dewSMART™

Model DSP-Ex

Portable Dewpoint Meter

Instruction Manual

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Instruction Manual
For the
Model DSP-Ex Portable Dewpoint Meter

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1 General Information

- The Model DSP-Ex Automatic Dewpoint Meter is a fully self-contained portable instrument, specifically designed to measure the moisture content of air or gas on a spot-check basis.
- The instrument is operated with its own internal batteries and requires no external power source.
- The read-out of moisture content is on a dot matrix LCD, in any one of several selectable engineering units.
- 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.
- Model DSP-Ex utilises Alpha Moisture Systems advanced dewSmart sensor, which allows complete interchangeability of sensors and ranges.
- The calibrated measuring range is stored within the sensor and is readable from the analyser display (see page 2, item 2).
- Details of normal operation, engineering unit selection, sensor data and configuration of the instrument are described within this manual.

2 Features

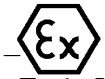
- 40 x 2 character dot matrix LCD display.
- Tactile membrane keypad, coupled with an easy to operate user interface.
- Operates from internal Duracell Alkaline "C" cells.
- 7 selectable moisture units (ºC, ºF, ppm(V), ppm (W), ppb(V), g/m3 and lb/MMSCF).
- Low battery indicator.
- Display Contrast control.

3 Safety Information

Read the safety information below, before use.

3.1 Warnings

The DSP-Ex is intrinsically safe. Therefore it can be used in hazardous areas.

Certification: ATEX Coding –  II 1G
Ex ia IIC T4 Ga (Ta = – 20ºC to +37ºC)
Ex ia IIC T3 Ga (Ta = – 20ºC to +50ºC)

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

3.2 Instructions specific to hazardous area installations

The following instructions apply to equipment covered by certificate **02ATEX2132X:**

- The equipment may be used in zones 0, 1 and 2 with flammable gases and vapours with apparatus groups IIA, IIB & IIC and with temperature classes T1, T2, T3 and T4.
- The equipment is only certified for use in ambient temperatures in the range -20^{o}C to +50^{o}C and should not be used outside this range
- The certificate number has an 'X' suffix, which indicates that the certificate contains one or more special conditions for safe use. Those installing or inspecting the equipment should have access to this section of the certificate. ***See Special Conditions of Use below.***
- Note that only the batteries specified on the equipment may be used.
- The equipment has not been assessed as a safety-related
- Repair of this equipment shall be carried out by the manufacturer or in accordance with the applicable code of practice.

3.3 Special Conditions of Use - (denoted by the X after the certificate number)

Under certain extreme circumstances, external non-metalic 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 conductive 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.

Also the apparatus enclosure is made from light metals and presents a risk of ignition due to impact or friction. The apparatus must therefore be carried in the (antistatic) protective carry case supplied when being transported in a hazardous area.

3.4 Pressure Exposure

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

0.3barg, 4.35psig, 30kpag or 0.3kg/cm^{2}g

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

4 Installing the Air/Gas Sampling System

The piping installation schematic diagram (see section 4.2) 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 DSP-Ex is not contaminated with any component that will damage, contaminate or affect the DSP-Ex 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 DSP-Ex response time will be lengthened, although the sensor calibration will not be effected.

