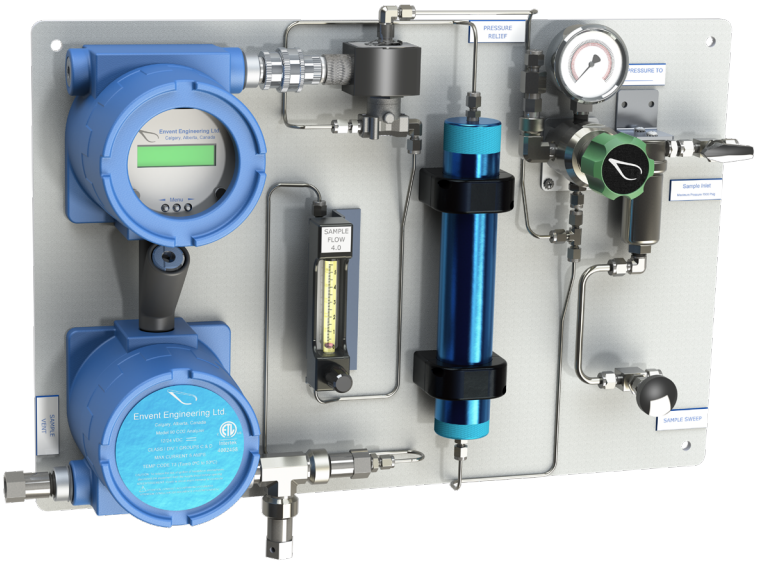
Moisture Monitor

Models: M70-XP

User's Manual



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Envent
Knowledge by Analysis

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B.1. About this Manual

All gases have a given temperature dependent capacity to absorb water vapor. Relative humidity is a measure of percentage of saturation capacity or dew point at a given temperature and pressure. The Envent Engineering Ltd. M70XP Moisture Monitor measures the concentrations of moisture (H_2O) in natural gas in lbs/mmscf or in ppmv. This manual contains a comprehensive overview of Envent Engineering's M70XP Moisture Monitor and step-by-step instructions on:

- Installation and Startup
- Operation
- Maintenance
- Troubleshooting

This manual should be read and referenced by the person who will install, operate, or have contact with the M70XP. Take time to familiarize yourself with the content of this Operator's Manual, reading each section carefully so you can quickly and easily install and operate the analyzer.

The manual includes images, tables, and charts that provide a visual understanding of the analyzer and its functions. Take note of all the caution symbols and notes, as they will alert you of potential hazards and important information.

B.2. Warnings and Cautions

CAUTION: M70: Do not exceed 25 psig in sample system.
M70 with Auto-zero: Do not exceed 100 psig in sample system.
Damage to sample system may result.

CAUTION: Seals Not Poured. Pour seals before energizing the circuit (see APPENDIX C).

CAUTION: Disassembly of the pressure regulator and solenoids in the field is not advised. Consult the factory if the regulator or solenoid appears contaminated.

CAUTION: Before resuming line pressure be sure that all port connections, sample sweep, and sample system are securely installed.

CAUTION: All connections must be LEAKTIGHT to ensure the effectiveness of the analyzer as well as SAFETY. The user, through his own analysis and testing, is solely responsible for the product selection and ensuring all responsibility, safety and warning requirements of the application are met. If the equipment is used in a manner not specified by Envent Engineering Ltd., the protection provided by the equipment may be impaired.

CAUTION: Electrical certification for hazardous locations requires that the sensor and flame arrestor threads be coated with liquid thread sealant (Swagelok Swak or equivalent). Use of Teflon tape will invalidate the certification.

CAUTION: Do not use solvents, brake cleaner, soaps or detergents.

CAUTION: Disassembly of the pressure regulator and solenoids in the field is not advised. Consult the factory if the regulator or solenoid appears contaminated.

CAUTION: The analyzer should be mounted in an enclosed area in which it is not exposed to vibration and excessive pressure, temperature and environmental variations. The M70XP is designed for Class 1 Div 1 areas. Ensure that the housing received is suitable for area classification.

CAUTION: Turn off power before servicing. Ensure breakers are off before connecting or disconnecting supply power.

CAUTION: This unit requires a disconnect device rated 24 VDC and 5 Amax, must be protected by a circuit breaker rated 24 VDC and 5 Amax, and is to be installed in accordance with local electrical codes.

CAUTION: This unit requires a disconnect device rated 240 VAC and 5 Amax, must be protected by a circuit breaker rated 240 VAC and 5 Amax, and is to be installed in accordance with local electrical codes.

C. M70XP Moisture Monitor Overview

C.1. Principle of Operation

The relative humidity sensor used in the M70XP is a temperature regulated thermo-set polymer-based capacitive sensor (Figure C-1). This sensor directly detects changes in relative saturation as a change in sensor capacitance. The sensor temperature is controlled normally to 60°C and run at ambient pressure. The constant temperature and pressure removes all calculations except for zero and span voltage produced by the sensor.

Figure C-1: Polypropylene moisture sensor

C.2. Conductive Polymer Sensor Theory

A capacitor is basically a component in an electrical circuit that stores energy as a build up of electrical charge. Physically, it consists of two conductive plates, separated by insulation called dielectric material. This material can be air, polyester, polypropylene, or a variety of other substances. The 'capacitance', or ability to store electrical charge, is dependent on the distance between the plates, the size of the plates, and the material dielectric constant.

This relationship appears as follows:

$$C = \frac{eA}{d}$$

Where: C = capacitance (Farads)
e = dielectric constant (Farads/meter)
A = area of the conductive plates (m^2)
d = distance between the plates (m)

The dielectric constant is uniquely dependent on molecular characteristics. The area and distance will not change for a given capacitor. The dielectric constant, however, can change under the right circumstances. The dielectric material is sensitive to humidity, in that its dielectric constant varies predictably with humidity. This, in turn, causes the capacitance of the sensor to change, providing a relative humidity response.

The measuring capacitor is placed in an electrical circuit, which varies voltage and/or current output proportionally to the measuring capacitance.

A percentage change in output voltage from supply voltage is equal to a percentage change in humidity level in the dielectric. The circuitry, with a 5 V source, produces an output voltage of 0.8 V at 0% humidity, and 3.9 V at 100% humidity (at 25ºC / 77ºF).
Mathematically, this appears as follows:

$$RH = \frac{V_{out} - V_{\min}}{V_{\max} - V_{\min}} \times 100$$
$$RH = \frac{V_{out} - 0.8}{3.9 - 0.8} \times 100$$

Where: RH = Relative Humidity (%)
V = Voltage

For example, if the output voltage from the moisture analyzer were 2.6V (at 25ºC/77ºF), the relative humidity would be:

$$RH = \frac{2.6 - 0.8}{3.9 - 0.8} \times 100$$
$$RH = 58.06$$

Material dielectric constant is temperature dependent, so temperature must be measured and a correction bias applied.

C.2.1. Moisture Sensor Construction

The sensor is constructed from a three-layer capacitor with a thermoset polymer dielectric (see Figure C-2). A thermoset polymer is a plastic that has been irreversibly solidified through heat application, and in this case, is moisture-sensitive. Two platinum plates act as the conducting sheets. The upper platinum plate is porous; so as to allow moisture to penetrate the sensor, but still act as a capacitor plate. There is a second thermoset polymer layer on top of the capacitor that acts as a protective layer, preventing contaminants from reaching the sensor, while still allowing moisture to reach the dielectric.

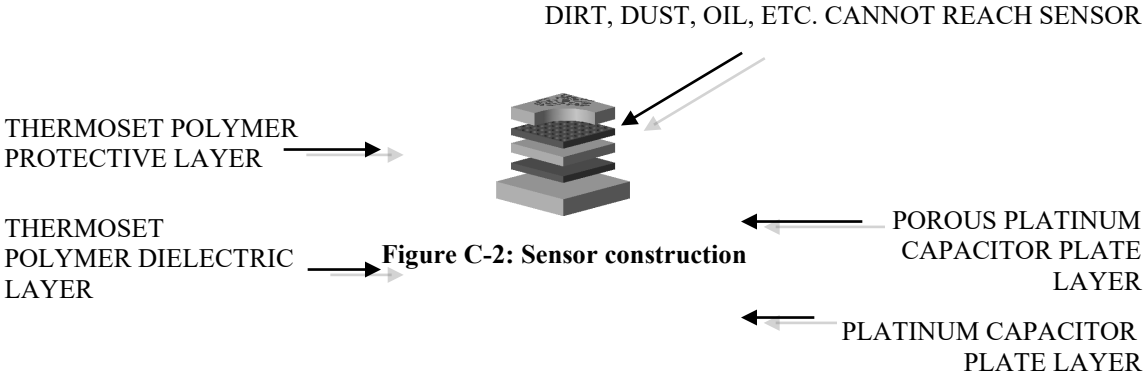


Figure C-2: Sensor construction

C.2.2. Pressure Input

Process pressure is required to calculate moisture concentration or dew-point temperature. Pressure can either be input as a fixed value or read dynamically from a transmitter.

C.2.3. Moisture Calculations

Relationships between dew point and concentration at various temperatures and pressure are calculated from empirical data.

