PALL CORPORATION

OPERATING INSTRUCTIONS

PALL PCM400 SERIES PORTABLE FLUID CLEANLINESS MONITOR

Pall Machinery and Equipment
(A division of Pall Europe Ltd)
Europe House, Havant Street,
Portsmouth; PO1 3PD England

Telephone: +44(0)23 92303303 Fax: +44(0)23 92302507
www.pall.com\m&e

Filtration. Separation. Solution.

Preface

The ‘Pall’ PCM400 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, either ISO4406, SAE AS4059D or NAS1638. This data can be downloaded from the dedicated handheld readout to a PC via the RS232 communications port, for subsequent trending of stored data.

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 PCM400 monitor is adequately flushed prior to testing with 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 PCM400 monitor is compatible with the application and is operated within local safety codes.

NOTICE TO USERS

The PCM400 user manual is provided to assist users in maximising the benefits of the PCM400 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 PCM400 is shipped to users with, a protective fluid, Rust veto NTP 32, which is miscible with 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.

This manual is divided into parts:

Section 1	Describes the environmental, mechanical and electrical aspects of the PCM400 monitor to include product specifications.
Section 2	Inspection, packaging and guidance note
Section 3	Description of the PCM400 monitor main items
Section 4	PCM400 principle of operation
Section 5	Pre-check and connection of the PCM400 to a fluid system
Section 6	Deals with operation of the PCM400 monitor, including communications to the handheld readout.
Section 7	Details the fluid change procedure
Section 8	Describes the PCM400 monitor function codes, possible causes and corrective actions.
Section 9	Spare parts list
Section 10	Covers the disposal of equipment
Appendix A	Details the **Pall** PCM400 series worldwide aftermarket and calibration service.
Appendix B	Gives the details of the ISO 4406, SAE AS4059 Table 1 (NAS1638) and SAE AS4059 Table 2 contamination codes.
Appendix C	PCM400 series flow charts.
Appendix D	Outlines the effects of measuring oils of vastly differing water levels on stabilization times to achieve accurate measurement.

MANUAL PART NUMBER	ISSUE	DATE
MA-PCM400	***H***	***March 2010***

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

DECLARATION OF CONFORMITY

PRODUCT DESCRIPTION:	**Portable Cleanliness Monitor**
PRODUCT PART NUMBER:	**PCM400 and PCM400W**
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:-

BSEN292-1 :1991	Safety of Machinery – Basic Concepts
BSEN60204-1 :1998	Safety of Machinery – Electrical Equipment of Machines
BSEN1050 :1997	Safety of Machinery – Risk Assessment
EN61000-6-3: 2001	Electromagnetic Compatibility – Generic Emissions Standard Pt 1 Light Industrial
EN61000-6-2: 2001	Electromagnetic Compatibility – Generic Immunity Standard Pt 2 Industrial Environment
EN61000-3-2 : 2001	Harmonic Current Emissions
EN61000-3-3 : 1995	Voltage Fluctuation and Flicker
BSEN60529 : 1992	Degrees of Protection Provided by Enclosures

This compliance is sufficient to meet the requirements of the EC Machinery Directive 89/392/EEC (as amended by Directive 91/368/EEC), the Low Voltage Directive 73/23/EEC and the EMC Directive 89/336/EEC (as amended by Directive 92/31/EEC).
This product must be regularly serviced by Pall and /or their approved agent for the declaration to remain effective after shipment.

A. P. Standing, Engineering 'Projects' Manager
For and on behalf of: *Pall Machinery and Equipment*
Europa House
Havant Street
Portsmouth *Hampshire England PO1 3PD*

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.

	***WARNINGS: THESE ARE INSTRUCTIONS THAT DRAW ATTENTION TO THE RISK OF INJURY OR DEATH.***

	***Cautions: These are instructions that draw attention to the risk of damage to the product, the process, the equipment or the surroundings.***

!	Important: These are instructions that draw attention to information that will aid installation, operation or maintenance.

Trademarks and Intellectual Property

Contents

Section 1:Pall PCM400 and PCM400W Fluid Cleanliness Monitors

Specification and Requirements

1.1 General Description

The **Pall** PCM400/PCM400W is specifically developed as a portable diagnostic monitoring device that provides an assessment of system fluid cleanliness. A detachable hand held 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 hand held display/controller shows the test results, a graph of data is available and this data is 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 PCM400W should not be used for aqueous solutions.
Fluid change procedures are included in this manual and these help to ensure the PCM400 monitor is adequately flushed ready for an alternative fluid application

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 cSt (30 to 2,200 SUS)	
Operating System Temperature	Mineral Oils	5ºC - 80ºC (41°F - 176°F)
	Water Glycols	5ºC - 60ºC (41°F - 140°F)
	Water Based Fluid	5ºC - 60ºC (41°F - 140°F)
	Fuels	5ºC - 40ºC (41°F - 104°F)
	Industrial Phosphate Esters & Polyesters	5ºC - 80ºC (41°F - 176°F)
Fluid Compatibility	Aqueous solutions having a pH <11.0, water glycols, high water based fluids, petroleum based fluids, industrial phosphate esters, mineral oils and synthetic fluids.	
Seals	Fluorocarbon	

1.3 Ambient Environment

Operating Temperature range	5°C - 50°C (14°F - 122°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)

1.4 Electrical

Power Supply Unit (PSU)	90 – 260 VAC (Auto Ranging), 47 – 63 Hz Single Phase. Battery Voltage 19.2 Vdc
Power supply from PSU to PCM400	48Vdc
Battery Life	Typically 35 samples depending on cleanliness levels & oil viscosity
Communications	RS232C, RS485 (not networking)

1.5 Fluid Connections

Inlet – 3 options	• High Pressure Hose via ¼" BSP female swivel fitting. • Metric or Imperial High Pressure Test Point connected to the hose fitting • Sampling stalk (for bottle sampling)
Outlet	M10 male fitted with 6mm dia. clear plastic hose, with straight adapter and cap.

1.6 Product Specification

Weight	10.8 Kg (22 lb)
Dimensions	342 x 260 x 235 mm (13.5” x 10.2” x 9.3“)
Monitoring range ISO4406	-/9/7 to -/21/17
Monitoring range SAE AS4059E Table 1 (NAS1638)	1 to 12 at 5 to 15µm
Monitoring range SAE AS4059E Table 2	>6µm: 1B to 12B and >14µm: 1C to 12C
Accuracy	±1/2 ISO Code
Water-in-Oil (PCM400W only) %RH. (PPM switchable but requires C1 & C2 fluid constant input. Contact PALL representative).	± 2% at 5 to 95%RH (non-condensing) 0 to 100% full range.

Section 2: Pall PCM400 and PCM400W Fluid Cleanliness Monitors

Inspection and Packaging

2.1 Inspection and Packaging

The PCM400 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.

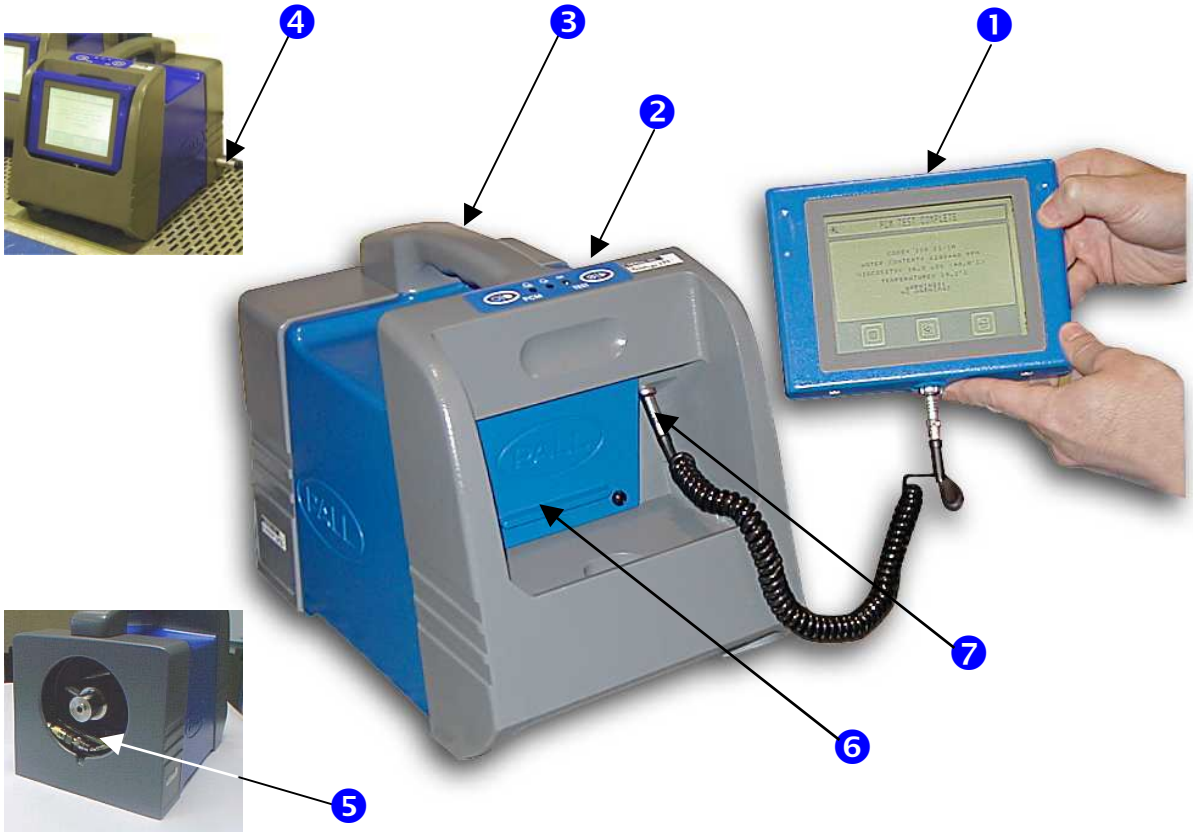
Inspect the interior of the case for damage to the contents as listed below. Compare the contents of the case with the shipping papers to assure all the content is present. If any items are missing, contact Pall or an approved agent.

The PCM400 package comprises of:

- Integrated PCM400 series monitor with sample hoses
- Power supply unit
- Mains power lead
- Handheld display
- PCM400 to handheld display cable
- PCM400 to PC communications cable
- PCM400 series Operating Instructions and Display Download software on CD ROM
- PCM400 series Quick Reference Guide
- Fluid Sampling stalk
- High Pressure test point connectors (1)
- Certificate of Conformity
- Certificate of Calibration Verification
- **Pall** 'Fluid Cleanliness Trender' software on CD ROM
- Packing note checklist
- Infrared Printer (Option)

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

Section 3: Pall PCM400 and PCM400W Fluid Cleanliness Monitors
Description of the Monitor



1 Detachable hand held display/controller **2 Control / Alarm panel**

3 Robust case with carrying handle **4 Power supply connection**

5 Hose storage compartment **6 Integral 19VDC battery**

7 RS232 communications connector

3.1 Description of the Monitor

The PCM400 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 PCM400 is likely to be subject to during operation.

As a self-contained unit, including sampling hose and adapters, the user is able to connect the PCM400 on-line or sample fluid directly from a system reservoir without breaking lines thereby avoiding extraneous contamination.

The PCM400 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 PCM400 and system fluid.

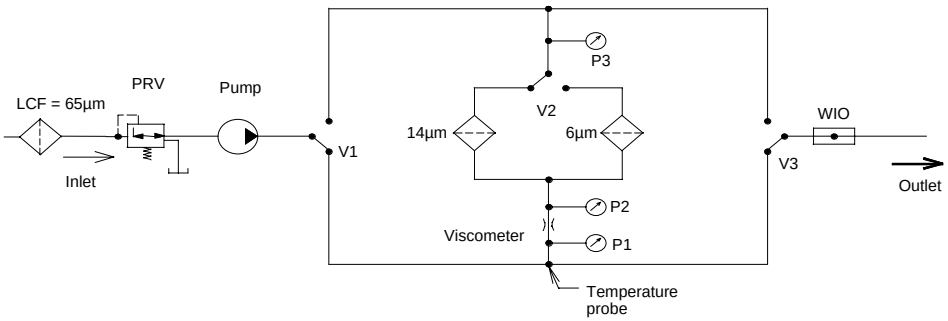
Section 4: Pall PCM400 and PCM400W Series Fluid Cleanliness Monitor

Principles of Operation

4.1 General Principles

On the start of a test sequence the PCM400 will self-prime and perform internal checks on the test fluid condition, this is an automatic part of the test time. After approximately one minute the PCM400 will then start the analysis. The screen will display a progressive time bar for the duration of the sampling period and identify at which stage in the monitoring cycle it is.

