

Model AcuDew

Dewpoint Transmitter

Instruction Manual

Issue 1



EU Declaration of Conformity

We
Of

Shaw Moisture Meters
Len Shaw Building, Bolton Lane, Bradford, England BD2 1AF

Declare That:
Model Name:

AcuDew

Description:

The AcuDew is a 2 wire 4-20 mA loop power transmitter.

Conforms to the following Directives:
2004/108/EC The Electromagnetic Compatibility Directive and its amending Directives
2006/95/EC The Low Voltage Directive and its amending Directives

And has been designed and manufactured to the following standards:
BS EN 61326-1:2013 Electrical Equipment for measurement, control and laboratory use-
EMC Requirements
BS EN 61010-1:2010 Safety Requirements for Electrical Equipment for Measurement, control
and laboratory use-General Requirements

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

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1.0 Unpacking Your Shaw Moisture Meters AcuDew

Please examine the AcuDew 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 AcuDew 4-20 mA dewpoint transmitter
- 1 connecting cable of the length specified on your order or two metres as standard
- 1 instruction manual
- 1 pressure dewpoint circular calculator
- 1 small screwdriver

If anything is missing please contact your distributor immediately.

1.1 General Description

The Shaw Moisture Meters Model AcuDew is a 2-wire 4-20 mA loop powered transmitter, used for continuous measurement of moisture in a process gas or compressed air. The Model AcuDew transmitter can be factory configured to output a 4-20 mA linear signal for any of the following moisture units: - °C or °F dewpoint, ppm(v), ppb(v), g/m³ and lb/MMSCF.

The ultra high capacitance SHAW sensing element is long lasting and offers excellent sensitivity, repeatability and response speed. Each unit is calibrated, traceable to International Humidity Standards and supplied with a Certificate of Calibration guaranteeing accuracy to ± 2 °C dewpoint.

The transmitter also incorporates an Automatic Calibration (AutoCal) feature, which allows the user to carry out field calibration/span check. The AutoCal feature is operated by means of a small potentiometer built into the transmitter body. To avoid accidental corruption, the potentiometer is covered by a weatherproof seal in normal use.

It is recommended that the AcuDew is calibrated at regular intervals to maintain accuracy. Annual laboratory calibration is recommended.

The RISC microprocessor circuitry of the Model AcuDew transmitter allows high resolution with advanced self-diagnostics for fault conditions. It also enables periodic recalibration of the dewpoint sensor, storing calibration data within the fully self-contained unit. Loop powered, by a 7 to 28V DC source, the Model AcuDew transmitter will provide the user with a linear 4-20 mA signal over the chosen range.

The mechanics of the Model AcuDew transmitter have been designed to cope with extreme environmental conditions. The rugged stainless steel construction offers protection to IP66 (NEMA 4X), with the transmitter electrical connections made via secure industrial type connector (M12 5 pin cable connector).

The AcuDew transmitter can withstand 35000kPa (350bar) maximum pressure and by employing low resistance cable, the transmitter can be located at significant distances, in excess of 1000 metres from the data collection point.

Designed with the operator in mind, for reliable and accurate measurements, the Model AcuDew is extremely easy to install and operate, requiring little or no maintenance.

1.2 Ranges

| | | |
|-------------|--|----------------------------------|
| ZD: | -100 °C to +20 °C (-148 °F to +68 °F) dewpoint | |
| HD: | -65 °C to +20 °C (-85 °F to +68 °F) dewpoint | |
| P (Purple): | -100 °C to 0 °C (-148 °F to +32 °F) dewpoint | 0 - 6,000 ppm(v) |
| S (Silver): | -100 °C to -20 °C (-148 °F to -4 °F) dewpoint | 0 - 1,000 ppm(v) |
| G (Grey): | -80 °C to 0 °C (-112 °F to +32 °F) dewpoint | 0 - 6,000 ppm(v) |
| R (Red): | -80 °C to -20 °C (-112 °F to +4 °F) dewpoint | 0 - 1,000 ppm(v) |
| B (Blue): | -80 °C to +20 °C (-112 °F to +68 °F) dewpoint | 0 - 23,000 ppm(v) |
| MP: | 0.1 to 100.0 ppm(v) | 0.1 ppm resolution |
| LP: | 0.01 to 10.00 ppm(v) | 0.01 ppm resolution |
| GH: | 0.01 to 10.00 g/m ³ | 0.01 g/m ³ resolution |
| LB: | 0.1 to 100.0 lb/MMSCF | 0.1 lb/MMSCF resolution |

2.0 Gas Compatibilities

The Model AcuDew sensing elements are Al_2O_3 and therefore 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. However, some gases must be avoided, as they are not compatible with the material used in the construction of the sensor. Ammonia (NH_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.

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

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

2.1 Installing the AcuDew in an Air/Gas Sampling System

The piping installation schematic diagram shows all components, which could be used in a gas measurement application. Not all items shown will be required for every installation.

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

The sensor is a variable capacitor, which is directly affected by changes in partial pressure of water vapour. These changes are proportional to the dewpoint/frost point temperature.

The measuring transmitter can be installed directly into the process line but this does create problems with access for maintenance and calibration. It is for these reasons that we recommend that the transmitter be installed in a bypass, fast loop or total loss sample system where the transmitter is accessible without interrupting the main process flow line.