C.2.4. Relative Humidity Correction for Temperature

The conductive polymer sensor has a temperature dependence, as can be seen in Figure C-3. Corrected relative humidity can be calculated as follows:

$$RH_{corr} = RC_{un-corr}(1.0546 - 0.00216 \times T)$$

Where: RH_{corr} = corrected relative humidity value
$RH_{un-corr}$= uncorrected relative humidity value
T = current ambient temperature (ºC)

C.2.5. Saturation Vapor Pressure

The saturation vapor pressure of water in a gas is dependent only on temperature. A model developed by Sonntag similar to the more established Magnus formula provides an accepted fit of experimental results:

$$\ln(P_{satw}) = -6096.9385 \times T_K^{-1} + 21.2409642 - 0.02711193 \times T_K + 0.0001673952 \times T_K^2 + 2.433502 \times \ln(T_K)$$

$$P_{satw} = e^{\ln(P_{satw})}$$

Where: P_{satw} = Saturation vapor pressure of water (Pa)
T_K = Temperature (K)

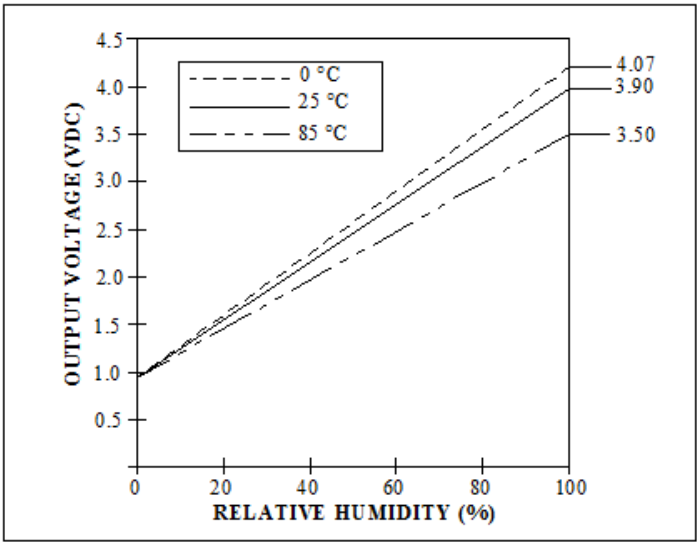


Figure C-3: Output voltage vs. relative humidity at different temperatures

C.2.6. Partial Pressure (of H_2O Vapor)

Multiplying the saturation vapor pressure by the relative humidity from the conductive polymer sensor will yield a value for the partial pressure of the water vapor.

$$p_w = P_{satw} \times RH$$

Where: p_w = Partial pressure of water vapor (Pa)
Psatw = Saturation vapor pressure of water (Pa)
RH = Relative humidity (unitless)

C.2.7. Molar Fraction

From the partial pressure, the molar fraction of water can be calculated:

$$x_w = \frac{p_w}{P_{gas}}$$

Where: x_w = Molar fraction of water (unitless)
p_w = Partial pressure of water vapor (Pa)
P_{gas} = Total pressure of gas (Pa)

C.2.8. PPMV (Parts Per Million by Volume)

Once the molar fraction is determined, the remaining calculations can be made. The parts per million by volume (relative to total dry gas) is:

$$ppmv = 1 \times 10^6 \times \left(\frac{x_w}{1 - x_w} \right)$$

Where: ppmv = Parts per million by volume
x_w = Molar fraction of water (unitless)

C.2.9. Dew Point

Empirical tables are available that chart the dew point for natural gas as process pressure and lb/mmscf varies. There are no precise theoretical formulae to calculate this, so the empirical data must be referred to. An example of a dew point table that is used can be found in ASTM Standard D 1142 -95. The process pressure runs along the top row, while the tabulated values are lb/mmscf. The corresponding dew point value can be found in the left hand column of the table. Data from these tables are input to a spreadsheet program (Microsoft Excel), and curve-fit for each process pressure range. The curve-fitting program came up with an equation of the form:

$$y = a + b \times \log(x) + c \times \log(x)^2$$

Where: y = dew point (ºC)
x = pounds of water per million standard cubic feet (lb/mmscf)
a,b,c = coefficients (unitless)

The coefficients are different for each process pressure range, and are determined via the program. For dew point values that fall between the table pressures, interpolation is used. All of this data is integrated into the analyzer.

Table 1: Comparison of thermoset polymer vs. bulk aluminum oxide

Active material	Thermoset polymer	Bulk aluminum oxide
Substrate	Ceramic silicon	n/a
Changing parameter	Capacitance	Resistance
Measured parameter	% RH	% RH
RH range	0% to 100%	2% to 90%
RH accuracy	± 1% to ± 5%	± 1% to ± 5%
Interchange ability	± 2% to ±10%	Poor
Linearity	± 1% RH	Poor
Rise time	15 seconds to 60 seconds	3 min to 5 min
Temperature range	-40°C to 65°C	-10°C to 75°C
Temperature effect	-0.0022% RH/%/RH/°C	>1% RH/°C
Long term stability	± 1% RH/5 yr	± 3% RH/yr
Contamination resistance	Excellent	Fair
Condensation resistance	Excellent	Fair

C.2.10. Definitions

Vapor pressure (of water): In a mixture of gases, it is the portion of the total pressure that is contributed by water vapor.

Saturation vapor pressure: The maximum pressure of water vapor that can exist at a given temperature, before 100% relative humidity is reached.

Relative humidity: The ratio of the actual vapor pressure to the saturation vapor pressure, expressed as a percentage (%). If the relative humidity is 0% in a given gas sample, the gas is completely dry. If the relative humidity is 100%, the gas is completely saturated and the water vapor condenses.

Dew point: The temperature at which condensation forms when cooling a gas at constant pressure. At this point, water vapor begins to condense into liquid water.

Partial pressure (of water vapor): The part of the overall pressure exerted by the water vapor component in a gas.

Mole: The amount of substance that contains as many elementary entities as there are atoms in 12 grams of carbon -12 (6.022×10^{23} mol^{-1}).

Molar fraction (of water): The ratio of the amount of water to the total amount of gas present.

C.2.11. Constants

The Following conversion factors are often used in different types of moisture calculations:

Ideal gas constant, as used in the Ideal Gas Law:

R = 0.08206 L·atm/mol·K
= 8.3145 kPa·dm3/mol·K
= 0.0426 psia·ft3/mol·K
= 1206 psia·cm3/mol·K
= 0.001206 psia·m3/mol·K

Molar mass of water = 18.01 g/mol
= 0.0397 lb/mol

Table 2: Common conversion factors in moisture measurement

	To convert from	To	Perform this operation
Mass H_20 / Vol.Gas	mg/m^3	lb/mmscf	Multiply by 0.0624269
	mg/m^3	grain/mcf	Divide by 2.288
	lb/mmscf	grain/mcf	Multiply by 7
	lb/mmscf	ppmv water	Multiply by 21.055

D. Technical Specifications

Performance

Moisture Concentration (H_2O)	0 – 20 lbs/mmscf Standard [a]
Accuracy (H_2O)	± 2% of reading or ± 10 ppm (0.5 lbs/mmscf), whichever is greater
Response Time	20 seconds to 90% of step change wetting 300 seconds to 90% dry down
ASTM Standard method	D5454-11 e1

Application Data

Environmental Temperature Range	0-50°C [a]
Sample Inlet Pressure	15 - 80 psig [a] (Standard Sample System) 60 – 90 psig [a] (Auto-Zero Sample System)
Sample Flow Rate	100 – 500 cc/min [a]
Contaminant Sensitivity	Resistant to Mercaptans, Methanol, Glycol, Amines

Electrical & Communications

Input Voltages	12-24 VDC @ 5 Watts Standard 100-240 VAC, 50/60 Hz @ 5 Watts Optional [f]
Outputs	4-20 mA loop (concentration only) Serial RS-232 (all parameters) [a] Dual 3 A solid state alarm relays [b] Modbus (optional) [a]
Data Logging	6500 data points recorded every 10 minutes Standard [d] [e]
LCD Display	Dual-line, 16 character display Line 1: Moisture in ppmv or lbs/mmscf Line 2: Alarm state, Heater duty, Offset, Sensor gain factor, Raw mV, Alarm set point(s), Temperature °C (°F optional), Temperature set point, Calibration gas set point [c], Initiate manual calibration [c]
Maximum wattage at Start Up (Surge Watts)	12 VDC Powered: 2.56W (Auto Zero Avg watts: 2.46W) 24 VDC Powered: 2.69W (Auto Zero Avg watts: 2.59W) 120 VAC Powered: 5.64W (Auto Zero Avg watts: 6.60W) 220 VAC Powered: 45.54W (Auto Zero Avg watts: 7.70W)
Average Power Consumption (Running Watts)	12 VDC Powered: 1.81W 24 VDC Powered: 1.94W 120 VAC Powered: 4.92W 220 VAC Powered: 7.04W

Physical Specifications

Size	Sample system mounted 16” x 24” anodized aluminum panel standard [a]
Enclosure Type	Electronics are housed in an ADALET XIHLGGCX 5-5/8” x 5-5/8” The sensor is housed in an ADALET XIHMCXL junction box.
Enclosure Rating	Class 1, Division 1, Groups B, C&D

Area Classification

Certification	Class 1, Division 1, Groups B,C&D

(a) Consult factory for alternative requirements

(b) Auto-calibration option negates relay 2 (Alarm 2)

(c) Auto-calibration option only

(d) Data logger can be configured to 1 minute, 5 minute, 10 minute, 15 minute, 20 minute, 30 minute, hourly or daily intervals

(e) Requires serial cable, ICE M70XP GUI software and computer (not included)

(f) VAC Option uses a CUI inc AC-DC Switching Mode Power-Supply (see APPENDIX D)