During the analysis cycle the sample fluid is presented to the meshes that capture the contamination in a specified sequence. Particle concentrations are measured and computed for each specific mesh.



Legend

LCF : Last Chance Filter
PRV : Pressure Reduction Valve
V1,V2,V3 : Bi-directional Valves
P1,P2,P3 :Pressure Transducers
WIO : Water in Oil sensor

PCM400 hydraulic schematic

During the sampling sequence, data is constantly analysed to identify any excessive variance in temperature, viscosity, and pressure to ensure results are not spurious. The PCM400 will advise the user by function codes, if any excessive variance occurs.

4.2 Control Panel

There are two soft touch control buttons and three light emitting diodes (LED) to indicate PCM400 operational status.

BUTTONS:
- On /Off
- Stop/Start

LEDs:
- Green
- Amber
- Red

Green			Amber		Red		Description
On	Flash		On		On		
	x						PCM400 On - Operational / Standby
x							Test in Progress
x			x				Sampling problem detected
					x		Hardware problem detected

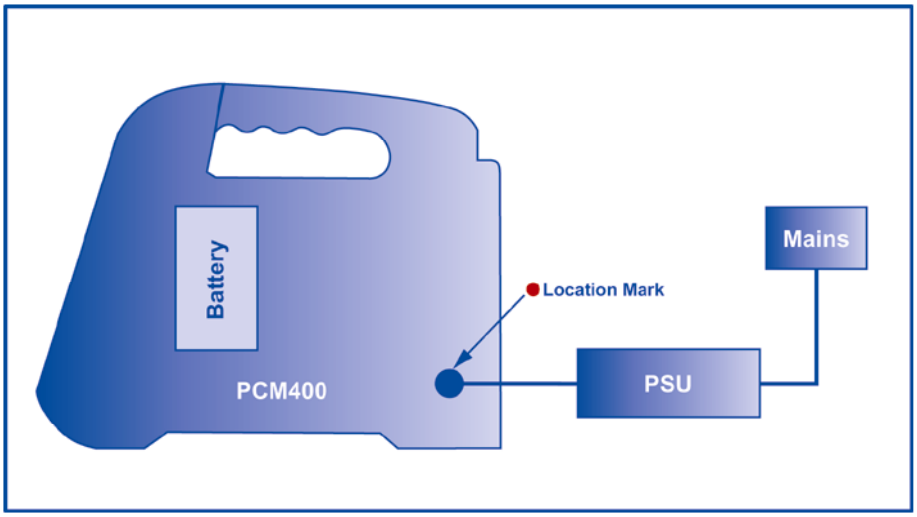
4.3 Test sampling

The hand held display panel is designed to provide clear viewing of the menu display, test data and any function codes. The test sample sequence is conducted by use of the primary function keys. In edit mode a qwerty keyboard is available, which enables users to enter, or edit data including sample points and fluid types.

4.4 Power Schematic

The PCM400 is normally powered by a battery located in the front of the unit, behind the display holder, and allows the monitor to operate for an average of 35 tests (depending on oil viscosity and level of battery charge). A power supply unit (PSU), supplied as part of the PCM400 package, allows the monitor to be run on mains power supply and to charge the installed battery.
Prior to connection ensure the PSU cable connector 'red' location mark is uppermost.
An LED next to the battery will remain ON when the battery is in fast charge mode, otherwise it will flash indicating trickle charge.

!	Important: The monitor must not be operated with the battery pack disconnected.



Section 5: Pall PCM400 and PCM400W Fluid Cleanliness Monitors

Connecting the PCM 400

5.1 Connection Options

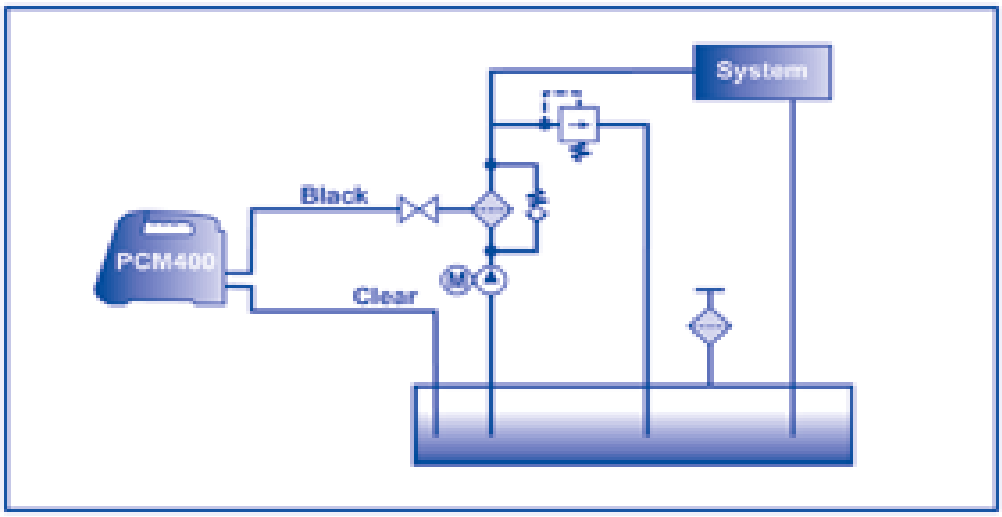
A general checklist for the user before starting is given in section 5.3 and also on the 'Useful information' quick reference card within the PCM400 unit.

PCM400 is configured for two hose operation, inlet and return. The high-pressure hose is used for both high and low-pressure sampling. Fluid entering the PCM400 is filtered for contaminant greater than 65µm by a mesh element (Last Chance Filter) that is user changeable. In the event of a blocked filter during testing, the fluid entering the PCM will be restricted. An alarm condition with a warning message will be given on the display. For high pressure, the sampling point should be cleaned of contaminant prior to connection and in both sampling modes the return line must be unrestricted and allowed to drain into a waste container or system reservoir.

The PCM400 is simply connected to a system via the appropriate integrated sampling hoses. The sampling hoses are stored within the PCM400 and are coiled around the inside of the rear of the instrument.

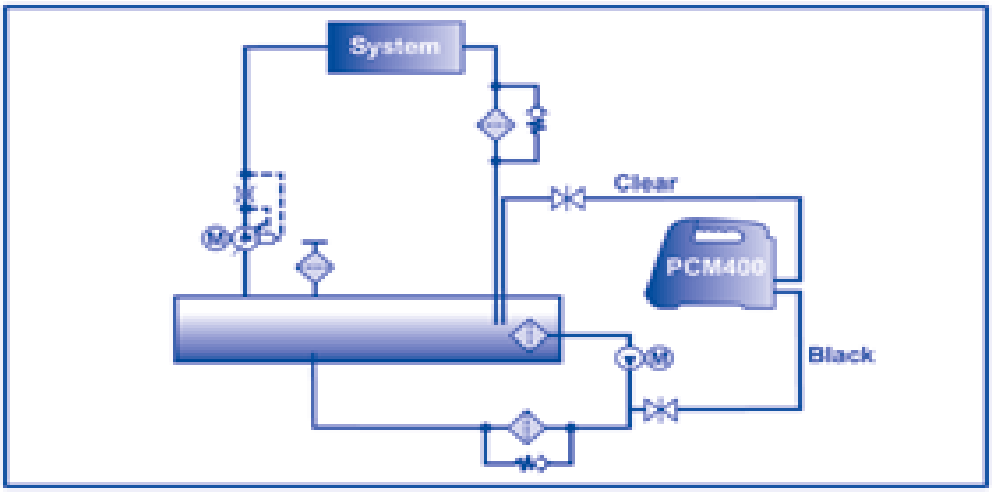
The PCM400 can be connected in various ways. High-pressure mode is considered to be the most appropriate to achieve representative sampling.

High Pressure Line (1 to 315 bar)

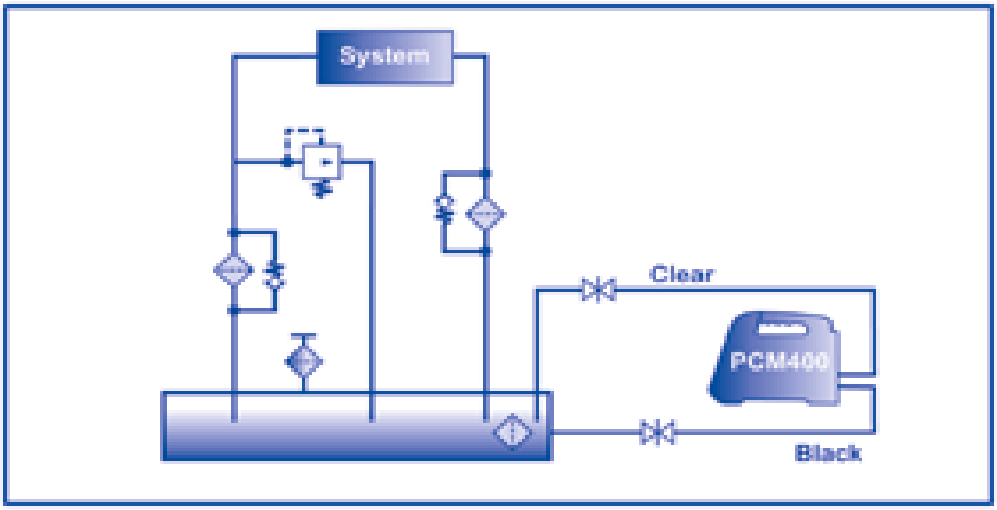


⚠	***Caution: In the interests of safety, always remove the end cap from the return line <u>before</u> connecting the inlet hose to high-pressure. If the PCM Pressure Reduction Valve does not regulate properly then excess outlet pressure can escape through a relief-valve into the return line.*** **NEVER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

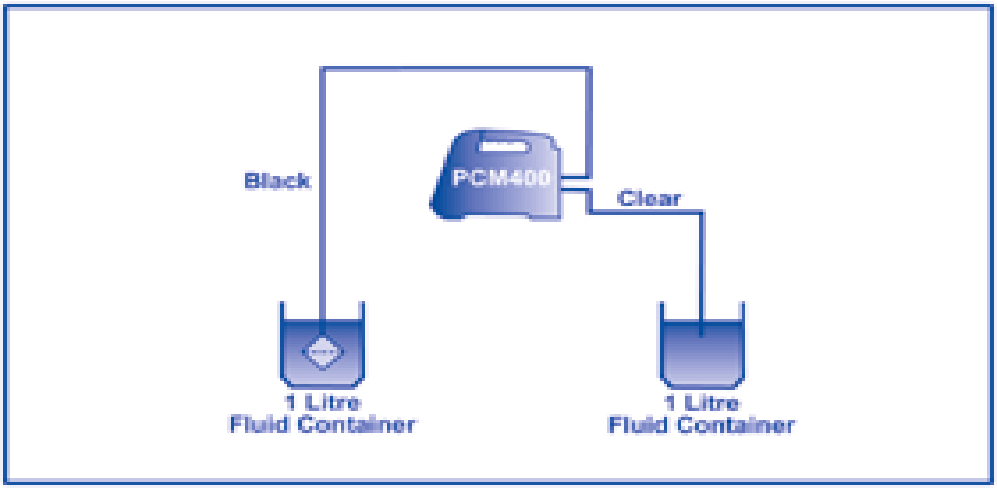
Low Pressure (0 to 1 bar)



Reservoir Sampling



Bottle Sample



5.2 Operational Checks

Preparation checks before going to the installation to be sampled.

