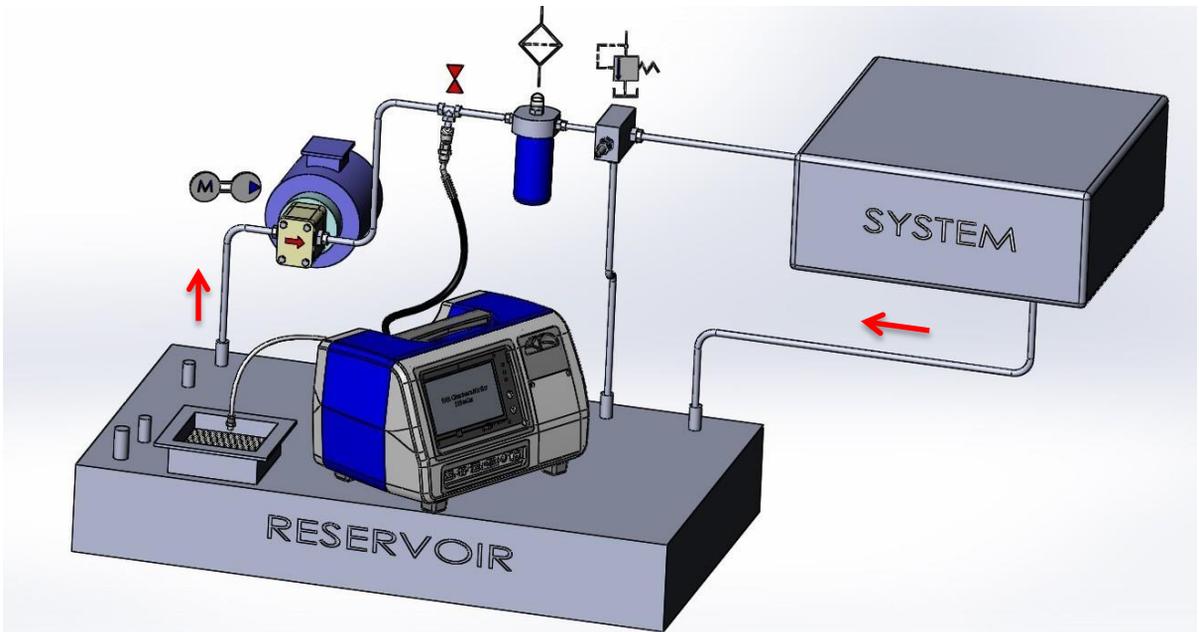
See the below image of diffuser location.



Safety Relief Exhaust Point

## 5.2 Connection Options

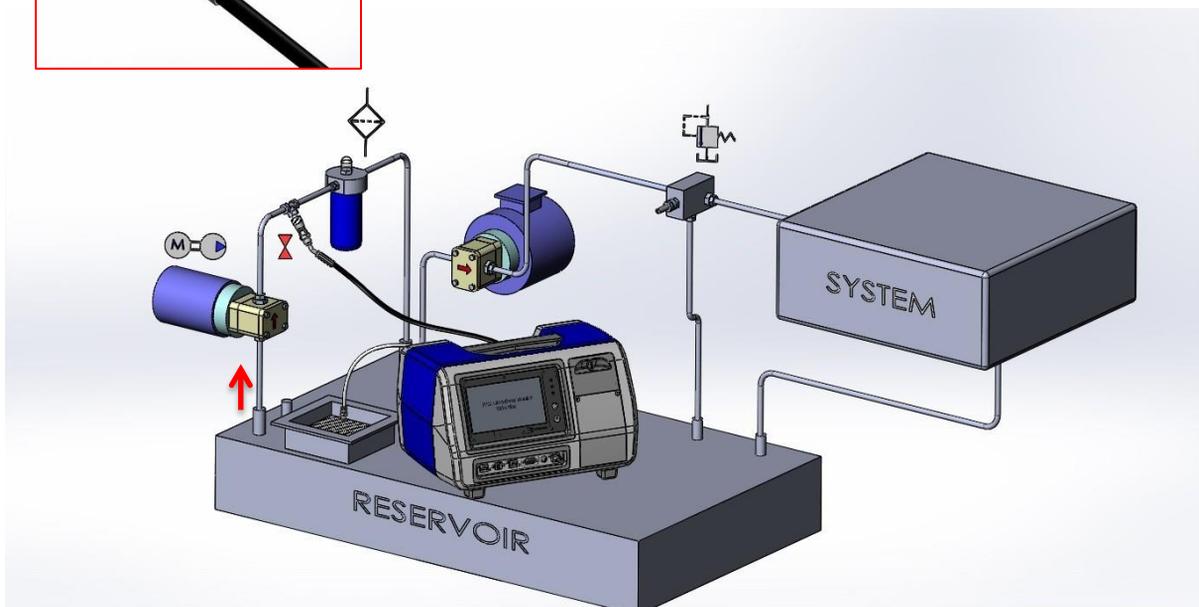
### 5.2.1 High Pressure Line (>1 to 315 bar)



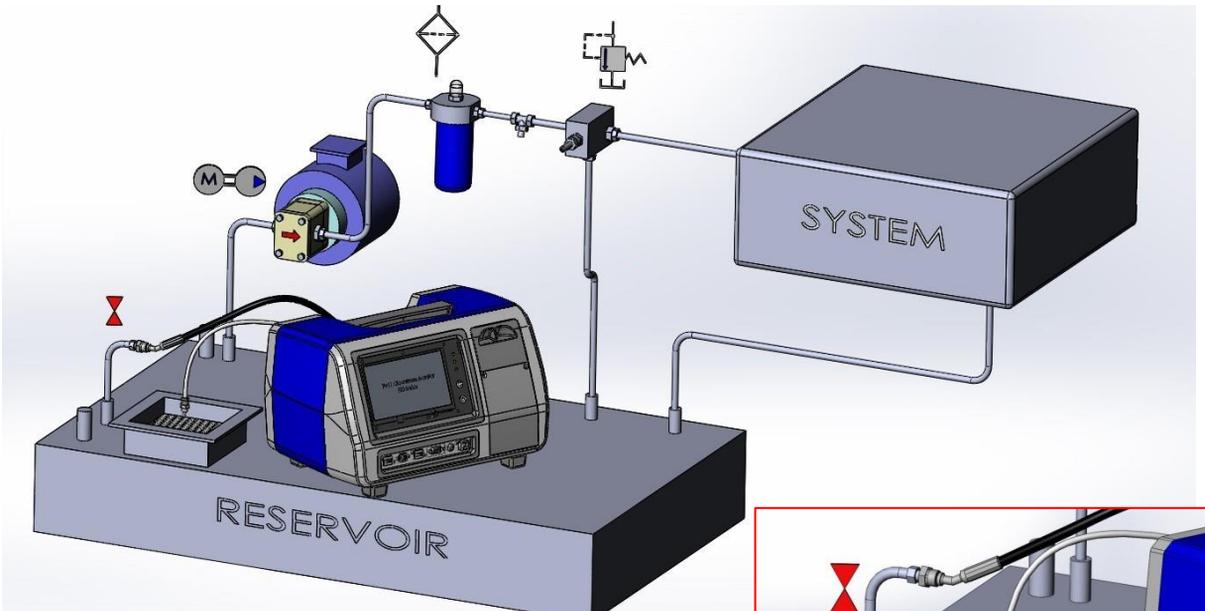
### 5.2.2 Low Pressure Line (0 - 1 bar)



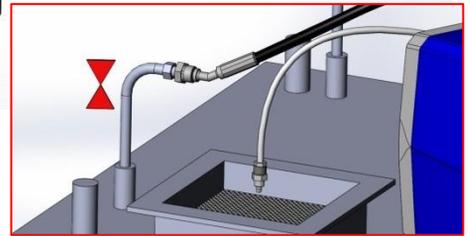
<1 bar at test point: - remove HP connector and couple the hose direct.



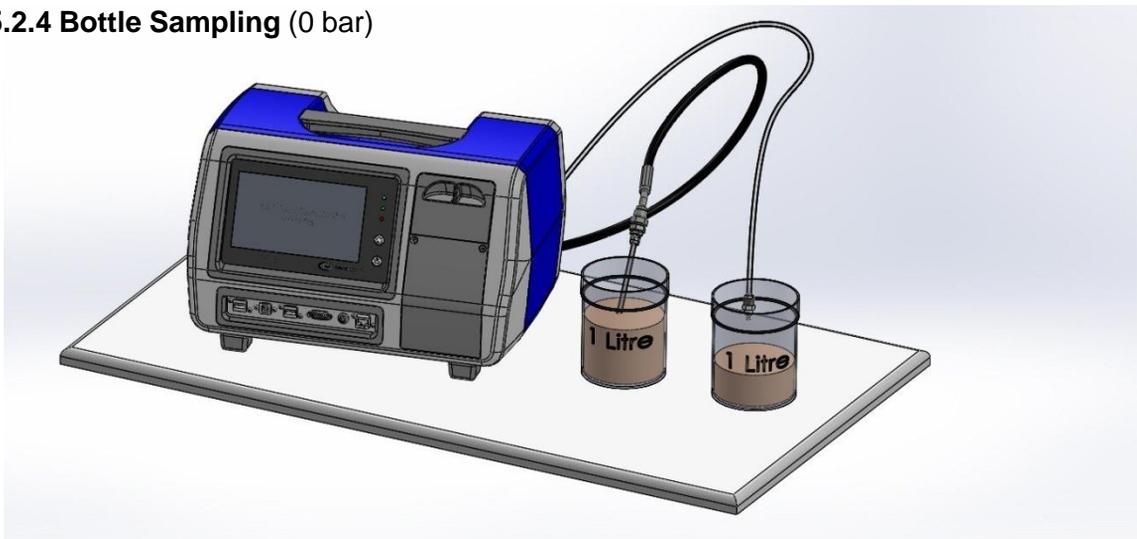
**5.2.3 Reservoir Sampling** (0 bar: - Direct coupled hose or use sampling stalk. Remove high-pressure connector)



**Note:** Ensure sample point and hose connection are cleaned before mating



**5.2.4 Bottle Sampling** (0 bar)



When sampling from a bottle or container, it is advised to run a single test to waste with a clean, compatible fluid ( $\leq$  ISO 12/10/8) and remove any residual contaminant from the PCM500. Depending on viscosity and cleanliness, the PCM500 may require up to a litre of fluid sample for a bottle test. Always ensure the containers are thoroughly cleaned prior to introducing a fluid sample..

When bottle sampling it is important to prevent extraneous contaminant entering the sample, such as may be found on the outer surface of the HP hose connection. It is advised to use the sampling stalk provided, which should be kept in a clean condition. In order to check the repeatability of cleanliness results, a larger sample may be cycled into the same container and averaged over a 3-test run for example.

### 5.3 Operational Checks

Preparation checks before going to the installation to be sampled.



**Caution: The PCM500 display touch sensitive screen must not be pressed with a sharp or pointed implement. Finger contact is sufficient to operate the display menu icons and keyboard.**

1. Press and release the PCM500 start button



The Control panel red LED will illuminate and the PCM500 enters the start-up phase. After a short period there is a test firing of internal valves (six clicks) and then the display will turn on and show a Pall Corporation splash screen and then the Main Menu screen.

If the PCM fails to power up on battery, connect the external PSU and check the blue LED on the front panel is ON. If not, check or replace the input fuse with the correct value. If the PCM fails to start, consult Pall.

Main Menu screen



2. If the PCM500 has been used with a different fluid to the new sample then the fluid change procedures detailed in section 8 should be adopted.