E. Installation and Start-up

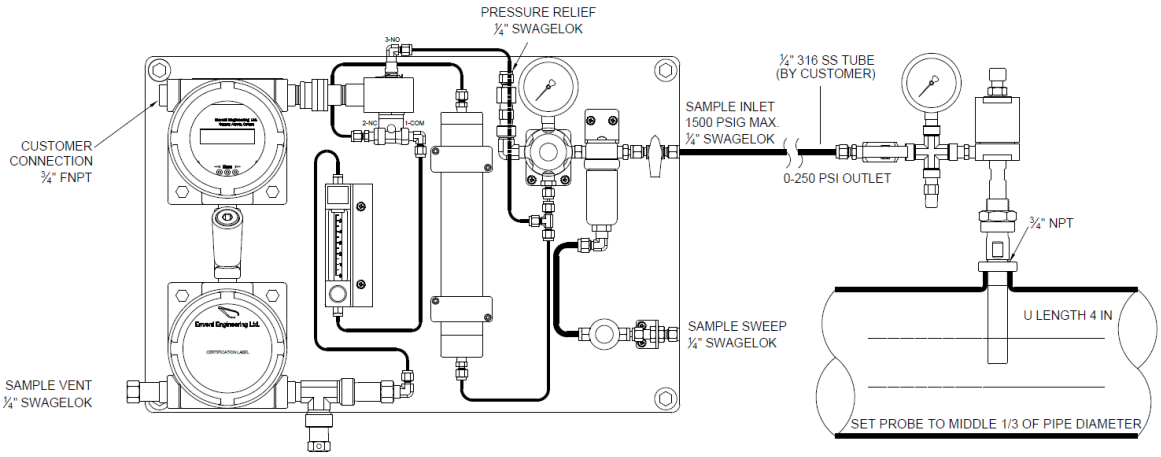
Your M70XP monitor was configured, functionally tested and calibrated at the factory. All test and calibration data is documented in the Factory Calibration Report.

The analyzer should be mounted in an enclosed area in which it is not exposed to vibration and excessive pressure, temperature and environmental variations. The M70XP is designed for Class 1 Div 1 areas. Ensure that the housing received is suitable for area classification.

Envent Engineering is available for installation and start-up, if required. See Envent's pre-commissioning guidelines on our website (http://www.envent-eng.com/documents.php).

E.1. Sample Point Selection

The sample delivered to the analyzer must be representative of the stream and should be taken from a point as close as possible to the analyzer to avoid lag times and sample degradation in the lines. The sensor is heated to 60°C by a small heater attached directly to the back of the sensor. Where possible, select a point where sample temperature is above 15°C and below 60°C. If the sample temperature is above 60°C either consult factory or, if software is available, set and calibrate the sensor at a higher temperature (80°C maximum).



M70XP Basic Installation.

Note: The flame arrestors act as heat sinks and will cool gas to ambient temperature if not insulated with sample inlet line for cold weather service.

E.2. Sample Volume and Flow Rate

Sample should be supplied to the analyzer at 10-15 psig and at a flow between 100-500 cc/min. A bypass sweep is recommended to reduce sample lag time if the sample lines are at high pressure or longer than 15 feet. If the line pressure is over 400 psig, a heated regulator is recommended.

Sample should be supplied to the analyzer at 50-100 psig and at a flow between 100-500 cc/min for M70 with Auto-Zero Option.

Note: The sample flow must be low enough as not to overload sensor heater.

E.2.1. Sample Lag Time vs. Tubing Size

Table 3: Sample Lag Time vs. Tubing Size

Tube Size (“)	Tube Gauge	ID (“)	ID (cm)	Flow (SCFH)	Flow Std. (cc/min)	Pressure (PSIA)	Lag Time per 100’ (min)	Lag Time per 100’ (sec)
3/8	20	0.319	0.810	5	2359	800	36.30	2178
3/8	20	0.319	0.810	5	2359	200	9.07	544
3/8	20	0.319	0.810	5	2359	50	2.27	136
1/4	20	0.181	0.459	5	2359	800	11.69	701
1/4	20	0.181	0.459	5	2359	200	2.92	175
1/4	20	0.181	0.459	5	2359	50	0.73	44
1/8	20	0.081	0.205	5	2359	800	2.34	140
1/8	20	0.081	0.205	5	2359	200	0.59	35
1/8	20	0.081	0.205	5	2359	50	0.15	9

E.3. Sample Conditioning

The function of the sample system available as an option with the M70XP is to regulate and filter particulate or free liquids in the sample. Consideration must be taken of upset conditions as well as normal conditions when designing the sample system. Figure E-1 and Figure E-2 show the typical sample system used for the M70XP Moisture Monitor.

Figure E-3 and Figure E-4 show the optional auto-zero sample system that is available. This uses a desiccant dryer to remove moisture from the sample gas to produce a known, predictable reference gas with low moisture content. This dry reference gas is used to verify and adjust the zero.

