Pall Corporation

WS09

service instructions

WS09 Series Water Sensor

Portable Measuring Device for Moisture Content in Oil

EN WS09 Operating Instructions

ENGLISH

IMSIWS09

*Filtration. Separation. Solution.*SM

WS09

WATER SENSOR

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Features
The Pall WS09 Series water sensor is a hand held, monitoring solution for measuring dissolved water content in hydraulic, lubricating and insulating fluids. Specifically designed for use in harsh and often remote industrial environments, readings are continuously displayed on the hand-held display as a key component in the predictive maintenance of plant and machinery.

- A sensing probe directly immersed in the fluid to monitor dissolved Water content and temperature
- Water content displayed in % saturation or PPM
- Temperature displayed in °C or °F.

GENERAL
The manual is a part of the scope of supply and serves to ensure proper handling and optimum function of the instrument. For this reason, the manual must be read before start-up.

In addition, the manual is for all personnel who require knowledge concerning transport, setup, operation, maintenance and repair. The manual must not be used for the purpose of competition without a written consent from Pall and must also not be forwarded to third parties.

Copies for personal use are permitted.

All information, technical data and illustrations contained in these instructions are based on information available at the time of publication.

WARNINGS, CAUTIONS AND NOTES
Care must be taken in referring to this manual 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.

Safety instructions
General Safety Instructions

- Excessive mechanical loads and incorrect usage should always be avoided.
- Do not remove the filter cap as the sensor element could be damaged.
- Installation, electrical connection, maintenance and commissioning should be performed by qualified personnel only.

Environmental aspects
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.

In Europe under the Waste Electrical and Electronic Equipment (WEEE) Directive and implementing regulations, when customers buy new electrical and electronic equipment from Pall they are entitled to:

Send old equipment for recycling on a one-for-one, like-for-like basis (this varies depending on the country). The customer is also entitled to send the new equipment back for recycling when this ultimately becomes waste. Instructions to both customers and recyclers/treatment facilities wishing to obtain disassembly information are provided by following the link below.

www.pall.com/weee

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.

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1. INTRODUCTION

The Pall WS09 Hand Held Water sensor was designed for the measurement of water content in hydraulic, lubricating and insulating fluids. Percentage saturation and temperature is measured by immersing the sensing probe into the fluid stream, reservoir or fluid sample. After a short stabilization period the WS09 LCD displays the percentage water saturation level and temperature in °C or °F. The probe is suitable for use in a wide range of mineral and synthetic fluids at temperatures up to 120 °C (248 °F). The WS09 transmitter features outstanding long term stability and resistance to pollution of the capacitive sensor elements.

Water contamination in oil and fluids can cause problems such as additive depletion, corrosion, oil oxidation, reduced lubricating film thickness, microbial growth and a reduction of dielectric strength.

Humidity measurement in oil is similar to the humidity measurement in the air; the actual water content in oil can be indicated by the relative value % RH.

% RH (expression of the water content as a percentage of the water saturation level of the oil at the measured temperature) and called percent relative humidity. % RH = 0 corresponds to completely water-free oil, while % RH = 100 indicates saturated oil. Saturation is the point where oil holds as much water as possible in solution at given temperature, any further addition of water will result in the presence of droplets of free water.

The physical quantities measured are % relative humidity, % RH, and temperature, T. With these quantities the Pall WS09 Water sensor can calculate, and display, the water content in parts per million (ppm), provided that the fluid constants for the specific fluid have been entered into the unit.

The WS09 is capable of displaying two outputs at one time. These outputs are shown on the display as sensor 1 and sensor 2. Sensor 1 is set to temperature and sensor 2 is set to % relative humidity as default. The display may be changed using the menu function. For example sensor 1 can be set to either °C or °F temperature and sensor 2 can be set to either % relative humidity (% saturation) or water content in PPM.

Calculation of water content in fluids can be accomplished by entering specific fluid constants for the fluid; contact Pall for the fluid constants.