3. Switch off the PCM500 and you are now ready to proceed to the installation to be sampled.

### 5.4 Installation Checks

At the installation to be sampled

- 1) Access the hoses at the rear of the PCM500.
- 2) Ensure the hose connectors are clean and free from visual contaminants.
- 3) Ensure the installation to be sampled is in operation and has been running for a minimum of 30 minutes prior to taking the sample in order to distribute the contamination within the fluid as evenly as possible. This is necessary to allow a representative fluid sample to be taken.
- 4) Connect the clear return line hose to the system reservoir or suitable capacity container ensuring cap is removed
- 5) Connect the black hose to the appropriate sampling point. Check for any leakage and rectify as required.



**Warning: Ensure the system operating pressure is within the PCM500 monitor specified limitation of 315 bar, 4,570 psi maximum.**

6) The PCM500 can now be switched on and the screen sequences followed. The specific procedure for start-up is detailed in section 5.4 and section 6 'Getting started'.

## Section 6: Getting Started

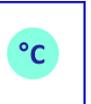
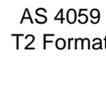
### 6.1 General

This section of the operating instructions enables a new user to perform tests using the PCM500 Cleanliness Monitor in a short space of time. It does not instruct the user in sampling techniques and the user should consult **Pall** for guidance on recommended sampling points.

### 6.2 System Components

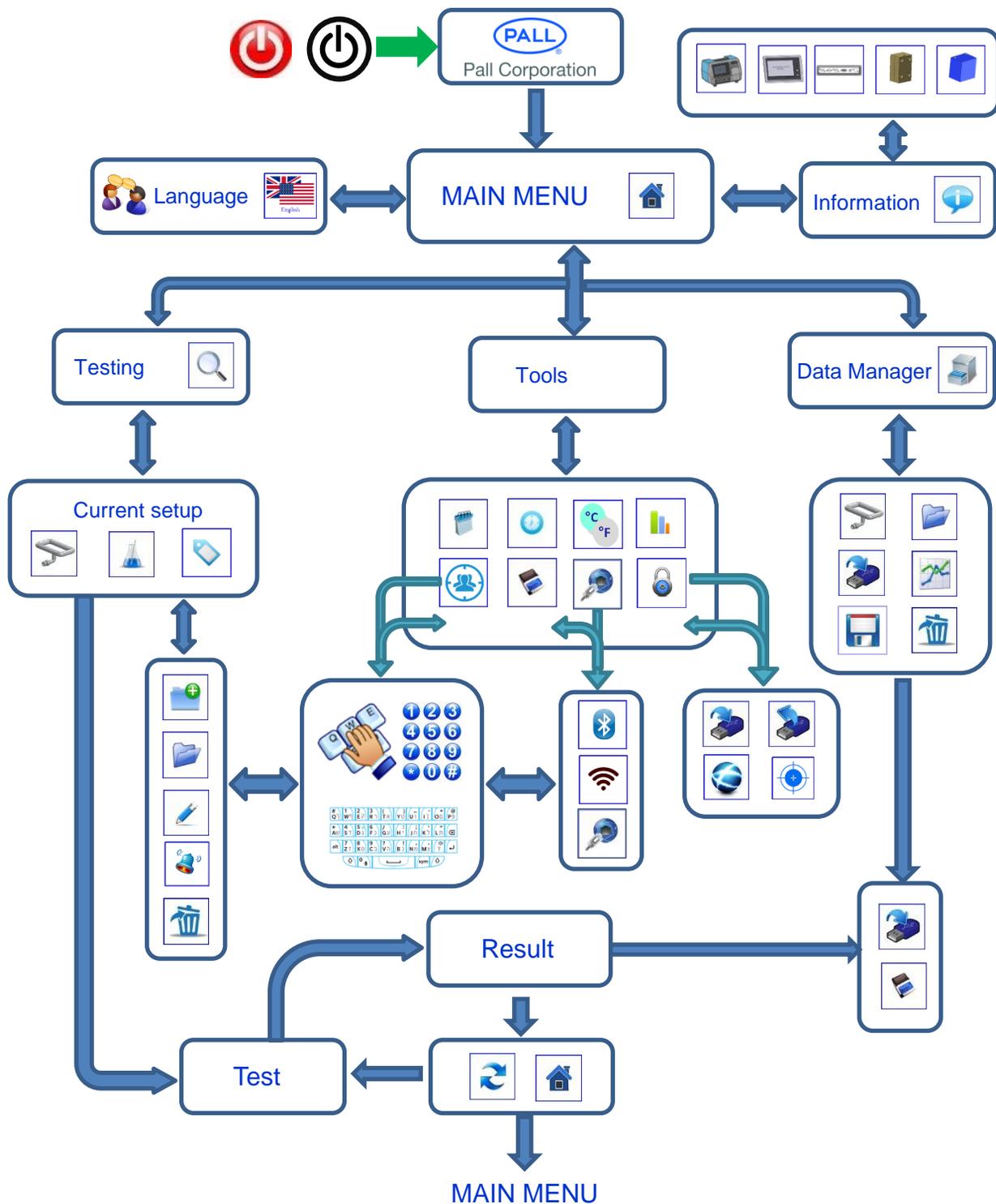
- PCM500 Cleanliness Monitor
- Power Supply Unit
- Battery Pack
- Bluetooth / USB Printer (Option)

### 6.3 Button Descriptions

<b>Main Menu</b>	 Home	 Set-up	 Tools	 File	 Info	 Language			
<b>Navigation</b>	 Previous	 Confirm	 Undo	 Cancel	 Up	 Down	 Forward	 Back	
<b>Editing &amp; Data</b>	 Delete	 Create	 Open	 Edit					
<b>Warnings</b>	 Critical	 Warning	 Shutdown					 AS4059 Table 2 -/*/*/-	
<b>Tools and Functions</b>	 Clock	 Date	 Format	 Print	 Customer ID	 Temp. Format	 ISO4406 -/*/*/*	 AS4059 Table 1 6-14µm	 AS4059 Table 2 */*/*/-
<b>Communication</b>	 Bluetooth Setup	 Wi-Fi Setup	 Comms Port/ Ethernet						 AS4059 Table 2 -/*/*/*
<b>User Support</b>	 Code Entry	 Touchscreen Calibration	 Web Update	 Import Settings	 Export Settings				 AS 4059 T2 Format
<b>Testing</b>	 Test Point	 Fluid	 Test Label	 Water in Oil	 Repeat	 Alarm Set-up			
<b>Data Management</b>	 Upload to Flash Drive	 Open Files	 Print	 Chart	 Save to disk				
<b>Information</b>	 PCM500 Spec	 Mesh Settings	 Battery Data	 Control Panel	 Comms. Ports	 Contact			

## 6.4 Display Flow Chart

The display flow chart can be used to help the new user become familiar with the PCM500 display operating sequence. The flow chart consists of a number of views using the previous Icon listing to indicate their access within the screens.

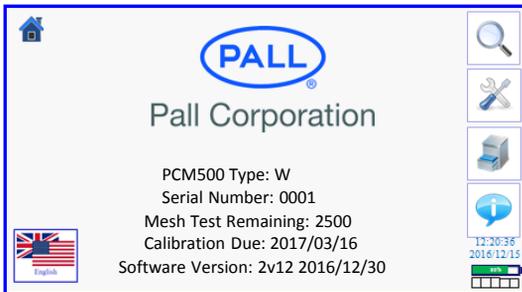


## 6.5 Example Screen

The screen below is an example of those that will be seen when using the PCM500. An explanation of common keys is incorporated here to prevent repetition.

The screens are structured into four main groups; Testing, Tools, Data Manager and Information. The home key will always return the user to the main menu. There is a flag icon that denotes the language setting. Use this button to change language setting. The new language will be loaded on restarting the PCM.

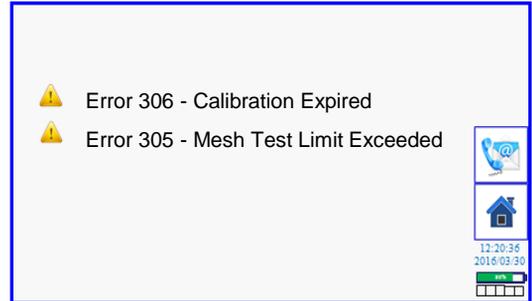
An example screen shot of the PCM500 main menu:



## 6.6 Start-up Sequence

Press and release the power on/off button on the front panel. This will power-up the PCM500 monitor and the Red LED activates until after the Pall Corporation splash screen appears and then the Green LED flashes in standby mode. The Main Menu screen is now visible..

If the PCM500 is out of calibration, requires an annual service or other intervention a warning screen will inform the user at start-up. This is to ensure the user keeps the PCM500 fully serviced and helps ensure the integrity of the high-pressure components in the instrument.

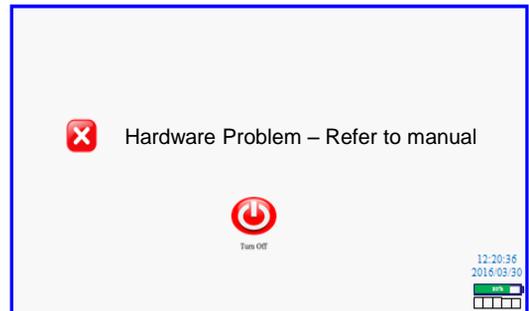


Press the contact button to open a contact details screen or proceed to home (Main Menu).



Contact screen for technical support

In the event of a major fault the next screen will appear and the PCM must be closed down and the problem reported to your local distributor or Pall Corporation.



## Main Menu Screen



The main menu details PCM500 Type; Serial number; Remaining mesh test; Calibration due date, and software version.

To the right-hand side are buttons to access menus for testing, tools, data manager and information,.

The time and date and a 5-division battery indicator is in the lower right corner.

To the bottom left is a button icon indicating the languages that are available. Press to select a different language.

## Language select screen



Available languages are as follows:

- English
- Danish
- Finnish
- Norwegian
- Swedish
- Italian
- Dutch
- Portuguese
- French
- Spanish
- German
- Polish
- Russian
- Chinese (Available 2017)
- Japanese (Available 2017)
- Korean (Available 2017)

## 6.7 Sampling

Sample can be on-line, from a reservoir, or bottled oil sources. Refer to sections 1 'Specifications and section 5.1 'Connection Options'.

### On Line or Tank Sampling Routine

From the main menu press the test button



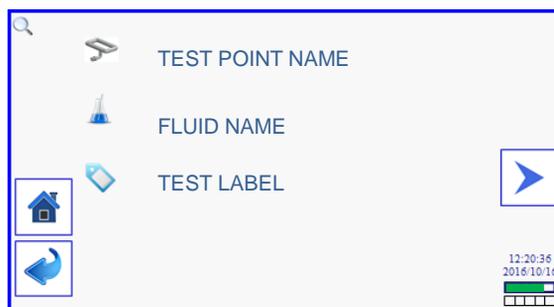
The user is presented with a Test Configuration screen. If the parameters are correct then advance to the next screen using the right arrow button. To edit or change the setup select one of the top three left hand buttons.

### Test Point screen:



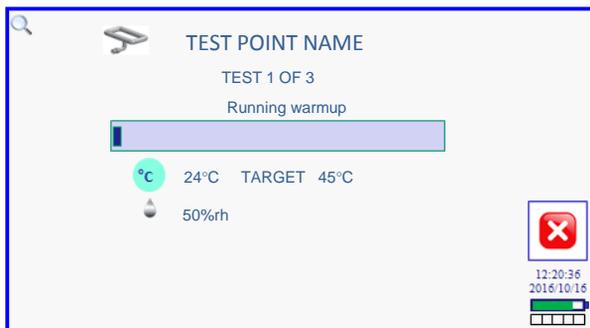
### Final Check Screen:

Check the parameters are correct then Start test using RIGHT arrow button.



