

MODEL SADP μ -D

Portable Dewpoint Meter



Instruction Manual

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MODEL SADP_μ-D

AUTOMATIC DEWPOINT METER

INSTRUCTION MANUAL

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Model SADP_μ-D

Automatic Dewpoint Meter

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GENERAL DESCRIPTION

The Automatic Dewpoint Meter is a battery operated portable unit designed for spot check or continuous use, and gives direct indication in Dewpoint on a 3 ½ digit LCD.

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.

RANGES

Model SADP _μ -D-SR	-110 to -20°C Dewpoint
Model SADP _μ -D-PL	-110 to +20°C Dewpoint
Model SADP _μ -D-RD	-80 to -20°C Dewpoint
Model SADP _μ -D-GY	-80 to 0°C Dewpoint
Model SADP _μ -D-BL	-80 to +20°C Dewpoint

CABINET

Aluminium and zinc plated steel, stove enamelled. 202mm wide x 225mm deep x 276mm high (320mm high with test chamber (head) in the open position). Typical weight 5kgs. Four feet fitted for bench use.

The instrument is provided as standard with a padded carrying case with shoulder strap, a moisture calculator, a screwdriver for the Automatic Calibration control, a special key for the security plate covering the battery carriers, and a 2 meter length of flexible PTFE (Teflon) sample pipe.

SAMPLE CONNECTIONS

There is a push-on sample connection 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 6mm (1/4"). 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.

POWER SUPPLY

The instrument is supplied with 6 c-size dry cells. In normal use these will last for 5-6 months.

GENERAL NOTES

The SADP μ -D is fitted with a microprocessor based PCB which allows very accurate calibrations to be performed.

This circuit has different characteristics to an analogue circuit although, in use, the general operation is the same, but the following points should be noted.

- 1) When the instrument is switched to the read position, the processor takes approximately 5 seconds to initialise. The display will indicate full range before returning to the actual sensor reading. This is normal.
- 2) The instrument is certified for use in hazardous areas (EEx ia IIC T5).

OPERATION

In normal operation the following procedure should be used.

- a) Switch the instrument ON and ensure that the 'Low Battery' warning symbol is not showing in the top left hand corner of the display.
- b) Connect the PTFE sample tube to the air or gas sample point.
- c) Open the sample point to allow a flow of air or gas through the sample tube at a rate of between 5 and 15 L/min., exhausting to atmosphere. Ensure that no liquid is passing through the tube as this could damage the sensor.
- d) After allowing the sample to flow for approximately 1 minute (to purge the sample point and sample tube), connect the tube to the instrument head assembly. This connection can be made to either side, whichever is most convenient.
- e) After allowing the air or gas to purge the instrument head assembly for approximately 1 minute, restrict the outlet of the head assembly by placing a finger over the outlet tube. The instruments telescopic head assembly will extend under the pressure of the air or gas. Where very low air or gas pressures are present it may be necessary to draw the head open, by hand, but this should be done very slowly in order not to draw in ambient air through to exhaust tube.

- f) When the head assembly is fully extended, remove the outlet flow restriction and allow the air or gas to flow through the head assembly.
- g) The instrument display will respond to the change in moisture content and the reading should be taken when the display stabilises.
- h) When the test is complete, push down the telescopic head, fully, turn off the air or gas flow and disconnect the sample tube. NOTE: While the head assembly is in the closed position the sensor will be dried, by the internal desiccant, ready for the next test.
- i) Switch the instrument off.

NOTE It is very important that the instrument head should be either fully closed or fully extended or the desiccant within the head will become wet and will influence readings. The instrument should always be stored with the head in the closed position.

IMPORTANT

The sensors are suitable for many different industrial research applications. Most gases can be checked for their moisture content, and there is 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. However, there are some gases, which must be avoided, as they are not compatible with the material of construction of the sensor. Ammonia and Chlorine must be avoided at all times, even in small quantities. HCL also attacks the sensors very quickly. Gases such as Sulphur Dioxide (SO₂) can be monitored, as long as the moisture content is low - generally less than 100Vpm. If in doubt, please ask your supplier.

CALIBRATION (Sensor Ranges up to 0°C Dewpoint)

The major advantage of the instrument is the Automatic Calibration Feature.