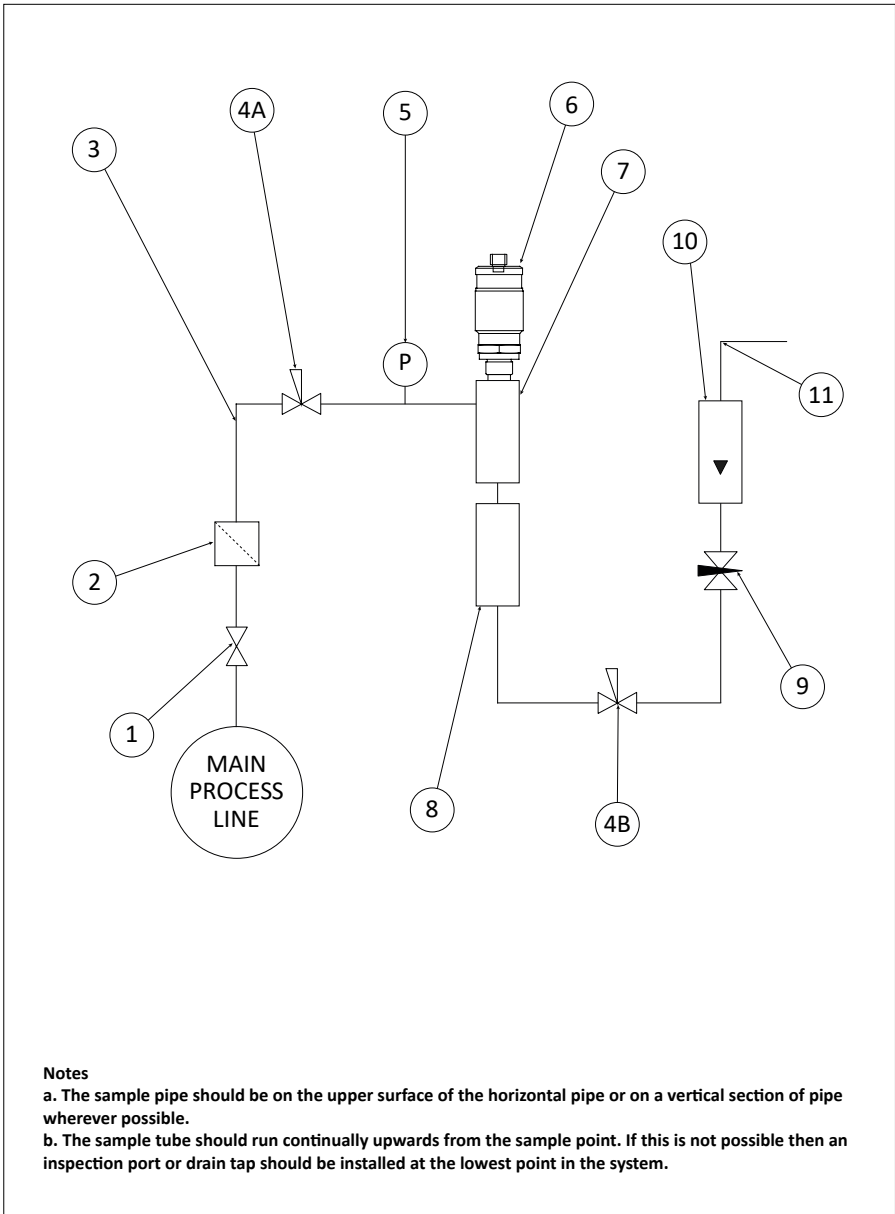
The AcuDew transmitter is suitable for use with:

- Model AcuTrak inline hygrometer
- Model AcuVu single channel dewpoint hygrometer
- Model AcuLoop, a self-contained, 4-20 mA loop powered plug in dewpoint display module
- SU4 sample system

The following accessories are also available for the AcuDew transmitter:

- Sensor Holder for installation of the AcuDew into a process line or sample system

2.2 Piping Installation Schematic



2.3 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 within 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** – If the sample is to be measured at atmospheric pressure then the valve 4A should be fitted and 4B omitted from the system. If the sample is to be measured, at full line pressure and the exhaust vented to atmosphere, then valve 4B should be fitted and 4A omitted from the system. If measurements are to be taken at full line pressure and the sample is to be returned to a part of the main line or a vent, which is at a pressure higher than atmospheric, and the input to that line needs a controlled pressure then both 4A and 4B will be required.
5. **Sample Pressure Gauge** – This is not a critical part of the moisture measurement but may be required if dew point/frost point measurements are to be made at higher than atmospheric pressure.
6. **Measuring Transmitter**, see "Appendix C – AcuDew with Connector, General Arrangement".
7. **Transmitter Holder**, see "Appendix E – Transmitter Holder General Arrangement".
8. **Desiccant Chamber** – This item is required when the sampling is to be intermittent. When installed, it prevents the ingress of wet air to the sample system while the sample is not flowing, improving the response time.
9. **Flow Control Valve** – This can be a separate item or combined with the flow indicator.
10. **Flow Indicator** – The recommended sample flow is 2-5 litres/min.
11. **Sample Exhaust** – The exhaust can be vented to atmosphere or returned to the process line as discussed above.

2.4 Installing and Commissioning

The AcuDew dewpoint transmitter can be installed in three general ways:

1. Directly in to the process line.
2. As part of a sample conditioning system using a Shaw Moisture Meters sensor holder.
3. Using the AcuLoop display module.

Before installing the dewpoint transmitter, it is advisable to carry out an initial purge routine of the sample loop in order to remove the possibility of sensor damage on start-up.

Refer to the sample system schematic in section 2.2. Open the inlet isolation valve slowly, until a small flow of air/gas at atmospheric pressure flows through the inlet pipe work to the transmitter holder and exhausts through the sensor entry port of the transmitter holder.

Allow this purge to continue for approximately 15-20 minutes to remove any residual moisture from the sample pipe work and components.

Close the inlet isolation valve and install the transmitter into the transmitter holder. Locate and secure the M12 5 pin cable connector positioned on the transmitter. Align the keyed groove in the connector with the keyed notch in the AcuDew. Push inwards and screw the locking ring clockwise in order to affect a weatherproof seal.

NOTE: The M12 connector is a single direction keyed groove.

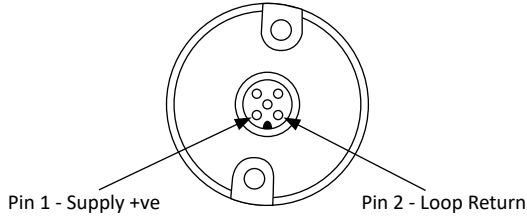
Slowly open the inlet valve again and by opening all valves after the transmitter holder, allow a low pressure purge through the whole sample system.

Set the required pressures and flows within the sample loop.

This completes the installation and commissioning but on initial start-up, it could take several hours for the system to reach equilibrium.

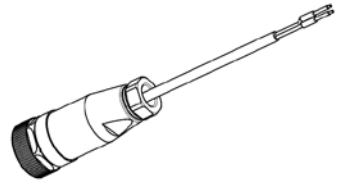
3.0 Connecting the AcuDew

Connector Pins



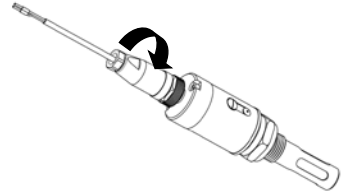
3.1 AcuDew 4 - 20 mA Cable Assembly

The cable assembly consists of a M12 5 pin cable connector used in conjunction with a 2 core 7/0.2 mm cable. Details of wiring can be found in Appendix D.