## Warm Up Screen example.

If the sample fluid temperature is below the value set in Test Point, the PCM will enter a warm-up cycle which pumps fluid continuously until the temperature measured in the PCM circuit is at the target temperature.

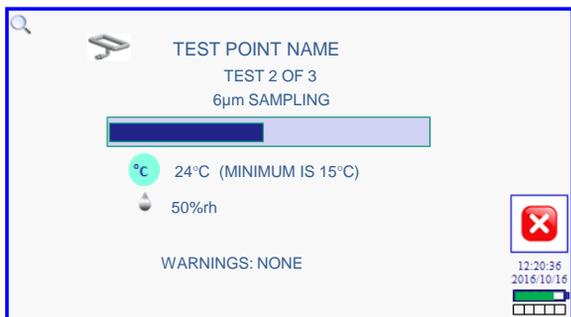


**Important:** The PCM can tolerate a 1°C per minute change in sample temperature during a measurement cycle. It is

important, therefore, to stabilise PCM temperature close to the system temperature for measurement accuracy.

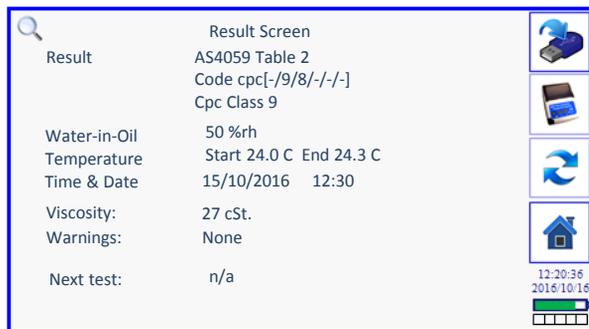
Once into the test measurement a progress screen provides real-time test data. The test can be cancelled at any time through the Cancel button icon.

The first measurement in the test cycle is of >14µm particulate followed by > 6µm. Temperature and Water-in-Oil (PCM500W) data is provided.



Should any test parameters be exceeded during a test a 'Warnings Present' label will be shown at the bottom of the screen. These will be recorded in the final result details screen.

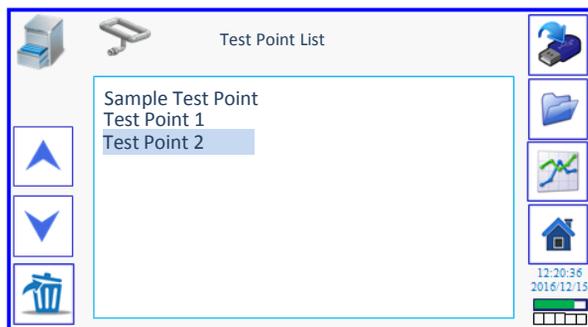
## A single test result screen



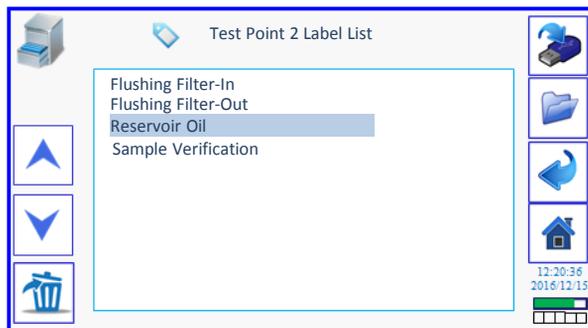
Individual test results in a multiple sequence are available to view in Data manager.



UP and DOWN buttons allow selection of a Test Point and then press the Open File button to view Test Labels.

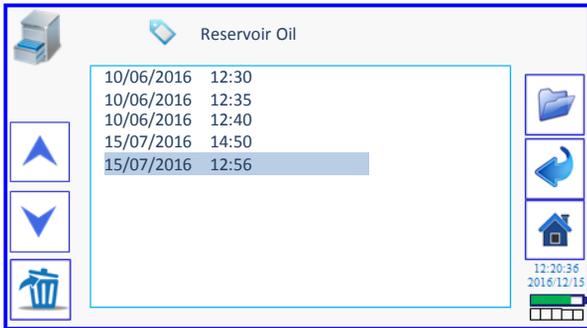


Use UP and DOWN buttons to select a Test label. Press the Open File button to view the individual Test List.

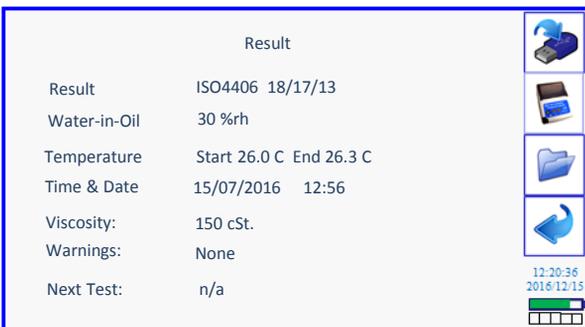


## Test result screen

Use UP and DOWN buttons to select a Test Point and then press the Open File button to view Test details.



The result can be transferred to USB Memory Stick or Printed.



## Print results screen

This follows the same control method as USB transfer but the option allows only one result printed at a time.

## 6.8 Test Point & Fluid Setup

If a new Test Point or Fluid is to be created for loading into the test setup or the current settings require editing, this is done through the Test Setup screens,



For example, if either the Test Point or Fluid buttons are pressed the screen will change to allow individual editing through buttons appearing to the right of the screen. Using the Test Label button will open the QWERTY keyboard.



Edit key to change values in Test Point and Fluid setup

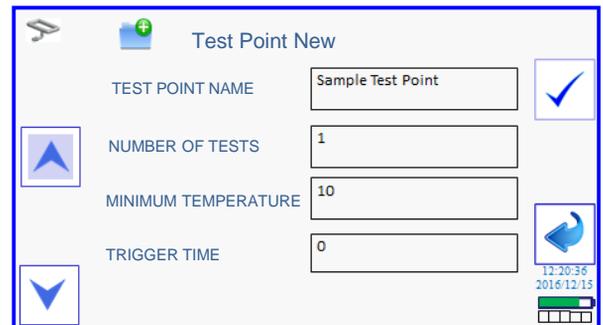


Create New for Test Point or Fluid

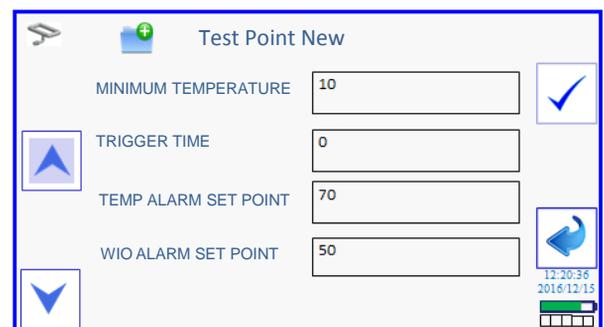


Open an existing Test Point or Fluid setup

## New Test point set-up



Touch inside the parameter box to edit the value. Use the DOWN arrow to view all parameters.



## New Test point set-up

- Test Point Name switches to qwerty keyboard screen
- Number of tests, minimum temperature trigger time, temperature and water-in-oil alarm points switch to the number pad screen
- Code alarm button screen view is determined by the code format selected (Tools Screens)
- Save the setup using the tick button.
- To return to test setup screen or cancel editing without saving use the Return button.

### ! Important:

The trigger period begins at the start of one test to the beginning of the next. The minimum set time is 7 minutes, which includes the maximum allowable test period and a 1 minute delay. e.g. Trigger time=7 max test time=6 min. time from end of test to the beginning of the next test = 1 min

If a test is started by external control, such as from a PLC, then the trigger period can remain at 0 minutes.

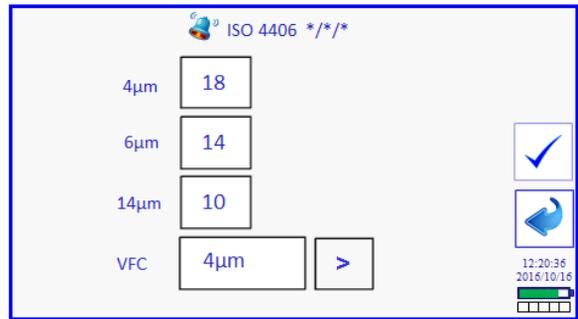
### ! Important:

The water content alarm is applicable to the PCM500W monitor only. The PCM500W monitor must not be used with water bearing fluids. The PCM500 does not incorporate a water sensor

## 6.9 Code Alarms Setup



Press the Alarms button



Pressing on a numeral will display the number pad to edit the value.

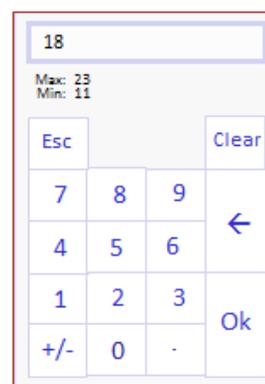
\*Note that in new units the default value is zero.

The Voltage Free Contact (VFC) button can toggle between all three sizes in the case of a 3-part ISO Code shown here or can be set to "Any" that will alarm when any of the three selected code limits is triggered. The next button toggles between < or > for the trigger action.

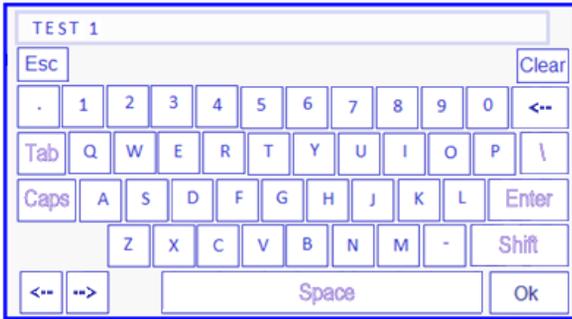
\*Note that the default alarm state for an on-screen result or printout is > than code set.

- Save the setup through the Tick button and use the Return button to go back to the Test Point screen.

Depending on which micron size is edited the number pad will indicate the maximum and minimum code values allowed.



## QWERTY Keyboard



### Fluid setup screen accessed through the Fluid button.

- Select Fluid name to edit through the QWERTY keyboard (enter/edit the name).
- For PCM500W the water-in-oil data is monitored by the program. If a PPM value is required press %RH box and PPM is available to select. Once PPM is selected then four absolute water constants are available for editing. C1, C2, C3 and C4. These values are supplied by Pall Corporation. Use the DOWN arrow to access C3 and C4.

FLUID EDIT

CURRENT FLUID NAME: Sample Fluid

%RH / PPM: %RH

CONST 1: 0

CONST 2: 0

FLUID EDIT

CONST 1:: 0

CONST 2: 0

CONST 3: 0

CONST 4: 0

Save the setup through the tick button. Use the Return button to go back to the Test Point screen.

## Load a stored Test Point



From the OPEN button in Test point, select a stored Test Point and make current by pressing the TICK button.

TEST POINT OPEN

SAMPLE TEST POINT

TEST POINT 1

TEST POINT 2

TEST POINT 3

## Load a stored Fluid



From the OPEN button in Fluids, select a stored Fluid and make current by pressing the TICK button.

FLUID OPEN

SAMPLE FLUID

FLUID 1

FLUID 2

FLUID 3

## Create a Test label



In the first Test Setup screen select the Label button to open the Test Label Edit screen.

