

Model SADP

Automatic Dewpoint Meter

Instruction Manual

v2.1.1



EU Declaration of Conformity

We
Of
Declare that
Model name:
Description:

Shaw Moisture Meters
Len Shaw Building, Bolton Lane, Bradford
England, BD2 1AF.
Automatic dewpoint meters types SADP & SADP-D
Ex II 1 G Ex ia IIC T6 Ga
Battery powered moisture analyser comprising a sensor contained
within a drying chamber mounted on a transportable instrument
casing.

Conforms to the following directives:
2014/34/EU Atex Directive
89/336/EEC The Electromagnetic Compatibility Directive and its amending Directives.

And has been designed and manufactured to the following standards:
EN 60079-0:2012 Electrical apparatus for potentially explosive atmospheres. General requirements
EN 60079-11:2012 Electrical apparatus for potentially explosive atmospheres intrinsic safety 'I'

I hereby declare that the aforementioned equipment has been designed to comply with the relevant sections of the above referenced specifications.

26TH JANUARY 2018



Andrew Coulton
Calibration & QA Manager

ATEX CERTIFICATE NUMBER: Baseefa03ATEX0065X
IECEx CERTIFICATE NUMBER: IECEx BAS 14.0131X

Notified body for ATEX & IECEx: SGS Baseefa Ltd, Rockhead Business Park, Staden Lane, Buxton, Derbyshire SK17 9RZ. Notified body No: 1180

CP12A issue 7

Contents

1	Unpacking your Shaw Moisture Meters Model SADP	4
	1.1 General Description	4
	1.2 Ranges	5
2	Hazardous Area Use	5
	2.1 Safety	5
	2.2 Pressure Exposure	6
3	Installing the Air/Gas Sampling System	6
	3.1 Gases to Avoid	7
	3.2 Piping Installation Schematic	8
	3.3 Piping Schematic Component Index	9
	3.4 Purging the Sample Connection	9
	3.5 Sample Connections	10
	3.6 Desiccant Dry-Down Technology	10
4	Controls	11
5	Normal Operation	11
6	Calibration Checking	12
	6.1 Automatic Calibration - All Models Excluding SADP-B	13
	6.2 Manual Calibration - Models SADP-B and SADP-D-B	14
7	The Sensor	14
	7.1 Gaining Access to the Sensor	15
8	Additional Information	15
	8.1 Anti-Static Carrying Case	15
	8.2 Desiccant and Head Seal	15
	8.3 Batteries and Battery Check	16
	8.4 Temperature	17
	8.5 Pressure	17
	8.6 Response Time	17
	8.7 Guarantee	18
9	Basic Definitions	18
10	Electrical Function Check	19
11	Problem Guide	20
12	Hygrometer Equivalents	21
13	SADP and SADP-D Specification	22
14	SADP General Assembly Diagram	23

1 Unpacking your Shaw Moisture Meters Model SADP

Please examine the SADP dewpoint meter package for any damage or mishandling. If any damage is evident please notify the carrier and the Shaw Moisture Meters representative from where this unit was purchased.

You should have received (if ordered):

- 1 Model SADP dewpoint instrument
- 1 carry case
- 1 screwdriver and Allen key
- 1 instruction manual
- 1 pressure dewpoint circular calculator
- 1 two metre length of PTFE tubing

If anything is missing please contact your distributor immediately.

1.1 General Description

The SADP & SADP-TR are battery operated portable dewpoint meters designed for spot checks or continuous use. The instrument provides direct indication in dewpoint temperature and parts per million on a 120 mm analogue scale. SADP-D versions perform the same function but display only dewpoint on a LCD display.

The instrument may be used to give a continuous reading as long as sample gas is flowing through the test chamber [head] of the instrument, a reading will be given of the gas moisture content. Alternatively results are obtained in a few minutes when making spot checks.

The SADP instrument is operated with its own internal batteries and requires no external power source. The instrument comes supplied with six “c” size cells. In normal operation these will last for over 12 months.

The unique measuring head is designed to keep the sensor dry when the instrument is not in use, making spot checks a simple and speedy process with minimum air or gas usage.

The SADP is provided as standard with a padded carrying case with shoulder strap, a dew point calculator, a screwdriver for the Automatic Calibration

control, a special key for the security plate covering the battery carriers and a two metre length of flexible PTFE (Teflon) sample pipe.

The instrument is certified intrinsically safe for use in hazardous areas.

1.2 Ranges

SADP-(r):	Range	
Purple (P)	-100 to 0 °C dewpoint	0 - 6,000 ppm
Silver (S)	-100 to -20 °C dewpoint	0 - 1,000 ppm
Red (R)	-80 to -20 °C dewpoint	0 - 1,000 ppm and 0 - 10 on TR version
Grey (G)	-80 to 0 °C dewpoint	0 - 6,000 ppm and 0 - 10 on TR version
Blue (B)	-80 to +20 °C dewpoint	0 - 23,000 ppm, (ManualCal)

2 Hazardous Area Use

2.1 Safety

All SHAW Model SADP automatic dewpoint meters are certified intrinsically safe as a standard feature. They must be fully assembled to meet the certification requirements, i.e. they must not be switched on in a hazardous location if any component is missing or removed, e.g. battery cover plate or sensor head assembly etc.. This instrument is only certified intrinsically safe to T6 with the use of the following batteries as supplied.