3.1.1 Connecting the AcuDew Cable

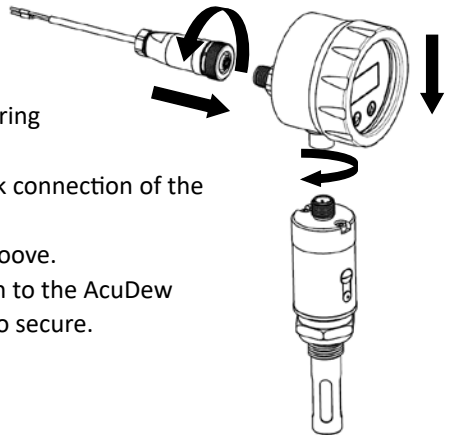
Align the keyed groove in the connector with the keyed notch in the AcuDew, push inwards and screw the locking ring clockwise finger tight.



3.1.2 Connecting the AcuLoop

To connect the AcuLoop display to the AcuDew:

1. Disconnect the connector from the AcuDew by turning the locking ring counter-clockwise.
2. Screw this connector on to the back connection of the AcuLoop display.
3. Align the keyed notch and keyed groove.
4. Gently push the AcuLoop display on to the AcuDew turning the locking ring clockwise to secure.



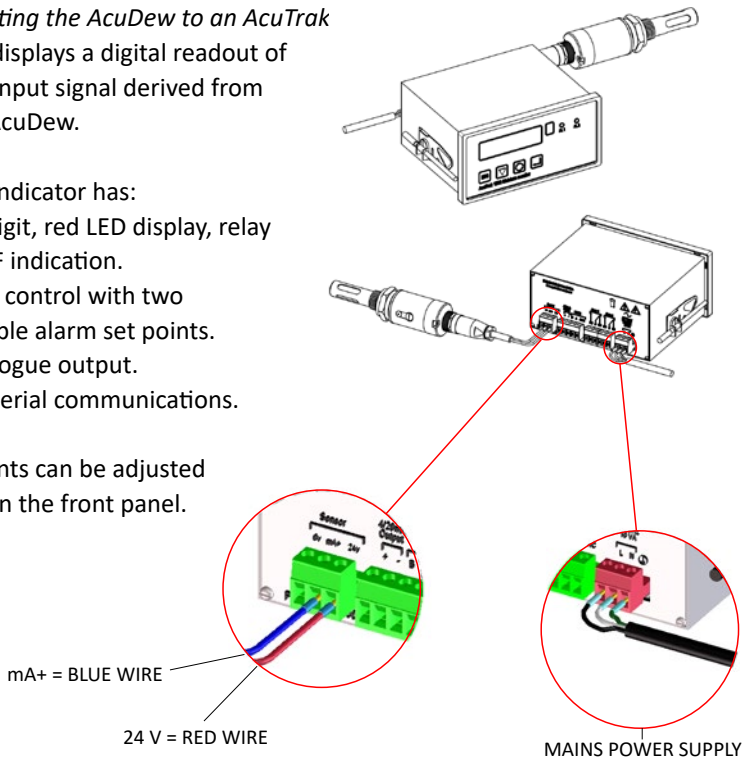
3.1.3 Connecting the AcuDew to an AcuTrak

The AcuTrak displays a digital readout of the 4-20 mA input signal derived from an attached AcuDew.

The AcuTrak indicator has:

- A five digit, red LED display, relay ON/OFF indication.
- Process control with two adjustable alarm set points.
- An analogue output.
- RS485 serial communications.

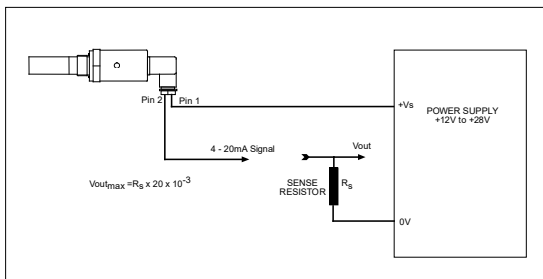
Alarm set points can be adjusted via the keys on the front panel.



3.2 Wiring the AcuDew

The AcuDew is a 2-wire, 4-20 mA transmitter. Typical electrical connection to generate a voltage output is shown below.

Note: the maximum value for R_s in this circuit can be calculated by the formula:



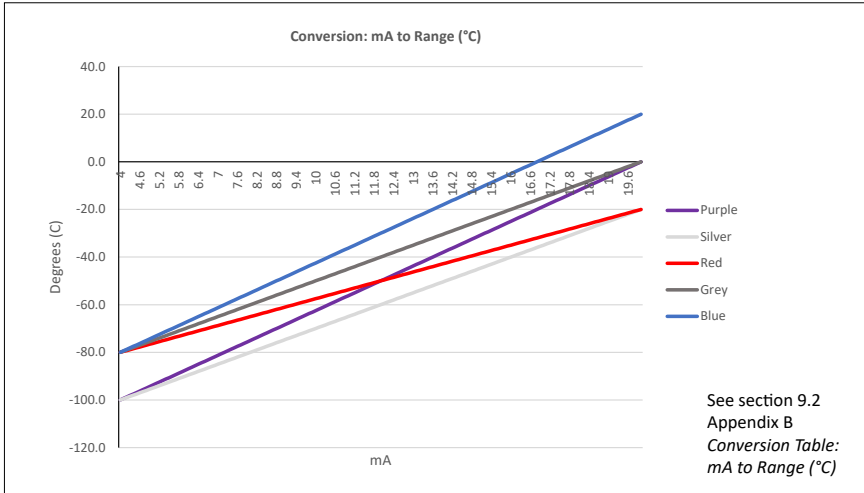
$$R_s \text{ max} = [40 \times (V_s - 7)] \Omega$$

If the wiring resistance is expected to be more than a few percent of the value of R_s , then this resistance must be taken away from the answer to get the maximum usable value of R_s .

4.0 Normal Operation

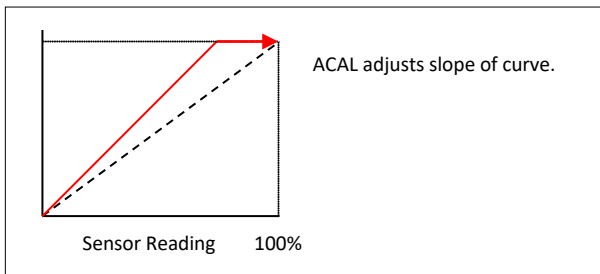
4.1 Analogue 4-20 mA Mode (2-wire)

In normal operation, the transmitter will produce a 4-20 mA signal, which is proportional to the level of moisture in the gas being monitored. The moisture reading is sampled and updated once per second. The AcuDew has 3,020 distinct steps over the 4-20 mA range corresponding to a resolution of 0.005 mA.