2. SPECIFICATION

Dimensions:	85 mm W X 145 mm L X 37 mm D (3.3" W x 5.7" L x 1.5" D)
Weight:	400 g (0.9 lb)
Power Supply:	4 x 1.5V AA alkali-manganese battery
Battery lifetime:	200 hours
Housing / Protection:	ABS / IP40
Temperature:	Probe Tip: -40 – 120 °C (-40 – 248 °F)
Hand Held Display:	0 to 50 °C (32 to 122 °F)
Grip of Sensing Probe:	0 to 50 °C (32 to 122 °F)
Fluids:	Petroleum and synthetic fluids and fuels
Probe Cable:	2 m (6.6 ft)
Hand Held Display and Grip of Sensing Probe:	Nema 1 / IP 40 BSEN60529
Sensing Probe:	Nema 4 / IP 66 BSEN60529
Accuracy:	± 2 % 0 to 90 % RH and ± 3 % 90 to 100 % RH
CE compatibility:	EN61000-6-4, EN61000-6-2, EN55011, EN61000-4-2 EN61000-4-3
Display:	LC display, 90 x 50 mm (3.5 x 2"), illuminated.

3. PROBE INSTALLATION

The sensor probe connects to the WS09 box with a threaded connector.

The probe should be inserted into the test fluid so that the probe tip is completely immersed in the fluid. To decrease stabilization time the fluid should be flowing or the probe should be stirred in the fluid to create a flow past the sensor element. Allow about three minutes for the reading to stabilize before taking the measurement.

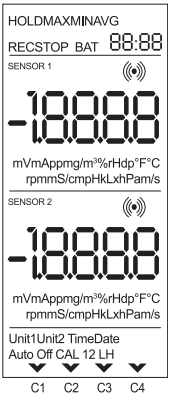
4. BEFORE INITIAL OPERATION

- Read the operating manual carefully and follow it in every detail before using the device.
- Observe the measurement ranges of the sensors (overheating may lead to malfunctions).
- Observe storage and transport conditions (protect the instrument from direct sunlight).
- For technical data, storage and transport conditions please refer to the datasheet.
- Make sure to place the batteries in the correct position.

5. NOTICE TO USERS

- The WS09 user manual is provided to assist users in maximizing the benefits of the WS09 portable moisture content in oil analyser.
- As part of the continuous improvement process that Pall adopts in the development of technology and satisfying customer requirements, this information or procedure may be subject to change.
- Pall welcomes feedback from users.
- The measuring device may be operated only within the range of the specified technical data.
- The measuring device may be used only under the conditions and for the purposes for which it was designed.
- The reliability of the measuring device cannot be guaranteed if modified or altered in any way.

6. THE DISPLAY



◀ Upper menu with date and time

◀ Measurement value indication and units of sensor 1

◀ Measurement value and units of sensor 2

◀ Lower menu for configuration and calibration

7. OPERATION


Thumb-wheel

In contrast to conventional hand-held instruments, the WS09 does not have a keypad instead it uses a simple "thumb-wheel", on the left-hand side of the unit.

The wheel can rotate 15° upwards and downwards and also be pressed in while in the upper, lower or centre position.

The upper menu is selected by rotating the wheel upwards. The lower menu for configuration and calibration is selected by rotating the wheel downwards.

The thumb-wheel must be pressed in the centre position to switch the instrument on and off and to confirm input values.

7.1 The 3 positions of the THUMB-WHEEL:

▶ Switch on: press briefly

Switch on backlight: press and hold for approx. 2 seconds

Switch off: press and hold for approx. 2 seconds (in normal mode - no menu activated)

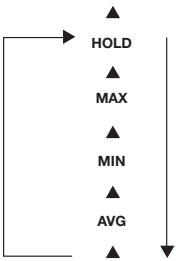
Press briefly (in normal mode - no menu activated): clear MIN/MAX memory.

▲ Activate upper menu with HOLD MAX MIN AVG. Selection with ▲, enter with ▶ and interrupt with ▼ or by not pressing the thumb-wheel for 20 seconds.

▼ Activate lower menu for configuration and calibration Selection with ▼, enter with ▶ and interrupt with ▲ or by not pressing the thumb-wheel for 20 seconds.

7.2 The upper menu

The following functions can be selected in the upper menu:



HOLD MAX MIN AVG

Selection with ▲, the selected function flashes and is entered with ▶. An entered function display is steady.