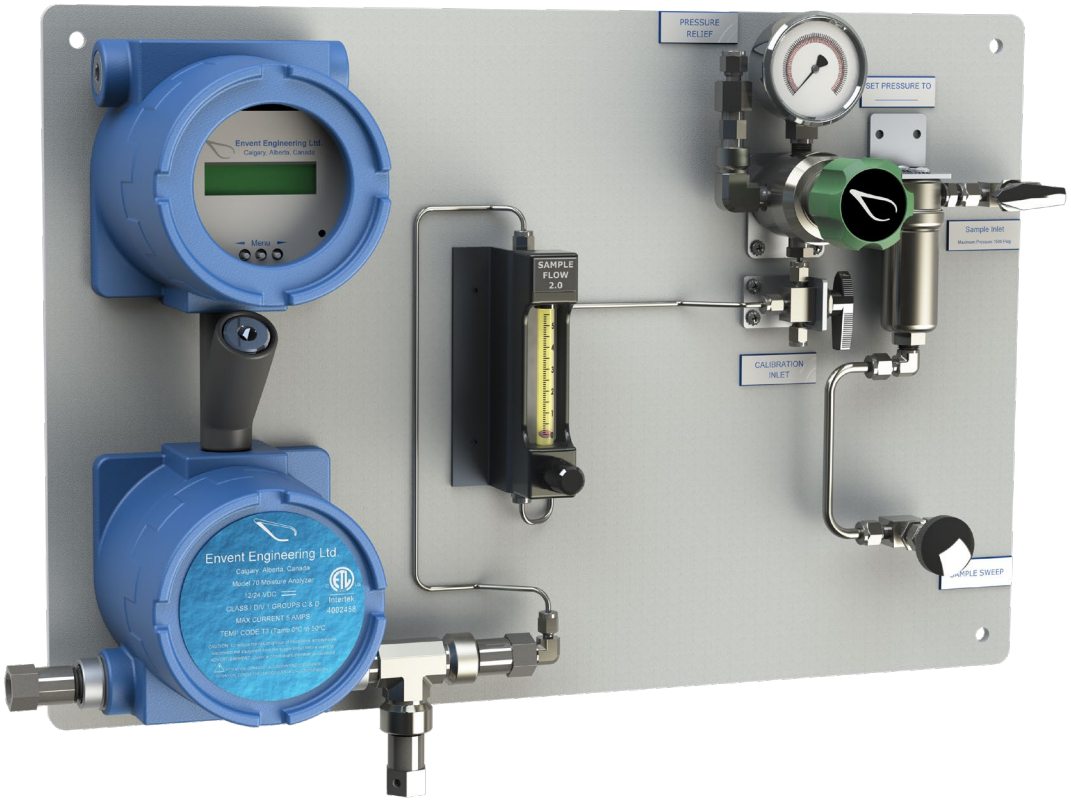


Figure E-4: M70XP standard sample system

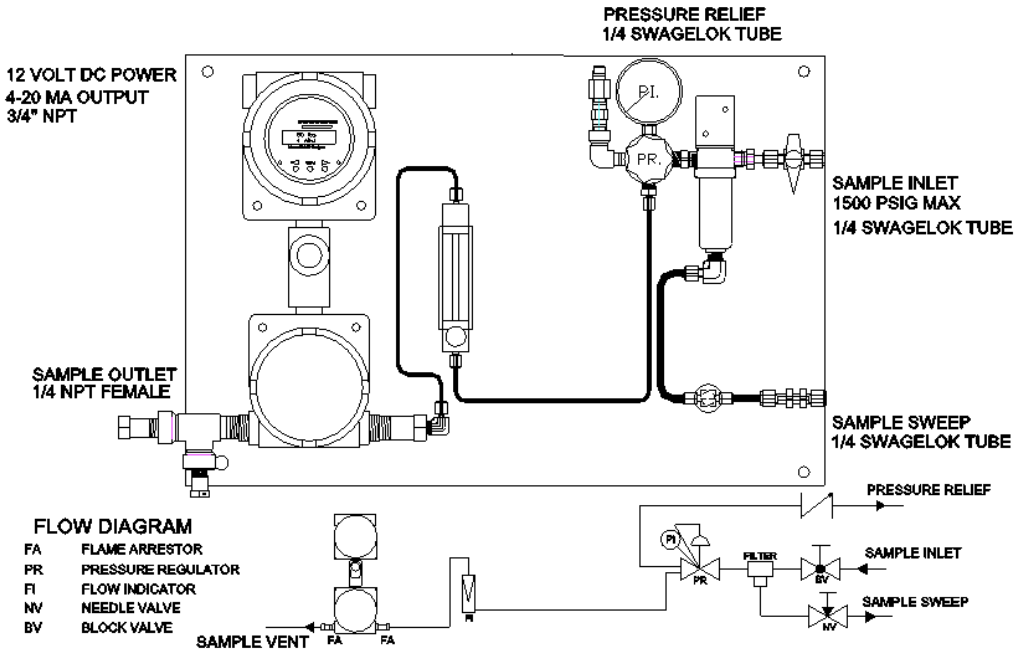


Figure E-5: M70XP standard sample system drawing

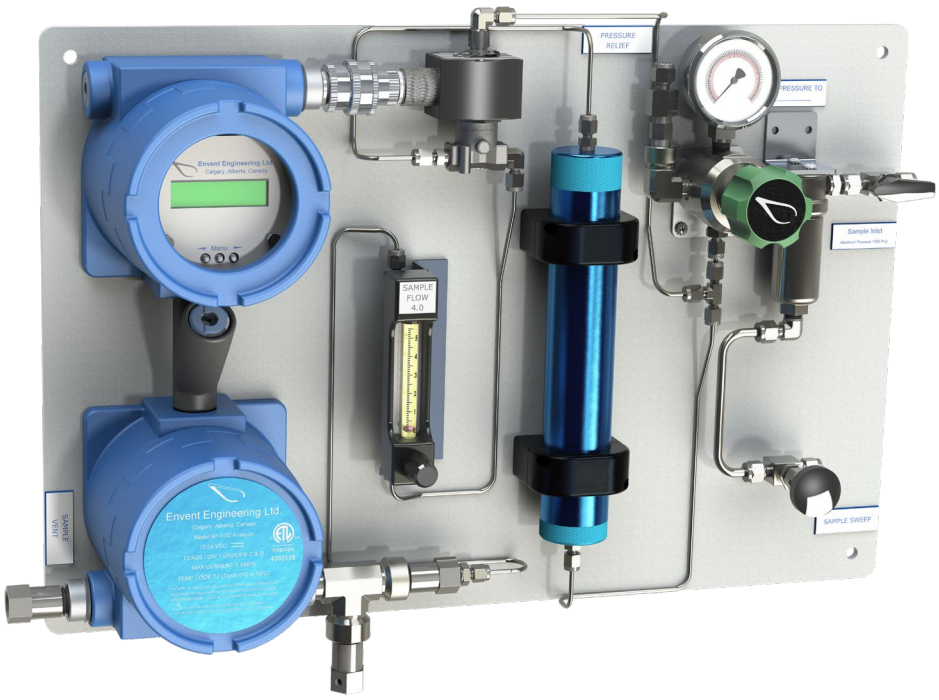


Figure E-6: M70XP standard sample system with auto-zero

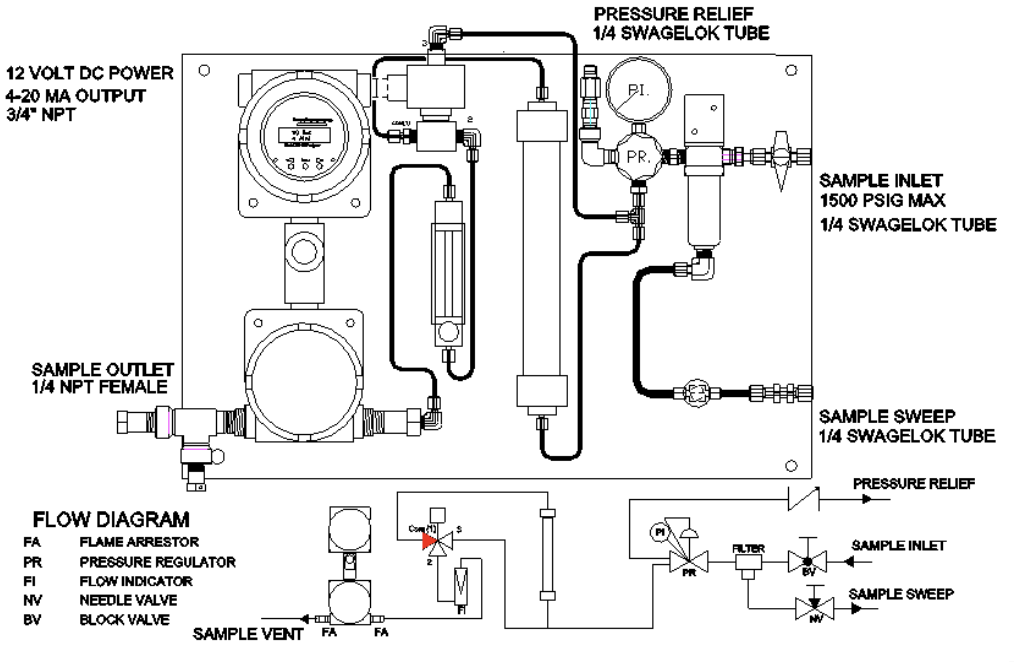


Figure E-7: M70XP standard sample system with auto-zero drawing

E.4. Customer Connections

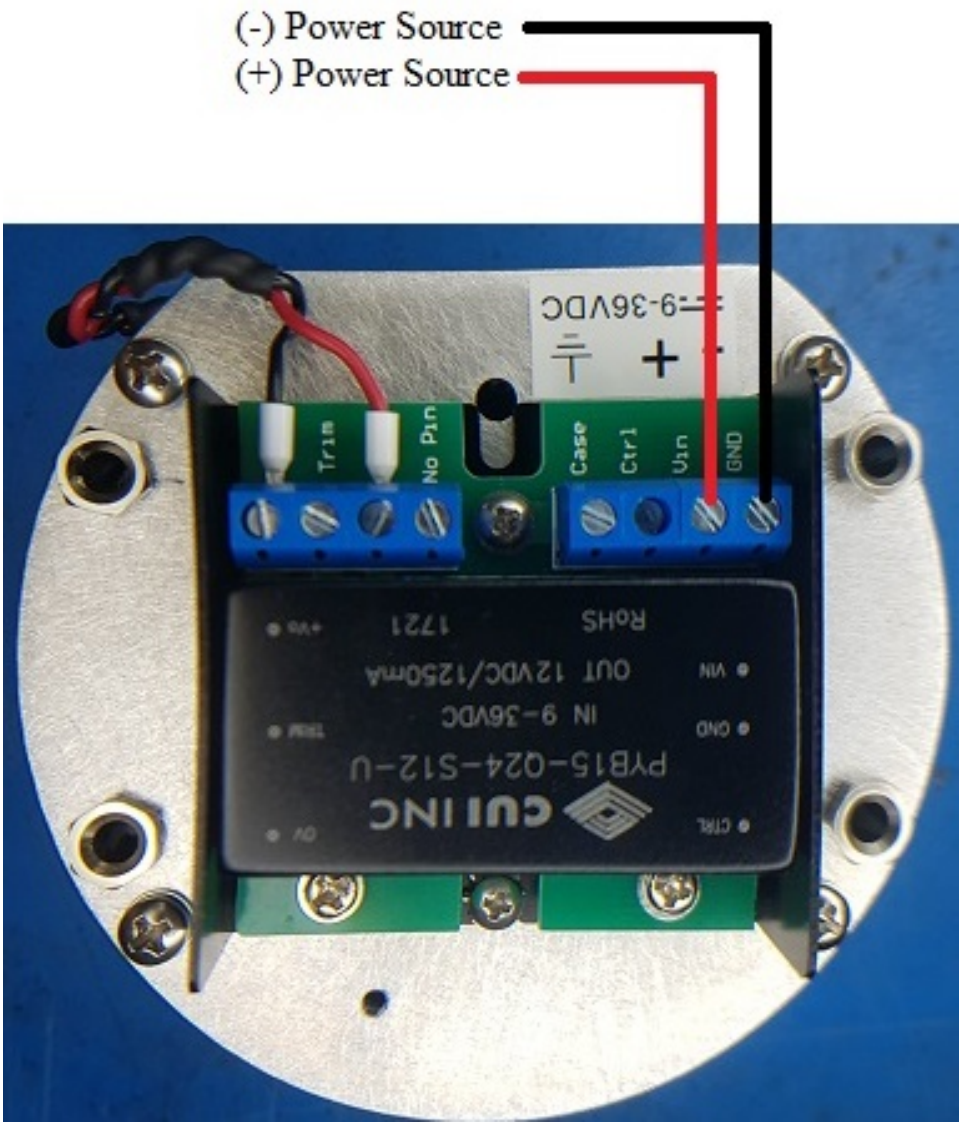
Figure E-8 lists all the default customer connections (for VAC see APPENDIX D). Contact Envent Engineering Ltd. for additional options (such as ModBus or VAC connections). Note: if you have unreliable power, consider using a backup battery or an uninterrupted power source.

Note: If the M70XP is equipped with auto-zero, an alarm relay is used up and not available for alarming functions.

Note: The 4-20 mA output requires a 24VDC power loop, which can be supplied by the analyzer.

CAUTION: This unit requires a disconnect device rated 24VDC and 5A max, must be protected by a circuit breaker rated 24VDC and 5A max, and is to be installed in accordance with local electrical codes.

CAUTION: Turn off power before servicing. Ensure breakers are off before connecting or disconnecting supply power.