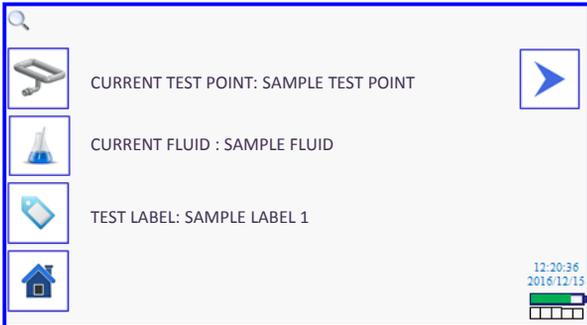
TEST LABEL EDIT

TEST LABEL: SAMPLE LABEL

Touch the current name box to open the QWERTY screen. Press the Tick button to confirm the change or the Return button to escape.

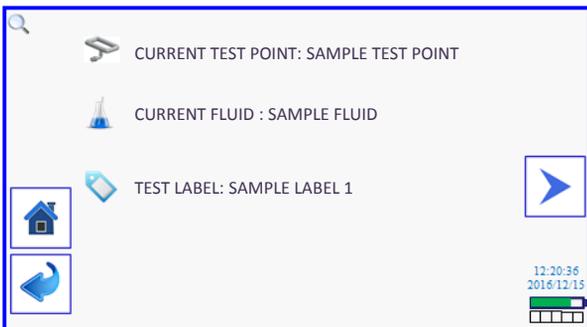
## Starting the test

Once all parameters are set then press the Right arrow button to progress to a final check screen.



If further editing is required press the Return button.

The Test is started by pressing the Right arrow button.



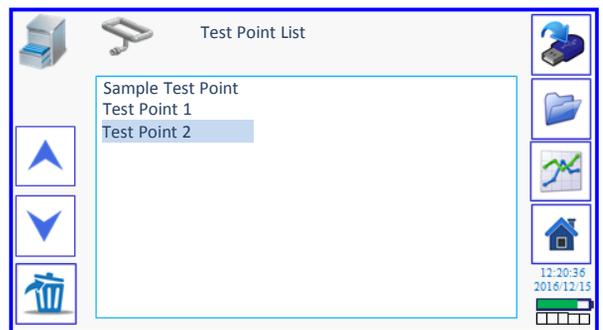
## 6.10 Data Manager Screens



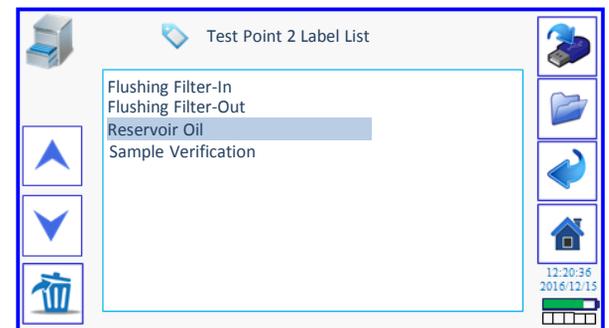
Results saved on the PCM500 can be viewed and managed using the data manager. To access the data manager press the data manager button in the main menu.

The data manager displays stored Test Points

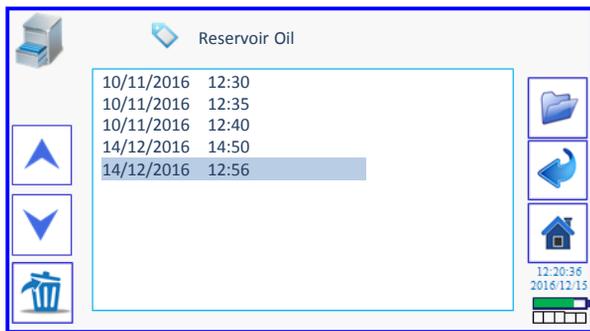
All Test Points created will be listed and can be individually transferred to USB memory device or deleted. There is also a chart function to display a Test Point result(s) in graphical format.



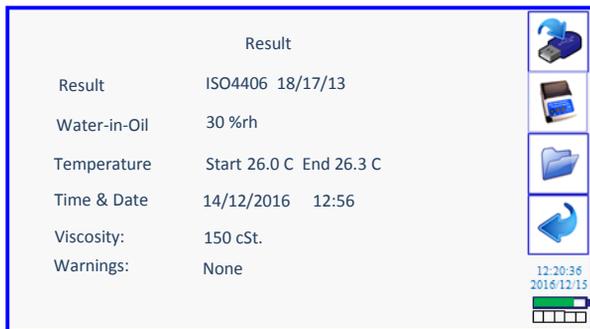
If tests under a certain label are required for download or deletion press the Open File button.



To manage individual tests under a Label press the Open File button.



Select the Test to open and press the Open File button.



The result can be transferred to memory device or printed.



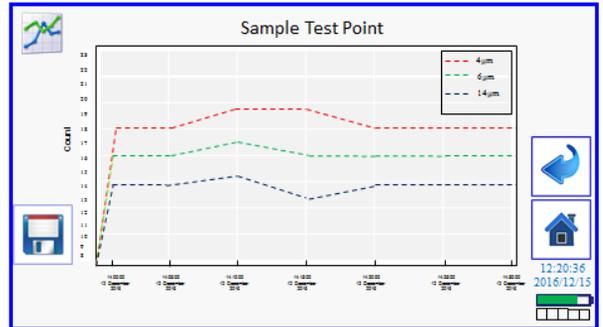
On a successful transfer a message box indicates the action is complete and also the number of tests transferred.

Press the OK button to return.

### Charting a Test Point:



The chart function will graph all tests recorded under a Test Point to provide a visual trend of cleanliness.



Select a Test Point and then press the Chart button.

The screen image can be saved to USB Flash drive in PNG format for printing. Use the Save-to-Disk button.

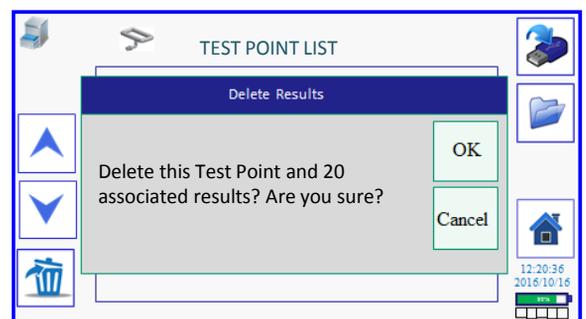
### Deleting:



Throughout the data management screens there is a Delete button for Test Points; Test Names; and individual tests

Example:

On pressing the DELETE button in the Test Points screen a Delete results box appears to confirm the delete action. The user then selects OK to delete or Cancel.



The total number of results in a Test Point is indicated for deleting.. When deleting a Test Name the number of results is also indicated.

### 6.11 Tools



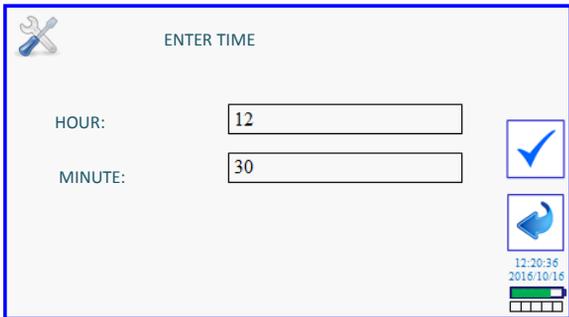
- Time
- Date
- Temperature (Press to toggle between Fahrenheit and Celsius)
- Code Format
- Engineer
- Printer Test
- Communications
- Customer ID



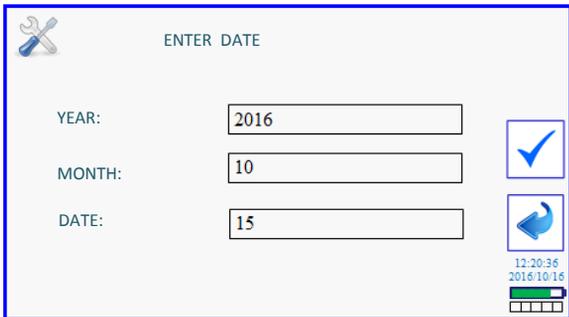
### Time & Date:



Touch the value to edit in the number pad.  
Press the Tick button to accept the change.

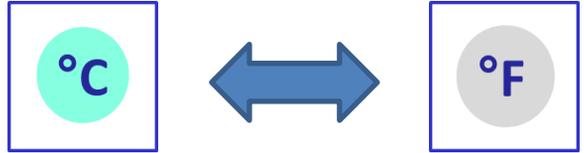


Note: - date is in the international standard format to ISO 8601



### Temperature:

Temperature reporting is changed by simply pressing the button to switch between Fahrenheit and Celsius

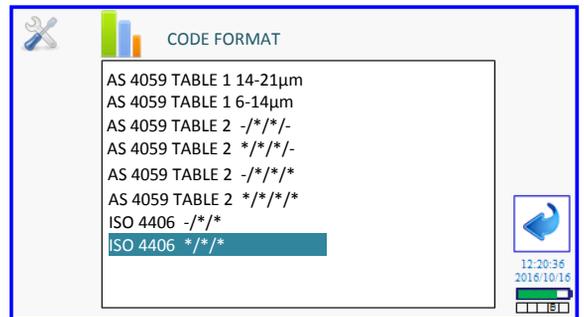


### Code Format:



There are several options for Code format within the three standards provided.

- ISO 4406 -/6μ/14μ (2-part)
- ISO 4406 4μ/6μ/14μ (3-part)
- AS4059 Revision F Table 1 6-14μm
- AS4059 Rev. F Table 1 14-21μm
- AS4059 Rev. F Table 2 Size 6, and 14μm
- AS4059 Rev. F Table 2 , Size 4, 6, & 14μm
- AS4059 Rev. F Table 2, Size 6, 14 & 21μm
- AS4059 Rev. F Table 2, Size 4, 6, 14 & 21μm



Touch to highlight the required code and press Return for the code change to take effect.

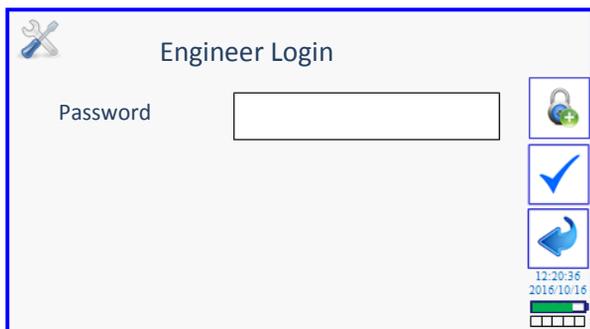
## User Support using Engineer Login:



A user support page is available and is accessed through the Engineer login screen. There are several options available to allow the user to maintain the PCM.

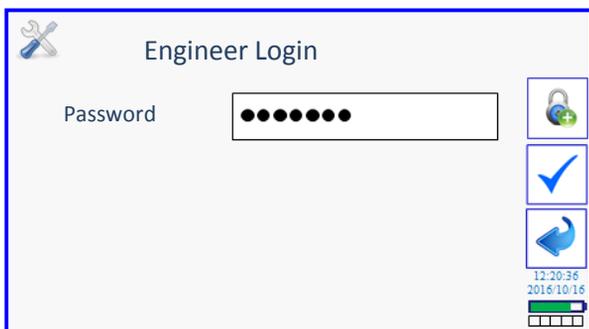
- Calibrate Touchscreen
- Program Update via the Web
- Manual Program Update
- Export Settings
- Import Settings
- Export Log Files

## Login

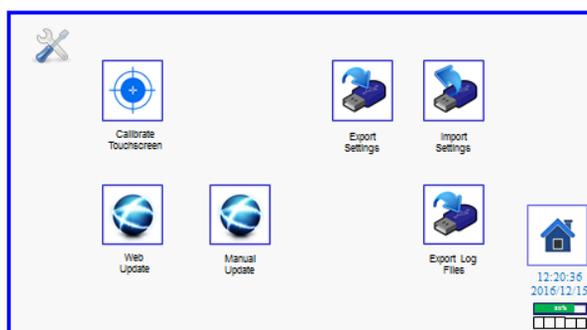


Press the Engineer button to access the login screen. Touch inside the text entry box to bring up the QWERTY screen.