- Varta 'Superlife' Zinc Carbon R14P C Size 1.5 V Primary Cells
- Panasonic Zinc Carbon R14 C Size 1.5 V Primary Cells

Intrinsic Safety Certification

Certified intrinsically safe to ATEX and IECEx standards


ATEX:  II 1 G Ex ia IIC T6 Ga

IECEx: Ex ia IIC T6 Ga



It is the responsibility of the user to ascertain the suitability of the SADP for use in hazardous areas. Risk assessments should be performed prior to use, taking into account the SADP certifications, the location and the gas being monitored etc..

The ATEX certification is  II 1 G Ex ia IIC T6 Ga. This means:-

 - European certification mark for electrical equipment for use in explosive atmospheres

II - Areas classified hazardous due to presence of flammable gases or vapour

I - Areas classified as Category 1 Risk according to the ATEX Directive

G - Risk due to presence of flammable gases or vapours according to the ATEX Directive Ex ia - Intrinsic Safe

IIC - Suitable for use with all classes of gasses and vapours

T6 - The product has a maximum surface temperature of 85 °C (in an ambient temperature range of -20 °C to +40 °C) and can be used with any gases or vapours which have an ignition temperature above this

Ga - EPL (Equipment Protection Level) marking

2.2 Pressure Exposure

The maximum pressure to which the telescopic measuring head is exposed must not be more than

0.3 barg, 4.35 psig, 30 kpag or 0.3 kg/cm²g

Exposing the measuring head to higher pressures may damage the instrument and result in injury to the operator or other personnel in the area.

3 Installing the Air/Gas Sampling System

The piping installation schematic diagram (see section 3.2) shows all components, which could be used in a dry gas measurement application although not all the items shown will be required for every installation.

Care should be taken to ensure that the sample presented to the SADP is not contaminated with any component that will damage, contaminate or affect the SADP in a way that will impair the unit's accuracy.

It is strongly recommended that the sample should not contain particulate matter, oil, hydrocarbon or any other condensate. If these components contaminate the sample system and/or the measuring sensor, the SADP response time will be lengthened, although the sensor calibration will not be affected.

The flow rate, although not critical to the sensor measurement, should be low enough to avoid abrasion to the sensor surface without being so low as to extend the SADP response time to an unacceptable level. In general, a flow rate of 2 - 5 litres/min at normal temperature and pressure will give the right balance.

The sensor used in the SADP is a variable capacitor, which is directly affected by changes in partial pressure of water vapour and these changes that are proportional to the dew point/frost point temperature are displayed on the instrument indicator.