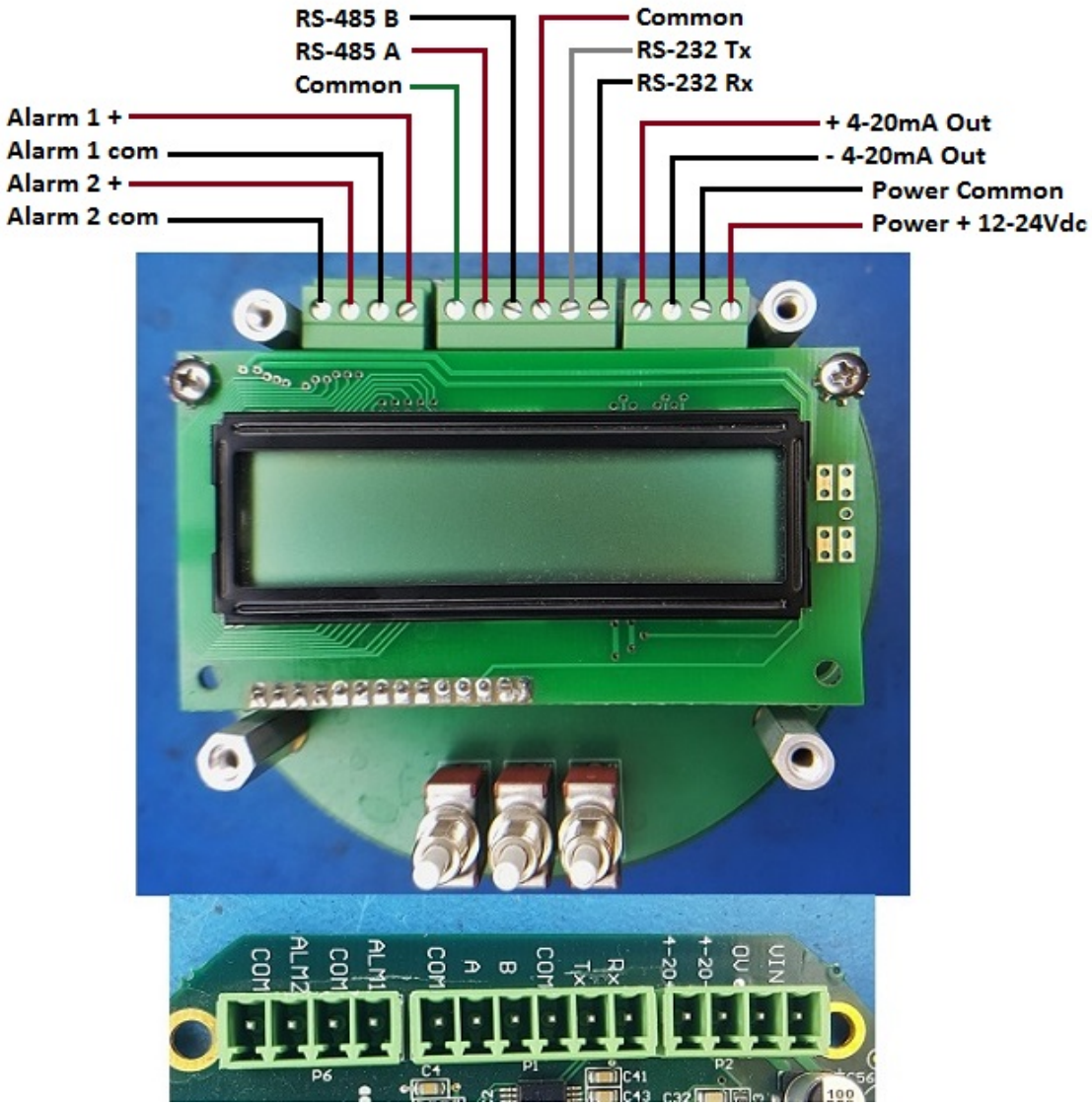


Figure E-8: Customer connections

E.5. *Installation Procedure*

Step 1. Ensure that the selected installation site provides adequate room for maintenance and repair procedures. The site should be as close as possible to the process stream being measured.

Step 2. Unpack and check for damage.

Step 3. Wire the appropriate power to the analyzer (see Section E.4). When the analyzer is powered up, the system will perform a self-diagnostic procedure, flashing "Envent Engineering", model #, revision and ppmv or lbs/mmscf moisture.

Note: The output will be erratic on power-up until the internal signal-averaging buffer is filled. This will take around 5 minutes after start-up.

CAUTION: Seals Not Poured. Pour seals before energizing the circuit (see APPENDIX C).

CAUTION: Turn off power before servicing. Ensure breakers are off before connecting or disconnecting supply power.

Step 4. The display will show concentration on the first line and another variable or status on second line. The sensor temperature set point is normally 60°C. Wait until temperature control has settled, this could take up to 30 minutes.

Note: Using the internal menu button, the second line of the display can be cycled to display various machine settings and outputs. Table 3 is a standard list of the second line variables.

Step 5. Turn on the sample gas and ensure the sample sweep is slightly open for proper filtration.

CAUTION: Before resuming line pressure be sure that all port connections, sample sweep, and sample system are securely installed.

CAUTION: All connections must be LEAKTIGHT to ensure the effectiveness of the analyzer as well as SAFETY. The user, through his own analysis and testing, is solely responsible for the product selection and ensuring all responsibility, safety and warning requirements of the application are met. If the equipment is used in a manner not specified by Envent Engineering Ltd., the protection provided by the equipment may be impaired.

Step 6. Set pressure to 10-15 psig.

CAUTION: Do not exceed 100 psig in sample system. Damage to sample system may result.

Step 7. Set sample flow to 4 (~300cc/min).

Step 8. Step through the remaining menu items to ensure raw sensor voltage, heating output load factor (0-1), and lastly calibration factor are within working parameters.

Step 9. Confirm 4-20 mA output matches display reading for lbs/mmscf or ppmv moisture as indicated in Factory Calibration Report.

Note: This is a 2-wire design and requires 24 VDC loop power.

F. Operation

F.1. Operational Notes

The M70XP Moisture Monitor is a practical compromise between price and accuracy. The electronics are designed to provide reliable indication as well as good resistance to fouling from sample stream contaminants. The sensor will perform best at concentrations between 50 and 5000 ppmv. The accuracy below 50 ppmv is ± 10 ppmv. However, the trended information should provide a good insight into process humidity values. The display shows concentration in ppmv and in lbs/million. Operating the sensor at 60°C and atmospheric pressure makes it resistant to process temperature and pressure variations. At atmospheric pressures, water and other contaminant adsorption on to the wetted sample path is minimized. In the event that the sample must be vented to a pressurized flare, the sensor should be calibrated and maintained at a constant pressure as low as possible. The sensor will respond very quickly at concentrations over 100 ppmv.

Note: The output of the M70XP will vary with pressure. It is recommended to operate the system at atmospheric pressure to reduce the affects of absorption of contaminants to the wet components. Some users would like to calculate and display dew point. The user is in this case must specify at what pressure they would like to have the dew point calculated. This change requires use of the factory GUI to adjust (Consult factory).

Note: In the event that a large amount of water (10,000 ppmv or more) comes in contact with the sensor it could take several hours or a day for the sensor to dry back down. It will act like an over ranged spring but will eventually return.

Note: As the sensor is drying down, there is less moisture differential between the sensor and the flowing sample as they approach the end point and therefore the dry down rate will slow appreciably. It is analogous to drying clothes with cool humid air.

F.2. Manual Calibration

The calibration on the M70XP is set at the factory. The current settings can be read by toggling through the menu items on the second line of the display using the middle push button. Their values can be adjusted from the front panel. If the moisture concentration of the gas is known:

Step 1. Adjust the zero "***Offset***" by pressing the center button until the "***Offset***" factor appears on the second line of the display.
Step 2. Pressing the right or left button will bring up a cursor under a digit of the current "***Offset***" number. Move the cursor by pressing left or right buttons to under the digit to be adjusted.
Step 3. Adjust by pressing middle button.
Step 4. When the number is right press the right button until the cursor moves all the way to the right and "***saved***" appears. To cancel press the left button repeatedly until "***cancel*** "appears.
Step 5. Adjust the "***Offset***" until the M70XP moisture display agrees with the value of obtained with the manual dew-point tester.

Note: It would be best to let the unit run for 1 week on sample gas before final calibration.

Note: The Offset is subtracted from the raw sensor reading, so decreasing the Offset number will increase the moisture reading. The electronics average the raw mV signal over time. Allow the reading to settle for 60 seconds before making further adjustments to the Offset.

The final reading on the display is provided by the following equation:

$$\frac{lbs}{mmscf} = Gain \times \left(Raw_{mV} - Offset_{mV} \right)$$

F.3. Auto-Zero Option

The M70XP can be equipped with an ASCO solenoid and moisture trap filled with indicating silica gel blue desiccant for an auto-zero option. The moisture trap will have a lifespan of over 3000 auto-zero runs before the desiccant needs replacement (under normal operating conditions).

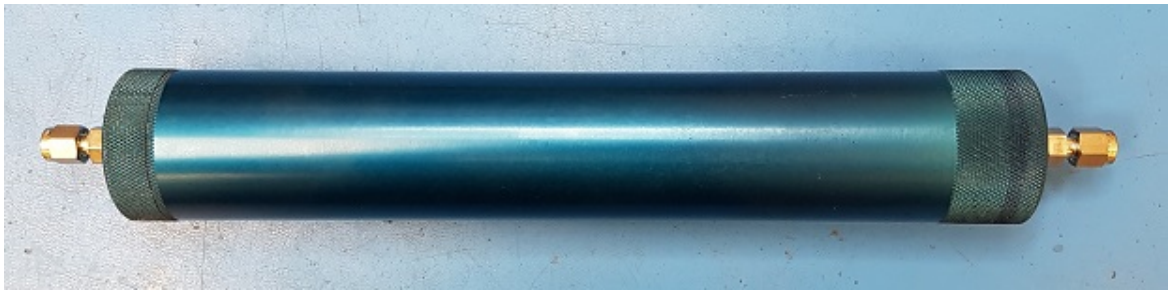


Figure F-9: Moisture trap with indicating silica gel blue desiccant

F.3.1. Measurement (Run Mode)

When in Run Mode, the sample gas flows to the de-energized solenoid valve and is directed to the moisture sensor for measurement as seen below in Figure F-2.