Enter “**support**” in lower case and press the Enter key. Then press the TICK button to access the User support screen.



## Support Screen



## Calibrate Touchscreen:



A function is incorporated to calibrate the accuracy of the Touchscreen. On pressing the button the screen will go black with a white crosshair in the top left of the screen. Press the centre of this crosshair and a second will appear in the top right corner. Repeat pressing of the crosshair for bottom right, bottom left and finally screen centre.

The Touchscreen will then reset itself with the new calibration data and return to Main Menu screen.

## Website Updates:

A PCM500 support website (PCM500.com) is available for the user to update the display program.

**The user must first register their PCM500 on the website before gaining access to any program updates.**



## Web Update:

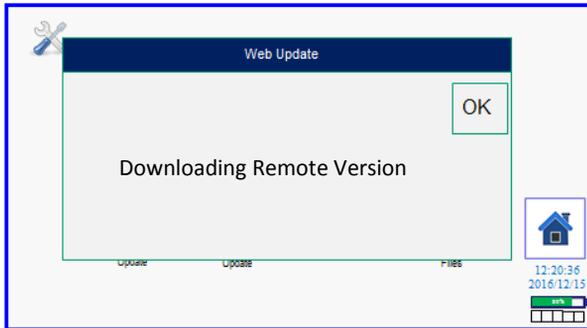
**(Ver. 2.13 and above for direct upload)**

When registered the latest display program can be accessed.

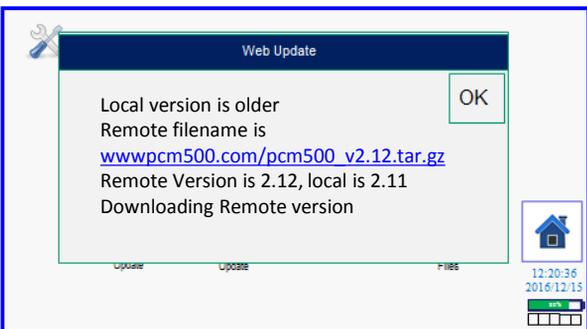
- Connect the PCM500 to a network via Ethernet.
- Wait for an “E” to appear in the bottom right box in the screen and then press the Web update button.
- The website will check that the PCM500 serial number is registered before releasing a program update.

## Web Update

The PCM will check the version number of the remote program and if the version is not newer a screen message will inform the user.



If the remote version is newer then the PCM500 will automatically upload the version to program memory.



Allow the PCM500 to complete the version update. At the end the Main Menu screen will appear with the new Software version number listed at the bottom.

## Manual Update: (Version 2.12 onwards)



If it is not possible to connect the PCM500 direct to a network then an update file can be downloaded from **PCM500.com** to a USB flash drive. The file can then be uploaded to the PCM500.

Procedure:

- 1) Go to <http://www.pcm500.com/> to download an update file.
- 2) Put file on USB flash drive and ensure the file name is "PCM500\_Update.tar.gz".
- 3) Insert flash drive into PCM500 and power on.



## Export Settings

This function allows the user to configure several PCM500 units of the same type with identical Test Point and Fluid file configurations.

Connect a USB flash drive and wait for the "U" to appear in the first box, bottom right of the screen, Press the Export button to transfer the Test Point and Fluid setup data.

The data is stored into SQL database files; one for Test Points and one for Fluids.



## Import Settings

This works in the opposite way to export above. Connect the USB flash drive with SQL files into a PCM500 and press the import button. Once the transfer is complete you can check that the Test Points and Fluids are present by going to Test Setup screen.

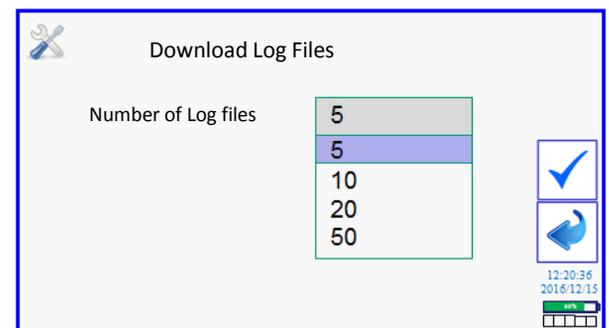


## Export Log Files

Export  
Log Files

This feature is a diagnostic tool to aid engineers in the process of diagnosing error codes that may be generated during testing.

The user can select a number of files to download to USB flash drive and then forward these to Pall or manufacturer.



## Printer Test



The printer can be tested over two types of connection; Bluetooth or USB lead. Once configured a test print will provide details of the PCM setup. If the printer does not connect a “No Printer” message is displayed on screen. Check that the printer battery is charged.



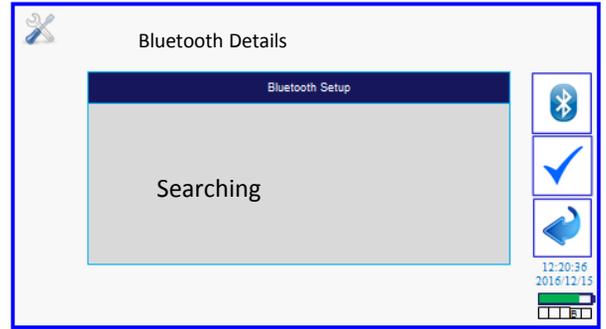
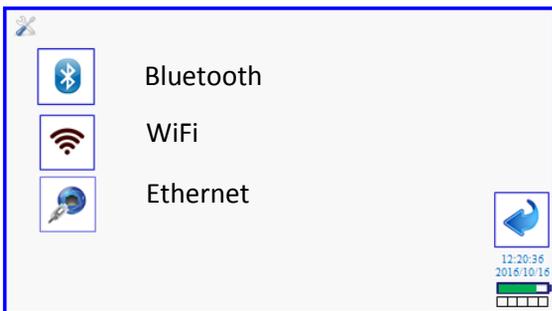
Press the Comms button in TOOLS to access the Bluetooth setup.



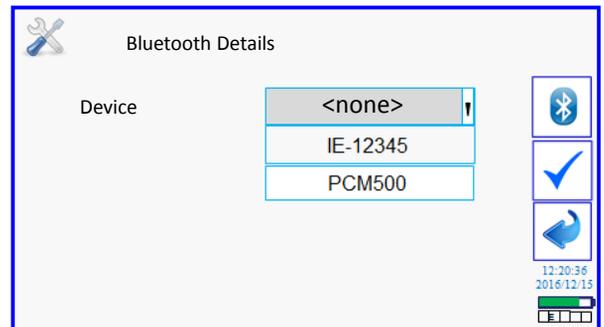
## Bluetooth: #

To test the Bluetooth function the printer has first to be linked with the PCM500.

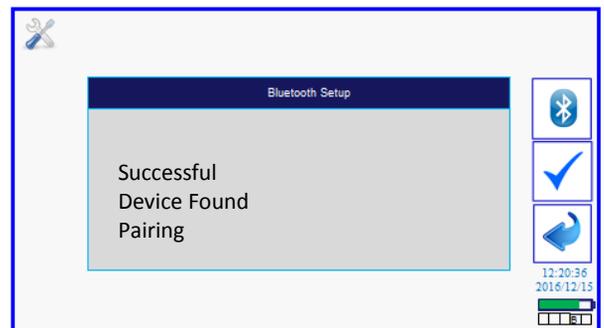
- Insert the Bluetooth USB adapter supplied with the printer into either USB-A type port. Switch on the printer.
- Press the Bluetooth button to initiate a search for devices.



- At the end of the search the device box may indicate <none>. Press this box for a dropdown list of devices found.
- Select **PCM500** and press the TICK button to confirm. (Note: Pre-2017 issued printers will have **WOOSIM** as the Bluetooth ID)



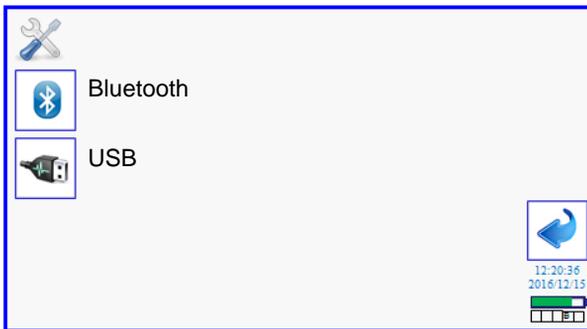
- Press the TICK icon to accept **PCM500** ID.
- The program will then connect to the printer through a “Pairing” routine. After the pairing is successful, a letter ‘B’ will appear in the fourth box in the bottom right of the screen. It may take up to 30 seconds for the letter to appear.



- **Note:** If the PCM500 is switched off it may be necessary to repeat the connection procedure.

## Test Print

- From the TOOLS screen press the PRINTER button. The next screen provides two options. The Bluetooth button will provide a test print with the newly paired printer.



- The second USB option is when the printer is connected directly to the PCM500 using the USB serial lead provided with the printer kit.
- Remove the Bluetooth USB adapter and connect the serial lead. Once the lead is connected then the letter 'P' will appear in the box.

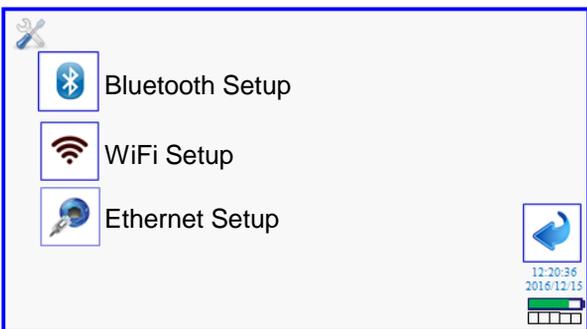
The test print lists the following:

- PCM Type
- PCM Serial Number
- Calibration Date
- Software Version
- Mesh Test Count.

## Communications:



The two remaining connection methods are WiFi and Ethernet.



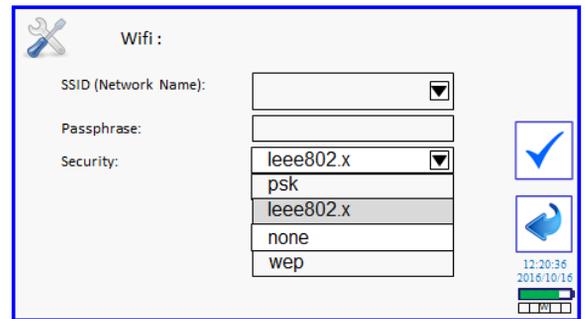
In addition to the use of Ethernet for program updates both WiFi and Ethernet will allow the user to connect to an internal Web page setup for remote control of the PCM500.

## WiFi: Connection method:

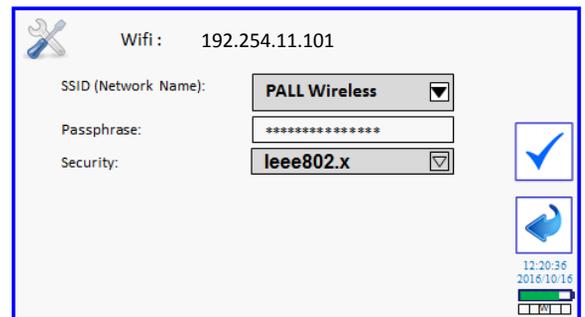


A Linux compatible USB wireless adapter (user supplied) is required.