5.0 AutoCal

AutoCal allows the user to ensure accuracy to the laboratory calibration by checking the span of the transmitter and correcting for any deviation. It should be operated periodically, every two to three months or can be used to verify operation of the AcuDew transmitter if confirmation of an unexpected result is required.



Note:
The AcuDew must be connected to an indicator or a device that is able to supply an accurate measurement of the mA output.

5.1 Pre-conditioning the Transmitter

To perform AutoCal, the transmitter needs to be removed from the process gas at which point the display/indicator will read the ambient dewpoint or full scale (if the ambient dewpoint level is above the range of the AcuDew). Expose the transmitter to the known AutoCal moisture level and allow the transmitter to attain equilibrium.

(For technical questions and advice on the time taken to attain equilibrium contact your AcuDew supplier.)

Method 1: Expose to a known moisture level
(Applicable to all versions of AcuDew transmitters.)

If a known gas is available within the range of the transmitter, then the AcuDew can be autocaled against this value.

Method 2: Saturating method
(Only applicable to 0 °C (+32 °F) and -20 °C (-4 °F) top end range AcuDew transmitters.)

When the AcuDew sensing element is exposed to dewpoint levels above the top end range of the transmitter, the sensor will saturate and the transmitter can be autocaled to 0 °C or -20 °C. For both 0 °C and -20 °C transmitters, ambient dewpoint is usually adequate to saturate the sensor.

Method 3: Set against ambient moisture level
(Only applicable to +20 °C (+68 °F) top end range AcuDew transmitters.)

When the ambient dewpoint is known, then the AcuDew can be autocaled to the ambient value.

5.2 Adjusting the AutoCal

WARNING

Do NOT power down while the AutoCal is active as this can lead to corruption of the AcuDew's memory.

The AcuDew is supplied with an adjustable potentiometer to perform AutoCal, which allows the calibration span of the transmitter to be adjusted. This potentiometer is located under the weatherproof guard and can be accessed by undoing the large silver coloured screw on the side of the transmitter body. The AutoCal is adjusted by turning the potentiometer with the small screwdriver supplied.

Once the transmitter has been pre-conditioned the potentiometer can be adjusted. **ONLY ADJUST THE POTENTIOMETER IF THE SENSOR IS PROPERLY PRE-CONDITIONED. FAILURE TO COMPLY WILL CORRUPT THE TRANSMITTERS CALIBRATION.**

Note: The AcuDew must be connected to its normal indicator so that readings can be taken or where no indicator is employed, an accurate measurement of the mA output must be taken.

Use the potentiometer to move the reading up or down so that the desired dewpoint is displayed.

Method 1: Adjust the AcuDew reading until the indicator reads the known moisture level.

Method 2: Adjust the AcuDew reading until the indicator reads 0 °C or –20 °C whichever is applicable to the AcuDew being autocaled.

Method 3: Adjust the AcuDew reading until the indicator reads the known ambient moisture reading.

5.3 Completing the AutoCal

Once the desired value is reached and the AutoCal process complete, remove the screwdriver from the potentiometer and replace and fasten the weatherproof guard using the large silver coloured screw.

The AcuDew will now output the corrected dewpoint and can be reinserted into the process.

5.4 AcuDew Range AutoCal Method Lookup Table

Use the table below to decide which AutoCal methods are appropriate for your AcuDew transmitter.

| Range | | Methods Appropriate | |
|----------------------------|-----------------------------|---------------------|---|
| -80 °C to -20 °C | -112 °F to -4 °F | 1 & 2 | |
| -110 °C to -20 °C | -166 °F to -4 °F | 1 & 2 | |
| -120 °C to -20 °C | -184 °F to -4 °F | 1 & 2 | |
| -65 °C to 0 °C | -85 °F to +32 °F | 1 & 2 | |
| -80 °C to 0 °C | -112 °F to +32 °F | 1 & 2 | |
| -100 °C to 0 °C | -148 °F to +32 °F | 1 & 2 | |
| -65 °C to +20 °C | -85 °F to +68 °F | 1 & 3 | |
| -100 °C to +20 °C | -148 °F to +68 °F | 1 & 3 | |
| -120 °C to +20 °C | -184 °F to +68 °F | 1 & 3 | |
| 1 - 1000 ppm(v) | 0.1 - 100 ppm(v) | 0.01 - 10 ppm(v) | 1 |
| 1 - 1000 ppb(v) | | | 1 |
| 0.01 - 10 g/m ³ | 0.001 to 1 g/m ³ | | 1 |
| 0.1 - 10 lb/MMSCF | 0.1 - 25 lb/MMSCF | 0.1 - 50 lb/MMSCF | 1 |

5.5 Faults/Errors

- If the sensor is short-circuited, the transmitter will produce a constant 20.75 mA output.
- If the sensor is open-circuited, the transmitter will produce a constant 20.50 mA output.

5.6 Troubleshooting AutoCal

| FAULT | ACTION |
|---|---|
| AcuDew fails to perform an ambient AutoCal. It is possible that the potentiometer has entered into the dead band. | Power down the AcuDew, turn the potentiometer two turns clockwise. Then power up and perform AutoCal again. |
| The AcuDew cannot achieve the desired moisture level when performing a “known moisture level”. The dew/frost point required is outside the set AcuDew limits. | The AcuDew is no longer within calibration and should be returned to Shaw Moisture Meters for calibration. |