The following formula is used to calculate the lbs/mmscf from the Raw mV signal:

$$\frac{lbs}{mmscf} = GAIN \times \left(Raw_{mV} - Offset \right)$$

Where: GAIN: The span value determined in the factory
Raw_{mV}: Raw millivolt signal from the sensor
Offset: The zero which is determined using a reference point

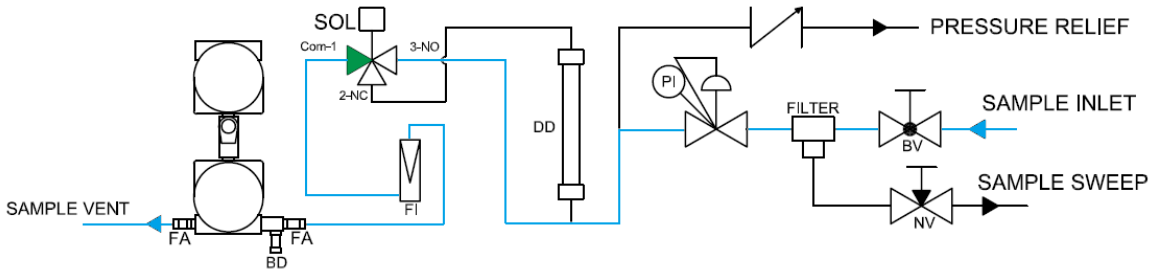


Figure F-10: Sample system flow diagram in Run mode

F.3.2. Auto-Zero Mode

When in auto-zero mode, the sample gas flows through the moisture trap, which dries it to a predictable value. This reference gas flows to the energized solenoid valve and is directed to the moisture sensor to provide a zero reference point. During an auto-zero the 4-20mA analog output is held at the last valid measurement.

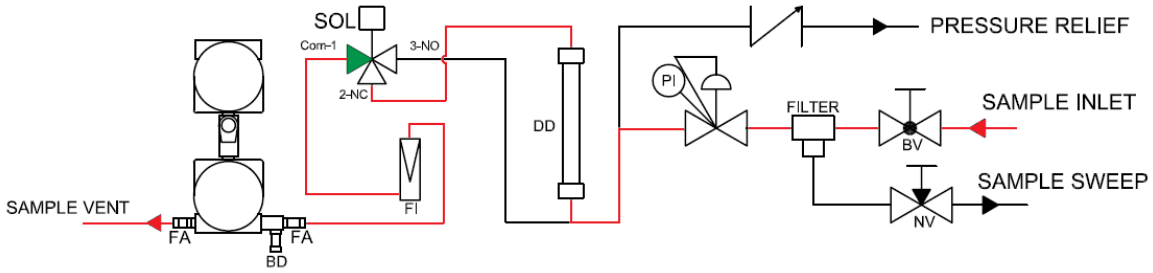


Figure F-11: Sample system flow diagram in auto-zero mode

Auto-zero is initiated on a pre-programmed schedule or when manually executed. Auto-zero can be pre-programmed to zero hourly or 1 to 3 times daily (Factory default is daily at 8:00AM). Consult Factory for additional options.

To manually auto-zero the M70XP, press the menu button until "Init Cal Idle" is displayed on the second line. To initiate the auto-zero press the right arrow button once, the "Idle" will change to "Active" momentarily and the solenoid will energize for 15-minutes.

The default adjustment limit (CalGas) is set at 1.5 lbs/mmscf in the factory.

Note: If the M70XP is equipped with auto-zero, one of the two alarm relays is used for the flow control solenoid and not available for alarming functions.

Example1: Sample Gas = 4 lbs/mmscf, Offset = 768, Raw_{mV}= 771, GAIN = 1, CalGas = 1.5. M70 is reading low at 3 lbs/mmscf. Auto-zero is manually initiated through the display. During the auto-zero the M70 reads 0.5 lbs/mmscf. The difference between the CalGas value is 1.5 – 0.5 = 1. The Adjusted Offset value is changed from 768 to: 768 – 1 = 767. When the solenoid switches back to Run Mode, 4 lbs/mmscf is displayed and matches the actual reading.	Example2: Sample Gas = 2 lbs/mmscf, Offset = 768, Raw_{mV}= 771, GAIN = 1, CalGas = 1.5. M70 is reading high at 3 lbs/mmscf. Auto-zero is manually initiated through the display. During the auto-zero the M70 reads 2.5 lbs/mmscf. The difference between the CalGas value is 1.5 – 2.5 = -1. The Adjusted Offset value is changed from 768 to: 768 – (-1) = 769. When the solenoid switches back to Run Mode, 2 lbs/mmscf is displayed and matches the actual reading.

F.4. Alarm Set Points

There are two solid-state alarms normally set on ppmv or lbs/mmscf concentration at the factory on increasing moisture. If the alarms need to be adjusted:

Step 1. Press the center button until the "**alm 1**" or "**alm 2**" appears on the second line of the display.
Step 2. Pressing the right or left button will bring up a cursor under a digit of the current set point number.
Step 3. Move the cursor by pressing left or right buttons under the digit to be adjusted.
Step 4. Adjust by pressing middle button.
Step 5. When the number is correct, press the right button until the cursor moves all the way to the right and "**Saved**" appears. To cancel and go back to the starting set point press the left button repeatedly until "**Cancel**" appears.

Note: Both alarms are normally open or de-energized and the hysteresis is set to 0.1 lbs.

Note: The alarms contacts are open collectors and solenoids can be wired as below.

CAUTION: Electrical certification for hazardous locations requires that the sensor and flame arrestor threads be coated with liquid thread sealant (Swagelok Swak or equivalent). Use of Teflon tape will invalidate the certification.

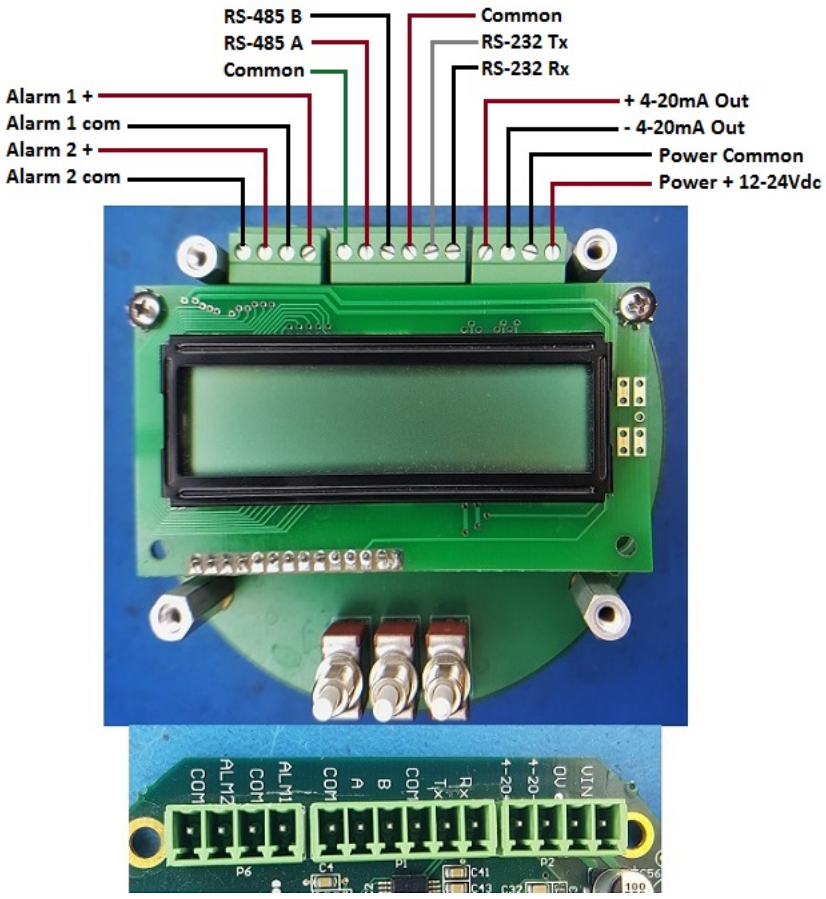


Figure F-12: Alarm wiring

F.5. Display Menu

CAUTION: The glass window on the model M70 must remain installed in order to ensure area classification is maintained

To configure the M70, if the area is non-hazardous, the window can be removed in order to press the internal buttons directly.

Figure F-13: MSeries-standard operator interface

Table 4: Analyzer display-button functions

Button	Description/Function
Scroll Right [→]	Used to move the cursor to the right. Also used to SAVE configuration adjustments.
Scroll Left [←]	Used to move the cursor to the left. Also used to CANCEL configuration adjustments.
Menu/Set	Used to cycle through the menu options. Also used to increase numerical values when making configuration adjustments

Table 5: Analyzer display-menu

Top line	Description
##.## lbs/mm	Moisture Concentration in lbs/mmscf [e]
Second line	**Description**
##.## Temp C	Temperature in °C [e]
#.## Pwm	Power Consumption of Temperature Controller
##.## Tset	Temperature Set Point [a]
####.## Offset	Sensor Zero Offset [a]
##.## Gain	Sensor Gain Factor [a]
INIT CAL IDLE	Initiate a Manual Calibration [b]
##.## Alm 1	Alarm 1 Set Point [a]
##.## Alm 2	Alarm 2 Set Point [a][c]
##.## AOSpan	4-20 mA output span in lbs/mmscf [a]
##.## CalGas	Moisture Concentration Set Point for Calibration Mode [a][b]
####.## mV	Raw Sensor mV Output
In Alarm Status	Alarm Status of M70XP
AO Zero/Span	4-20 mA zero/span output in lbs/mmscf [a]
Optional	**Consult factory for additional options**
###.# DP °C	Dew Point in °C [d]

(a) User configurable

(b) Auto-calibration option only

(c) Alarm 2 relay is used for the flow control solenoid for the Auto-calibration option

(d) Factory configurable upon demand

(e) Other units available upon demand

G. Maintenance

G.1. Monthly Check-up

Your analyzer will provide reliable service with very little attention. However, a monthly check-up will ensure that the analyzer is operating to specifications. Check filters and flow meters for liquid or solid contamination. Replace inlet filters as required.