	***Caution: The PCM400 hand held 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.***

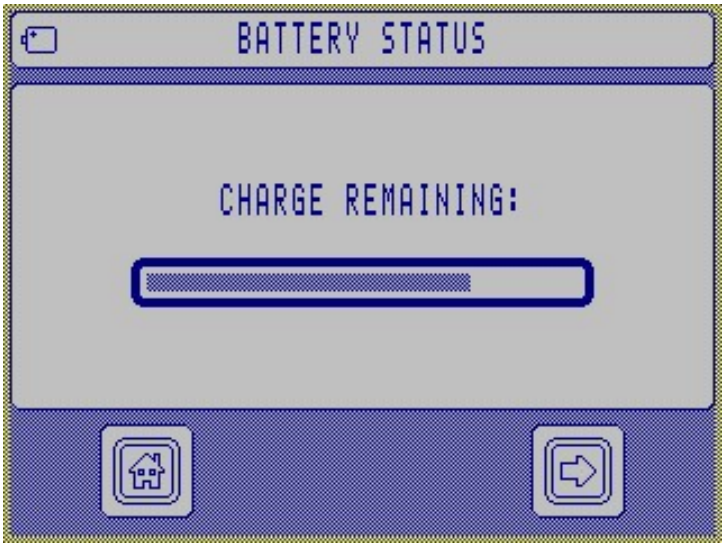
1) Press and hold the PCM400 start button ○ | ● The Control panel green LED will flash within a few seconds and the PCM400 enters a boot-up phase. After approximately 15 seconds the valves complete a test sequence and the screen activates. If no screen appears, connect the PCM400 to the power supply unit (PSU) to check the available battery power level on the hand held display. If the PSU is connected and the PCM fails to work, consult Pall.

Press the ⇨ key to continue.

Press the ⇨ key to continue.

2) Further screens will advise the current time, date and battery status bar chart.

Press the ⇨ key to continue, to alter the time press 🕐 , or date 📅 keys. Enter correct values using the ⇧ and ⇩ keys. Press ✓ to accept.



Press the ⇨ key to continue.

3) If the PCM400 has been used previously with a different fluid to the new sample then fluid change procedures detailed in section 7 must be adopted.

4) Switch off the PCM400 and you are now ready to proceed to the installation to be sampled.

5.3 Installation Checks

At installation to be sampled

1) Access the hoses at the rear of the PCM400.

2) Ensure the hose connectors are clean and free from any 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 as evenly as possible within the fluid. 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.

5) Connect the black hose to the appropriate sampling point. Check for any leakage, rectify as required.

Cautions: Ensure the system operating pressure is within the PCM400 monitor specified limitation of 315 bar, 4,570 psi maximum.

6) The PCM400 can now be switched on and the screen sequence followed. The specific procedure for start-up is detailed in section 6 ‘Getting started’.

Section 6: Pall PCM400 and PCM400W Fluid Cleanliness Monitors

Getting Started

6.1 General

This section of the operating instructions enables a new user to perform tests using the PCM400 Cleanliness Monitor in a short space of time. It does not instruct the user in sampling techniques and the user should consult for guidance on recommended sampling points.

6.2 System Components

- PCM400 Cleanliness Monitor
- Power Supply Unit
- Battery Pack
- PCM400 Handheld Display
- Infrared Printer (Option)

6.3 Key Descriptions


Returns the user to the main menu


Steps to the previous screen


Advances to the next screen


Displays the edit keyboard


Select/edit specific fluid property


Select/edit test point properties


Start a new test


Accept edited parameters and exit screen


Disregard edited parameter and exit screen


Warm-up routine

Repeat a test


Alarm key


Battery Charge Status


Select Language


Time setting


Date setting


View Test Report


Save test result


View Data Manager


Open button


Scroll Up


Scroll Down


Trash (bin) Delete data


Create New file

Period key


Engineering Set up

Password protection


Code Format


Print current test

6.4 Display Flow Chart

The display flow chart can be used to help the new user become familiar with the PCM400 display operating sequence, refer to the quick reference guide and appendix C of this manual. The flow chart consists of a number of views, each of which summarises a screen displayed by the PCM400.

The flow chart also gives the user an overview of the operating system, showing the position of screens relative to each other and the path that the system follows. These will help the user to quickly become familiar and comfortable with the system.

6.5 Example Screen

The screen below is an example of those that will be seen when using the PCM400. Explanations of common key uses are incorporated here to prevent repetition. The key will always return the user to the main menu. The key will cause a keyboard to appear, enabling both text and/or numbers to be directly edited. The key will move the user back to the previous screen, likewise the key will advance the user to the next screen.

An example screen shot of the PCM400 main menu:

6.6 Start-up Sequence

Hold down the power on/off button ○ | ● (left of the blue panel on top of the PCM400) for approximately 2 seconds. This will power-up the PCM400 monitor. The green light (marked as 'OK' on the panel) will flash for several seconds. Whilst the unit powers up, the display will activate and the following appears:

The user must either press to proceed to the main menu screen, or press key to advance through the screens. The next screen displays information unique to that specific PCM400. This information includes PCM400 serial number, firmware version, and customer details.

!	**Important:** Pall recommends returning the monitor for service and calibration annually and also for mesh replacement, when indicated on screen, after 1000 to 3000 tests depending on use.

If the PCM400 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 PCM400 fully serviced and helps ensure the integrity of the high-pressure part of the instrument. Refer to section 8 Function Codes, Possible Cause(s) and Corrective Actions. Press ✓ to advance.

The PCM400 next displays the time and date screen, which enable the user to ensure the unit time and date are correct. Pressing either the ⏱ or the 📅 icon enable the time or date to be set respectively. For more information on setting the clock refer to section 5.2.

Press the ⇨ key to continue.

The PCM next displays the battery status. Remaining charge is given in the bar chart.

Press the ⇨ key to continue.

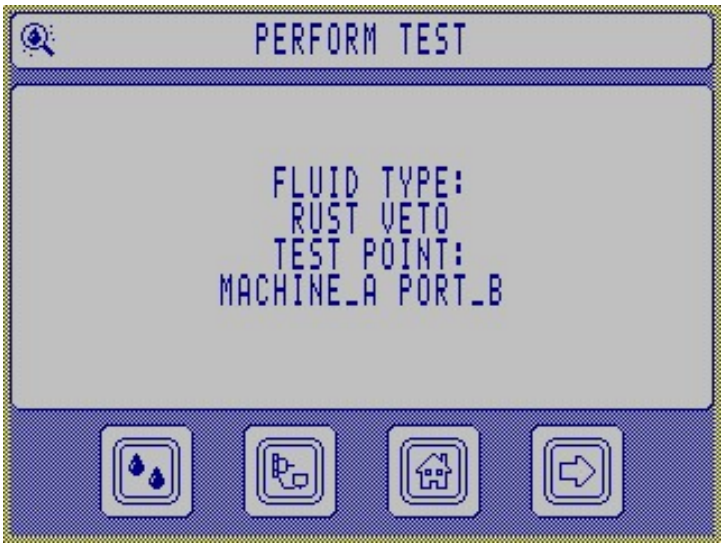
The final screen in the boot screen sequence is the main menu screen. From the main menu it is possible to configure/start a test, perform a warm-up sequence, review previous results, or configure unit settings.

6.7 Sampling

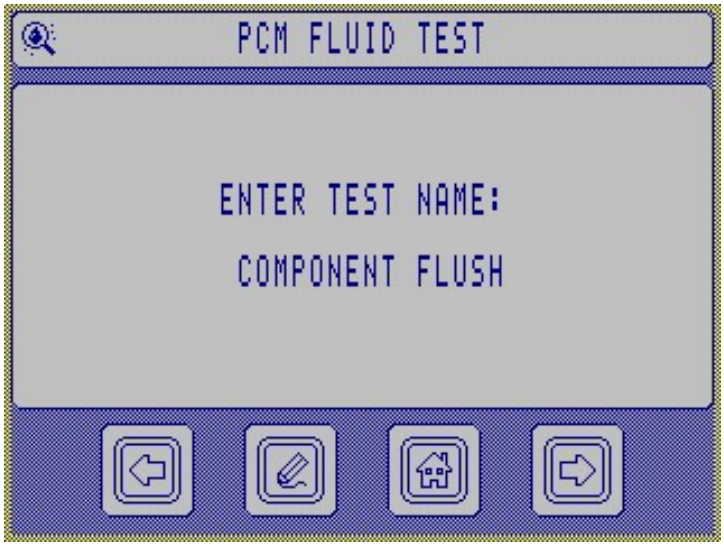
Preferably sample on-line, or alternatively from a reservoir, or bottled oil sources. Refer to sections 1 ‘Specifications’ and section 5.1 ‘Connection Options’.

6.8 On Line Test/Tank Sampling Routine

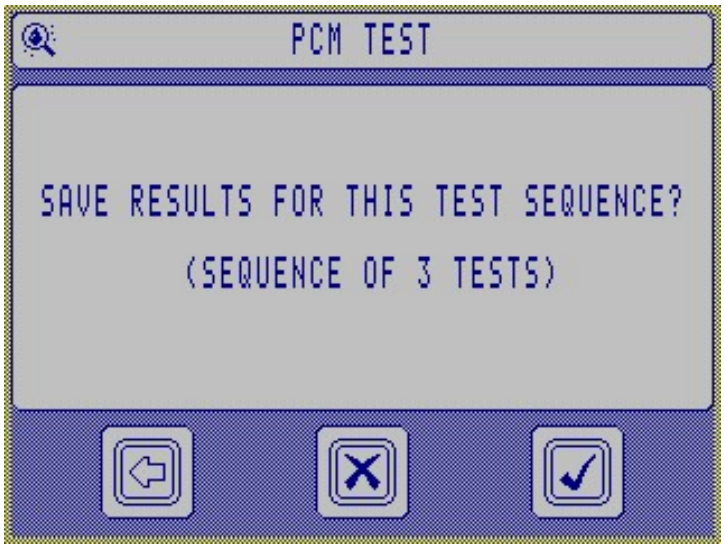
From the main menu press the test button . The user will be presented with the ‘Perform Test’ screen, from which the user can edit the fluid properties (section 6.11) or the test point properties (section 6.14), the user can also return to the main menu . To perform a test
Press the right arrow to advance to the next screen.



The user must now select a label to identify the test(s) about to be performed. The edit button will produce the keyboard screen and enable the user to edit the label. The left arrow button moves back to the previous screen. The home button shortcuts back to the main menu. The right arrow advances to the next screen.

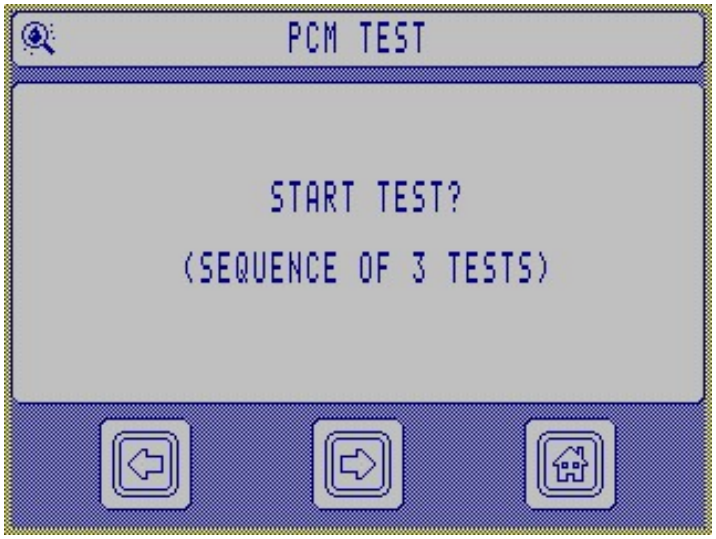


Press the key to continue.