6.0 AcuDew Specification

| | |
|---|---|
| Sensing Element: | Shaw Ultra High Capacitance - Aluminium Oxide Sensor |
| Display: | Compatible with the 4-20 mA loop powered indicator |
| Ranges: | Dewpoint = 0.1 °C / 0.2 °F resolution |
| ZD: | -100 °C to +20 °C (-148 °F to +68 °F) dewpoint |
| HD: | -65 °C to +20 °C (-85 °F to +68 °F) dewpoint |
| P (Purple): | -100 to 0 °C (-148 to +32 °F) dewpoint 0 - 6,000 ppm(v) |
| S (Silver): | -100 to -20 °C (-148 to -4 °F) dewpoint 0 - 1,000 ppm(v) |
| G (Grey): | -80 to 0 °C (-112 to +32 °F) dewpoint 0 - 6,000 ppm(v) |
| R (Red): | -80 to -20 °C (-112 to -4 °F) dewpoint 0 - 1,000 ppm(v) |
| B (Blue): | -80 to +20 °C (-112 to +68 °F) dewpoint 0 - 23,000 ppm(v) |
| MP: | 0.1 to 100.0 ppm(v) 0.1 ppm resolution |
| LP: | 0.01 to 10.00 ppm(v) 0.01 ppm resolution |
| GH: | 0.01 to 10.00 g/m ³ 0.01 g/m ³ resolution |
| LB: | 0.1 to 100.0 lb/MMSCF 0.1 lb/MMSCF resolution |
| AutoCal: | Field calibration/span check facility. Activated and operated via the potentiometer on the transmitter body |
| Factory Calibration: | Supplied with Certificate of Calibration traceable to National Physical Laboratory (NPL) |
| Accuracy: | ± 2 °C (±3.6 °F) dewpoint NPL traceable -90 °C to +20 °C (-130 °F to +68 °F) |
| Temperature Coefficient: | Temperature compensated for operating range |
| Resolution: | 0.005 mA |
| Repeatability: | Better than ±0.3 °C (±0.54 °F) dewpoint |
| Operating Temperature: | -20 °C to +60 °C (-4 °F to +140 °F) |
| Storage Temperature: | -20 °C to +70 °C (-4 °F to +158 °F) |
| Response Times: | Wet to dry: -20 °C to -60 °C - less than 120 secs Dry to wet: -100 °C to -20 °C - less than 20 secs |
| Sample Flow Rate: | Flow independent but ideally 2 to 5 litres per minute. Max: 25 litres/min |
| Calibration Warranty: | 12 months from date of dispatch |
| Electromagnetic Compatibility (EMC): | Immunity: complies with EN 61326-1:2013 Emissions: complies with EN 61010-1:2010 |
| Warm Up Time: | 10 seconds |
| Fault Conditions: | Open circuit/under range: output drives to 20.5 mA Short circuit/over range: output drives to 20.75 mA |
| Isolation: | Sensing element connected to the 4-20 mA loop but isolated from transmitter body |
| Output Signal: | 4-20 mA Linear |
| Operating Voltage: | 7-28 V DC reverse polarity protected |
| Maximum Series Resistance: | = {40 x (Supply Voltage – 7)} Ω |
| Operating Pressure: | From 1kPa (0.01 barA) to maximum 35,000kPa (350 barA) |
| Operating Humidity (External): | Maximum - 95% RH non-condensing |
| Cable Terminations: | IP66/NEMA 4X rated, M12 five pin cable connector at the transmitter and the other end terminated with bootlace ferrules |
| Cable: | Supplied with 2m standard cable. Nominal diameter 3.4mm, 92 Ω/km at 20°C |
| Transmitter Enclosure: | 316 stainless steel body with five pin integrated cable plug |
| Sensor Protection: | 316 sintered stainless steel filter - 50 micron |
| Probe Material (Wetted Parts): | 316 stainless steel |
| Weatherproof Classification: | IP66 (NEMA 4X) when connector mated to transmitter |
| Mechanical Connection: | ¾" UNF (16tpi) with integral Viton "O" ring seal |
| Mechanical Warranty: | 24 months in case of faulty workmanship and defective parts |
| Weight: | 215 grams (0.474 lb) includes connector |

7.0 Guarantee

All Shaw Moisture Meters 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.

8.0 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 dew point 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.

9.0 Appendix

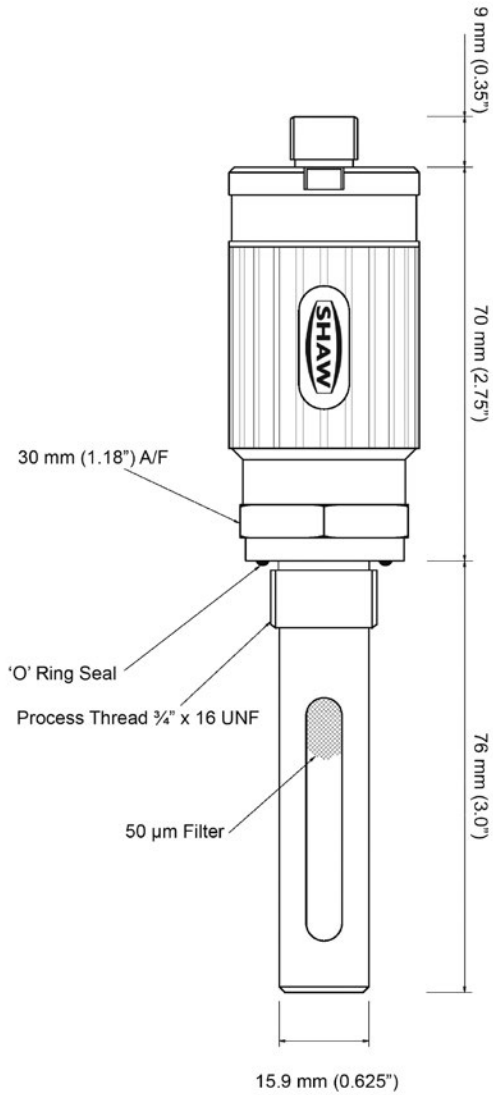
9.1 Appendix A - Hygrometric Equivalents

| 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 |

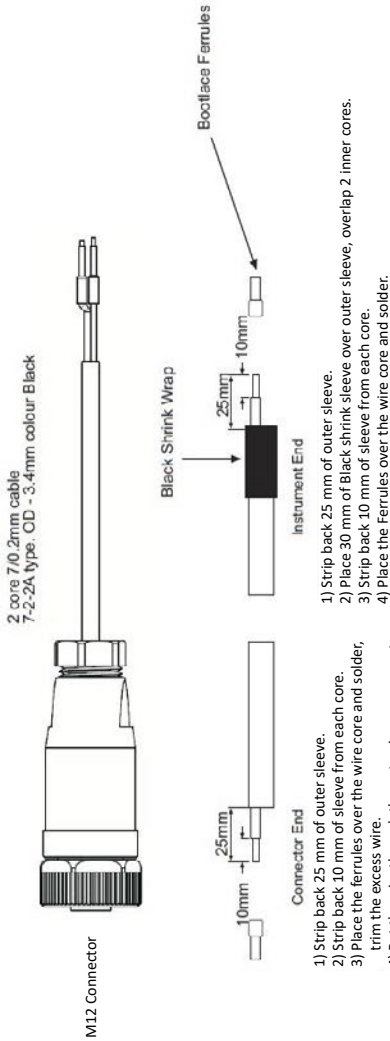
9.2 Appendix B - Conversion Table: mA to Range (°C)