G.2. Sensor Replacement

G.2.1. When to Replace the Sensor

It is recommended to replace the sensor only after contacting Event Engineering to ensure that the sensor needs replacement. The sensor should last 3+ years, sample conditioning dependent.

G.2.2. Sensor Replacement Procedure

Step 1. Disconnect power from the analyzer.
Step 2. Shut off line pressure before changing sensor.
Step 3. Remove sensor screw on housing lid, insulation and disconnect 1/8” sample inlet and outlet tubing.
Step 4. Unplug 9-pin connector and plug in replacement sensor.
Step 5. Reconnect the sample inlet and outlet tubing and reinstall the insulation and cover.
Step 6. Connect power.
Step 7. Before resuming line pressure, check that all connections are LEAKTIGHT to ensure effective moisture concentration sampling as well as SAFETY.
Step 8. Allow the M70XP to warm up to the set sensor temperature (normally 60°C.)
Step 9. Calibrate after 24 or more hours on sample.

Note: The new calibration factor should be recorded for future reference.

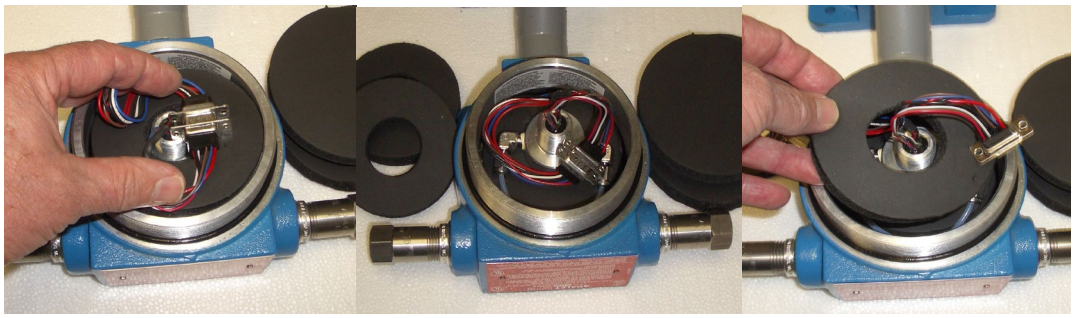


Figure G-14: Sensor replacement procedure

G.3. Filter Replacement

G.3.1. When to Change the Filter Element

It is recommended to replace the filter element when the pressure drop reaches 10 psig across the filter.

G.3.2. Filter Replacement Procedure

Step 1. Shut off the line pressure before changing elements. Ensure there is no pressure in the filter housing.
Step 2. Remove the bowl, element retainer and filter element.
Step 3. Replace Filter element with Bonded Microfiber Filter Element **(note: not a coalescing filter element)**
Step 4. Tightening the element retainer a ¼ to 1 turn after it first contacts the filter element securely seals the filter tube. The amount will depend on the housing type and element size. A mark on the end of the retainer can be used as a guide.
Step 5. Before replacing the housing bowl ensure that the mating threads and sealing surfaces are clean and damage free. It is recommended that the threads and sealing faces be lubricated with a small amount of silicone grease before assembly. Stainless steel housings fitting with a solid PTFE gasket the bowl should be tightened to a torque of between 30Nm and 40 Nm.
Step 6. Before resuming line pressure be sure that all the port connections, the drain plug, and the housing bowl are securely installed. All connections must be LEAKTIGHT to ensure effective filtration as well as SAFETY.

G.4. Recommended Spare Parts List

Table 6: Recommended spare parts list for 2 years

Part Number	Part Description
100040	Sample flow meter 0-600 cc/min
201102-P	Poly Propylene Moisture/RTD Sensor/Heater
200023	Foam insulation kit
330406	Set of 5 membranes for inlet filter
P15-M53A81201	3A Molecular Sieve

G.5. M70XP Cleaning Procedures

When cleaning the Envent Engineering Ltd. M70 Moisture Monitor sample system, leave the sweep valve on the sample filter slightly open at all times. This will decrease the likelihood of contamination.

If the analyzer requires cleaning on a regular basis, the sample point may have to be relocated or additional sample conditioning may be required. Please consult Envent Engineering Ltd.

During startup or plant upset situations, the M70XP analyzer may become contaminated with a scavenger solution. This will cause the analyzer to read unexpected moisture concentrations. The flowmeter should be inspected for liquids and to ensure the float moves freely.

Note: The scavenger solution is water-soluble and therefore is relatively easy to clean.

G.5.1. Cleaning Materials List

- Alconox laboratory cleaner or equivalent residue free cleaning agent

CAUTION: Do not use solvents, brake cleaner, soaps or detergents.

- Fresh clean water
- 100% Isopropyl alcohol. Do not use rubbing alcohol
- Large bucket to mix cleaning solution
- Rinse bottle

G.5.2. Cleaning Procedures

Mix 1% (2-1/2 tbsp per gal.) of Alconox cleaner in warm water.

G.5.2.a. Sample Tubing

Step 1. Shut off flow at the sample point prior to sample system
Step 2. Flush the sample line and components with cleaning solution
Step 3. Rinse with fresh water
Step 4. Flush with isopropyl alcohol
Step 5. Dry with clean, dry instrument air or gas

G.5.2.b. Sample System

CAUTION: Disassembly of the pressure regulator and solenoids in the field is not advised. Consult the factory if the regulator or solenoid appears contaminated.

Step 1. Remove the filter element from the filter housing and discard
Step 2. Remove moisture trap and replace indicating silica gel blue desiccant if the desiccant is pink.
Step 3. Remove all sample system components and soak in cleaning solution
Step 4. Ensure valves are fully open when cleaning. 3-way valves should be cleaned with handle in all positions.
Step 5. Flush the sample components with fresh water
Step 6. Rinse with isopropyl alcohol
Step 7. Blow dry with clean compressed air or fuel gas
Step 8. If Teflon tubing appears discolored, replace with new tubing (tubing connecting the sensor)
Step 9. Rinse Sensor with isopropyl alcohol
Step 10. Install new filter elements into filter housings
Step 11. Re-assemble Stainless Steel Tubing to analyzer according to analyzer drawing.

Step 12. Adjust Gain to indicate the value from the factory calibration sheet or the last calibration.
Step 13. If the reading is not with in range, then system may need further cleaning. Please consult factory.

H. ICE M70XP GUI

The M70XP is configured in the factory using a windows based software and serial cable (note you may need a serial to USB converter for most laptops). This software is not normally required in the field unless the user needs to make a fundamental changes to displayed units or retrieve archived data. At the time of printing for this manual the ICE GUI for the M70XP is not shipped with unit. If you require a copy, Envent can forward via mail or electronically (Consult factory).

I. Troubleshooting Guide

1) Sensor reading higher than expected:
   Sensor reading above 20 lbs/mmscf:
   Sensor does not dry down after several hours:
   a. Check for leaks
   b. Check that the flow rate is between 100 and 500 cc/min
   c. Ensure that the sample vent line is not blocked
   d. Check for free water in sample line fittings
   e. Check for 24 VDC (18 – 30 V) on the power terminals
   f. Replace sensor

Note: If the calibration of the M70XP is believed to be incorrect, the sensor can be cleaned (refer to section G.5). If the moisture content of the sample is known, the output of the M70XP can be adjusted. The sensor must be replaced (refer to section G.2) if the above procedure does not restore the M70XP to service. The M70XP electronics board has no user serviceable parts and must be replaced or returned to the factory if found to be non-functional.

2) Sensor reading 0.00 lbs/mmscf:
   a. Check to see if the sensor is connected to the mainboard.
   b. Check for loose pin connections.
   c. Replace the sensor.

3) Sensor reading 0.10 lbs/mmscf or lower then expected:
   a. New installs will often drift until the sample system comes to equilibrium. Allow 24 hours before final calibration.
   b. The Offset setting is too high. Adjust according to the following formula:

$$\frac{lbs}{mmscf} = Gain \times (Raw_{mV} - Offset_{mV})$$

4) Sensor reading fluctuates more then 1 lbs/mmscf within minutes:
   a. Check for loose pin connections between the sensor and mainboard.
   b. The GAIN factor is too high. Adjust the GAIN factor by ½ it's original value. Adjust the Offset to match your known moisture concentration.
   c. Replace Sensor

5) Sensor reading does not respond as much as expected:
   a. The GAIN factor is too low. Adjust the GAIN factor by 2 times it's original value. Adjust the Offset to match your known moisture concentration.

6) Temperature will not reach set point
   a. Check that the flow rate is between 100 and 500 cc/min

b. Check if the gas temperature is too cold
c. Check if the ambient temperature is too low.
d. Push the display menu button to PWM to check the heating output value (0-1.00), if temperature is below 60 deg C, the temp control should eventually ramp the output to 1.00.