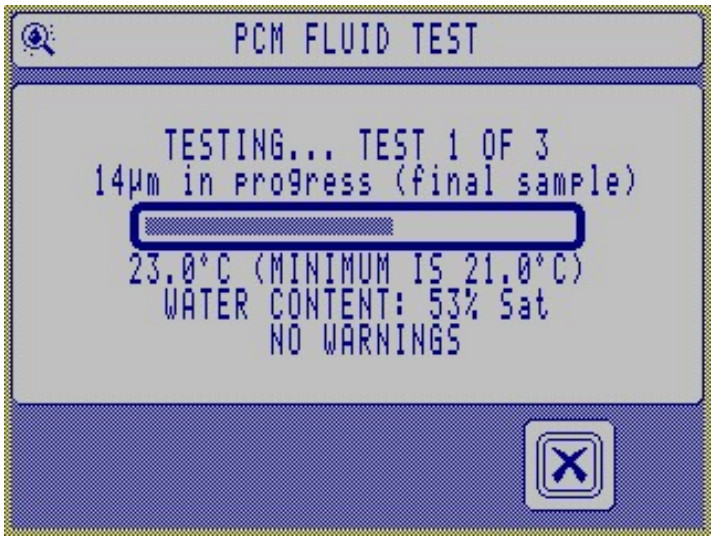


The user can select to save, or as required, or press to return to the previous screen.

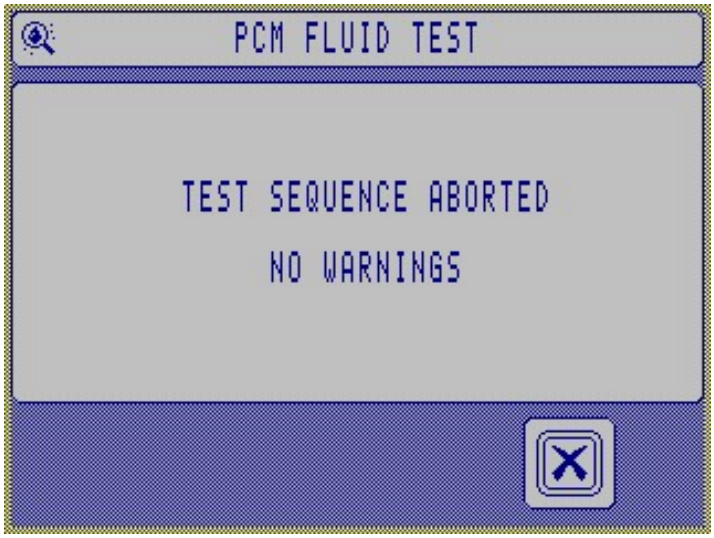
The new screen enables the user to start the test, move back to the previous screen, or jump to the main menu.



To start a test press ⇨ , the PCM400 will now perform a test. The unit displays a percentage bar to illustrate how far through the test the unit is. The test can be stopped at any time by pressing the main menu button ✕.



If the ✕ icon is pressed the test sequence is aborted and the following screen displayed



Press ✕ to continue.
On completion of a test the PCM400 displays a summary of results. If multiple tests were

specified the unit will display a test period countdown screen and then start testing again. For more information on 'number of tests' and 'test trigger periods' see section 6.16 and 6.17 respectively.

A more detailed explanation of test results, including any test warnings or alarms can be seen by pressing the report icon (Test Details) and icon (Test Warnings). From the details page the option to print the result is available.

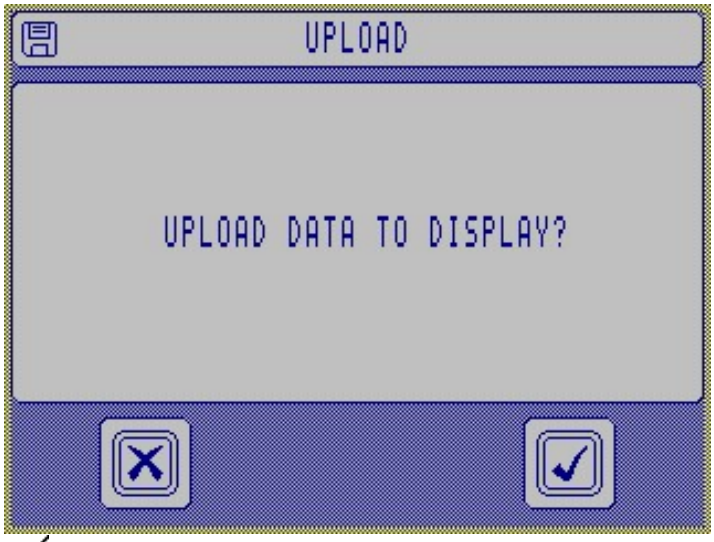
Press to perform another test(s).

6.9 Output Results Routine

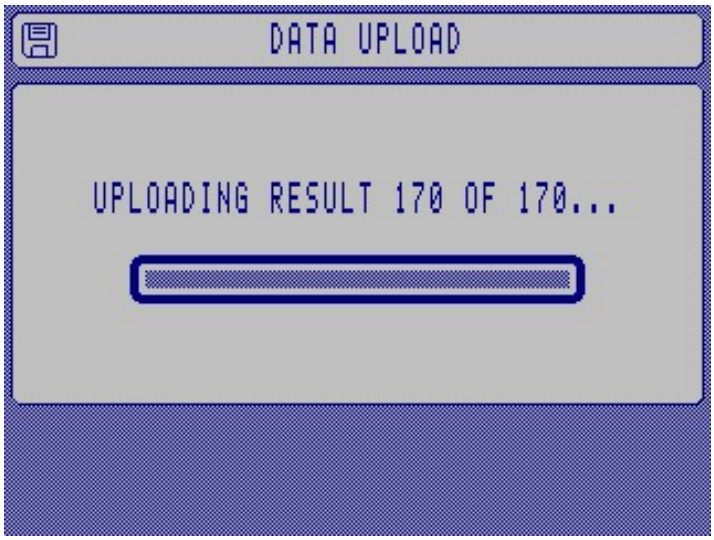
Any results saved on the PCM400 can be viewed and managed using the data manager. To get to the data manager press the data manager button in the main menu.

The data manager displays the current result label.

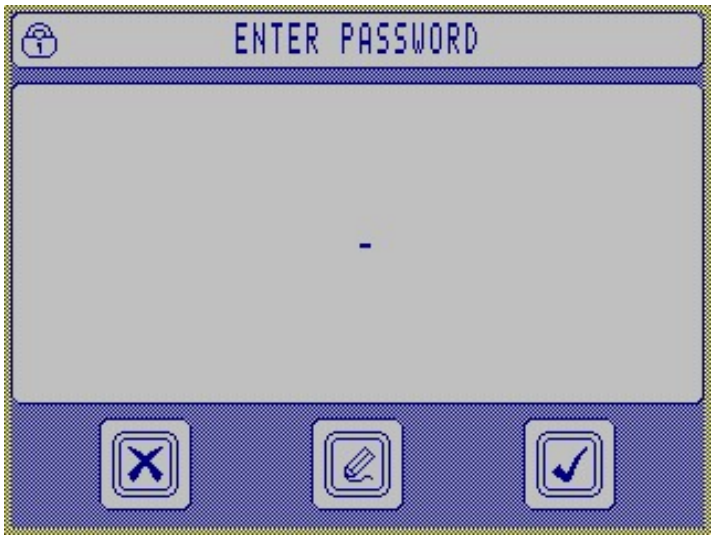
Press followed by to save and upload (store) the test results to the PCM400 series hand held display/controller.



To continue select the ✓ icon

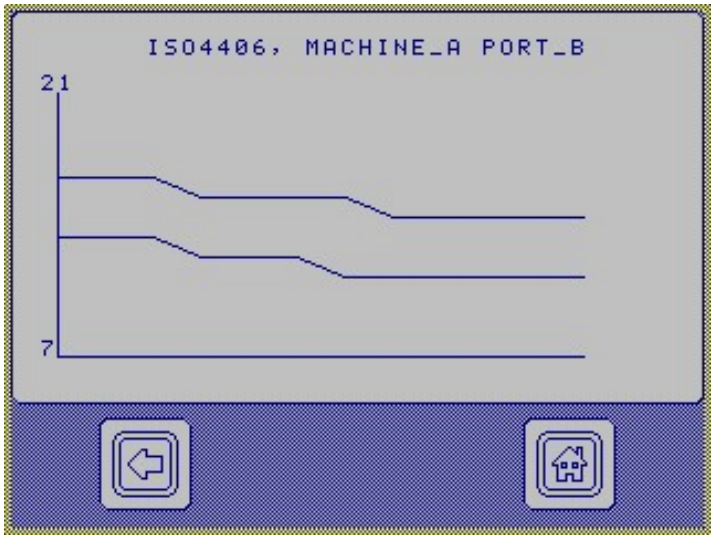


To delete the result press the ✓ icon, otherwise, press ✗ to retain results in PCM memory.



Press and enter *DEL1* followed by ✓ and ✓ to delete all test results. Refer to section 6.21 for additional information.

The user can view a set of results from a common test point in graphical form. This enables the user to easily see any trends in the results. Open a set of results from the desired test point, then select the trend button from the data manager screen. This will display a simple time graph of the saved results.



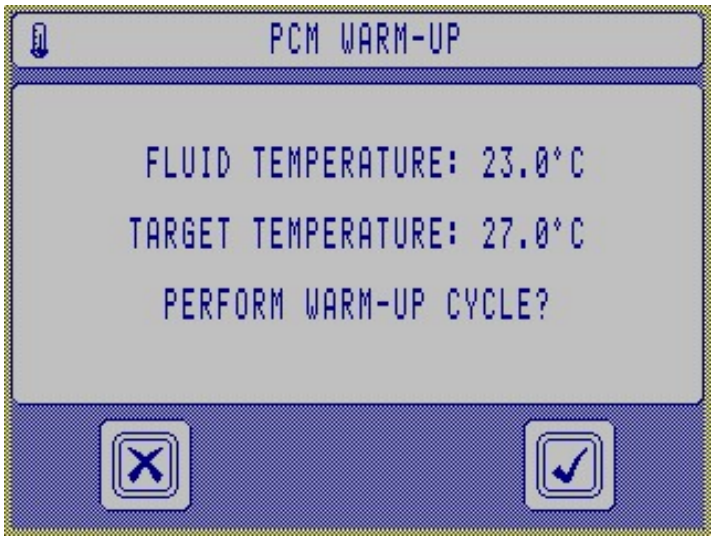
Pressing the open icon 🗁 can display a stored result. The open result screen enables the user to scroll up ⇧ and down ⇩ through previously saved results.

The displayed result can be selected by pressing the ✓ Icon.

The user can view a detailed report on the test by pressing the report icon 📋 (Test Details) and ⇨ icon (Test Warnings). The report displays all parameters measured by the PCM400 with any function codes. For a printout, fit the printer, switch on and press 🖶 to print the current test details.

6.10 Warm-up routine

The warm-up routine can be accessed from the main menu by pressing the thermometer button 🌡. The warm-up routine is used to raise the temperature of the PCM400 unit to that of the test fluid. This helps to prevent spurious test results due to severe viscosity changes during the test procedure. During warm-up the unit pumps the test fluid through the instrument and displays the current unit temperature on the screen. The warm-up target temperature is that entered in the current test point.

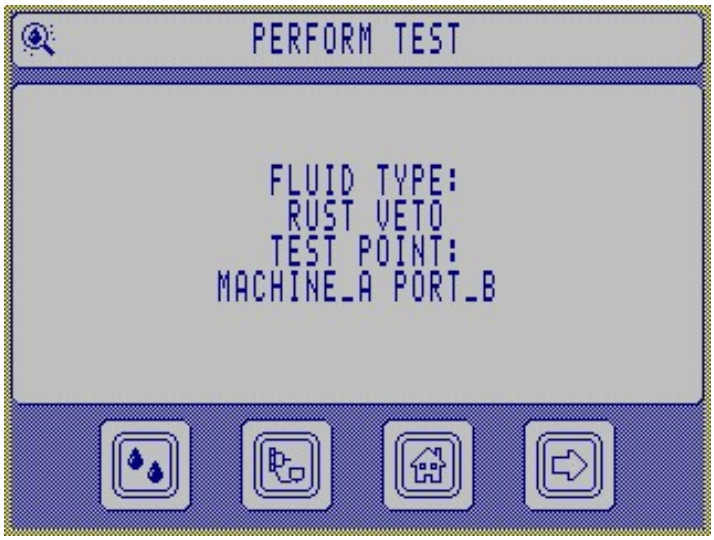


Press the ✓ icon to start the warm-up cycle

Either abort using the ✗ icon, or continue until the test point pre-set temperature is attained. Refer to section 6.18 to reset the target temperature.