| mA | Purple | Silver | Red | Grey | Blue | mA | Purple | Silver | Red | Grey | Blue | mA | Purple | Silver | Red | Grey | Blue |
|-----|--------------|----------------|---------------|-------------|--------------|------|--------------|----------------|---------------|-------------|--------------|------|--------------|----------------|---------------|-------------|--------------|
| | -100 to 0 °C | -100 to -20 °C | -80 to -20 °C | -80 to 0 °C | -80 to 20 °C | | -100 to 0 °C | -100 to -20 °C | -80 to -20 °C | -80 to 0 °C | -80 to 20 °C | | -100 to 0 °C | -100 to -20 °C | -80 to -20 °C | -80 to 0 °C | -80 to 20 °C |
| 4 | -100.0 | -100.0 | -80.0 | -80.0 | -80.0 | 9.4 | -66.2 | -73.0 | -59.7 | -53.0 | -46.2 | 14.8 | -32.5 | -46.0 | -39.5 | -26.0 | -12.5 |
| 4.1 | -99.4 | -99.5 | -79.6 | -79.5 | -79.4 | 9.5 | -65.6 | -72.5 | -59.4 | -52.5 | -45.6 | 14.9 | -31.9 | -45.5 | -39.1 | -25.5 | -11.9 |
| 4.2 | -98.8 | -99.0 | -79.3 | -79.0 | -78.8 | 9.6 | -65.0 | -72.0 | -59.0 | -52.0 | -45.0 | 15 | -31.2 | -45.0 | -38.7 | -25.0 | -11.2 |
| 4.3 | -98.1 | -98.5 | -78.9 | -78.5 | -78.1 | 9.7 | -64.4 | -71.5 | -58.6 | -51.5 | -44.4 | 15.1 | -30.6 | -44.5 | -38.4 | -24.5 | -10.6 |
| 4.4 | -97.5 | -98.0 | -78.5 | -78.0 | -77.5 | 9.8 | -63.7 | -71.0 | -58.2 | -51.0 | -43.7 | 15.2 | -30.0 | -44.0 | -38.0 | -24.0 | -10.0 |
| 4.5 | -96.9 | -97.5 | -78.1 | -77.5 | -76.9 | 9.9 | -63.1 | -70.5 | -57.9 | -50.5 | -43.1 | 15.3 | -29.4 | -43.5 | -37.6 | -23.5 | -9.4 |
| 4.6 | -96.3 | -97.0 | -77.8 | -77.0 | -76.3 | 10 | -62.5 | -70.0 | -57.5 | -50.0 | -42.5 | 15.4 | -28.7 | -43.0 | -37.2 | -23.0 | -8.7 |
| 4.7 | -95.6 | -96.5 | -77.4 | -76.5 | -75.6 | 10.1 | -61.9 | -69.5 | -57.1 | -49.5 | -41.9 | 15.5 | -28.1 | -42.5 | -36.9 | -22.5 | -8.1 |
| 4.8 | -95.0 | -96.0 | -77.0 | -76.0 | -75.0 | 10.2 | -61.3 | -69.0 | -56.8 | -49.0 | -41.3 | 15.6 | -27.5 | -42.0 | -36.5 | -22.0 | -7.5 |
| 4.9 | -94.4 | -95.5 | -76.6 | -75.5 | -74.4 | 10.3 | -60.6 | -68.5 | -56.4 | -48.5 | -40.6 | 15.7 | -26.9 | -41.5 | -36.1 | -21.5 | -6.9 |
| 5 | -93.8 | -95.0 | -76.3 | -75.0 | -73.8 | 10.4 | -60.0 | -68.0 | -56.0 | -48.0 | -40.0 | 15.8 | -26.2 | -41.0 | -35.7 | -21.0 | -6.2 |
| 5.1 | -93.1 | -94.5 | -75.9 | -74.5 | -73.1 | 10.5 | -59.4 | -67.5 | -55.6 | -47.5 | -39.4 | 15.9 | -25.6 | -40.5 | -35.4 | -20.5 | -5.6 |
| 5.2 | -92.5 | -94.0 | -75.5 | -74.0 | -72.5 | 10.6 | -58.8 | -67.0 | -55.3 | -47.0 | -38.8 | 16 | -25.0 | -40.0 | -35.0 | -20.0 | -5.0 |
| 5.3 | -91.9 | -93.5 | -75.1 | -73.5 | -71.9 | 10.7 | -58.1 | -66.5 | -54.9 | -46.5 | -38.1 | 16.1 | -24.4 | -39.5 | -34.6 | -19.5 | -4.4 |
| 5.4 | -91.2 | -93.0 | -74.8 | -73.0 | -71.2 | 10.8 | -57.5 | -66.0 | -54.5 | -46.0 | -37.5 | 16.2 | -23.7 | -39.0 | -34.2 | -19.0 | -3.7 |
| 5.5 | -90.6 | -92.5 | -74.4 | -72.5 | -70.6 | 10.9 | -56.9 | -65.5 | -54.1 | -45.5 | -36.9 | 16.3 | -23.1 | -38.5 | -33.9 | -18.5 | -3.1 |
| 5.6 | -90.0 | -92.0 | -74.0 | -72.0 | -70.0 | 11 | -56.3 | -65.0 | -53.8 | -45.0 | -36.3 | 16.4 | -22.5 | -38.0 | -33.5 | -18.0 | -2.5 |
| 5.7 | -89.4 | -91.5 | -73.6 | -71.5 | -69.4 | 11.1 | -55.6 | -64.5 | -53.4 | -44.5 | -35.6 | 16.5 | -21.9 | -37.5 | -33.1 | -17.5 | -1.9 |
| 5.8 | -88.7 | -91.0 | -73.3 | -71.0 | -68.7 | 11.2 | -55.0 | -64.0 | -53.0 | -44.0 | -35.0 | 16.6 | -21.2 | -37.0 | -32.7 | -17.0 | -1.2 |
| 5.9 | -88.1 | -90.5 | -72.9 | -70.5 | -68.1 | 11.3 | -54.4 | -63.5 | -52.6 | -43.5 | -34.4 | 16.7 | -20.6 | -36.5 | -32.4 | -16.5 | -0.6 |
| 6 | -87.5 | -90.0 | -72.5 | -70.0 | -67.5 | 11.4 | -53.8 | -63.0 | -52.3 | -43.0 | -33.8 | 16.8 | -20.0 | -36.0 | -32.0 | -16.0 | 0.0 |
| 6.1 | -86.9 | -89.5 | -72.1 | -69.5 | -66.9 | 11.5 | -53.1 | -62.5 | -51.9 | -42.5 | -33.1 | 16.9 | -19.4 | -35.5 | -31.6 | -15.5 | 0.6 |
| 6.2 | -86.2 | -89.0 | -71.8 | -69.0 | -66.2 | 11.6 | -52.5 | -62.0 | -51.5 | -42.0 | -32.5 | 17 | -18.7 | -35.0 | -31.2 | -15.0 | 1.3 |
| 6.3 | -85.6 | -88.5 | -71.4 | -68.5 | -65.6 | 11.7 | -51.9 | -61.5 | -51.1 | -41.5 | -31.9 | 17.1 | -18.1 | -34.5 | -30.9 | -14.5 | 1.9 |
| 6.4 | -85.0 | -88.0 | -71.0 | -68.0 | -65.0 | 11.8 | -51.3 | -61.0 | -50.8 | -41.0 | -31.3 | 17.2 | -17.5 | -34.0 | -30.5 | -14.0 | 2.5 |