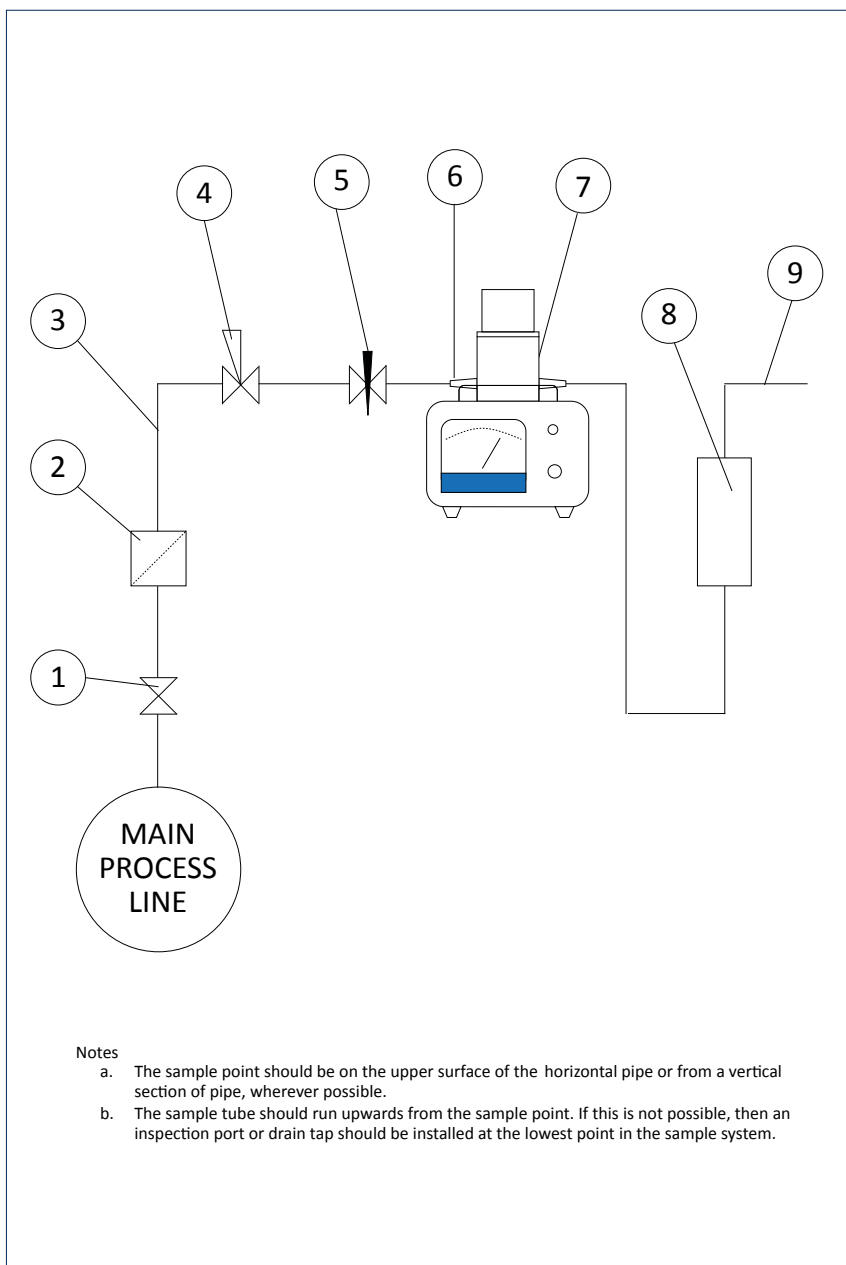
3.1 Gases to Avoid

The moisture sensors are suitable for many different industrial and research applications. Most gases can be checked for their moisture content with no need for the calibration to be altered when changing between different gases, as the sensor operates only with reference to the water vapour content.

There are however, some gases that must be avoided, as they are not compatible with the material of construction of the sensor. Ammonia (NH_3), Ozone (O_3) and Chlorine (Cl_2) must be avoided at all times, even in small quantities. Hydrogen Chloride (HCl) also attacks the sensors very quickly. Some less aggressive acidic gases, such as Sulphur Dioxide (SO_2) can be monitored as long as the moisture content is low, generally less than 100 ppm(v). If in doubt, please ask your supplier.

Sulphur hexafluoride (SF_6) has no effect on the sensor. However, if the gas has been exposed to arcing it is possible that various acidic species will have been formed that will corrode the sensor. Therefore, when testing SF_6 that may have been arced, an acidity test should be carried out first. If the gas proves to be acidic then the moisture test should not be carried out.

3.2 Piping Installation Schematic



Notes

- The sample point should be on the upper surface of the horizontal pipe or from a vertical section of pipe, wherever possible.
- The sample tube should run upwards from the sample point. If this is not possible, then an inspection port or drain tap should be installed at the lowest point in the sample system.

3.3 Piping Schematic Component Index

1. **Sample Isolation Valve** - This is a recommended item as it allows access to the sample system without interrupting the main process line.
2. **Filter Unit** – A filter unit is recommended when the samples are likely to contain particulate matter. If the air/gas sample contains heavy hydrocarbon condensate, the filter must be of the coalescing type with a drain. The filter unit should be positioned as close to the sample point as practical.
3. **Sample Tube** – This should be stainless steel for dry air or gas applications but copper or carbon steel can be used where wetter gases are to be measured. If any section of the sample tube must be flexible then PTFE should be used. In most cases, 3 mm OD ($\frac{1}{8}$ ") is sufficient as it provides good system response time with minimum flow. 6 mm OD ($\frac{1}{4}$ ") tube can be used where pressure drops across the 3 mm tube are too high.
4. **Pressure Reduction Valve or Pressure Regulator** – the sample is measured at atmospheric pressure requiring that valve 4 is fitted to the system.
5. **Flow Control Valve** – This can be a separate item or combined with the flow indicator (8).
6. **Sample Connection.**
7. **SADP.**
8. **Flow Indicator** – The recommended sample flow is 2 - 5 litres/min.
9. **Sample Exhaust** – The exhaust is vented to atmosphere or returned to an atmospheric pressure line.

3.4 Purging the Sample Connection

Please refer to the sample system schematic in section 3.2.

It is advisable to carry out an initial purge of the sample loop without connecting the SADP in order to avoid the possibility of sensor damage on start up.

Open the sample isolation valve (1) slowly until there is a small flow of air/gas at atmospheric pressure from the pressure reduction valve (4). Allow the air/gas to exhaust through the sample connection (9).

Continue this for two minutes to remove any residual moisture from the sample pipe work and components. Check that no liquid or particulate contamination, which could damage the sensor, is passing through the sample pipe. Directing the sample onto a piece of white paper (such as a filter paper) will make it easier to see any dust or oil mist in the sample.

Connect the SADP. The SADP is not flow sensitive, however the sample flow needs to be enough to fill the sensor head with gas effectively, so anything less than 1 litre/min would mean that the instrument would take too long to settle to a stable reading. The flow should also not be so high that the gas velocity could physically damage the sensor or cause back pressure in the sensor head, so should not exceed about 8 litres/min.

3.5 Sample Connections

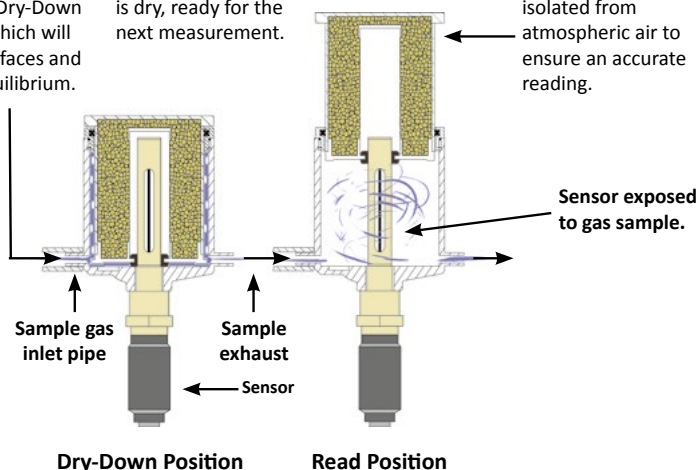
The SADP instrument is supplied with push-on sample connections on each side of the test chamber (head) of the instrument. These connections are reversible and flow direction is not important. The fittings are designed for pipe having an internal bore of approximately 6 mm (¼"). Only the PTFE (Teflon) pipe provided should be used as other materials are unsuitable. The sample pipe should be heated in a naked flame for a few seconds before being pushed onto the instrument connection for the first time. This will provide a good gas type connection and ensure accurate results.