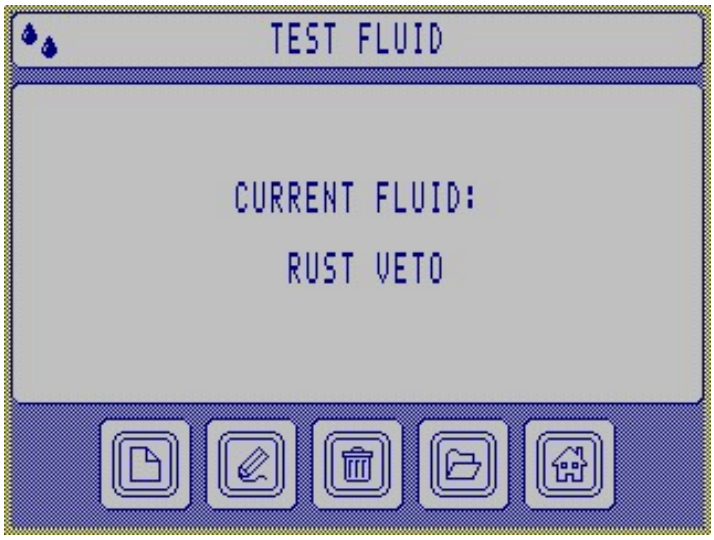
6.11 Fluid set-up routine

To access the fluid set-up menu, select the test button from the main menu.



Now select the fluid button. As with previous routines; the left arrow button displays the previous screen, the right arrow button advances to the next screen.

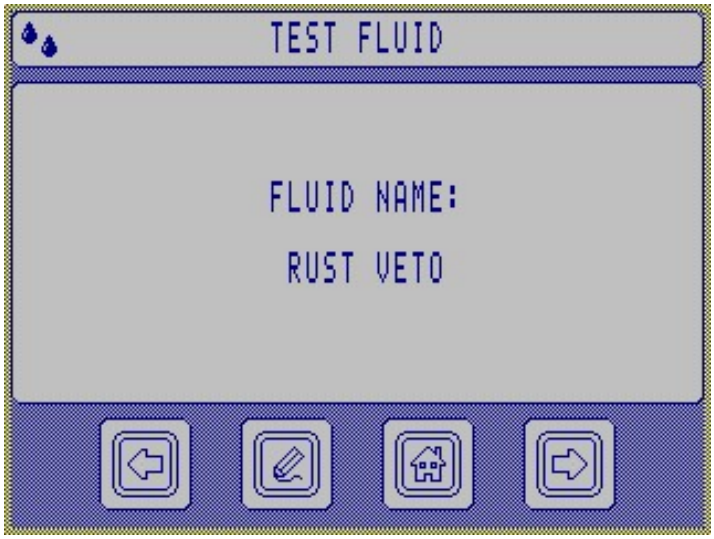
6.12 Fluid name



This screen displays the name of the current fluid type. From this screen the user can create a new fluid name, edit the current fluid, open an existing fluid, or return to the main menu. Up to 250 individual test fluids can be created.

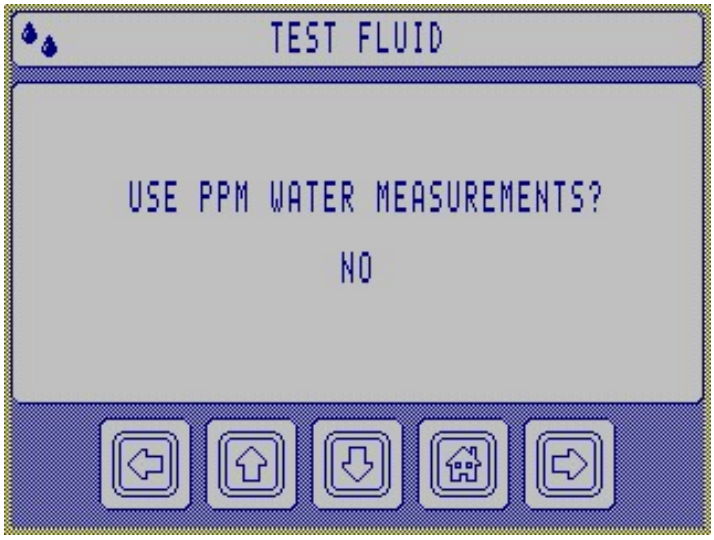
The open button presents the user with a screen that enables them to scroll through existing fluids, using the up and down buttons, followed by to select.

If the edit button is pressed the user is presented with the fluid name, which can be edited by pressing the edit button once again.



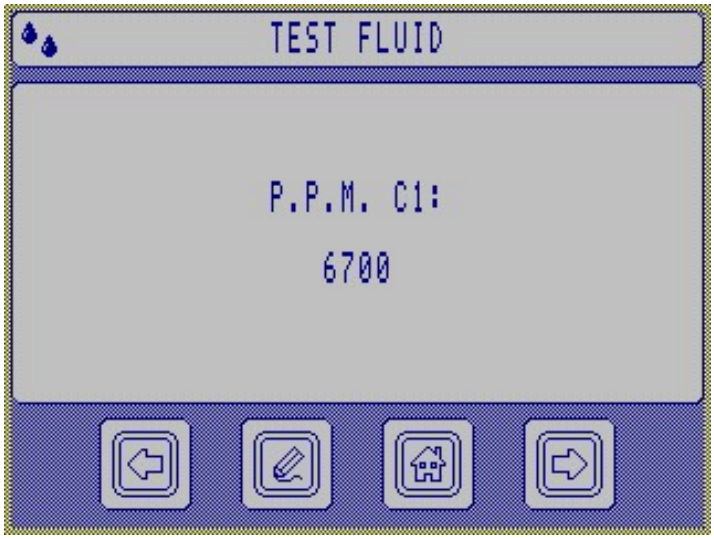
6.13 Fluid water content

Pressing the advance button ⇨ from the fluid name screen enables the PCM400W to calculate the absolute water content (PPM) of a test fluid. If PPM is set to NO then C1 and C2 will not be requested and the results will be given in % saturation terms.



Use ⇧ ⇩ to select, Yes or No and ⇨ to continue.

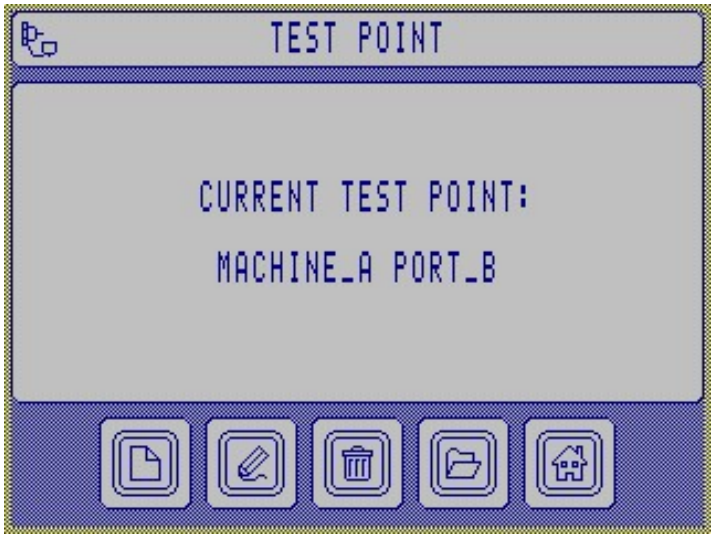
Use the edit button to enter these values, when prompted, and the advance arrow ⇨ to move to the next screen.



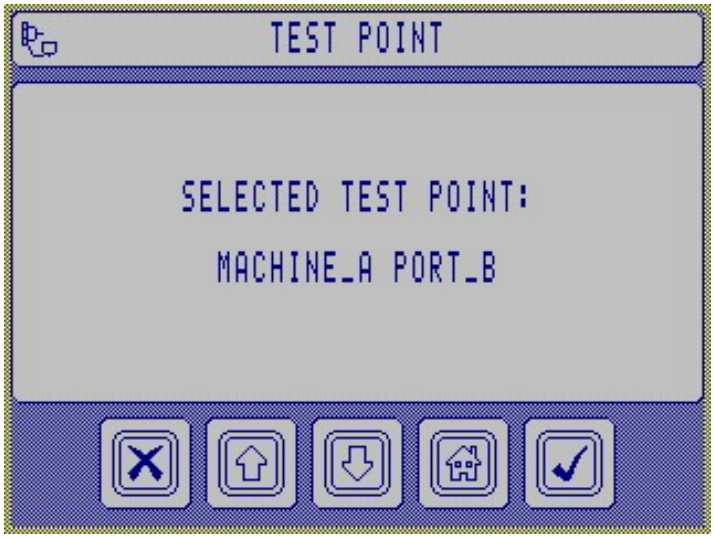
Numerical values for C1 and C2 can be obtained by contacting you local Pall representative.

6.14 Test Point set-up routine

The test point set-up routine is accessed by pressing test button icon from the main menu and then pressing the test point button.



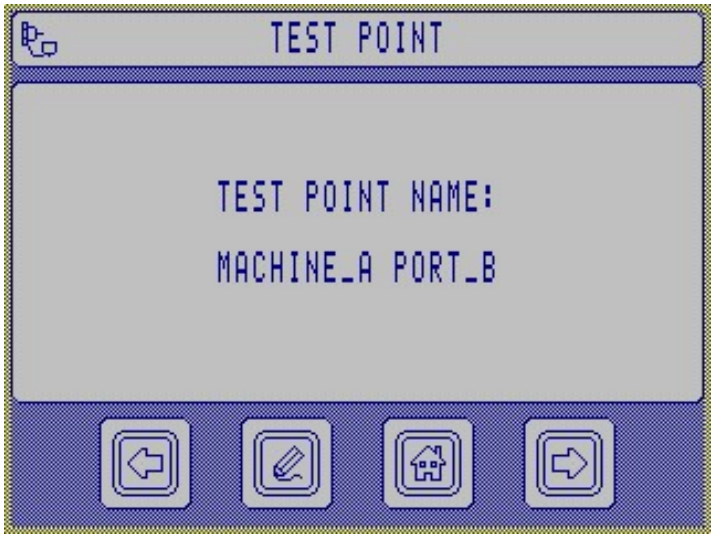
The test point screen enables the user to create a new test point, edit an existing test point, open an existing test point, or return to the main menu. Up to 250 individual test points can be created.
Press to delete a current test point.



Pressing the open button enables the user to scroll up and down through the existing test points. Press to select required test point.

6.15 Test Point name

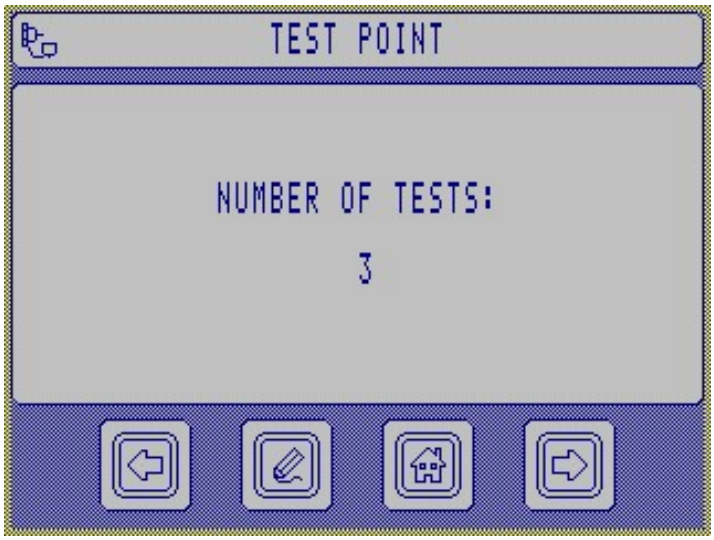
The user can edit the test point name by selecting the edit button.