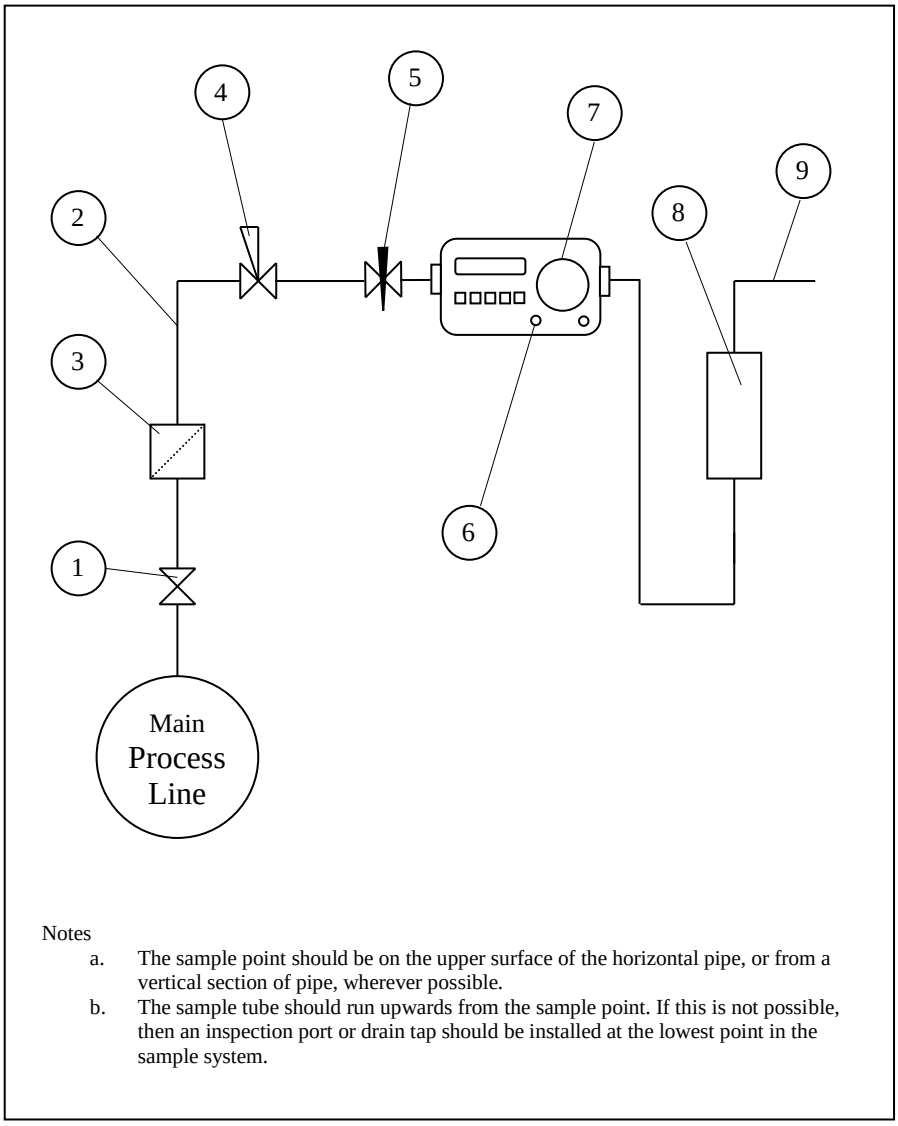
The flow rate, although not critical to the sensor measurement, should be low enough to avoid abrasion to the sensor surface without being so low as to extend the DSP-Ex response time to an unacceptable level. In general, a flow rate of between 5 and 8 litres/min at NTP will give the right balance.

The sensor used in the DSP-Ex 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/frost point temperature, are displayed on the instrument indicator.

4.1 Gases to Avoid

Corrosive Gases: The Sensor should not be exposed to corrosive gases (or corrosive contaminants in the gas sample) as these can chemically attack the sensor, impairing calibration accuracy and/or damaging it beyond economic repair. Examples of such gases are mercury (Hg), ammonia (NH_3), chlorine (Cl_2) etc. Strong oxidising agents such as ozone (O_3) should also be prevented from coming into contact with the sensor.

4.2 Piping installation Schematic



Notes

a. The sample point should be on the upper surface of the horizontal pipe, or from a vertical section of pipe, wherever possible.
b. 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.

4.3 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. 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, 3mm OD (1/8”) is sufficient as it provides good system response time with minimum flow. 6mm OD (1/4”) tube can be used where pressure drops across the 3mm tube are too high
3. 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.

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. DSP-Ex.
8. Flow Indicator – The recommended sample flow is 5 to 8 L/M.
9. Sample Exhaust – The exhaust is vented to atmosphere or returned to an atmospheric pressure line.