3.6 Desiccant Dry-Down Technology

The unique design allows purging of the gas in the "Dry-Down Position", which will bring all surfaces and voids to equilibrium.

Sensor surrounded by desiccant ensuring it is dry, ready for the next measurement.

The desiccant and sensor are always isolated from atmospheric air to ensure an accurate reading.



Keeping the sensor dry between tests ensures that the SADP is ready to carry out rapid spot checks. The unique design of the desiccant head achieves this by surrounding the sensor with desiccant, keeping the sensor dry. The head is then lifted for sampling, exposing the sensor to the sample gas.

Between tests the sensor is not allowed to come into contact with ambient air. The chamber is designed so that the void space and chamber wall surfaces are purged with sample gas before exposure of the sensor, giving faster, more accurate and reliable results.

4 Controls

SADP instruments have a single rotary switch to the right of the indicator, which controls the power supply, the battery check and the range selection (in dual range models). The switch positions are marked on the instrument fascia. SADP-D models have a single on/off switch.

5 Normal Operation

Brief operating instructions will be found on the label fastened to the top of the instrument cabinet. The standard test procedure is as follows:

1. Switch the instrument on and check the battery condition.
2. At the sample point to be tested open the sample valve or regulator slightly and check that no dirt or condensate is expelled. (If any dirt or condensate is present, wait until it is cleared or abandon the test).
The pressure of the sample source is not important: **however the instrument needs a small sample of the air or gas which has been reduced to atmospheric pressure at the sample point (it must not exceed 5 Psi for safe operation)** - easily achieved by opening the valve just enough to allow a small flow to escape through the dew point meter.
3. Connect the PTFE sample pipe supplied with the instrument between the sample tapping point and the instrument, using either of the connections of the head/sensor assembly.
4. Adjust the sample valve or regulator to give a gentle flow through the instrument. (2 - 5 litres/min is ideal but the flow rate is not particularly critical. **Do not exceed a flow of about 20 litres/min.**)
5. Allow the sample to flow for 2 - 3 minutes in order to purge the sample pipe (a longer time might be needed if testing very dry gas - drier than about -65 °C dewpoint). Then place a finger over the outlet connection of the instrument head and the sample pressure will cause the head to open. Remove finger from the instrument when the head is fully open. (If there is insufficient sample pressure, fit a length of one or two metres of flexible pipe to the outlet connection of the instrument head and slowly raise the head by hand).

6. The instrument reading will move up the scale (wetter) and stabilise. When there is no further change in reading, note the result. If the reading moves up the scale (wetter) and then moves down the scale (drier) then either the sample pipe was not purged enough before the head was raised or the sample is becoming drier during the test. (Perhaps by taking the sample from a pipe in which the gas has been stagnant for some time).

If in doubt about the suitability of the sample flow rate or the materials of the sample pipe being used, increase the sample flow rate after the final reading has been obtained. If the instrument moves to a drier reading this indicates that the original flow rate was too low or that there is a leak in the system allowing ambient moisture into the sample or that the sample pipe is still wet.

7. After the test is complete and if a continuous reading is not needed, close the instrument head ready for the next test.
8. Note these instruments are designed for rapid moisture determination when operated from Dry to Wet, in this case they should give a 95% step change within 30 seconds. When operated Wet to Dry we cannot quote any response time as this is dependant upon many variables but will be considerably longer than the Dry to Wet response time.

Dual Range Model TR

This model should be operated in the same way as the standard range model except that when the reading has stabilized you can move the switch from STD RANGE to LOW RANGE. This will activate the lower red scale marked WATER VAPOUR. This is simply an amplification of the middle green scale marked ppm(v) and will display a more accurate reading between the range of 0 - 10 ppm.

PLEASE NOTE: When performing the Automatic Calibration procedure the switch must be returned to the STD RANGE position.

6 Calibration Checking

When SHAW invented the capacitance sensor many years ago it was a real breakthrough. The second major breakthrough came when we introduced the unique Automatic Calibration System for our dewpoint sensors.

This is a major advantage of the SHAW measurement system. No other instrument can be checked so easily and quickly.