- Connect the WiFi adapter into one of the USB ports
- A letter "W" will appear in the third box, bottom right of Main Menu.
- Go to TOOLS->COMS->WiFi



- Select the security type used by the network and press the Tick button. The screen may return to the Comms screen but press the WiFi button to continue the setup.
- If a network is discovered it will be listed in the SSID ( Service Set Identifier) drop down box.
- Enter the Passphrase to log onto the Network



- Once the network detects the PCM it will assign an IP address that will appear at the top of the screen.
- Enter this address into a Web browser to connect with the PCM and view the web page.

## Web page layout:

The screenshot shows the Pall Corporation web interface. At the top right is the Pall Corporation logo. Below it are navigation tabs for 'Testing', 'CSV Downloads', and 'Help'. The main content area is divided into two sections: 'PCM500 Details' and 'Test Details'. The 'PCM500 Details' section contains fields for 'PCM500 Type: 500W', 'Serial Number: 0001', 'Customer ID: Pall Corporation', and 'Software Version: 2v12 2016/12/09'. The 'Test Details' section contains fields for 'Current Test Point: Sample Test Point', 'Current Fluid: Sample Fluid', 'Test Label: Sample label', and 'Current Code: AS 4059 Table 2 \*/\*\*/\*'. Below these fields is a text area displaying test results, including time, date, customer ID, test name, test point, fluid type, code, and various parameters like viscosity, water content, and temperatures. At the bottom left of the text area are 'Start' and 'Abort' buttons.

- Click on Start to begin a test routine.
- Progress is indicated during a test and a full result listing provided at the end.
- Please note that the web page controller cannot change Test Points or Fluids for a test cycle. These must be pre-set in the PCM500.

The screenshot shows the Pall Corporation web interface with a table of test results. The table has three columns: 'Test Points', 'Labels', and 'Tests'. The 'Test Points' column contains 'ALL' and 'Sample Test Point'. The 'Labels' column contains 'V2.12 09~12~2016' and 'Sample label'. The 'Tests' column contains '20/12/2016 13:10' and '20/12/2016 13:26'. Below the table is a 'Generate Selected CSV(s)' button. The 'Sample label' cell in the 'Labels' column is highlighted in blue.

Test Points	Labels	Tests
ALL	V2.12 09~12~2016	20/12/2016 13:10
Sample Test Point	Sample label	20/12/2016 13:26

- To download test results Click on 'CSV Downloads' and highlight a Test Point or Label.
- Click on 'Generate Selected CSV(s)'. A window will appear with options to OPEN; SAVE or SAVE AS.
- The file is then opened with the result data in comma separated format.

The screenshot shows a Microsoft Excel spreadsheet titled 'Sample label [Read-Only] - Microsoft Excel'. The spreadsheet contains test results in a comma-separated format. The columns are labeled A through J, and the rows are numbered 1 through 9. The data is as follows:

1	Time	Serial Number	Customer ID	Tag	Code (AS 4059 Table 2 */**/*)	4um Code	6um Code	14um Code	21um Code	Result
2	20/12/2016 13:10	1	Pall Corporation	Sample label	Code cpc[8/8/8/9/-/-] cpc Class 9	8	8	8	8	9 157
3	20/12/2016 13:26	1	Pall Corporation	Sample label	Code cpc[8/8/8/9/-/-] cpc Class 9	8	8	8	8	9 161
4										
5										
6										
7										
8										
9										

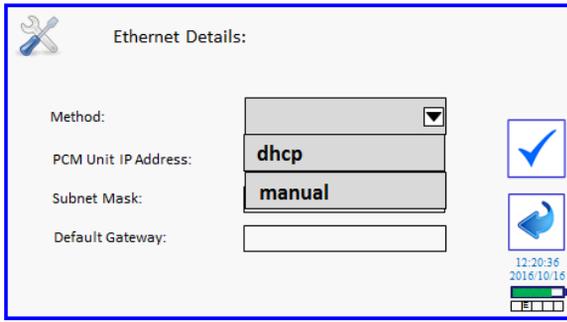
## Ethernet:



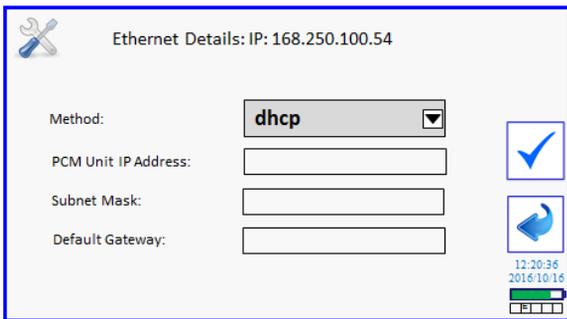
The same remote PCM control functions are available through Ethernet.

If a direct connection is required between PCM and a PC then a “Crossed” Ethernet cable must be used.

- Connect the PCM500 Ethernet to a Network (or PC) port and wait for an “E” to appear in the second box in the bottom right of the screen.
- In the Method drop down selection there are two options of **dhcp** and **manual** configuration.



- For automatic connection select dhcp and press the Tick button.
- If the screen changes to the Comms select screen, return to the Ethernet setup screen.
- Once the Network or PC assigns an IP Address to the PCM500 this will appear at the top of the screen.

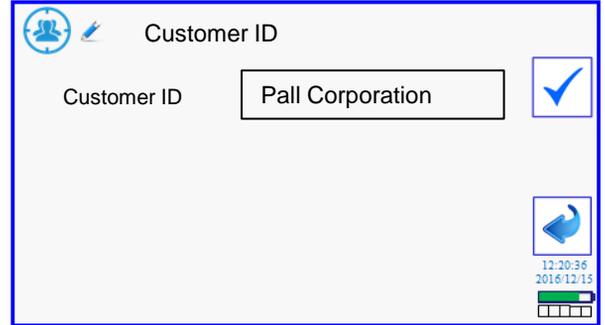


- Enter the IP address into a Web browser to connect to the PCM and view the embedded PCM500 Control panel.

## Customer ID:



Select this button to open the QWERTY keyboard and enter the name you require. Press Enter and on the following screen press the TICK button to confirm.



## New Main Menu screen-layout



## Section 7: Pall PCM500 Series Fluid Cleanliness Monitors

### Interface Protocol for PLC control using DB9 Serial and USB-B port

#### 1. Hardware details

##### DB9 Serial

Port settings are: 9600, 8, N, 1  
 Pin 2 TxD (Transmit Data)  
 Pin 3 RxD (Receive Data)  
 Pin 5 GnD (Ground)  
 Pin 2 and 3 must be crossed over when using a PC.

##### USB Serial

Port settings are: 115200,8,N,1

#### 2. Protocol between PCM500 and PLC (or computer)

The commands available to the PLC or a computer start and end with a square bracket as follows:

- [P] – “Ping” the unit to see the current status.
- [L] – Request last result.
- [S] – Start a test.
- [A] – Abort a test.

Please note that the command letters are in UPPER CASE; it will not work with commands in lower case.

[P] – Ping

The purpose of this command is to verify the PCM500’s current status.

When [P] is sent, the PCM500 responds with a comma-separated string, terminated by a carriage return and a new line.

e.g.

PCM,P,0,00,00,00,00

PCM	P	0	00	00	00	00
A	B	C	D	E	F	G

Where:

- A** - Label to identify that it is a valid transmission from the PCM500
- B** - The P signifies that the transmission doesn’t contain a result.

**C** – PCM500 status:

0: The unit is in standby.

1: The unit has ended a test and it is waiting to start a new test at the set time interval.

2: The unit is currently performing a test.

**D,E,F,G** – Latest error codes if any. See below for details.

#### [L] – Request last result

The latest valid result is transmitted via DB9 communications port. An example data string appears like this:

PCM, R, 20/12/2016 20:28, 1,2,00,00,00,00,AST2: Code cpc (9/8/7/-/-/1) cpc Class 9 50.22.10.Test 1, 39648.

PCM	R	20/12/2016 20:28			1	2	00	00
A	B	C			D	E	F	G
00	00	AS4059 Table 2: Code cpc(9/8/7/-/-/1) cpc Class 9	50	22	10	TEST1	39648	
H	I	J	K	L	M	N	O	

Where:

- A. Label sent by the PCM to signify start of transmission.
- B. The transmitted string is a result. R=Result, A=Aborted test, P=Ping.
- C. Date and time the test was performed.
- D. Test number in the sequence.
- E. Number of tests in the sequence.
- F. Error codes (Hex) Byte 1. Hardware problems. (see below).
- G. Error codes (Hex) Byte 2. Sampling problems. (see below).
- H. Error codes (Hex) Byte 3. Sampling problems. (see below).
- I. Error codes (Hex) Byte 4. User defined settings exceeded. (see below).
- J. Result codes as selected on the unit (ISO, AST1: (AS4059 Table1), or AST2: (AS4059 Table2).
- K. Viscosity.
- L. Temperature.
- M. Water In Oil (%SAT or PPM).
- N. Test Label
- O. Checksum.

### Result code format examples:

ISO4406 12/10/8

ISO4406 -/10/8

AS4059 Table 1: Code cpc[9/-/-/-] cpc Class 9

AS4059 Table 2: Code cpc[8/7/6/-/-] cpc Class 8

AS4059 Table 2: Code cpc[-/7/6/-/-] cpc Class 7

### Error codes

The codes are in hexadecimal format.

Byte	Code	Description
1	0x01	Very low battery
1	0x02	High motor current
1	0x04	Viscometer blocked
1	0x08	Low mesh differential pressure
1	0x10	Pressure transmitter failure
1	0x20	Temp transducer failure
1	0x40	Internal controller failure
1	0x80	Internal error
2	0x01	Low battery
2	0x02	High line pressure
2	0x04	Low line pressure
2	0x08	Unstable temperature
2	0x10	Unstable viscosity
2	0x20	Unstable sampling
2	0x40	High mesh differential pressure
2	0x80	Water in oil sensor failure
3	0x01	Water in oil
3	0x02	Internal Flag
3	0x04	6-micron mesh blocking
3	0x08	14-micron mesh blocking
3	0x10	Mesh test limit exceeded
3	0x20	Calibration period exceeded
3	0x40	High viscosity differential pressure
3	0x80	RESERVED
4	0x01	Solid contamination alarm
4	0x02	Water content alarm
4	0x04	Temperature alarm
4	0x08	Too much contaminant
4	0x10	Test aborted
4	0x20	Test sequence aborted
4	0x40	RESERVED
4	0x80	RESERVED

### [S] – Starts a Test

The exact effect of this command depends on the status of the PCM500 unit.

**The PCM500 is currently running a test:** the command is ignored.

**The PCM500 is in standby:** the test series is initiated, with the maximum number of tests as previously entered from the display.

**The PCM500 is waiting between tests:** a test is initiated and the scheduled test is then started at the appropriate time. The total number of tests is decremented by one.

Once a test is started the results will be sent to the PLC on completion of the test.

### [A] – Abort test.

By sending [A], the entire test sequence is aborted and the result string would appear like this:

PCM,A,23/12/2016

15:46,1,2,00,00,00,20,58695

The second string item is set to **A** (aborted), and error Byte number 4 contains the "Test sequence aborted" message (0x20).

The code field is NOT present.

Another example of a data-string is included here following an aborted test due to the PCM500 fluid return-line being dead-ended:

PCM, A, 23/12/2016 16:15,0,2,04,

02,30,20,51384

Byte1 = 04: Viscometer blocked

Byte2 = 02: High line pressure

Byte3 = 30: (10+20) Mesh test limit exceeded (10) and Calibration period exceeded (20)

Byte4 = 20: Aborted test sequence.