5 Purging the sample connection

Refer to the sample system schematic in section 4.2.

It is advisable to carry out an initial purge of the sample loop, before connecting the DSP-Ex, in order to avoid the possibility of sensor damage on start-up.

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

The DSP-Ex is not flow sensitive however the sample flow needs to be enough to purge the sensor head 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 backpressure in the sensor head, so should not exceed about 8 litres/min.

Allow this purge to continue for 2 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.

6 Instrument Start-up

The standard factory settings are such that the instrument will display the moisture content in °C Dewpoint has the auto switch-off facility activated and the display contrast set at a mid-point.

The other facilities and information available from the sensor and instrument are determined by the range of sensor in use, it's calibration data and the hardware of the instrument itself.

To access the available information and change variables use the following procedure:-

- Switch the instrument on by pressing the **I/0** key once.
- The display will read the word **INITIALISING**. This is the normal start-up routine during which the functions of the instrument and integrity of the sensor calibration data are verified.

- The display will then read **INSTRUMENT OK**. This confirms that all instrument functions are working normally.
- The display will then read **CALIBRATION DATA OK**. This confirms that normal communications with the sensor have been established and that the integrity of the calibration data, held within the sensor, has been verified.
- The display will then read the moisture content of the air/gas surrounding the sensor in °C Dewpoint, (or the equivalent in other engineering units if so selected).

7 Normal Operation

In order to take moisture content readings of air or gas, having pre-selected the required units of measurement, use the following procedure:-

1) Locate the instrument in a convenient position, as close as is practical to the sample point and move the handle from its carrying position to allow clear operation of the telescopic measuring head.

   NOTE. The position of the handle is adjustable, in 300 steps, by pressing the two black buttons, one at each pivot point, and manually positioning the handle. Releasing the buttons allows the handle to lock into the required position.

   It is not important which position the instrument is placed in, as it will operate in any attitude.

2) Switch the instrument ON by pressing the key marked I/0.

   NOTE. When the instrument is switched ON, the instrument will go through its initialising routine and data verification procedures described above. This routine takes approximately 10 seconds, after which time the instrument will display the moisture content of the air or gas surrounding the sensor, in whatever engineering units have been selected. This will happens every time the instrument is switched ON.

3) The sample tube supplied is fitted with a Female Swagelok quick connect coupling, at one end, for connection to the male connector positioned below and to the left of the measuring head. To make this connection, simply push the two halves of the connector together and allow the locking ring to locate. To disconnect this coupling push the locking ring towards the instrument panel and the two halves will spring apart.

   The other end of the sample tube is supplied with a 1/8" NPT male connector which should be adapted to fit the sample point connector.

   NOTE. It is important to note, at this time, that the material used for the sample tube is critical, especially when measuring very low moisture levels. The ideal material is stainless steel but this is normally impractical for a portable instrument. Where flexible tube is to be used, the preferred material is PTFE (Teflon). This offers a reasonable degree of flexibility and has good resistance to external moisture ingress. The sample tube supplied with the instrument is ideally suited to this purpose.

4) Open the sample valve, at the sample point, to allow a small flow of air or gas through the system, at atmospheric pressure. The actual flow is unimportant, as the measuring sensor is not flow sensitive, but it is suggested that a flow of between 5 and 10 L/min is an ideal compromise between minimum gas usage and system response speed.

5) Allow the instrument and pipework to purge and then restrict the sample exhaust, from the instrument, with a finger. This will cause the telescopic section of the measuring head to extend from the front panel of the instrument under the pressure of air or gas. If there is insufficient gas pressure to extend the head, grip the outer knurled section of the head and, while twisting clockwise, gently extend the head by pulling it out from the front panel, while keeping the sample exhaust blocked. When the head is fully extended, remove the finger from the sample exhaust and allow the sample to flow through the measuring head.

6) The display will indicate the change in moisture content surrounding the sensor. Observe the display and when there is no further change in reading; the displayed value is the gas moisture content.