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 that, for instance, the Silver Spot or Red Spot sensor will read –20°C Dewpoint when it is exposed to gas at –20°C Dewpoint, but will continue to read -20°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 –20°C Dewpoint and adjusting the reading to that point on the dial. For the Grey Spot Sensor the maximum level is 0°C DP and the same principle applies.

In practice, the instrument's calibration is checked as follows:-

AUTOMATIC CALIBRATION

1. Switch the instrument ON.
2. Ensure that no gas sample is connected to the instrument head connections.
3. Raise the head of the instrument by hand and pump it up and down a few times, ending in the raised position.
4. After about 1 minute (not critical, but not more than a few minutes) check the instrument reading. It should display the maximum level of Dewpoint for the instrument (i.e. –20°C for Red and 0°C for Grey).
5. If the reading requires adjustment locate the AutoCal 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 anticlockwise to decrease it.
6. Close the instrument head.

NOTE We suggest that this procedure should be carried out at a time when the head assembly can be allowed to dry thoroughly before any further test samples are measured. We also suggest that the overall calibration of the instrument should be verified on a yearly basis.

CALIBRATION (Sensor Ranges up to +20°C Dewpoint)

Factory calibration is performed by firstly setting the span of the instrument, using the AutoCal potentiometer, on the instrument front panel, to +20°C Dewpoint, while exposing the measuring sensor to air with a moisture content equivalent to +20°C Dewpoint.

The instrument head and sensor are then dried. Thereafter, air at controlled Dewpoints is passed through the measuring head, in steps, from dry to wet and the instrument is adjusted to be correct at those points.

The results of the calibration are shown in the Certificate of Test and Calibration supplied with the instrument. The values of all calibration points are verified against a primary standard analyser, which is traceable to the British Standard Moisture Generator, held by the National Physical Laboratory.

CALIBRATION VERIFICATION

In order to verify the calibration of the instrument, in service, it will be necessary to measure the ambient air Dewpoint by some other method. Careful use of a sling or whirling hygrometer can achieve accurate results or a cooled mirror device can be used.

The following procedure should be used:-

1. With the instrument switched on and all gas samples disconnected, raise the instrument head, by hand and pump it up and down a few times, leaving it in the raised position.
2. Compare the readings of the instrument, on the ambient air drawn into the head, with those obtained by another method and IF NECESSARY, adjust the AutoCal control until the values coincide.
3. Close the instrument head, switch off.

This procedure confirms the validity of the calibration.

We recommend that verification of the overall linearity of calibration be carried out on a 12 monthly basis.

THE SENSOR

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 pickup 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.

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 22mm 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 don't forget to fit the brass spacer.

ADDITIONAL INFORMATION

DESICCANT

The sensor is kept dry when not in use by the desiccant contained in the head assembly. The instrument is designed to maintain the sensor below -70°C Dewpoint as 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. After very long service, or in case of accident the desiccant can easily be replaced as follows:-

1. Hold the plastic ring, 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.
2. Unscrew the plain brass base of the inner section, discard the old desiccant and replace with new.
3. Check that the white seal is in place in the base of the inner section and then reassemble the head assembly.

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.

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 2 special screws with the key provided, take off the cap of each battery carrier, and replace the batteries with 6 c-size (R14) cells. Always replace all 6 batteries at the same time, and do not leave completely discharged batteries in the instrument.

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.

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.

PROBLEM GUIDE

<u>PROBLEM</u>	<u>CAUSE</u>	<u>SOLUTION</u>
FULL SCALE READING	Wet gas	Stop gas supply & switch analyser off
	Short Circuit Sensor Cable or Plug	Disconnect plug from sensor & 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 & note the indicator falls to 0 deflection. Apply approx 24VDC 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 4).
	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.