(Byte3 has been artificially generated for the benefit of the example.)

If the last test was requested then it would be a result with the latest valid code.

PCM, R, 23/12/2016

10:22,2,2,00,00,00,00,AS4059 Table 2:

cpc[9/8/7/-/-] cpc Class 9,50,22,10,Test1, 10323

If a ping were issued it would include the latest error codes.

PCM, P, 0,04,02,30,20

### **3. Modes of Operation**

#### **a). – Test timing set on the PCM500**

In the PCM500 Test Point setup, enter the number of tests to be performed in a test-cycle and also include any delay between individual tests. A test sequence can then be started from the PCM500 or from the PLC.

If an additional test is required, whilst in a test-cycle delay period, then the PLC can initiate this, without compromising the existing delay in the test-cycle setting.

Please be aware, the delay period entered will start from the beginning of a test.

#### **b). – Test timing set by the PLC**

In the PCM500 Test Point setup, enter the number of tests to 1 (one) and enable the PLC to start a test at the appropriate time.

## Section 8: Pall PCM500 and PCM500W Fluid Cleanliness Monitors

### Fluid Change Procedure

**!** **Important:** Mixing of incompatible fluids with Rust Veto is likely to create gels and block the PCM500 meshes. One example is Mono Ethylene Glycol (MEG).

Contact Pall if there is doubt over the compatibility of test sample and Rust Veto transit fluid.

**When Changing from mineral oil to water based fluids or vice versa, a strict fluid changeover procedure must be adhered to.**

The changeover fluid is “Rust veto NTP 32”, which is miscible with both aqueous liquids and oils. All changeover and flushing fluid should be drained into a suitable waste container and disposed of in accordance with local Health and Safety legislation.

#### Mineral oil to water based fluids:

- 1 Run a single test to waste using clean Rust Veto NTP32 to flush out the mineral oil.
- 2 Run a test to waste using the water based fluid. Repeat testing until there are no traces of Rust Veto NTP32 in the return line.

#### Water based fluids to mineral oil:

- 1 Run a single test to waste using clean Rust Veto NTP32 to flush out the water-based fluid.
- 2 Run a test to waste using the mineral oil sample. Repeat testing until there are no traces of Rust Veto NTP32 in the return line.



**Important:** The PCM500W should not be used on water-based fluids.

If fluid changes are regular, the monitoring programme should be modified so as to reduce the requirement for fluid changes. e.g. monitor mineral oil during a 4 week period, followed by 4 weeks monitoring water based fluids

#### Wet to dry Oil or vice versa:

- 1 When using PCM500W, stabilization times can affect the water sensor accuracy when sampling fluids of vastly differing water content in short succession. The related precautions, recommended guidelines and test data related to this subject can be located in appendix D of this operating manual.



**Important:** The PCM500W should never be used in applications whose water content is known to be at or above 100% saturation.

## Section 9: Pall PCM500 and PCM500W Fluid Cleanliness Monitors

### Function Codes, Possible Cause(s) and Corrective Actions

Function codes are flags that indicate to the user an awareness of a borderline test situation or when a test is curtailed. Function codes generally occur during the warm up cycle and while testing. There are several different function messages incorporated into the PCM500. Below is a list of these messages, possible causes and corrective actions.

Function Code	PCM500 Condition	PCM500 Status	Possible Cause	Corrective Action
100	No battery	No battery communication	No battery fitted. Fault in battery.	Fit battery. Change battery.
101	Very Low Battery	Unit gives warning of a very low battery charge level at the end of the test.	Extra low battery level detected	Connect Power Supply Unit (PSU) to a mains power supply
102	High Motor Current	Unit halts the test and puts error message on screen. Red L.E.D. on HMI panel on.	Fluid viscosity too high. Motor current over set limit. Pump malfunction.	Decrease fluid viscosity. Contact Pall or an approved agent
103	Viscometer blocked	PCM500 will abort the current test and display a warning message. Red L.E.D. on HMI panel on.	Viscometer orifice blocked/blocking with contaminant causing differential viscosity and/or line pressure to exceed operational limits.	Flush by testing with clean, low viscosity oil. Contact Pall or an approved agent.
104	Low mesh differential pressure	PCM500 will abort current test/cycle and report error/warning message on the display screen. Red L.E.D. on HMI panel on.	Differential pressure across mesh element is below set limit. Probable cause; hole in the mesh, incorrect direction of flow, pressure transducer failure.	Contact Pall or an approved agent
105	Pressure transducer failure	PCM500 will abort test. Warning message on screen. Red L.E.D. on HMI panel on.	Incorrect or no signal received from pressure transducer during calibration / background check.	Contact Pall or an approved agent
106	Temperature transducer failure.	PCM500 will abort test. Warning message on screen. Red L.E.D. on HMI panel on.	Incorrect output from the transducer.	Contact Pall or an approved agent
107	Internal peripheral micro-controller failure.	Error/warning message on screen (if possible). Alarm set. Hold in this state. Red L.E.D. on HMI panel on...	No communication with main controller.	Contact Pall or an approved agent
108	Internal error	Unit inoperative. Hold in this state. Red L.E.D. on HMI panel on. Warning message on display if active.	Possible hardware failure	Contact Pall or an approved agent

**Section 9: Pall PCM500 and PCM500W  
Fluid Cleanliness Monitors (continued)**

**Function Codes, Possible Cause(s) and Corrective Actions**

Function Code	PCM500 Condition	PCM500 Status	Possible Cause	Corrective Action
200	Contamination Too High	Unit halts test and displays error message on screen Red L.E.D. on HMI panel on.	Maximum Solid contamination level exceeded	Investigate process. Dilute the sample with clean fluid
201	Low Battery	Unit gives warning of low battery charge level at the end of the test.	Low voltage level detected from internal battery	Connect Power Supply Unit (PSU) to a mains power supply
202	High Line Pressure	Unit halts the test and puts error message on screen indicating high line pressure. Red L.E.D. on HMI panel on.	Blockage in hydraulic circuit. Fluid viscosity too high. Pressure transducer failure	Ensure return hose is not blocked. Decrease fluid viscosity. Contact Pall.
203	Low line pressure	Unit halts the test and puts error message on screen indicating low line pressure. Red L.E.D. on HMI panel on.	No fluid. Last Chance Filter (LCF) blocked. Pump Malfunction. Pressure transducer failure.	Check fluid supply and inlet hose connection. Remove, clean or replace Pressure Relief Valve LCF. Contact Pall.
204	Unstable temperature	Unit halts test and displays error message on screen. Red L.E.D. on HMI panel on.	Change >1deg / minute. High oil temperature. Low temperature.	Operate Warm-up Cycle refer to section 6.10. Allow system fluid temperature to stabilise
205	Unstable viscosity	Unit halts test and displays error message on screen Red L.E.D. on HMI panel on.	Fluid dilution. Large temperature gradient across PCM500	Operate Warm-up Cycle refer to section 6.10. Allow system fluid temperature to stabilise
206	Unstable sampling	Unit halts test and displays error message on screen. Red L.E.D. on HMI panel on.	Aeration problem. Pressure spikes in system sampled. Fluid sample dilution/mixing. See Unstable viscosity.	Ensure inlet hose is in contact with system fluid. Ensure system return line is full of fluid.
207	High mesh differential pressure	PCM500 will abort current test and report error/warning message on the display screen. Red L.E.D. on HMI panel on..	Mesh element currently in the flow is blocked/blocking with contaminant causing differential mesh pressure to exceed operational limits	Flush by testing with clean, low viscosity oil. Contact Pall or an approved agent
208	Water in Oil (WIO) sensor failure (if applicable)	PCM500W will display error/warning on successive tests.	Incorrect output from the sensor.	Contact Pall or an approved agent

**Section 9: Pall PCM500 and PCM500W  
Fluid Cleanliness Monitors (continued)**

**Function Codes, Possible Cause(s) and Corrective Actions**

Function Code	PCM500 Condition	PCM500 Status	Possible Cause	Corrective Action
300	Test aborted	Unit halts test and displays warning message on screen.	Test aborted due to one of the other warning conditions,	Repeat test if possible.
301	Water in Oil	Unit completes test. Warning displayed on screen.	Outside set limit	Information only.
302	Internal error	Unit completes test. Error number displayed in result.		Information only.
303	6-micron mesh blocking	PCM500 screen message that mesh pores are becoming permanently blocked. Warning on screen and logged result.	Limits of ratio between dP and dV taken at the cycle start have been exceeded	Flush by testing with clean, low viscosity oil
304	14-micron mesh blocking	PCM500 screen message that mesh pores are becoming permanently blocked. Warning on screen and logged result	Limits of ratio between dP and dV taken at the cycle start have been exceeded	Flush by testing with clean, low viscosity oil
305	Mesh test limit exceeded	Display warning message on screen at PCM500 start-up or at the end of current test operation	Tests performed on the same mesh set above set limit.	Contact Pall or an approved agent for service details
306	Calibration period exceeded	Display warning message on screen at PCM500 start-up	12 month calibration interval expired	Contact Pall or an approved agent for service details
307	RESERVED			
308	High viscosity differential pressure	Unit halts test and displays error message on screen. Red L.E.D. on HMI panel on.	Fluid viscosity out of specification, low fluid temperature	Reduce fluid viscosity. Increase fluid temperature at PCM500

**Section 9: Pall PCM500 and PCM500W  
Fluid Cleanliness Monitors (continued)**

**Function Codes, Possible Cause(s) and Corrective Actions**

Function Code	PCM500 Condition	PCM500 Status	Possible Cause	Corrective Action
401	Solid Contamination Alarm	Display warning message on screen. VFC relay activated.	Pre-set Solid contamination level exceeded	Repeat test to verify. Investigate process.
402	Water Saturation Alarm	Display warning message on screen.	Pre-set Fluid water saturation level exceeded	Investigate cause of elevated water contents
403	High fluid Temperature Alarm	Display warning message on screen.	Pre-set Fluid temperature level exceeded	Investigate process, reduce operating temperature

NOTE: Refer to section 6 to review and / or amend your selected alarm levels

Coding:-		
	100	High priority warning
	200	Medium priority warning
	300	Low priority warning
	400	User defined alarm

## Section 10: Pall PCM500 and PCM500W Fluid Cleanliness Monitors

### Spare Parts List

Part Number	Description
PCM500.211	Power Supply Unit
PCM500.235A	Mains Cable UK
PCM500.235B	Mains Cable Europe
PCM500.235C	Mains Cable USA
PCM500.235D	Mains Cable Australasia
PCM500.235E	Mains Cable Japan
PCM500.213ASSY	Battery Pack
PCM100.217	RS232 Communication Cable
PCM500.121	Last Chance Filter Element
PCM500.122	High Pressure Hose Assembly
PCM500.197	Low pressure Sampling Stalk
PCM500.154A	Metric Test Point Connector
PCM500.154B	Imperial Test Point Connector
PCM500.154C	NPT Test Point Connector
500.470	Operating Instructions - PCM500 USB Memory Stick
500.470B	Operating Instructions PCM500 Quick Reference Card
PCM500.520A	Printer Kit - UK
PCM500.520B	Printer Kit - EUROPE
PCM500.520C	Printer Kit - USA
PCM500.520D	Printer Kit - AUSTRALASIA
PCM500.520E	Printer Kit - JAPAN
PCM500.253	Printer Paper Roll (Pk.10)
PCM500.252	Printer USB Cable
PCM500.232	VFC Relay Cable
PCM500.600	Transit Case
PCM500.500M	Replacement Mesh Manifold

## Section 11: Pall PCM500 and PCM500W Fluid Cleanliness Monitors

### Cleaning and Decontamination

As a matter of protection to the PCM enclosure and safety to the user it is advised to clean any fluid spills with suitable cleaning materials and dispose of these safely. Chemicals that may be harmful to the ABS material itself should be removed immediately.