The system relies on the fact that each sensor is designed to give no further increase in reading when it reaches its maximum moisture level. This means, for example, that the grey spot sensor used in the Model SADP-G for the range -80 to 0 °C dewpoint will read 0 °C when exposed to gas at 0 °C dewpoint but will continue to read 0 °C dewpoint when it is exposed to wetter gas. The system can therefore be calibrated very simply by exposing the sensor to anything wetter than 0 °C dewpoint and adjusting the reading to that point on the dial. In practice there is not an immediate cut-off and the 0 °C dewpoint mark on the dial will be found at about 3 °C below the *Automatic Calibration* line. This enables the instrument to retain the maximum possible accuracy throughout its range. In practice, the instrument's calibration is checked as follows:

6.1 AUTOMATIC CALIBRATION - All Models Excluding SADP-B

1. Ensure that no gas sample is connected to the instrument head connections. Switch meter to READ or STANDARD range if a TR Model. Switch to ON for SADP-D models.
2. Raise the head of the instrument by hand and pump it up and down a few times, ending in the raised position.
3. After about one minute (not critical but not more than a few minutes) check the instrument reading. On SADP models it should be at the AUTOMATIC CALIBRATION line. It is not critical within 1 or 2 °C.
NOTE: Extremes of humid or dry room air conditions may affect the reading slightly - see below. SADP-D models must be set to the wet limit of the sensor.
4. If the reading requires adjustment locate the AUTOMATIC CALIBRATION control, which is to be found on the front panel of the instrument and using the small screwdriver provided, turn the control clockwise to increase the reading (wetter) or anti-clockwise to decrease it.
5. Close the instrument head.

NOTE: When the outside temperature is below 0 °C or in an air-conditioned environment, the room dewpoint may also be below 0 °C. Under these conditions we suggest that an independent check of the room dewpoint be made against which the calibration can be set or more easily, assume that the room dewpoint temperature is the same as the outdoor air temperature. This will be quite sufficient except in very unusual weather conditions.

6.2 MANUAL CALIBRATION - Models SADP-B and SADP-D-B

The wide range of the Model SADP-B and SADP-D-B means that very rarely will the room air dewpoint be above the maximum of the range. This means that true Automatic Calibration will not work. To overcome this, simply use a wet and dry bulb hygrometer or similar, to determine the room air dewpoint temperature and at stage (4) set the reading to the actual air dewpoint. There is of course, no Automatic Calibration line on these meters.

We suggest you check the automatic calibration a minimum of two to three times each year and that the instrument is returned annually for a full range calibration check.

7 The Sensor

The SHAW High Capacitance Sensor has been undergoing continuous development since it was invented by Mr. J. L. Shaw in the late 1940s. Protected by world patents the dewpoint sensor is manufactured by a unique automated process, which results in a long life device with fast response, high accuracy and good stability.

Construction of the sensor starts with an ultra-high purity aluminium wire, which is coated with a hygroscopic layer and finally covered by a film of porous gold. The gold film and the aluminium core form the plates of the capacitor. The capacitance value and the change in capacitance over the measuring range of each sensor is many times greater than any other device resulting in a system, which can operate at low frequency (50 or 60Hz) without any risk of interference or pick-up from external cables or other sources.

Some of the water vapour molecules in the atmosphere surrounding the sensor will enter the dielectric layer where, due to the extremely small size of the pores, their Brownian motion will be limited, their energy will consequently be reduced and they will condense into liquid water. Due to the very high dielectric constant of water (about 80) compared with the other vapours which may be present, this produces a marked change in the dielectric value of the sensor which is then measured by the analyser. A dynamic equilibrium will exist between the water vapour outside the sensor and the condensed water within the pores. This equilibrium is maintained and the response time of the sensor can generally be considered to be at least as quick as the system into which it is installed.

Molecules larger than water vapour (one of the smallest gas molecules) cannot enter the pores, making the sensor resistant to many contaminants and specific to water vapour pressure regardless of the carrier gas. Even molecules such as Hydrogen which may enter the pores, have such a low dielectric constant and will not condense, so cannot interfere with the reading.

This is a feature unique to the SHAW sensor. All other sensors of the capacitance type are affected by molecules such as methanol which cause great inaccuracy.

7.1 Gaining Access to the Sensor

The sensor is mounted inside the test chamber (head) of the instrument and is accessible by removing the test chamber from the instrument as follows:-

1. Undo the three screws in the base flange of the head assembly and lift the complete head off the instrument. Pull out the plug from the sensor.
2. Using a 22 mm A/F wrench, unscrew the sensor from the head assembly. Do not leave the head without a sensor fitted for more than a few minutes, as the desiccant will absorb moisture from the room air.
3. When refitting the sensor, push the coaxial plug in firmly and do not forget to fit the brass spacer.

8 Additional Information

8.1 Anti-Static Carrying Case

The carrying case supplied with the SADP is manufactured from anti-static material. The SADP unit can be fully operated within the carrying case. It is recommended that the SADP is left in the carrying case whenever in the hazardous area.

8.2 Desiccant and Head Seal

The sensor is kept dry when not in use by the desiccant contained in the head assembly. In the Model SADP this is designed to maintain the sensor at about -75 °C dewpoint, many years' experience has shown that this maintains the optimum responsiveness of the sensor.