The menu can be interrupted with ▼ or by not pressing the thumb wheel for 20 seconds.

HOLD: Hold "freezes" the measurement value.

MAX: MAX shows the maximum value in the active time period.

MIN: MIN shows the minimum value in the active time period.

AVG: AVG shows the arithmetical average value in the active time period. The MAX value/MIN value/AVG memory is cleared by switching the WS09 ON/OFF, by disconnecting and reconnecting the sensor, or by briefly pressing ▶ in normal mode.

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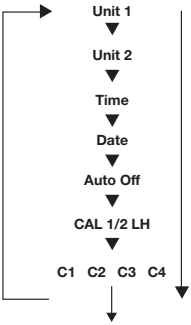
7.3 The lower menu

In the lower menu for configuration and calibration the following functions can be selected:



UNIT1, UNIT2, Time, Date, AutoOff, CAL 1, CAL 2, CAL2L, CAL2H and oil parameter: C1, C2, C3, C4

Selection with ▼, the selected function flashes and is entered with ▶. An entered function is displayed steady.

The menu can be interrupted with ▲ or by not pressing the thumb wheel for 20 seconds.

⚠ Only functions supported by the current sensor can be selected.

UNIT1 (FOR SENSOR 1):

UNIT1 (default temperature) enables the selection of different units for the first sensor channel. The selected unit flashes and is activated using ▶.

Units can be selected using ▲ and ▼. Available temperature units are °C or °F.

UNIT2 (FOR SENSOR 2):

UNIT2 (default humidity % RH) enables the selection of different units for the second sensor channel. The selected unit flashes and is activated using ▶.

Units can be selected using ▲ and ▼. Available saturation units are % or PPM.

Time: Set time. Hours and minutes are input in sequence.

Selection can be made using ▲ and ▼ enter with ▶.

Date: Set date. Day, month and year are input in sequence.

Selection can be made using ▲ and ▼ enter with ▶.

Auto-Off: The time in minutes for automatic switch off is set with Auto-Off. If OFF (<1) is set, the device does not switch off automatically.

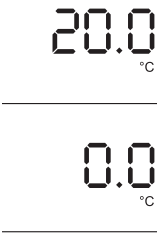
Select with ▲ and ▼; enter with ▶.

7.4 Calibration

There are two methods of % saturation calibration. One point calibration is used more as a quick verification where only one humidity standard is available. For accuracy it is recommended that a two point calibration is always performed

7.4.1 Temperature calibration

⚠ Important: Calibration should only be carried out by skilled personnel using suitable calibration standards.



CAL1: CAL1 initiates the one point calibration for temperature.

The symbols for Sensor 1 and Sensor 2 disappear from the display. The actual value for temperature is now displayed in the upper half of the display. The offset value for temperature flashes in the lower area; this value can be incremented using ▲ and decremented using ▼. The temperature offset can be adjusted ±10 °C (±18 °F) in steps of 0.1 °C.

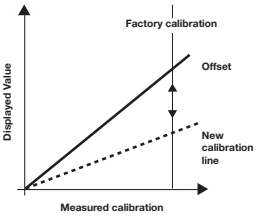
The offset value is confirmed with ▶.

The menu is than exited automatically and **CAL END** is displayed.

Incorrect calibration is indicated by **CAL FAIL** and must be repeated.

The factory settings can be restored by setting the offset to 0.0.

7.4.2 One point calibration for % Saturation



Setting the offset for relative humidity

CAL2: CAL2 initiates the one point calibration for humidity % RH.

The symbols for Sensor 1 and Sensor 2 disappear from the display.

The actual value for humidity is now displayed in the lower half of the display. The offset value for humidity flashes in the upper area; this value can be incremented using ▲ and decremented using ▼. The % saturation offset value can be adjusted a maximum ±10 % S in 0.1 % S steps. The offset value is confirmed with ▶.

The menu is than exited automatically and **CAL END** is displayed.

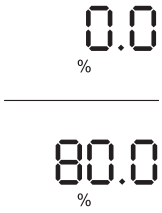
Incorrect calibration is indicated by **CAL FAIL** and must be repeated.

The factory settings can be restored by setting the offset to 0.0.