Press to continue.

6.16 Number of Tests / Continuous Test

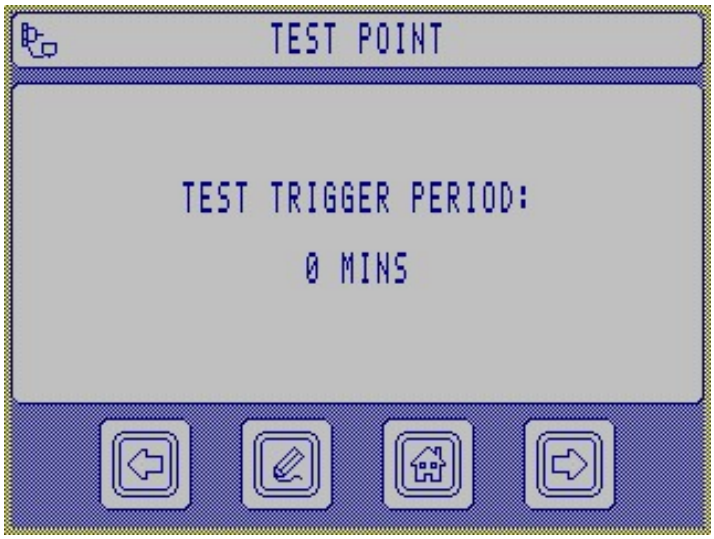
This screen simply enables the user to enter the number times the PCM400 should repeat the test procedure. Entering 0 in the number of tests will cause the PCM400 to continuously test the fluid. Press to amend value, or press to advance.



Press to proceed.

6.17 Test trigger period

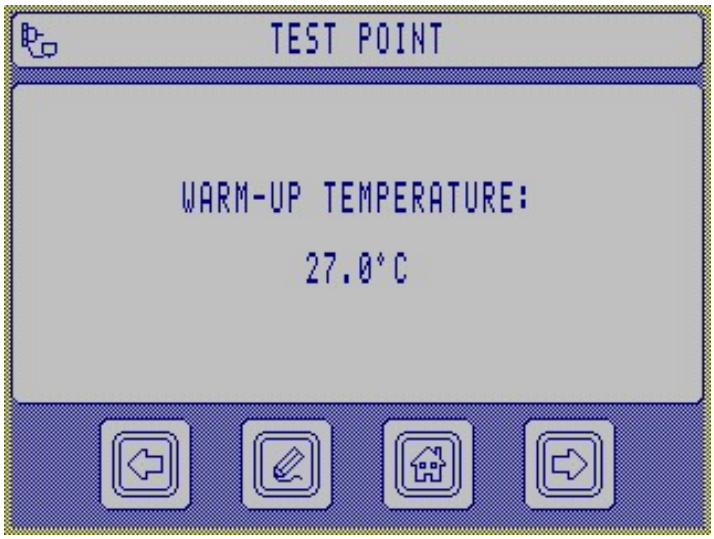
This screen enables the user to specify the time period between the start of consecutive tests. A period of 0 will cause tests to immediately follow each other. Press to amend value, or press to advance.



!	Important: The trigger test period is from the start of a one test to the start of the following test. If the trigger period were shorter than the test time then there would be no delay before the start of the following test. It is suggested to set the minimum period to 10 minutes. e.g. Trigger time=10 min. test time=6 min. time from end of test to the beginning of the next test = 4 min.

6.18 Warm-up cycle target temperature

This screen enables the user to specify the warm-up cycle target temperature. Press to amend value.



Press to proceed.

6.19 Test Point alarms

The alarms routine enables the user to advance through several screens using the edit or advance icons and specify alarm levels for different parameters. The parameters are in the sequence Water content % saturation or ppm; 6µm Code 14µm Code (or SAE 4059 Table 1 or 2, if previously selected) and Temperature.

!	Important: The water content alarm is applicable to the PCM400W monitor only. The PCM400W monitor must not be used with water bearing fluids. The PCM400 monitor does not include a water sensor.

Example of alarm setup screen.

6.20 Setting the Time and Date

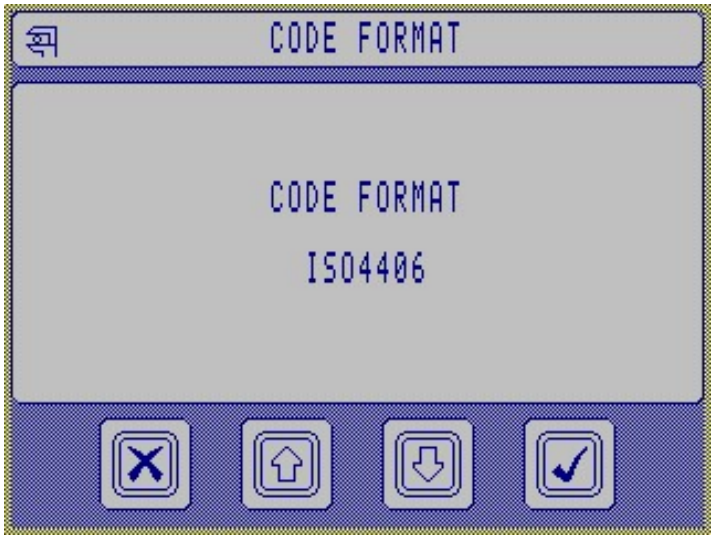
The Time and Date can be accessed during the start-up screen sequence. For more information see section 5.2.2

6.21 Engineering set-up

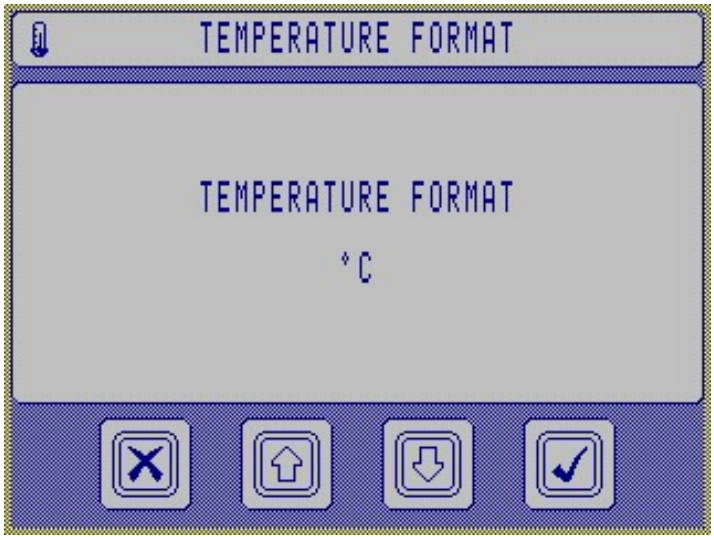
From the main menu press the engineering set-up button and the PCM400 will display the engineering set-up screen. From this screen the user can change the PCM400 time , date and language settings.

Press to proceed to the next screen.

Press to change the code format, using select either ISO4406, NAS1638 or SAE AS4059D.



Press to change the temperature format.



Press to amend variables, including customer name and change the result protection password.

Press to enter password *ENG1* and to accept.

The default variable is *Customer*, press edit to change customer name.

The Delete Result password *DEL1* can be changed. Press and type *password*, followed by . The variable (*password*) and value (*del1*) are shown. Press edit and enter your preferred delete result password _ _ _ _ , press . The *new* value is displayed.

Section 7: Pall PCM400 and PCM400W Fluid Cleanliness Monitors

Fluid Change Procedure

!	Important: These instructions draw attention to information relating to the correct fluid change procedure and subsequent continued operation of the monitor. Mixing of incompatible fluids is likely to block the PCM400 meshes.

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

❶ Run a single test to waste using clean Rust Veto NTP32 to flush out the mineral oil.

❷ 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:

❶ Run a single test to waste using clean Rust Veto NTP32 to flush out the water-based fluid.

❷ 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 PCM400W 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:

❶ When using PCM400W, 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 PCM400W should never be used in applications whose water content is known to be at or above 100% saturation.**

Section 8: Pall PCM400 and PCM400W Fluid Cleanliness Monitors

Function Codes, Possible Cause(s) and Corrective Actions

Function codes either are flags only to indicate to the user an awareness of a borderline test situation or curtail the test. An alarm will indicate registered function codes that can be cancelled by pressing any key. A message will appear indicating the problem to the user. Function codes generally occur during the warm up cycle first and while testing. There are several different function messages incorporated into the PCM400.
Below is a list of these messages, possible causes and corrective actions.

Function Code	PCM400 Condition	PCM400 Status	Possible Cause	Corrective Action
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
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
202	High Line Pressure	Unit halts the test and puts error message on screen indicating high line pressure. Amber L.E.D. on control panel activated on detection.	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. Amber L.E.D. on control panel activated on detection.	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.
102	High Pulse Width Modulation	Unit halts the test and puts error message on screen. Amber L.E.D. on control panel activated on detection.	Fluid viscosity too high. Motor current over set limit. Pump malfunction.	Decrease fluid viscosity. Contact Pall or an approved agent
***204**	Unstable temperature	Unit halts test and displays error message on screen. Amber L.E.D. on control panel activated on detection.	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. Amber L.E.D. on control panel activated on detection.	Fluid dilution. Large temperature gradient across PCM400	Operate Warm-up Cycle refer to section 6.10. Allow system fluid temperature to stabilise
Function Code	**PCM400 Condition**	**PCM400 Status**	**Possible Cause**	**Corrective Action**
***206**	Unstable sampling	Unit halts test and displays error message on screen. Amber L.E.D. on control panel activated on detection.	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.
301	Water in Oil	Unit completes test. Amber L.E.D. activated on detection.	Outside set limit	Information only.
302	Memory Full	Memory Full message will appear on screen at start-up and when test store attempted.	Internal store for test data full	Upload test data to hand held programmer, refer to section 6.9
103	Viscometer blocked	PCM400 will abort current test and display warning message. Amber L.E.D. on control panel activated on detection.	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.
207	High mesh differential pressure	PCM400 will abort current test and report error/warning message on the display screen. Amber L.E.D. on control panel activated on detection.	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
104	Low mesh differential pressure	PCM400 will abort current test/cycle and report error/warning message on the display screen. Amber L.E.D. on control panel activated on detection.	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	PCM400 will abort test.	Incorrect or no signal received from pressure transducer during calibration / background check.	Contact Pall or an approved agent
Function Code	**PCM400 Condition**	**PCM400 Status**	**Possible Cause**	**Corrective Action**
208	Water in Oil (WIO) sensor failure (if applicable)	PCM400W will display error/warning on successive tests. Amber L.E.D. on control panel activated on detection.	Incorrect output from the sensor.	Contact Pall or an approved agent
106	Temperature transducer failure.	PCM400 will abort test.	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. will activate.	No communication with main controller.	Contact Pall or an approved agent
303	6-micron mesh blocking	PCM400 will abort current test and display warning message on screen. Amber L.E.D. activated	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	PCM400 will abort current test and display warning message on screen. Amber L.E.D. activated	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 PCM400 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 PCM400 start-up	12 month calibration interval expired	Contact Pall or an approved agent for service details
308	High viscosity differential pressure	Unit halts test and displays error message on screen. Amber L.E.D. on control panel activated on detection.	Fluid viscosity out of specification, low fluid temperature	Reduce fluid viscosity. Increase fluid temperature at PCM400
108	Internal error	Unit inoperative. Hold in this state. Red L.E.D. will activate. Warning message on display.	Possible hardware failure	Contact Pall or an approved agent

Function Code	PCM400 Condition	PCM400 Status	Possible Cause	Corrective Action
401	Solid Contamination Alarm	Display warning message on screen. Amber L.E.D. activated	Pre-set Solid contamination level exceeded	Repeat test to verify. Investigate process.
402	Water Saturation Alarm	Display warning message on screen. Amber L.E.D. activated	Pre-set Fluid water saturation level exceeded	Investigate cause of elevated water contents
403	High fluid Temperature Alarm	Display warning message on screen. Amber L.E.D. activated	Pre-set Fluid temperature level exceeded	Investigate process, reduce operating temperature
404	Contamination Too High	Unit halts test and displays error message on screen. Amber L.E.D. on control panel activated on detection.	Maximum Solid contamination level exceeded	Investigate process. Dilute the sample with clean fluid
405	Test aborted	Unit halts test and displays warning message on screen.	Test aborted due to one of the other warning conditions, remote message received from COM port, or glitch generated in program during debug file creation	Repeat test if possible.
406	Test sequence aborted	Unit halts test sequence and displays warning message on screen.	Test sequence aborted due to one of the other warning conditions, stop button pressed on control panel, key pressed on display or received an abort test command from PLC.	Repeat test if possible.