The above readings should be obtained when the instrument has been left with the head in the closed position for a few hours e.g. overnight. As the desiccant only has to dry a very small volume of air or gas after each test and is completely isolated from the test gas and the room air, it has a life of approximately five years in normal use. After very long service or in case of accident, the desiccant can easily be replaced as follows:

1. Grasp the black plastic ring (Head Seal), which separates the inner and outer sections of the head assembly and unscrew it until it can be removed. Pull the inner section out of the outer section. In the case that the **Head Seal** requires **replacement**, slide the old seal off noting the orientation and place the replacement on a firm bench upside down (threads uppermost). Now insert the head into the seal and when it meets the seal, push firmly till it passes the seal.
2. Unscrew the plain brass base of the inner section, discard the old desiccant and replace with new.
3. Check that the rubber grommet is intact and in place in the base of the inner section and then reassemble the head assembly. Otherwise replace the grommet seal if necessary, applying a trace of silicon grease and ensuring the seal is in place correctly and the sensor will travel up and down it without displacement or contamination with silicon grease of the sensor filters.

8.3 Batteries and Battery Check

When the battery check position is selected the reading should be in the green sector or to the right of it. If the reading is to the left of the green sector (drier), then the batteries should be replaced.

The instrument is supplied with one of the following batteries. In normal use these will last for one to two years.

- Varta 'Superlife' Zinc Carbon R14P C Size 1.5V Primary Cells
- Panasonic Zinc Carbon R14 C Size 1.5V Primary Cells

This instrument is only certified intrinsically safe to T6 with the use of the above batteries as supplied. The use of other batteries invalidates the certification of the equipment for use in hazardous areas.

To replace the batteries, first remove the instrument from its carrying case. The battery holders will be found on the instrument back panel and protected by a metal plate. Remove the plate by removing the two special screws with the key provided, take off the cap of each battery carrier and replace the batteries with six c-size (R14) cells. Always replace all six batteries at the same time and do not leave completely discharged batteries in the instrument. This must be carried out in the Safe Area.

8.4 Temperature

Typical ambient variations experienced throughout the world are quite acceptable but avoid placing the instrument in direct sunlight or near a source of radiant or convected heat. In countries that experience extremes of temperature, always carry out the *Automatic Calibration* with the instrument at its operating temperature.

8.5 Pressure

The automatic dewpoint meter operates with the sensor at atmospheric pressure and the readings given in dewpoint temperature and parts per million are therefore correct at 1 bar (A). However, dewpoint temperature is directly proportional to pressure and the results obtained from the instrument can be referred to any other pressure by use of the pressure calculator, which is supplied with the instrument. Instructions for the use of the calculator are printed on it.

8.6 Response Time

The response time of any water vapour pressure detector will naturally be very much quicker from dry to wet, than from wet to dry. This is the reason that the SHAW Automatic Dewpoint Meter is so successful. The sensor is kept in a dry condition when it is not in use and therefore results are obtained in the quickest possible time.

To check whether a particular instrument is within specification, carry out the *AUTOMATIC CALIBRATION* procedure, close the instrument head and note the reading ten minutes later. If the unit has not dried down to $-40\text{ }^{\circ}\text{C}$ after this ten minute period, the instrument should be returned to your local dealer for examination.

8.7 Guarantee

All SHAW products are guaranteed for two years from the date of purchase, some exclusions are as follows:

Removing protective guard from any sensor, subjecting sensor to shock or black list gases e.g. caustic and acidic gases like ammonia and chlorine, tampering with any internal electronics and applying incorrect supply voltage to meters, subjecting to excessive flow rate, contaminants and general misuse.

If you suspect a fault which you feel needs to be attended to under guarantee please contact us for assistance hopefully to help fault find and effect a remedy and if this is not successful to give precise instructions for the return for inspection.

No equipment will be replaced or repaired without having been returned for inspection either to ourselves or an authorised distributor.

9 Basic Definitions

WATER VAPOUR PRESSURE: the pressure exerted by the water vapour contained in any mixture of gases. The total pressure exerted by the gas mixture is the sum of the pressures exerted by its components — including the water vapour. Water Vapour Pressure varies in direct proportion to the total gas.

DEWPOINT TEMPERATURE: the temperature to which the gas must be cooled in order that it should be saturated with water vapour (i.e. 100% relative humidity). For practical reasons it is referred to dewpoint above 0 °C and frost point below 0 °C.

PARTS PER MILLION BY VOLUME: ppm(v) is the ratio of the water vapour pressure to the total gas pressure.

PARTS PER MILLION BY WEIGHT: ppm(w) is the ratio of the molecular weight of water vapour to the molecular weight of the carrier gas mixture.

RELATIVE HUMIDITY: the ratio of the actual water vapour pressure in the gas to the saturation water vapour pressure at the same temperature.

10 Electrical Function Check

If there is any doubt about the functioning of the ANALYSER, the following test may be carried out (this must always be carried out in the Safe Area).

1. Switch off the instrument.
2. Check that the meter reading is accurately at the *ZERO* (left-hand) end of the scale. If not, adjust the reading by means of the plastic screw on the meter face.
3. Remove the instrument head by taking out the three screws in the base flange and disconnect the sensor by pulling out the coaxial plug.
4. Switch instrument to the *BATTERY CHECK* position to confirm that the batteries are in good condition (replace them if they are not) and then select the *READ* position (the standard range on extended range models).
5. Apply a short circuit to the sensor cable plug on the instrument - the voltage is extremely low and so there is no hazard.
6. Adjust the *AUTOMATIC CALIBRATION* control to give a reading of full scale (i.e. on the *AUTOMATIC CALIBRATION* line).
7. Remove the short circuit and the reading should return to the left-hand end of the scale. This establishes that there is no major fault in the instrument. If the tests so far do not produce the expected results, the instrument should be returned to your local dealer.
8. Apply a load of $8.6\text{k}\ \Omega$ to the sensor cable plug. Readjust the reading to full scale using the *AUTOMATIC CALIBRATION* control.
9. Increase the load to $18.6\text{k}\ \Omega$. The reading should decrease to 62% of scale $\pm 1\%$.
10. Increase the load to $62\text{k}\ \Omega$. The reading should decrease to 23.5% of scale with the same tolerance as above.
11. Refit the head assembly and carry out the *AUTOMATIC CALIBRATION* procedure.