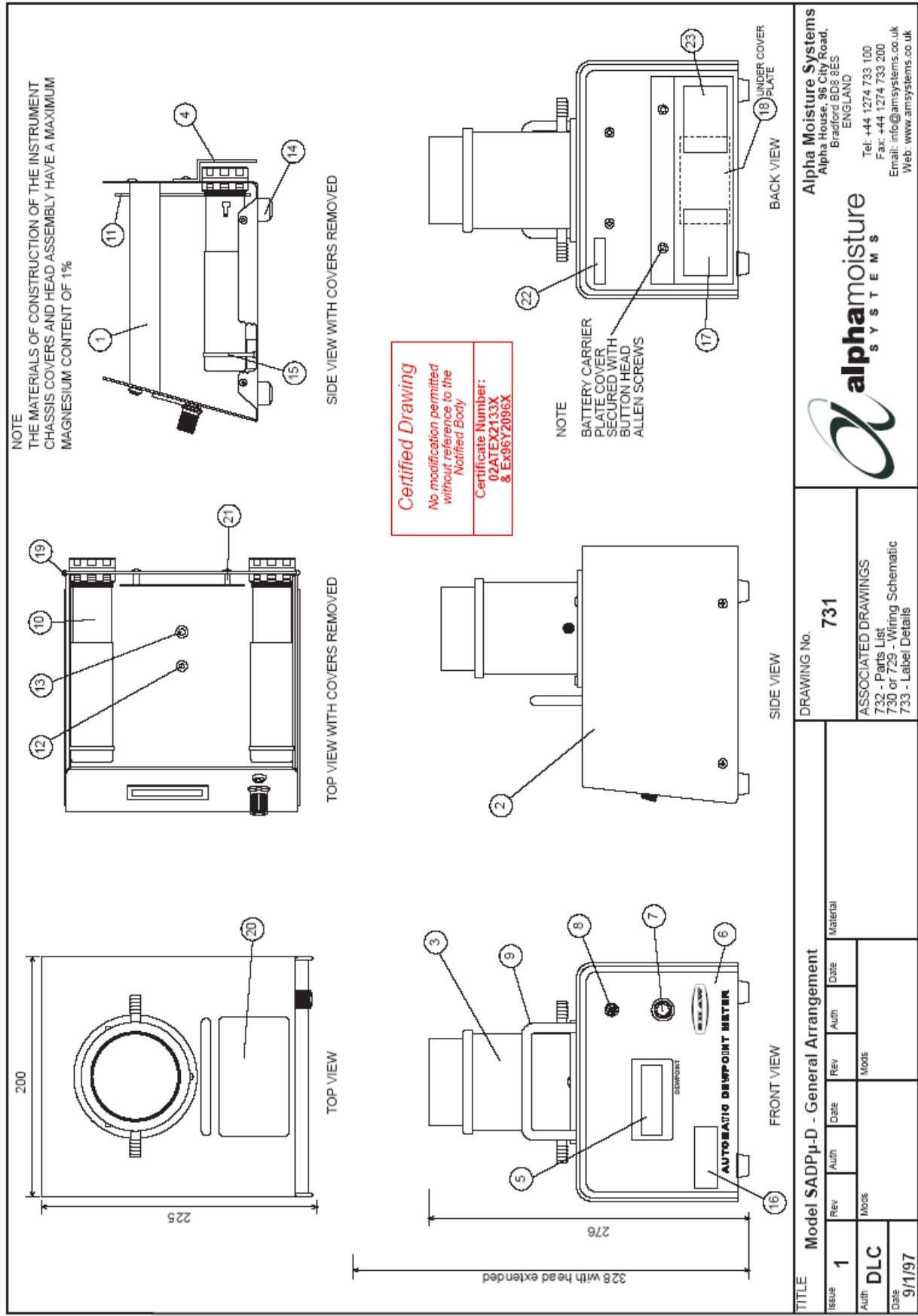
PROBLEM GUIDE (CONTINUED)

<u>PROBLEM</u>	<u>CAUSE</u>	<u>SOLUTION</u>
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 problems still occur Change sensor.
SLOW RESPONSE	Free Water in System	Check drain & inspection ports in the main system & sample pipe work.
	Wrongly Sized or Incorrect Material on Sample Lines	Refer to page 1 of manual & ensure sample tube material & flow rates are as recommended.
DRY READING	AutoCal Wrongly Set	Refer to page 4 of manual & Re-check AutoCal. If this does not cure problem return for calibration.
	Comparison with Secondary Standard Instrument or Calibration Gas	Refer to page 4 of manual & 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.