| 6.5 | -84.4 | -87.5 | -70.6 | -67.5 | -64.4 | 11.9 | -50.6 | -60.5 | -50.4 | -40.5 | -30.6 | 17.3 | -16.9 | -33.5 | -30.1 | -13.5 | 3.1 |
| 6.6 | -83.7 | -87.0 | -70.3 | -67.0 | -63.7 | 12 | -50.0 | -60.0 | -50.0 | -40.0 | -30.0 | 17.4 | -16.2 | -33.0 | -29.7 | -13.0 | 3.8 |
| 6.7 | -83.1 | -86.5 | -69.9 | -66.5 | -63.1 | 12.1 | -49.4 | -59.5 | -49.6 | -39.5 | -29.4 | 17.5 | -15.6 | -32.5 | -29.4 | -12.5 | 4.4 |
| 6.8 | -82.5 | -86.0 | -69.5 | -66.0 | -62.5 | 12.2 | -48.8 | -59.0 | -49.3 | -39.0 | -28.8 | 17.6 | -15.0 | -32.0 | -29.0 | -12.0 | 5.0 |
| 6.9 | -81.9 | -85.5 | -69.1 | -65.5 | -61.9 | 12.3 | -48.1 | -58.5 | -48.9 | -38.5 | -28.1 | 17.7 | -14.4 | -31.5 | -28.6 | -11.5 | 5.6 |
| 7 | -81.2 | -85.0 | -68.8 | -65.0 | -61.2 | 12.4 | -47.5 | -58.0 | -48.5 | -38.0 | -27.5 | 17.8 | -13.7 | -31.0 | -28.2 | -11.0 | 6.3 |
| 7.1 | -80.6 | -84.5 | -68.4 | -64.5 | -60.6 | 12.5 | -46.9 | -57.5 | -48.1 | -37.5 | -26.9 | 17.9 | -13.1 | -30.5 | -27.9 | -10.5 | 6.9 |
| 7.2 | -80.0 | -84.0 | -68.0 | -64.0 | -60.0 | 12.6 | -46.3 | -57.0 | -47.8 | -37.0 | -26.3 | 18 | -12.5 | -30.0 | -27.5 | -10.0 | 7.5 |
| 7.3 | -79.4 | -83.5 | -67.6 | -63.5 | -59.4 | 12.7 | -45.6 | -56.5 | -47.4 | -36.5 | -25.6 | 18.1 | -11.9 | -29.5 | -27.1 | -9.5 | 8.1 |
| 7.4 | -78.7 | -83.0 | -67.2 | -63.0 | -58.7 | 12.8 | -45.0 | -56.0 | -47.0 | -36.0 | -25.0 | 18.2 | -11.2 | -29.0 | -26.7 | -9.0 | 8.8 |
| 7.5 | -78.1 | -82.5 | -66.9 | -62.5 | -58.1 | 12.9 | -44.4 | -55.5 | -46.6 | -35.5 | -24.4 | 18.3 | -10.6 | -28.5 | -26.4 | -8.5 | 9.4 |
| 7.6 | -77.5 | -82.0 | -66.5 | -62.0 | -57.5 | 13 | -43.8 | -55.0 | -46.3 | -35.0 | -23.8 | 18.4 | -10.0 | -28.0 | -26.0 | -8.0 | 10.0 |
| 7.7 | -76.9 | -81.5 | -66.1 | -61.5 | -56.9 | 13.1 | -43.1 | -54.5 | -45.9 | -34.5 | -23.1 | 18.5 | -9.4 | -27.5 | -25.6 | -7.5 | 10.6 |
| 7.8 | -76.2 | -81.0 | -65.7 | -61.0 | -56.2 | 13.2 | -42.5 | -54.0 | -45.5 | -34.0 | -22.5 | 18.6 | -8.7 | -27.0 | -25.2 | -7.0 | 11.3 |
| 7.9 | -75.6 | -80.5 | -65.4 | -60.5 | -55.6 | 13.3 | -41.9 | -53.5 | -45.1 | -33.5 | -21.9 | 18.7 | -8.1 | -26.5 | -24.9 | -6.5 | 11.9 |
| 8 | -75.0 | -80.0 | -65.0 | -60.0 | -55.0 | 13.4 | -41.3 | -53.0 | -44.8 | -33.0 | -21.3 | 18.8 | -7.5 | -26.0 | -24.5 | -6.0 | 12.5 |
| 8.1 | -74.4 | -79.5 | -64.6 | -59.5 | -54.4 | 13.5 | -40.6 | -52.5 | -44.4 | -32.5 | -20.6 | 18.9 | -6.9 | -25.5 | -24.1 | -5.5 | 13.1 |
| 8.2 | -73.7 | -79.0 | -64.2 | -59.0 | -53.7 | 13.6 | -40.0 | -52.0 | -44.0 | -32.0 | -20.0 | 19 | -6.2 | -25.0 | -23.7 | -5.0 | 13.8 |
| 8.3 | -73.1 | -78.5 | -63.9 | -58.5 | -53.1 | 13.7 | -39.4 | -51.5 | -43.6 | -31.5 | -19.4 | 19.1 | -5.6 | -24.5 | -23.4 | -4.5 | 14.4 |
| 8.4 | -72.5 | -78.0 | -63.5 | -58.0 | -52.5 | 13.8 | -38.7 | -51.0 | -43.2 | -31.0 | -18.7 | 19.2 | -5.0 | -24.0 | -23.0 | -4.0 | 15.0 |
| 8.5 | -71.9 | -77.5 | -63.1 | -57.5 | -51.9 | 13.9 | -38.1 | -50.5 | -42.9 | -30.5 | -18.1 | 19.3 | -4.4 | -23.5 | -22.6 | -3.5 | 15.6 |
| 8.6 | -71.2 | -77.0 | -62.7 | -57.0 | -51.2 | 14 | -37.5 | -50.0 | -42.5 | -30.0 | -17.5 | 19.4 | -3.7 | -23.0 | -22.2 | -3.0 | 16.3 |
| 8.7 | -70.6 | -76.5 | -62.4 | -56.5 | -50.6 | 14.1 | -36.9 | -49.5 | -42.1 | -29.5 | -16.9 | 19.5 | -3.1 | -22.5 | -21.9 | -2.5 | 16.9 |
| 8.8 | -70.0 | -76.0 | -62.0 | -56.0 | -50.0 | 14.2 | -36.3 | -49.0 | -41.8 | -29.0 | -16.3 | 19.6 | -2.5 | -22.0 | -21.5 | -2.0 | 17.5 |
| 8.9 | -69.4 | -75.5 | -61.6 | -55.5 | -49.4 | 14.3 | -35.6 | -48.5 | -41.4 | -28.5 | -15.6 | 19.7 | -1.9 | -21.5 | -21.1 | -1.5 | 18.1 |
| 9 | -68.7 | -75.0 | -61.2 | -55.0 | -48.7 | 14.4 | -35.0 | -48.0 | -41.0 | -28.0 | -15.0 | 19.8 | -1.2 | -21.0 | -20.7 | -1.0 | 18.8 |
| 9.1 | -68.1 | -74.5 | -60.9 | -54.5 | -48.1 | 14.5 | -34.4 | -47.5 | -40.6 | -27.5 | -14.4 | 19.9 | -0.6 | -20.5 | -20.4 | -0.5 | 19.4 |
| 9.2 | -67.5 | -74.0 | -60.5 | -54.0 | -47.5 | 14.6 | -33.7 | -47.0 | -40.2 | -27.0 | -13.7 | 20 | 0.0 | -20.0 | -20.0 | 0.0 | 20.0 |
| 9.3 | -66.9 | -73.5 | -60.1 | -53.5 | -46.9 | 14.7 | -33.1 | -46.5 | -39.9 | -26.5 | -13.1 | | | | | | |