This completes the electrical function check.

PLEASE NOTE: VP1 on the printed circuit board is factory set. If the adjustment of this control is altered, it will be necessary to return the instrument to our works.


11 Problem Guide

PROBLEMS	CAUSE	SOLUTION
ERRATIC READINGS	Static on indicator	Moisten indicator face with 50/50 mixture of detergent and water or use proprietary anti-static cleaner. DO NOT POLISH INDICATOR FACE.
FULL SCALE READING	Wet gas	Stop gas supply and switch analyser off.
	Short circuit sensor, cable or plug	Disconnect plug from sensor and if the indicator still reads over full scale deflection, cure the short circuit in the cable or plug or replace.
	Short circuit sensor	Disconnect the plug from the sensor and note the indicator falls to 0 deflection. Apply approx 24 V DC to sensor terminals MOMENTARILY with the sensor in a dry condition. Polarity is not important but the contact must be brief or the sensor may be damaged. If this fails to clear the fault the sensor must be replaced.
ZERO READING	Open circuit on cable	Disconnect plug from sensor and connect centre pin of plug to the outer connection. No reading will be obtained. Repair cable.
	Open circuit on sensor	Test as for open circuit on cable but note that reading over FSD obtained. Check sensor connection or replace sensor.
	AutoCal wrongly set	Readjust to correct setting (i.e. carry out the AutoCal procedure as on page 12).
	Instrument unserviceable	Disconnect coaxial cable from instrument and connect short circuit across terminals and note no reading even with AutoCal control turned up. Return instrument for service.
WET READING	Leak in system or use of unsuitable pipe	Cure leak or replace unsuitable pipe with copper or stainless steel. Flexible connections should be made with PTFE pipe. NEVER use rubber or plastic pipe.
	Comparison with secondary standard instrument or calibration gas	Ensure that samples are taken from same sample point. Re-check AutoCal setting. If problem still occurs change sensor.
SLOW RESPONSE	Free water in system	Check drain and inspection ports in the main system and sample pipe work.
	Wrongly sized or incorrect material on sample lines	Refer to Section 3.2 of manual and ensure sample tube material and flow rates are as recommended.
DRY READING	AutoCal wrongly set	Refer to Section 6.0 of manual and re-check AutoCal. If this does not cure problem return for calibration.
	Comparison with secondary standard instrument or calibration gas	Refer to Section 6.0 of manual and re-check AutoCal. If this does not cure problem return for calibration.
CONSTANT READING	Condensation in sample system	Condensation will occur if temperature of the sample system or main pipe, at any point, is below (colder than) the DP temperature of the sample gas. Once having formed, the sample reaching the sensor will have a DP equal to temperature of the condensate regardless of the DP at the sample point.