### Maintenance

Check the condition of the high-pressure hose (PCM500.122) for signs of external damage. This should be done before each analysis session. If in doubt, contact your Pall distributor or the manufacturer for advice on a replacement part. Replacement is carried out by a Pall service centre, where a new hose installation is validated for maximum operating pressure prior to release.

The Last Chance Filter element is a user serviceable part and can be accessed by releasing the housing end plug. The element is removed by inserting an M5 thread bolt into the end cap and is then retracted. Ensure no external contaminant enters the housing before a new element is fitted.

If the PCM is unused for long periods it is advised to re-charge the battery every 6 to 8 weeks. Simply connect the external mains power pack and ensure the blue LED in the HMI panel is on. Allow to charge for a minimum 4 hours.

### Disposal of Equipment

At the end of its life, the monitor should be dismantled and disposed of in accordance with all applicable local waste disposal laws and bylaws. Where facilities exist, component parts of the unit may be recycled. Details of the materials of construction are given on the product installation drawing and if required, more detailed information regarding specific items may be obtained from Pall or an approved agent.

If component parts of the equipment were previously contaminated with the service fluid, an appropriate Manufacturer's Safety Data Sheet (MSDS) for the fluid should be obtained and read to ensure that contaminated component parts are disposed of safely.

## Appendix A: Pall PCM500 and PCM500W Fluid Cleanliness Monitors

### Calibration and After Market Services

#### Calibration and Aftermarket Service

Pall PCM500 series fluid cleanliness monitors are designed to provide trouble free operation for many years. However, as for all condition monitoring equipment, optimal performance can only be achieved through regular routine maintenance. To ensure your PCM500 receives the maintenance necessary, Pall provides a maintenance package designed to increase the overall effectiveness of the monitor. Pall recommends returning the PCM monitor for Service and Calibration annually. Mesh replacement should be carried out when the test limit is exceeded. The limit is variable from 1000 to 3000 tests depending on fluid sample cleanliness and viscosity.

**!** Important: Pall recommends returning the PCM monitor for Service and Calibration annually. Mesh replacement should be carried out when **3000** usage points is exceeded.

#### The annual service includes;

- Analysis of engineers diagnostic report and rectification of any faults found
- Battery, Power supply and clock check
- Performance evaluation on calibration fluid
- Software update to latest release level
- Check for oil leaks and rectification as necessary
- Check condition of Last chance filter
- Low-pressure hose replacement
- Safety check of High-pressure hose. Replaced at two year interval.
- Flush, strip and clean internal hydraulic components
- Pressure Reduction Valve Assembly check and reset
- Replace 6µm and 14µm meshes, O-ring seals and flush out the housings
- Transducer calibrations
- Perform production validation procedures
- Software menu checks
- Return carriage to customer

Any additional work required is subject to a separate written quotation.

Please contact Pall Aftermarket Division or its approved agent for additional information.

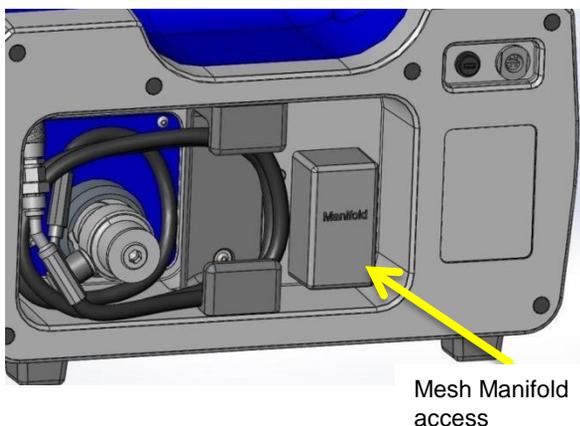
## Appendix B: PCM500.500 Mesh Manifold Exchange Procedure

This procedure must be carried out in a clean environment and great care taken to avoid extraneous contamination entering the PCM500. The mesh manifold should be replaced once 3000 points are accrued and to continue testing will produce a warning on screen and recorded as error code 305 on a test result until the mesh manifold is replaced.

Every completed test is allocated points between 1 and 3 depending on the severity of fluid condition. As example, a low contaminant, low viscosity sample will be given 1 point, whereas a dirt laden, high viscosity sample will be given 3 points. This is to ensure the integrity of the mesh will remain constant throughout the available usage. It can be seen, therefore, that the available tests range from 1000 to 3000 depending on sample condition.

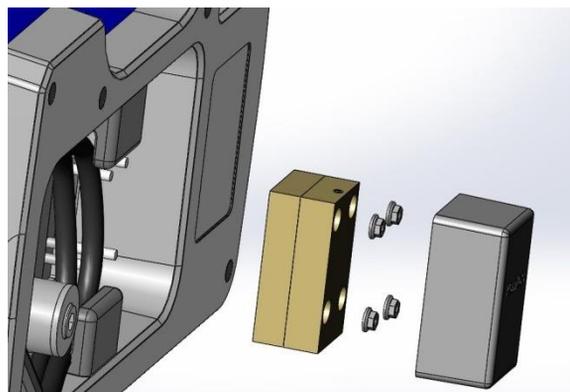
### Procedure:

1. Place the PCM500 on a clean surface and have adsorbent lint free paper wipes available.
2. Ensure the PCM500 is switched OFF.
3. Cap off both hoses.
4. Remove the rubber manifold cover.

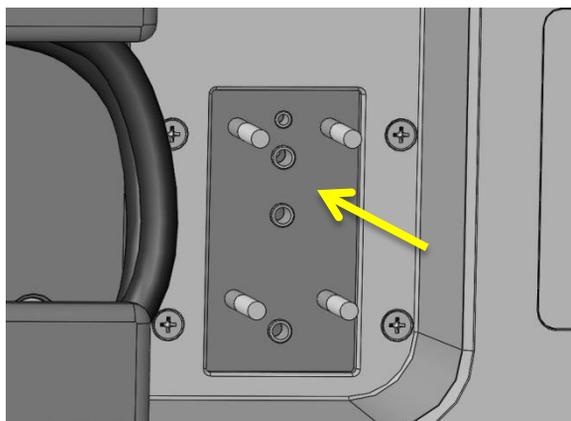


1. Use an M5 socket driver to remove four M5 Flange securing nuts.
2. Carefully remove the mesh manifold by pulling on the outer body and place in protective packaging that came with the replacement mesh manifold. Do not use mechanical grips that may damage the housing.
3. The old O-ring seals may remain on the main manifold stem connections. Remove these to waste and dry up any fluid spillage with the lint free wipes.

### Mesh Manifold Removal



### Main manifold stem connections

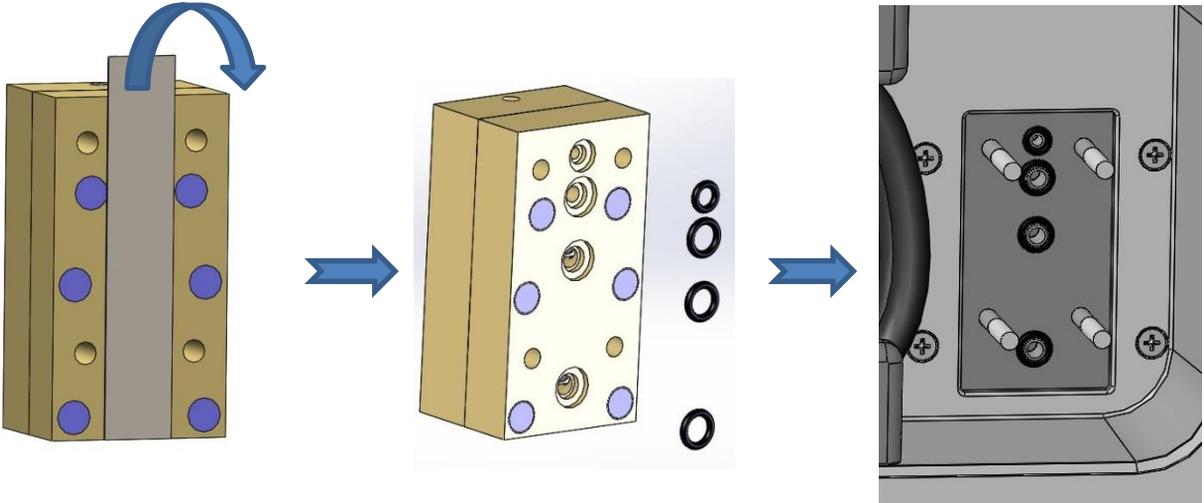


4. Remove the Replacement Mesh Manifold from its packaging and carefully remove the protective tape covering the ports. The O-rings may come away with the tape but this is normal and it is advisable to fit all four O-rings onto the main manifold stems before fitting the mesh manifold.

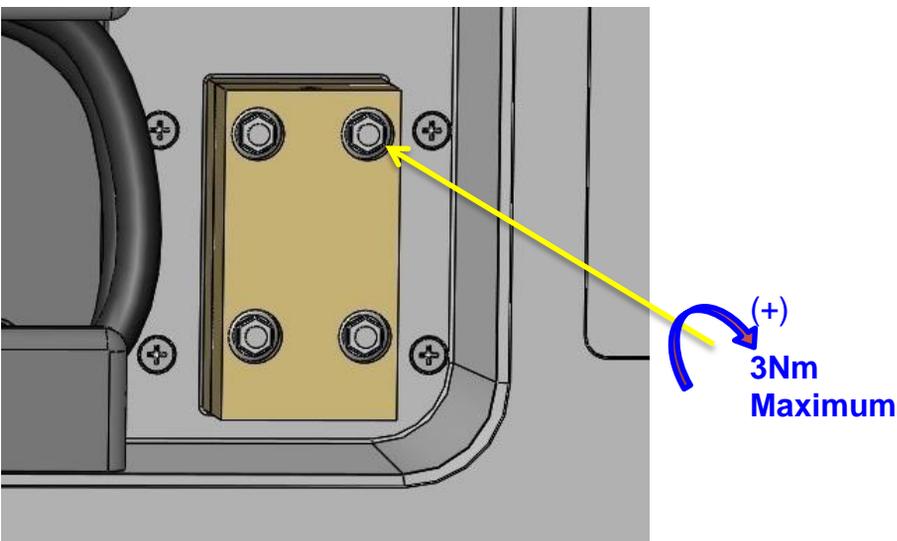
## Appendix B: PCM500.500 Mesh Manifold Exchange Procedure

### Replacement Mesh Manifold – 'O'-ring fitting

- Slide the Mesh Manifold onto the four bolts and push firmly onto the O-rings.
- Fit the four M5 Flange nuts. Be very careful not to cross thread onto the bolts.



- Tighten the nuts to a maximum of 3 Newton-Metre.
- Re-fit the rubber cover.
- When the PCM500 is switched on it will automatically detect the new mesh manifold and reset the points total in program memory to zero.



## Pall PCM500 and PCM500W Fluid Cleanliness Monitors

### World-wide Warranty

Pall products are rigidly inspected during manufacture and on completion by a modern Quality Control Department and are guaranteed for a period of one year from date of commissioning, against defective materials and workmanship when properly installed and operated at design conditions.

All parts proven to be defective within this period will be replaced free of charge FOB England or original FOB point as applicable.

However, claims for damage or labour will not be allowed; nor can the seller's equipment be warranted of failure where the operating conditions are beyond the control of the seller or beyond monitor specification. All claims must be accompanied by full particulars including system conditions if applicable.



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