NOTE: Refer to section 6.19 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 9: Pall PCM400 and PCM400W Fluid Cleanliness Monitors

Spare Parts List

Part Number	Description
PCM200.211	Power Supply Unit
PCM200.235A	Mains Cable UK
PCM200.235B	Mains Cable Europe
PCM200.235C	Mains Cable USA
PCM200.235D	Mains Cable Australia
PCM200.235E	Mains Cable Japan
PCM200.213	Battery Pack
PCM200.512	Hand Held Display
PCM200.505	Display Link Cable
PCM200.239	RS232 Communication Cable
PCM200.121	Last Chance Filter Element
PCM200.122	High Pressure Hose Assembly
PCM200.197	Low pressure Sampling Stalk
PCM200.154A	Metric Test Point Connector
PCM200.154B	Imperial Test Point Connector
UK60267	Operating Instructions - Cleanliness Trender CD ROM
UK29962	Operating Instructions - PCM400 CD ROM
UK29977	Operating Instructions PCM400 Quick Reference Card
PCM200.520	Printer Kit
PCM200.324	Printer Paper Roll (Pk.10)

Section 10: Pall PCM400 and PCM400W Fluid Cleanliness Monitors

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 PCM400 and PCM400W Fluid Cleanliness Monitors

Commissioning, Training, Calibration and After Market Services

Commissioning and Training Packages

A valuable service encompassing guidance in the commissioning of the PCM400 monitor and training in its use is available from Pall or its approved agent.
It is strongly recommended that this service be utilised in order to ensure correct installation and operation of the equipment, as incorrect installation leading to incorrect or inefficient operation may result in invalidation of warranty.
As with all condition monitoring equipment, regular servicing and maintenance will extend the life of the equipment and lead to more effective operation. For this reason, Pall also recommends that all operators undertake this service.
Note: Pall or its approved agent will attempt to contact each customer in advance in order to arrange commissioning and training involvement. However, prior to attempting any installation work, it is recommended that the customer should contact the Pall in order to ensure that guidance and involvement of a Pall technician has been arranged.

Note: The extent of involvement for Pall in this activity is an advisory role; no parts will be supplied. The customer should ensure that all works requested by the Pall technician are completed prior to his visit to the customer site.

Further Training Packages

In many cases, the users of equipment such as the PCM400 series monitor will require further, more in-depth, training.
These training packages increase awareness of the function and benefit of the equipment, which leads to a more effective operating environment.

It is strongly recommended that further operator training be undertaken in order to ensure a full appreciation of service limits, routine maintenance requirements, alarm conditions and corrections.

This can be offered by the Pall Aftermarket Division and can be tailored to meet the requirements of the particular user.

Arrangements for training packages may be made by contacting Pall or its approved agent.

Calibration and Aftermarket Service

Pall PCM400 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 PCM400 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 the test limit is exceeded. The limit is variable from 1000 to 3000 tests depending on the cleanliness and viscosity of fluid samples.*

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
- Last chance filter replacement
- Low-pressure hose replacement
- High-pressure hose replaced if required
- Flush, strip and clean all internal components
- Pressure Reduction Valve Assembly check and reset
- If appropriate, the incorporation of any design enhancements introduced since build
- Replace 6µm and 14µm meshes, O-ring seals and flush 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: Pall PCM400 and PCM400W Fluid Cleanliness Monitor
ISO 4406, SAE AS4059E Table 1 (NAS 1638) and SAE AS4059E Table 2
Contamination classes

There have been several code systems proposed for reporting the solid contamination levels in hydraulic and lubricant fluid, reducing particle count/size data down to a few easily understood numbers. Of these systems, the two most commonly in use are described in the standards ISO4406 and NAS1638, published by the International Standards Organisation and the Aerospace Industries Association of America Inc. respectively. Society of Automotive Engineers standard SAE AS4059E has superseded the latter standard.

ISO 4406:1987 defined an international standard way of representing contamination in terms of the concentration of particles larger than 5µm and 15µm in a lubricating/hydraulic fluid. The ISO Cleanliness Code is a two number code in which the first number indicates the >5µm particle concentration and the second the >15µm particle concentration. Each number represents a concentration range of particles, given in particles per mL of fluid. The numbers are defined according to the following table:

ISO 4406: 1987		
No. of particles per mL		Code No.
More Than	Up to and including	
>2.5 x 10^6		>28
1.3 x 10^6	2.5 x 10^6	28
640 x 10^3	1.3 x 10^6	27
320 x 10^3	640 x 10^3	26
160 x 10^3	320 x 10^3	25
80 x 10^3	160 x 10^3	24
40 x 10^3	80 x 10^3	23
20 x 10^3	40 x 10^3	22
10 x 10^3	20 x 10^3	21
5000	10 x 10^3	20
2500	5000	19
1300	2500	18
640	1300	17
320	640	16
160	320	15
80	160	14
40	80	13
20	40	12
10	20	11
5	10	10
2.5	5	9
1.3	2.5	8
0.64	1.3	7
0.32	0.64	6
0.16	0.32	5
0.08	0.16	4
0.04	0.08	3
0.02	0.04	2
0.01	0.02	1
0	0.01	0

Thus a reported code of 14/12 would indicate that the fluid had a concentration of particles larger than 5µm between 80 and 160 per mL, and a concentration of particles larger than 15µm between 20 and 40 per mL. This method of reporting cleanliness of fluids was generally used for particle counts carried out by microscopy; however, the extensive use of automatic particle counters (APCs) meant that it was also applied to counts determined by such counters which had been calibrated according to ISO 4402 using Air Cleaner Fine Test Dust (ACFTD) as a calibrant.

In 1999, ISO4406 was revised to give the option of including the concentration of particles larger than 2µm. In this case, a three-part code (e.g. 16/14/12) is used with the first number giving the appropriate code for the smaller particles.

It should be realised that microscopic sizing of particles requires taking the length of the longest chord of each observed particle. Most automatic counters, used for fluid cleanliness determinations, assess size according to the diameter of a circle of equivalent projected area. Generally speaking, by using a distribution of ACFTD originally determined by Kirnbauer, assessments of cleanliness made by automatic counting and by microscopy agreed within acceptable limits. However, in 1992, ACFTD ceased being produced, and an alternative calibrant for APCs was sought.

The opportunity was taken to correct the errors in the original ACFTD distribution, introduced partly by the limitations of the equipment then available and partly by the use of a mathematical function to describe the particle size distribution. Accordingly, the American National Institute of Standards and Technology characterised a large sample of ISO 12103-A3 test dust over the range 1 to 50µm. Due to the differences in apparent size distribution between ACFTD and ISO A3 dust, and the necessity to relate the automatic particle counts to microscope counts, it was decided that for APCs calibrated with the ISO A3 dust (commonly known as NIST dust), the counts at 4µm(c), 6µm(c) and 14µm(c) should be recorded. These were considered to be the nearest equivalent (using integer micrometre sizes) to automatic counts carried out at 2µm, 5µm and 15µm using a counter calibrated with ACFTD. The PCM400 monitor reports ISO 4406 cleanliness codes based on counts at 6µm and 14µm with a “NIST dust” calibration as described in ISO standard 11171:1999.

National Aerospace Standard 1638 describes a code for quantifying fluid cleanliness in which the particle concentrations are defined for particle size ranges, and are given in particles per 100 mL. The reported single number, or class, is given by the highest of the numbers, from all the different size ranges, for the fluid under test. Although still widely used, particularly in the offshore industries and in some parts of the aircraft industry, the NAS 1638 standard has now been superseded, partly because it does not include particles smaller than 5µm, and partly because it does not cover particle counting by electronic automatic particle counters. SAE standard AS4059, revision E, uses the same cleanliness classes as NAS 1638, and the counts are still expressed per 100 mL. However, the particle sizes are now expressed as “larger than Xµm”, and the use of NIST calibrated counters (per ISO 11171:1999) is included. Adding cleanliness classes 00 and 000 has accommodated further improvement cleanliness of modern hydraulic and lubrication systems. The table below gives the particle concentration limits for the SAE AS4059 classes. The use of “(c)” in the size identifier indicates counter calibration per ISO 11171.

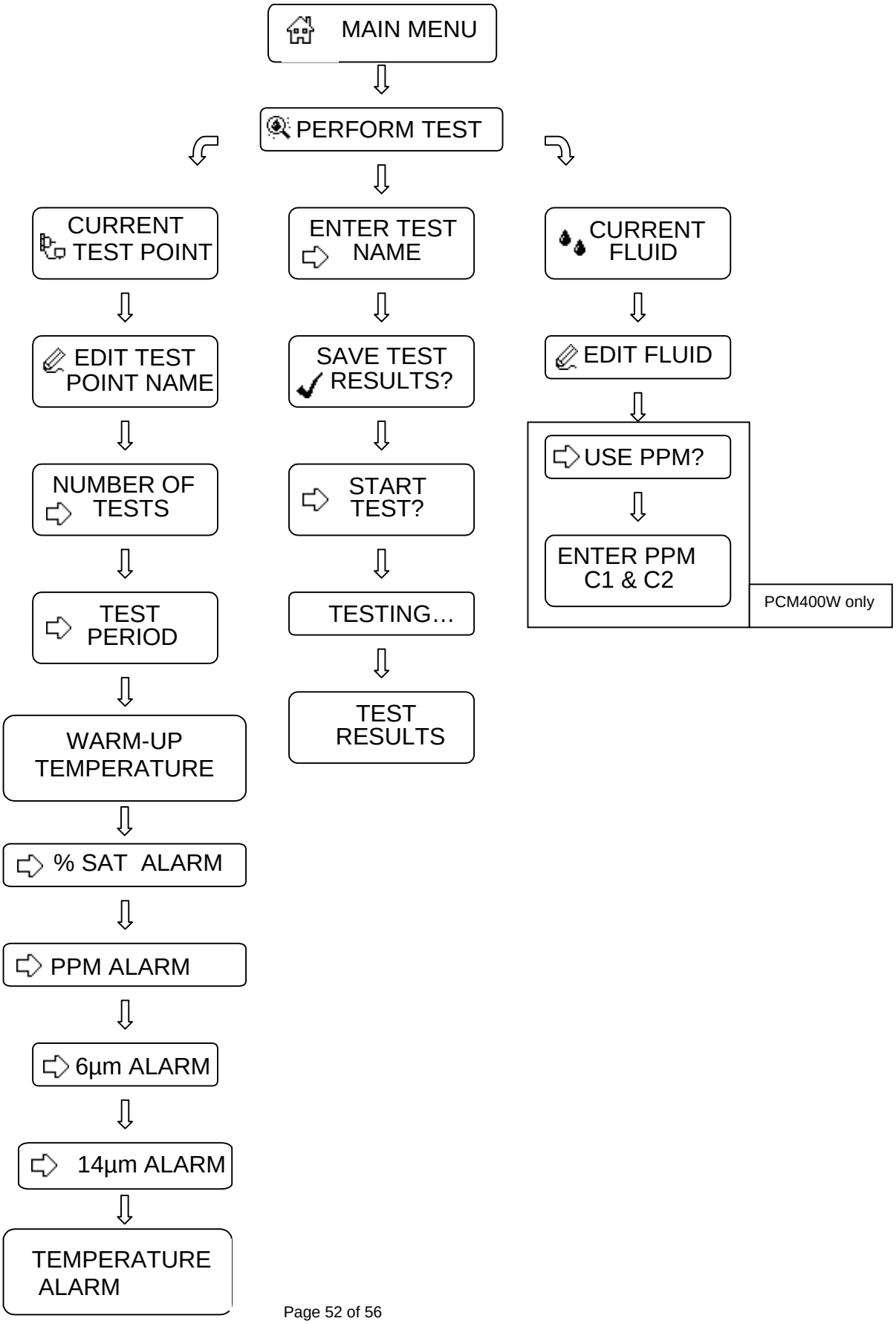
Although SAE AS4059 has effectively replaced NAS 1638, which has been declared “inactive for new design”, and the particle counts within the classes are virtually identical, SAE AS4059 is still not widely known. The PCM400 display shows the NAS equivalent code as being according to AS4059 Table 1 (NAS). The only significant difference this will make to the user is that a code for smaller particles (>4µm(c)) is included in the determination of the final displayed figure.