The calibration point should be in the range 11...95 % S (recommended 80 %).

For % saturation, setting the offset changes the angle of the characteristic with zero as centre point.

7.4.3 Two point calibration for % Saturation



CAL2L, CAL2H: in menu CAL2L the lower value and in menu CAL2H the higher value can be calibrated. The lower value should be between 0...40 % S (preferably 11 %) and the higher value should be between 60...95 % (preferably 80 %).

It can be set with increments of 0.1 %.

Incorrect calibration is indicated by CAL FAIL and must be repeated.

Important: Two point calibrations should preferable be carried out by accredited calibration laboratories!

Factory calibration can be restored by entering offset 0.0.

7.4.4 Calibration kit & ordering information

Water sensor (handheld unit and probe) with case:	**WS09DS**
Water sensor, case and optional calibration kit:	**WS09DSC**
Probe only:	**WS09S**
*Calibration kit:	**WS09CALK**
**Calibration salts only:	**WS09CALS**
Connecting cable:	**WS09CABLE**

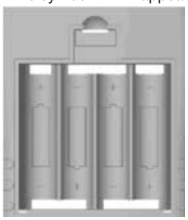
* Consists of the calibration device which allows the sensor probed to be tightly installed so that measurements is not influenced by the surrounding air, complete with five ampoules. 10 % RH humidity standard, five ampoules 30 % RH humidity and ten textile discs.

** Consists of five ampoules 10 % RH humidity standard, five ampoules 80 % RH humidity standard and ten textile discs.

8. CHANGING THE BATTERY

If the symbol “BAT” appears in the display, the batteries have to be replaced. Open the battery case at the back of the instrument.

Remove the exhausted batteries and insert new ones.


Open battery case WS09

Use only batteries of type IEC LR6 AA.

Do not use rechargeable cells!

Reverse polarity may destroy the instrument; make sure to place the batteries in the correct position and to use high quality batteries only.

9. MAINTENANCE AND ADJUSTMENT

Clean the hand-held case as required using a damp cloth.
Do not use cleaning agents. Only use clean water to moisten the cloth.

9.1 Probe

Oil probe 12 mm (0.47")

Application:	measurement of moisture in mineral and synthetic oil
Working range:	0...100 % Saturation / 0...20000 ppm / -40... 120 °C (-40...248 °F)
Accuracy:	±2 % Saturation (0...90 % Saturation), ±3 % Saturation (90...100 % Saturation) ±0.2 °C (±0.36 °F) at 20 °C (68 °F), ±0.7 °C (±1.26 °F) at -40 & 100 °C (-40 & 212 °F)
Measured value:	Sensor 1: temperature [°C/°F]
	Sensor 2: % saturation % S [%], water content x [ppm]
Calibration:	One point calibration (page 6)
	Two point calibration (page 7)

9.2 Cleaning of humidity and temperature sensors

1) Immerse the measuring head of the probe in a cleaning solution such as n-heptane, 100–120 °C boiling range petroleum ether or Stoddard Solvent and swirl for approx. 30 seconds at ambient temperature

2) Remove excess liquid and allow to air dry for approx. 30 seconds.

Cleaning of the probe is recommended before immersion in a different fluid and before a calibration.

10. ENTERING OIL SPECIFIC PARAMETERS FOR CALCULATING THE WATER CONTENT

To display the water content in PPM for a specific fluid, four parameters, C1 to C4 must be set. To obtain values for these parameters, contact Pall Corporation. The factory default settings for these parameters is C1=1; C2=1; C3=1; C4=1.

The oil specific parameter C1 (-5000...500) can be set with special function C1.

The oil specific parameter C2 (0.000...10.000) can be set with special function C2.

The oil specific parameter C3 (-5000...500) can be set with special function C3.

The oil specific parameter C4 (0.000...10.000) can be set with special function C4.

If no oil constants are entered the display will read 0000 if PPM display mode is entered.