12 Hygrometer Equivalents

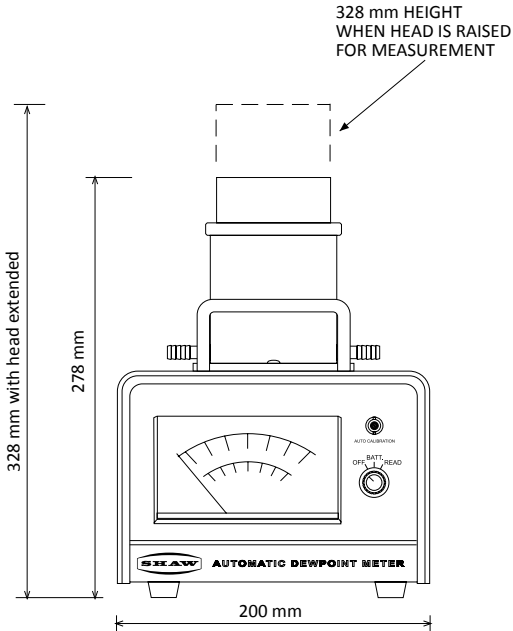
DEWPOINT ° C	DEWPOINT ° F	VAPOUR PRESSURE mmHG	PARTS PER MILLION by VOLUME	DEWPOINT ° C	DEWPOINT ° F	VAPOUR PRESSURE mmHG	PARTS PER MILLION by VOLUME
-150	-238	7 x 10 (-15)	9.2 x 10 (-12)	-52	-62	.02305	30.329
-140	-220	3 x 10 (-10)	3.9 x 10 (-7)	-50	-58	.02961	38.961
-130	-202	7 x 10 (-9)	9.2 x 10 (-6)	-48	-54	.03786	49.816
-120	-164	9 x 10 (-8)	1.2 x 10 (-4)	-46	-51	.04819	63.408
-118	-180	.00000015	.00020	-44	-47	.06108	80.368
-116	-177	.00000025	.00033	-42	-44	.07709	101.43
-114	-173	.00000041	.00054	-40	-40	.09691	127.51
-112	-170	.00000066	.00087	-38	-36	.12133	159.64
-110	-166	.00000107	.00141	-36	-33	.15133	199.12
-108	-162	.00000169	.00222	-34	-29	.1880	247.37
-106	-159	.00000266	.00350	-32	-26	.2328	306.32
-104	-155	.00000413	.00543	-30	-22	.2871	377.76
-102	-152	.00000636	.00837	-28	-18	.3529	464.34
-100	-148	.00000968	.0127	-26	-15	.4323	568.82
-98	-144	.00001459	.0192	-24	-11	.5277	694.34
-96	-141	.00002178	.0287	-22	-8	.6422	845.00
-94	-137	.00003224	.0424	-20	-4	.7790	1025.00
-92	-134	.00004729	.0622	-18	0	.9421	1239.61
-90	-130	.00006879	.0905	-16	+3	1.136	1494.74
-88	-126	.00009924	.1305	-14	+7	1.365	1796.05
-86	-123	.00014205	.1869	-12	+10	1.636	2152.63
-84	-119	.0002018	.2655	-10	+14	1.956	2573.68
-82	-116	.0002844	.3742	-8	+18	2.331	3067.11
-80	-112	.0003981	.5238	-6	+21	2.771	3646.05
-78	-108	.0005533	.7208	-4	+25	3.285	4322.37
-76	-105	.0007638	1.005	-2	+28	3.884	5110.53
-74	-101	.0010476	1.378	0	+32	4.581	6027.63
-72	-98	.0014275	1.878	+2	+36	5.292	6963.16
-70	-94	.001933	2.543	+4	+39	6.099	8025.00
-68	-90	.002603	3.425	+6	+43	7.012	9226.32
-66	-87	.003483	4.583	+8	+46	8.045	10585.53
-64	-83	.004635	6.099	+10	+50	9.209	12117.10
-62	-80	.006135	8.072	+12	+54	10.518	13839.47
-60	-76	.008076	10.626	+14	+57	11.988	15773.68
-58	-72	.010576	13.916	+16	+61	13.635	17940.79
-56	-69	.013780	18.132	+18	+64	15.478	20365.79
-54	-65	.01787	23.513	+20	+68	17.535	23072.37

13 SADP and SADP-D Specification

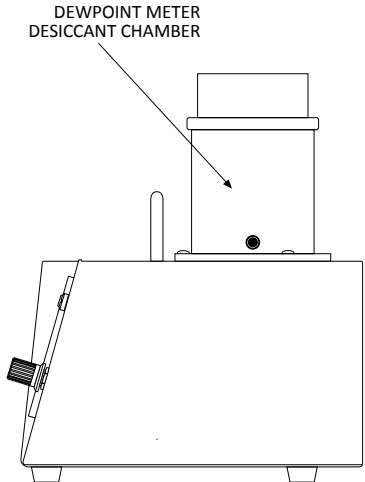
Accuracy:	±1ppm , (±3 °C DP red/silver spot, ±4 °C DP all others).
Type:	Portable hygrometer in stove enamelled zinc plated steel and alloy case, complete with carrying case. For table top or portable use with desiccant chamber for rapid readings. Certified intrinsically safe for operation in hazardous areas. Intrinsically safe to ATEX and IECEx ATEX:  II 1 G Ex ia IIC T6 Ga IECEx: Ex ia IIC T6 Ga
Dimensions:	200 mm (w) x 225 mm (d) x 278 mm (h). Height 328 mm with head extended.
Weight:	4.5 kg approximately.
Display:	SADP 12 cm Taut Band indicating meter showing dewpoint and ppm, with amplified range of 0 - 10ppm on TR versions. SADP-D 2 cm 3 ½ Digit LCD with battery check symbol.
Sensor Connection:	Internal.
Power Supply:	9 V DC Internal – use only batteries supplied with instrument. <ul style="list-style-type: none">● Varta ‘Superlife’ Zinc Carbon R14P C Size 1.5 V Primary Cells● Panasonic Zinc Carbon R14 C Size 1.5 V Primary Cells
Sampling:	Pressure: atmospheric with flow rate of 2 - 5 litres/min.
Outputs:	None.
Calibration:	AutoCal on all but Blue range.
Accessories/Options:	SU4 Lo, Med or Hi sample system for sample conditioning pressurised gases to atmospheric conditions and controlled flow.
Sensor Type (r):	Sensor Range:
Purple: (P)	-100 / 0 °C dewpoint, 0 - 6,000 ppm, (AutoCal)
Silver (S)	-100 / -20 °C dewpoint, 0 - 1,000 ppm, (AutoCal)
Red: (R)	-80 / -20 °C dewpoint, 0 - 1,000 ppm and 0 - 10 on TR version, (AutoCal)
Grey : (G)	-80 / 0 °C dewpoint, 0 - 6,000 ppm and 0 - 10 on TR version, (AutoCal)
Blue : (B)	-80 / +20 °C dewpoint, 0 - 23,000 ppm (ManualCal)
To Order:	Analogue versions SADP (r): suffix TR if required for G and R ranges only. Digital Versions SADP-D-(r)



14 SADP General Assembly Diagram



FRONT VIEW



SIDE VIEW