HYGROMETRIC EQUIVALENTS

DEWPOINT °C	DEWPOINT °F	VAPOUR PRESSURE mmHg	PARTS PER MILLION by VOLUME	DEWPOIN T °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	.7280	-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

Drawing 731 Model SADPμ-D - GA



Drawing 732 Model SADP_μ - Parts List

PART NO. DESCRIPTION

1	INSTRUMENT CHASSIS
2	INSTRUMENT COVER
3	HEAD / SENSOR ASSEMBLY
4	BATTERY COVER PLATE
5	IDIGITAL DISPLAY
6	FRONT PANEL OVERLAY
7	ROTARY SWITCH
8	CALIBRATION POTENTIOMETER
9	CARRYING HANDLE
10	BATTERY CARRIERS
11	PRINTED CIRCUIT BOARD (AMS Ex PCB Mk1)
12	COAXIAL CABLE SUPPORT STUD
13	NOT USED
14	CABINET FEET
15	BATTERY CARRIER RETAINING STRAPS
16	INTRINSICALLY SAFE DETAIL LABEL
17	BATTERY INSTRUCTION DETAIL LABEL
18	BATTERY INSTALLATION DETAIL LABEL
19	TRIM BEADING
20	INSTRUMENT OPERATING INSTRUCTION LABEL
21	NYLON SPACERS
22	SERIAL NUMBER DETAIL LABEL
23	MANUFACTURERS DETAIL LABEL

Certified Drawing

*No modification permitted
without reference to the
Notified Body*

Certificate Number:
02ATEX2133X
& Ex96Y2096X

NOTE : ITEM 15, THE BATTERY CARRIER RETAINING STRAP PASSES UNDER
A METAL SUPPORT CRADLE SECURED TO THE INSTRUMENT CHASSIS
BASE WITH SCREWS.

TITLE MODEL SADP _μ - PARTS LIST					
Issue	1	Rev	1	Auth	DLC
		Date	23/01/97	DRAWING No.	732
Auth	DLC	Modis	Add note re. battery carrier retaining strap and support cradle		
Date	9/1/97				
				ASSOCIATED DRAWINGS	
				731 GENERAL ARRANGEMENT	



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Intrinsic Safety Documentation



EC TYPE-EXAMINATION CERTIFICATE

Equipment intended for use in Potentially Explosive Atmospheres Directive 94/9/EC

Certificate Number: Sira 02ATEX2133X

Equipment: Model Ex, Model Ex-A, Model SADP_μ-D and Model SADP_μ Automatic Dewpoint Meters

Applicant: Alpha Moisture Systems

Address: Alpha House
96 City Road
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BD8 8ES
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This equipment and any acceptable variation thereto is specified in the schedule to this certificate and the documents therein referred to.

Sira Certification Service, notified body number 0518 in accordance with Article 9 of Directive 94/9/EC of 23 March 1994, certifies that this equipment has been found to comply with the Essential Health and Safety Requirements relating to the design and construction of equipment intended for use in potentially explosive atmospheres given in Annex II to the Directive.

The examination and test results are recorded in confidential report number R52A9102B.

Compliance with the Essential Health and Safety Requirements, with the exception of those listed in the schedule to this certificate, has been assured by compliance with the following documents:

EN 50014:1997 including amendments A1 and A2
EN 50020:2002
EN 50284:1998

If the sign 'X' is placed after the certificate number, it indicates that the equipment is subject to special conditions for safe use specified in the schedule to this certificate.

This EC type-examination certificate relates only to the design and construction of the specified equipment. If applicable, further requirements of this Directive apply to the manufacture and supply of this equipment.

The marking of the equipment shall include the following:



II 1G

EEx ia IIC T4 (T_a = -20°C to +37°C)

EEx ia IIC T3 (T_a = -20°C to +50°C)

Project Number 52V10767
Date 6 November 2002
Re-issued 15 September 2003
C. Index 13

C Ellaby
Certification Officer

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SCHEDULE

EC TYPE-EXAMINATION CERTIFICATE

Sira 02ATEX2133X

Re-issued 15 September 2003 to permit report number R52A9102B to replace report number R52A9102A and to correct the list of descriptive documents in section 14.1.