NOTE. If there is any uncertainty as to whether equilibrium has been achieved in the system (pipe work and measuring head), which is necessary to reach an accurate measurement, a simple test can be carried out as follows:-

- After the display has stopped moving, increase the sample flow, slightly.
- Observe the display.
- If the displayed value remains constant the reading is accurate.
- If the displayed value begins to fall, the system was insufficiently purged and water vapour is still outgassing from the internal surfaces of the sample pipe work or measuring head OR there is a leak at the sample valve or one of the connections.

It is very important to note that if there is a leak in any part of the system, water vapour will defuse, from the ambient air, into the sample, even though the gas is flowing out of the faulty connection.

7) When the measurement is complete,

- Close the measuring head by manually pushing the extended section back towards the panel front and switch the instrument OFF.

NOTE. Ensure that the measuring head is fully closed. Failure to do so will cause the internal desiccant to become wet and impair the efficiency of operation of the instrument.

- Remove the sample by closing the valve at the tapping point,
- Disconnect the sample tube from the instrument and sample point.

This completes the procedure and the instrument can be removed to the next test point or stored until required again.

NOTE. If the reading taken from the instrument is in 0C or 0F dewpoint, it is important to remember that this value is at 1 bar A pressure. If the dewpoint is required at any other pressure, the dewpoint calculator, supplied with the instrument, should be used to calculate that dewpoint. Instructions for use are printed on the calculator face.

8 Adjusting Variables

To read Sensor and Instrument information, change the display contrast and enable/disable the automatic shut-down facility:-

- Press the keys marked  and  together and hold pressed for approximately 4 seconds.

  The display will read **SENSOR INFORMATION.**

- Press the key marked  once.

  The display will show the sensor (probe) serial number.

- Press the key marked  once more.

  The display will show the calibrated range of the sensor installed.

- Press the key marked  once more.

  The display will show the calibration date of the sensor installed.

- Press the key marked  once more.

  The display will show the suggested date of recalibration of the sensor installed. Normally 12 months after the calibration date.

- Press the key marked  once.

  The display will show the instrument type and software version

- Press the key marked  once more.

  The display will show **LCD CONTRAST- LIGHTER DARKER**

  At this point the contrast can be adjusted to the desired level by pressing either the key marked  to lighten the display or  to darken the display.

  NOTE: The contrast is incremented by the keys and does not scroll by holding pressed.

- When the contrast level is satisfactory press the key marked  once more.

  The display will show **AUTO SHUT DOWN** together with the status of this facility, either **ON** or **OFF**.

  To put this facility **ON** (enable) press 

To turn it **OFF** (disable) press 

NOTE: When the AUTO SHUT DOWN is ON, the instrument will automatically switch OFF if no keys are pressed within a period of 5 minutes.

- When the variables have been set to the desired positions press the key marked  . This fixes the settings within the instrument and on each subsequent start-up these levels will be maintained.

  The display will now be shown °C Dewpoint (or equivalent).

9 Selecting Engineering Units

To change the displayed engineering units from ºC Dewpoint to either ºF Dewpoint, PPM(V), PPB(V), g/m3, lb/MMSCF or PPM(W), use the following procedure:-

- Press the key marked  and hold pressed for approximately 4 seconds.

  The display will show the letters SU (select units) in the top right hand corner.

- Subsequent presses of the key marked  will scroll the display through the options of engineering units available.

  The order in which the engineering units will appear on the display and their definitions is as follows:-

°C Dewpoint:	The temperature at which Condensation or Frost forms if the gas is cooled, expressed in degrees centigrade. It is important to note that the term DEWPOINT is commonly used to include frost point and all readings below 0ºC are in fact measurements in equilibrium over ice.
°F Dewpoint:	As above but expressed in degrees Fahrenheit.
ppm(V):	The volume of water vapour per total volume of gas expressed as parts of water vapour per million parts of gas.
ppb(V):	As ppm(V) but expressed in parts of water vapour per billion parts of gas. This unit is only used in cases where the moisture content of the gas is less than 1ppm(V) (1000 ppb(V)). At levels above 1000 ppb(V) the instrument display will show OUT OF RANGE if switched to the PPB(V) section.

g/m3:	Mass of water per unit volume of gas expressed as grams of water per standard cubic meter of gas.
lb/MMSCF:	As g/m3 but expressed as pounds of water per million standard cubic feet of gas.
ppm(W):	Similar to ppm(V) but with reference to mass (weight) rather than volume. In this case the ratio of weights change with the molecular weight of the carrier gas.