ENGLISH

11. DECLARATION OF CONFORMITY

PALL

PALL EUROPE LIMITED

DECLARATION OF CONFORMITY

PRODUCT DESCRIPTION:	MEASURING DEVICE FOR MOISTURE IN OIL
PRODUCT PART NUMBER:	WS09
SERIAL NUMBER:	SEE NAMEPLATE

On behalf of Pall Europe Ltd, we hereby declare that the above product complies with the following transposed harmonised standards:-

BSEN ISO 12100-2:2003	Safety of Machinery – Basic Concepts
BSEN60204-1:2006	Safety of Machinery – Electrical Equipment of machines
BSEN ISO 14121-1:2007	Safety of Machinery – Risk Assessment
EN61000-6-4: 2007	Electromagnetic Compatibility – Generic Emissions Standard Pt 2 Industrial Environment
EN61000-6-2: 2005	Electromagnetic Compatibility – Generic Immunity Standard Pt 2 Industrial Environment
EN61000-4-2: 2009	ESD
EN61000-4-3: 2006	Radiated Emissions
BSEN60529: 1992	Degrees of Protection Provided by Enclosures

This compliance is sufficient to meet the requirements of the EC Machinery Directive 2006/42/EC, the Low Voltage Directive 2006/95/EC and the EMC Directive 2004/108/EC This product must be regularly serviced by Pall and /or their approved agent for the declaration to remain effective after shipment.

J.Collard, Engineering 'Projects' Manager
For and on behalf of: *Pall Europe Limited*
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12. TRADEMARKS AND INTELLECTUAL PROPERTY

The design of this equipment, software and supporting documentation is the intellectual property of Pall Europe Ltd and is subject to copyright.
NOTE: Pall and (PALL) are trademarks of Pall Corporation.
® Indicates a trademark registered in the USA.
Filtration. Separation. Solution.SM is a service mark of Pall Corporation.

13. WARRANTY, LIMITATION OF LIABILITY

There is no warranty of merchantability or fitness for any particular purpose with respect to any of the products, nor is there any other warranty express or implied, except as provided for herein.

For a period of twelve months from the date of delivery from the Seller or three thousand hours of use, whichever occurs first (the "Warranty Period"), the Seller warrants that products manufactured by the Seller when properly installed and maintained, and operated at ratings, specifications and design conditions, will be free from defects in material and workmanship.

The Seller's liability under any warranty is limited solely (at the Seller's discretion) to replacing (FOB original ship point), repairing or issuing credit for products which become defective during the Warranty Period. The Purchaser shall notify the Seller promptly in writing of any claims and provide the Seller with an opportunity to inspect and test the product claimed to be defective.

Buyer shall provide the Seller with a copy of the original invoice for the product, and prepay all freight charges to return any products to the Seller's factory, or other facility designated by the Seller. All claims must be accompanied by full particulars, including system operating conditions, if applicable.

The Seller shall not be liable for any product altered outside of the Seller's factory except by the Seller or the Seller's authorized distributor, and then, as to the latter, only for products which have been assembled by the distributor in accordance with the Seller's written instructions. Nor shall the Seller be liable for a product subjected to misuse, abuse, improper installation, application, operation, maintenance or repair, alteration, accident or negligence in use, storage transportation or handling.

In no event will the Seller be liable for any damages, incidental, consequential or otherwise, whether arising out of or in connection with the manufacture, packaging, delivery, storage, use, misuse, or non use of any of its products or any other cause whatsoever.

LIABILITY

Pall does not accept warranty and liability claims either upon this publication or in case of improper treatment of the described products.

The document may contain technical inaccuracies and typographical errors.

The content will be revised on a regular basis. These changes will be implemented in later versions. The described products can be improved and changed at any time without prior notice.

Because of developments in technology this data or procedures may be subject to change. Consequently we advise users to review their continuing validity annually.

USA

FCC notice:
This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates uses and can radiate radio frequency energy and, if not installed and used in accordance with the installation manual, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

CAUTION:
Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate this device.

CANADIAN

ICES-003 notification:
This class B digital apparatus complies with Canadian ICES-003.

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Notes

Notes

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Pall Corporation has offices and plants throughout the world. For Pall representatives in your area, please go to www.pall.com/contact

Because of technological developments related to the products, systems, and/or services described herein, the data and procedures are subject to change without notice. Please consult your Pall representative or visit www.pall.com to verify that this information remains valid.

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