13 DESCRIPTION OF EQUIPMENT

The model Ex Automatic Dewpoint Meter is a battery operated, self-contained instrument used to measure the dewpoint and moisture content of gases. The instrument incorporates a telescopic head arrangement for dry down of sensor and automatic calibration facility. The models Ex-A, SADP_μ-D and SADP_μ Automatic Dewpoint Meters incorporate the following variances:

- The model Ex-A uses an analogue display rather than a digital display.
- The Model SADP_μ-D is installed in an alternative enclosure.
- The Model SADP_μ uses an analogue display rather than a digital display and is installed in an alternative enclosure.

14 DESCRIPTIVE DOCUMENTS

14.1	Drawing No.	Sheets	Issue	Rev.	Date	Title
	Drawings common to all builds					
	611	1 of 1	2	-	22 Oct 02	Battery carrier
	634	1 of 1	1	2	16 Oct 96	Schematic
	635	1 of 1	2	3	15 Dec 98	Parts list
	636	1 of 1	1	-	01 Apr 96	PCB layout
	637	1 of 1	1	-	01 Apr 96	Artwork, component side
	638	1 of 1	1	-	01 Apr 96	Artwork, solder side
	Model Ex only					
	632	1 of 1	1	2	07 Jul 00	Model Ex – general arrangement
	633	1 of 1	1	2	07 Jul 00	Model Ex – parts list
	1191	1 of 1	1	-	01 Jul 03	Model Ex - labels
	Model Ex-A only					
	720	1 of 1	1	-	18 Dec 96	Model Ex-A – general arrangement
	721	1 of 1	1	1	23 Jan 97	Model Ex-A – parts list
	727	1 of 1	1	-	08 Jan 97	Model Ex-A – single range schematic
	728	1 of 1	1	-	08 Jan 97	Model Ex-A – dual range schematic
	1192	1 of 1	1	-	01 Jul 03	Model Ex-A - labels
	Model SADP_μ-D only					
	730	1 of 1	1	1	20 Jun 02	SADP _μ -D – schematic
	731	1 of 1	1	-	09 Jan 97	SADP _μ -D – general arrangement
	732	1 of 1	1	1	23 Jan 97	SADP _μ -D – parts list
	1193	1 of 1	1	-	01 Jul 03	SADP _μ -D – labels
	Model SADP_μ only					
	726	1 of 1	1	-	07 Jan 97	SADP _μ – single range schematic
	729	1 of 1	1	-	08 Jan 97	SADP _μ – dual range schematic
	734	1 of 1	1	-	09 Jan 97	SADP _μ – general arrangement
	735	1 of 1	1	1	23 Jan 97	SADP _μ – parts list
	1194	1 of 1	1	-	01 Jul 03	SADP _μ – labels

14.2 Report No. R52A9102B

Date 6 November 2002
Re-issued 15 September 2003

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Sira Certification Service is a service of Sira Test & Certification Ltd



SCHEDULE

EC TYPE-EXAMINATION CERTIFICATE

Sira 02ATEX2133X

15 **SPECIAL CONDITIONS FOR SAFE USE** (denoted by X after the certificate number)

- 15.1 Under certain extreme circumstances, external non-metallic parts of this equipment may generate an ignition-capable level of electrostatic charge. Therefore, when it is used for applications that specifically require group II, category 1 equipment, the equipment shall not be located where the external conditions are conducive to the build-up of electrostatic charge on such surfaces. Additionally, the non-metallic parts of the equipment shall only be cleaned with a damp cloth.

16 **ESSENTIAL HEALTH AND SAFETY REQUIREMENTS OF ANNEX II** (EHSRs)

The relevant EHSRs that are not addressed by the standards listed in this certificate have been identified and individually assessed in Report No. R52A9102B.

17 **CONDITIONS OF CERTIFICATION**

- 17.1 The use of this certificate is subject to the Regulations Applicable to Holders of SCS Certificates.
- 17.2 Holders of EC type-examination certificates are required to comply with the production control requirements defined in Article 8 of directive 94/9/EC.
- 17.3 This certificate relies on the following previously-certified product. When used as part of the equipment, the key attributes listed in the table below shall still be maintained by their original certificate.

Product	Certificate number	Key attributes
Dewpoint Hygrometer Sensor	Sira 02ATEX2130X	EEx ia IIC T6 ($T_a = -20^{\circ}\text{C}$ to $+50^{\circ}\text{C}$)

Date 6 November 2002
Re-issued 15 September 2003

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