	AS4059 TABLE 1 (NAS 1638)				
	Differential Particle Count Limits – (particles/100 mL)				
Particle size range	5-15µm	15-25µm	25-50µm	50-100µm	>100µm
Cleanliness class					
00	125	22	4	1	0
0	250	44	8	2	0
1	500	89	16	3	1
2	1,000	178	32	6	1
3	2,000	356	64	11	2
4	4,000	712	128	22	4
5	8,000	1,425	253	45	8
6	16,000	2,850	506	90	16
7	32,000	5,700	1,012	180	32
8	64,000	11,400	2,025	360	64
9	128,000	22,800	4,050	720	128
10	256,000	45,600	8,100	1,440	256
11	512,000	91,200	16,200	2,880	512
12	1,024,000	182,400	32,400	5,760	1,024

SAE AS4059 REVISION E, TABLE 2							
Cleanliness Levels by Cumulative Particle Count							
		Maximum Contamination Limits (particles/100 mL)					
Size, ISO 4402 Calibration, or Optical Microscope Count*		> 1 µm	> 5 µm	> 15 µm	> 25 µm	> 50 µm	> 100 µm
Size, ISO 11171 Calibration or Electron Microscope**		> 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**
CLASSES	000	195	76	14	3	1	0
	00	390	152	27	5	1	0
	0	780	304	54	10	2	0
	1	1560	609	109	20	4	1
	2	3120	1217	217	39	7	1
	3	6250	2432	432	76	13	2
	4	12,500	4864	864	152	26	4
	5	25,000	9731	1731	306	53	8
	6	50,000	19,462	3462	612	106	16
	7	100,000	38,924	6924	1224	212	32
	8	200,000	77,849	13,849	2449	424	64
	9	400,000	155,698	27,698	4898	848	128
	10	800,000	311,396	55,396	9796	1696	256
	11	1,600,000	622,792	110,792	19,592	3392	512
	12	3,200,000	1,245,584	221,584	39,184	6784	1020

Appendix C: Pall PCM400 and PCM400W Fluid Cleanliness Monitors

Menu Flow Chart



Appendix D: Water in Oil Sensor Stabilization Times - Limitations to Use

- The Pall Water Sensors will react to differing water conditions and the time to stabilize will depend upon the RH gradient of the sensor and the fluid being analyzed.
- The recovery time is faster when going from dry oil to wet oil than going from ‘wet to dry’. Under ‘normal’ conditions the response time is quick i.e. within two tests.
- The response time with a previously ‘saturated’ sensor will depend upon the time of immersion and may be extensive, e.g. ‘hours’.
- If the sensor has been exposed to saturated oil for a period >24 hours, a temporary shift in calibration may occur.
- The PCM400W should not be used in applications whose water content is known to be at or above 100% saturation.
- If the oil is found to be close to or above saturation then the test cycle should be terminated and the PCM flushed out with an oil of known dryness. It shall not be left to cool down as the water may condense.
- Where possible systems that have a tendency to be near saturation should be sampled first. This will avoid leaving saturated oil in the PCM400W unit for long periods i.e. overnight, and the consequent slow response time, as the probe dries out.
- When using values of water content from three consecutive samples, the third value should be used as the record. This will allow the unit time to respond to the changed conditions.

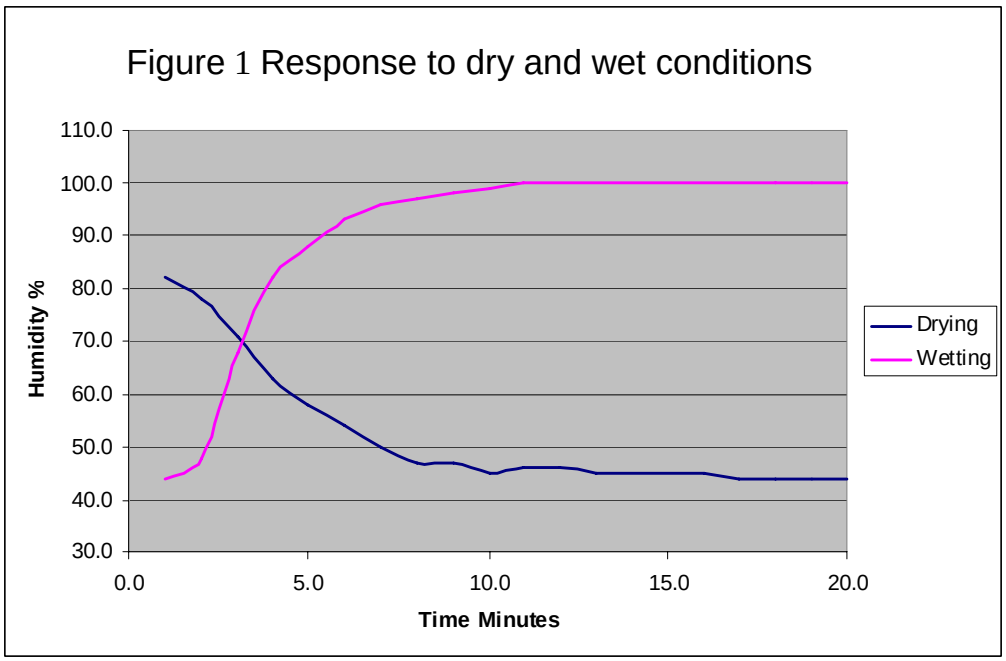
(See also Test Data on next page)

Appendix D: Water in Oil Sensor Stabilization Times - Test Data

Test Data

To verify stabilization times for the PCM400W, a monitor was subjected to oil of near to 100% saturation then immersed in a much drier oil to determine stabilization time to achieve the stated calibration accuracy limits of +/- 2%. The reverse procedure was also adapted to establish the effect of low to high water levels.

Figure 1 shows the response curves for the PCM400W water sensor when subjected to rising and falling % of saturation levels of water in oil.



It can be seen from Figure 1 that in these conditions going from ‘dry’ to wet it took approximately 13 minutes (or 2 complete tests) to reach stabilization.

Moving in the opposite direction i.e. going from ‘wet’ to ‘dry’ took approximately 19 minutes (or 3 complete tests) to achieve stabilization.

It can be concluded from this that the probe will generally respond more quickly to increasing humidity than decreasing humidity.

The PCM400W was subsequently subjected to an oil of 100% saturation for short period of time then set to perform analyze on an oil of know low saturation.

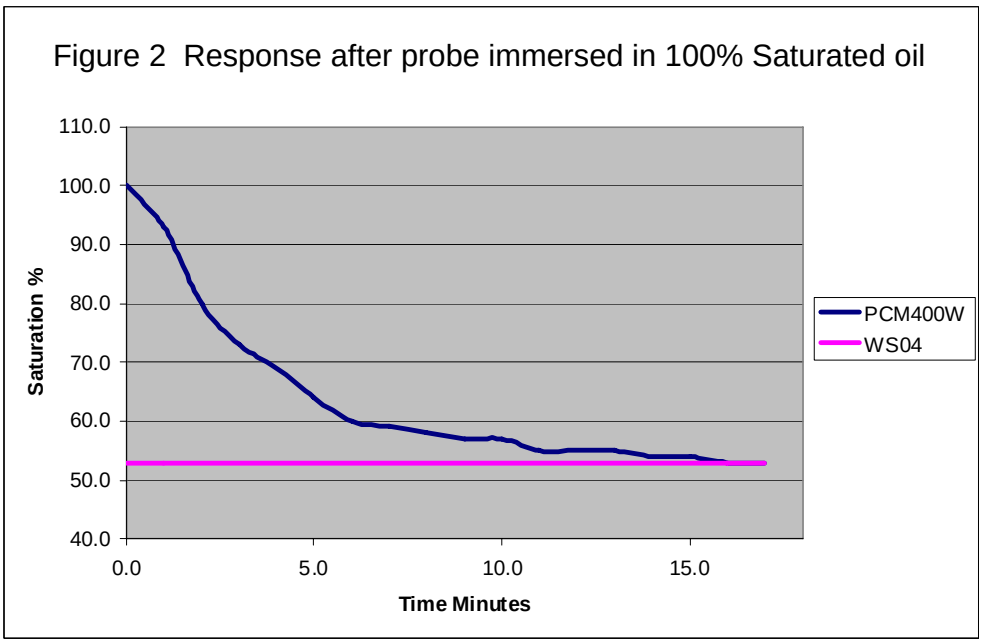
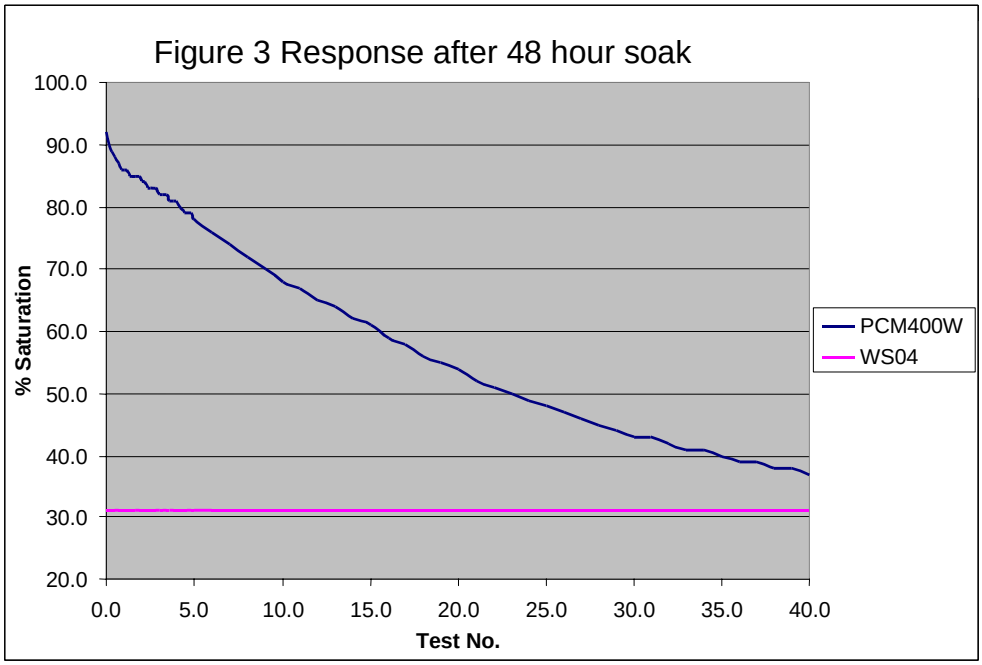


Figure 2 shows that the even though the probe had been immersed in 100% saturated oil for a short period of time stabilization still takes 3 tests.

The next test was to test the response of a PCM400W water sensor probe when subjected to 'dry' oil after the probe has been soaked in over 100% saturated fluid for 48 Hours. The data shown in Figure 3 suggests it took over 40 tests (240 minutes in operation) before probe was approached equilibrium.



Pall PCM400 and PCM400W 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.