- When the required units of measurement are displayed, press  to enter this information into the instrument.

  The instrument will then display the moisture content in the selected engineering units on each subsequent start-up

When ppm(W) is selected there is an option available to select one of several common gases or a variable setting where the molecular weight of any other gas can be entered. This option is denoted by the letters SG (Select Gas) that will be seen in the top right hand corner of the display.

- The common gas types installed are AIR, ARGON, NITROGEN, CO2, SF6 & H2. Scrolling through these options is achieved by pressing the  key.

- Following the end of the list shown above, the screen will display PPM(W) Mol Wt: X; where X is any number between 0 and 99.

- If ppm(W) is the required unit of measurement and the gas to be measured does not appear on the installed list, then the molecular weight of this gas should be installed by pressing the key marked  which indexes the number (mol weight) between 0 and 99 (1 press = 1 digit).If the  key is pressed at 99 then the number reverts to 0.

- When the required gas or molecular weight has been selected, press the key marked  , at this point the letters SG will disappear. This installs the selected units into the instrument programme and the instrument will start-up in these units at every subsequent 'start-up'.

  NOTE. If when the  key is pressed to select units in ppm(W), the display already shows the correct gas, simply press  again to confirm this setting.

Other units can be installed by reselecting and storing, using the above procedure.

10 Factory Calibration

Comparing the readings given from the instrument with those obtained from a standard, traceable dewpoint analyser performs factory calibration. The traceability is to the British Standard Moisture Generator held at the National Physical Laboratory, London. These comparative results are detailed in the Certificate of Test and Calibration supplied with the instrument.

11 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.

12 Batteries

The Model DSP-Ex is powered by 6 x C size batteries.

The typical battery life is in excess of 250 hrs. continuous operation.

The analyser will display, in the top left hand corner of the screen, the letters **LB (LOW BATTERY)** when the batteries are to be changed.

At the point when the **LB** sign is displayed there is approximately 2 hrs. battery life left before the sign changes to **VLB (VERY LOW BATTERY).**

At the point when the VLB sign is displayed the batteries will only power the instrument for a further 30 minutes, at which time the instrument will shut-down totally, and will not be operational until new batteries are installed.

If the instrument is switched ON after the very low battery automatic shut-down has taken place it will automatically switch itself OFF again.

Access to the batteries, for replacement purposes, is gained by firstly removing the cover plate, on the back panel of the instrument, using the Allen Key provided and then unscrewing the covers from both of the battery holders.

Fit new batteries as shown on label adjacent to the battery holders, replace the covers and refit the cover plate.

13 Anti Static Carrying Case

The anti static carrying case supplied with the DSP-Ex has been designed for use in intrinsically safe areas. The DSP-Ex unit can be fully operated within the carrying case. It is recommended that the DSP-Ex is left in the carrying case whenever in the intrinsically safe areas.

14 Transit Case - FOR USE IN SAFE AREA ONLY

(If Supplied)

The transit case is designed specifically to protect the instrument during transportation and storage it is not indented that the transit case be used in intrinsically safe areas.

The sample tube, dewpoint calculator and Allen key to remove the battery carrier cover plate, are housed in the hinged section inside the lid of the transit case.

The transit case carrying shoulder strap and keys to lock the case are also housed in the hinged section inside the lid.

Access to this storage compartment is achieved by pulling the small leather strap, positioned near the outer edge of the hinged cover, to release the two spring catches, which secure it.

Ensure that both catches are secure when closing the cover of the compartment to guarantee secure storage of the items held within.