9.3 Appendix C - AcuDew with Connector, General Arrangement

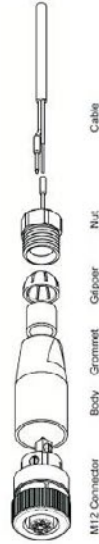


9.4 Appendix D - AcuDew Cable Assembly



- 1) Strip back 25 mm of outer sleeve.
- 2) Place 30 mm of Black shrink sleeve over outer sleeve, overlap 2 inner cores.
- 3) Strip back 10 mm of sleeve from each core.
- 4) Place the Ferrules over the wire core and solder.

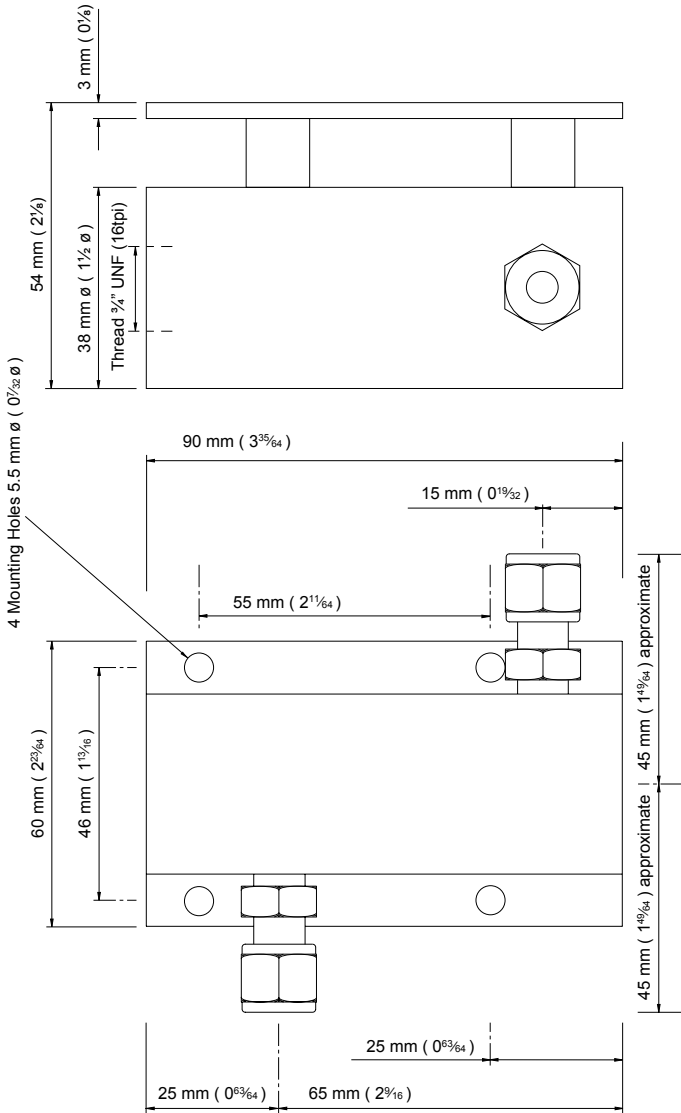
- 1) Strip back 25 mm of outer sleeve.
- 2) Strip back 10 mm of sleeve from each core.
- 3) Place the ferrules over the wire core and solder, trim the excess wire.
- 4) Put the wire through the nut, gripper, grommet and into the body of the connector.
- 5) Locate Ferrules in contacts and tighten screws as per table below.



| Connector Pin | Wire | Signal |
|---------------|------|--------|
| 1 | Red | +ve |
| 2 | Blue | 4-20mA |
| 3 | N/C | |
| 4 | N/C | |



9.5 Appendix E - Transmitter Holder General Arrangement



NOTE: The assembly is shown with 6.35 mm (1/4 inch) OD tube fittings. The dimension across the tube fittings will vary for all other size fittings.

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