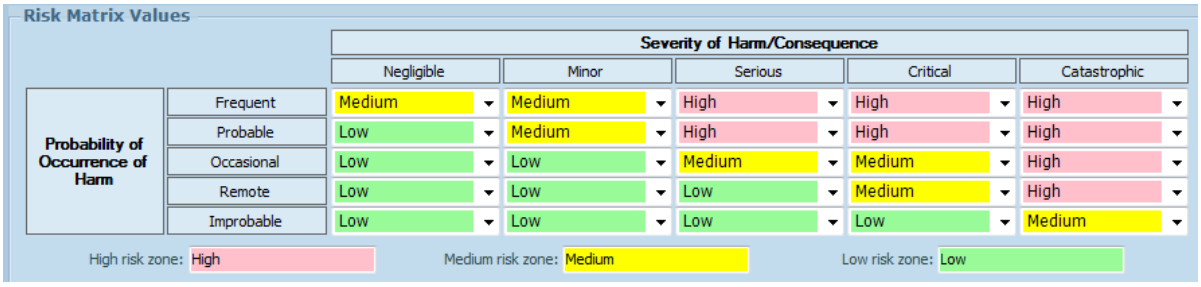
7) No apparent Sensor heater power
   a. Check all inter board connections.
   b. Replace sensor and see if sensor begins to heat

8) No 4-20 ma output
   a. Ensure there is loop power connected

J. Risk Assessment – Safety Information

Hydrogen Sulfide Properties	
Physical State	Usually encountered as a gas
Color	Colorless - No visible sign of H2S to warn you of its presence
Odor	Characteristic smell of rotten eggs at 0.5 ppb; paralyzes the olfactory nerve around 100 ppm
Vapor Density	Heavier than air (1.19 compared to 1.0 for air) > In gas mixtures, it will be present wherever the gas mixture is found > Gas mixtures may be heavier or lighter than air, depending upon their vapor density and temperature compared to the ambient atmosphere (i.e. usually air) > In its pure state, or as a high proportion of a gas mixture, it may flow or settle into low-lying areas, such as pits, trenches and natural depressions
Flammability	Flammable Flammable at 4.3 - 46 percent vapor concentration in air, by volume Burns with a blue flame and gives off Sulphur dioxide (SO2) gas SO2 is also hazardous and irritates the eyes and the respiratory system
Solubility	Soluble in water and oil, solubility is inversely proportional to fluid temperature
Common Locations for H2S	Piping systems, pipelines, wellheads or wellbores, vessels, production facilities, tanks, pits and low spots, confined or enclosure spaces, shacks or buildings, bermed or diked area, sour spills.

Hydrogen Sulfide Quantities and Health Effects	
H2S Exposure	**Possible health Effects**
Less than 1 ppm	you can smell it
10 ppm	> No known health effects for most people > For 10 ppm or less, the exposure limit is 8 hours - Check your local legislation as they vary. > For 15 ppm, the exposure limit is 15 min with 60 minutes breaks. Check your local legislation as they vary.
20-200 ppm	> Eye and respiratory tract irritation and loss of smell > Headache and nausea - loss of smell after 2 - 5 min > Respiratory Protection is required beyond this level such as SCBA (Self-contained Breathing Apparatus) and SABA (Supplied Air Breathing Apparatus)
200 - 500 ppm	> Above effects, but sooner and more severe > Loss of breathing and death in 30 min to 1 hour
500 - 700 ppm	> Affects the central nervous system > Rapid unconsciousness, cessation of breathing, and death
700 ppm and above	> Immediate loss of consciousness > Permanent brain damage and death in a few minutes even if removed to fresh air at once



Risk Assessment					
Hazard Identification - Task	**Who might be harmed by this hazards**	**Health and Safety Risks**	**Initial Risk**	**Hazard Control Recommended**	**Residual Risk**
Maintenance: Changing filter in SCS	Operator(s)	Potential safety risk - release of gases at a high pressure level can cause serious injuries	Occasional – Critical (High)	Due to the fact that the filter is located before the pressure regulator, the operator could be dealing with pressures up to 3600 PSI. The operator must isolate the sample system before changing the filter As an overall practice when doing maintenance into an M-Series analyzer, the	Improvable – Critical (Low)

				operator should carry a personal H2S monitor, wear a hard hat, hearing protection (if applicable), safety glasses, hand protection, steel toed boots. Depending on the location of the M-Series analyzer, appropriate breathing device might be required such as SCBA (Self-contained Breathing Apparatus) and SABA (Supplied Air Breathing Apparatus)	
Leakage or rupture due to high pressure	Operator(s)	Potential safety risk - release of gases at a high pressure level can cause serious injuries	Remote – Critical (Medium)	Depending on the sample conditioning system, the inlet maximum pressure varies. Please consult document package to find out about maximum pressure for the sample system. Do not apply more pressure than the one specified, as this can cause damage to the analyzer and can cause safety risks.	Improbable – Critical (Low)
H2S Exposure (Atmosphere)	Operator(s)	Potential safety and health risk - Death - Consult Table Hydrogen Sulfide Quantities and Health Effects.	Remote – Critical (Medium)	For atmospheres where there is H2S, depending on the levels and company policy, the operator must wear the appropriate equipment before servicing an M-Series analyzer As an overall practice when doing maintenance into an M-Series analyzer, the operator should carry a personal H2S monitor, wear a hard hat, hearing protection (if applicable), safety glasses, hand protection, steel toed boots. Depending on the location of the M-Series analyzer, appropriate breathing device might be required such as SCBA (Self-contained Breathing Apparatus) and SABA (Supplied Air Breathing Apparatus)	Improvable – Critical (Low)
H2S Exposure (Leakage - Overpressure)	Operator(s)	Potential safety and health risk - Death - Consult Table Hydrogen Sulfide Quantities and	Remote – Catastrophic (Medium)	In case of a leakage, follow company's health and safety policies on how to deal with an H2S leak. Depending on the application and location of the M-Series analyzer, the operator might have to use the proper breathing	Improvable – Catastrophic (Medium)

		Health Effects.		equipment As an overall practice when doing maintenance into an M-Series analyzer, the operator should carry a personal H2S monitor, wear a hard hat, hearing protection (if applicable), safety glasses, hand protection, steel toed boots. Depending on the location of the M-Series analyzer, appropriate breathing device might be required such as SCBA (Self-contained Breathing Apparatus) and SABA (Supplied Air Breathing Apparatus)	
Exposure to other gases	Operator(s)	Potential safety and health risk – Explosion, Oxygen deprivation, Death	Remote – Catastrophic (Medium)	In case of a leakage, follow company's health and safety policies on how to deal with gas leak. Depending on the application and location of the M-Series analyzer, the operator might have to use the proper breathing equipment As an overall practice when doing maintenance into a M-Series analyzer, the operator should carry a personal H2S monitor, wear a hard hat, hearing protection (if applicable), safety glasses, hand protection, steel toed boots. Depending on the location of the M-Series analyzer, appropriate breathing device might be required such as SCBA (Self-contained Breathing Apparatus) and SABA (Supplied Air Breathing Apparatus)	Improvable – Catastrophic (Medium)
Flooding the Sample system & analyzer	Operator(s)	Not immediate safety and health concern	Occasional – Minor (Low)	If the analyzer is flooded, the analyzer needs to be immediately isolated, turned off and cleaned. As an overall practice when doing maintenance into an M-Series analyzer, the operator should carry a personal H2S monitor, wear a hard hat, hearing protection (if applicable), safety glasses, hand protection, steel toed	Remote – Minor (Low)

				boots. Depending on the location of the M-Series analyzer, appropriate breathing device might be required such as SCBA (Self-contained Breathing Apparatus) and SABA (Supplied Air Breathing Apparatus)	
Voltage hazards	Operator(s)	Immediate safety and health risk.	Remote – Critical (Medium)	It is important that the operator is trained on handling the analyzer when it is on. The analyzer does not need to be off when it goes into maintenance. However, it is very important that the operator is aware of the danger of an electric shock	Improvable – Critical (Low)
Electrostatic hazard - Explosion hazard	Operator(s)	Immediate safety and health risk.	Remote – Catastrophic (High)	Electrostatic Hazard – Backpan and Certification nameplate must be cleaned only with a damp cloth to prevent static charging hazard which could result in an explosion	Improbable – Catastrophic (High)
Analyzer heavy Weight	Operator(s)	Body Injury	Remote – Serious (Low)	In some cases, unpacking and transporting requires a minimum of two persons.	Improbable – Low (Low)
Re-configuring the GC Analyzer configuration file and or physical configuration to the analyzer and or sample conditioning system	Operator(s)	Potential safety risk	Remote – Critical (Medium)	Do not modify physically the M-Series analyzer or sample conditioning system as this void hazardous location certification. Software configuration should not be changed by the user.	Remote – Critical (Medium)

APPENDIX A

M70XP Default Modbus Setup

Output Status (Coils)	
Registry Number	**Data Field**
(0)	Relay 1
(2)	Relay 1
(4)	Relay 2
(6)	Relay 2

	Output Registry Numbers		
Data Field	**16 Bit Integers**	**32 Bit Integers**	**Floating Point**
lbs/mmscf	(40001)	(40013)	(40037)
lbs/mmscf	(40002)	(40015)	(40039)
ppmv	(40003)	(40017)	(40041)
ppmv	(40004)	(40019)	(40043)
mV	(40005)	(40021)	(40045)
mV	(40006)	(40023)	(40047)
Temp C	(40007)	(40025)	(40049)
Temp C	(40008)	(40027)	(40051)
Temp F	(40009)	(40029)	(40053)
Temp F	(40010)	(40031)	(40055)
PWM	(40011)	(40033)	(40057)
PWM	(40012)	(40035)	(40059)

APPENDIX C

Chico A Sealing Compound

For Sealing Fittings in Hazardous Locations
Installation & Maintenance Information

INSTALLATION

DAM:

Using "Chico X" Fiber, make a dam in each conduit hub (except the one extending upward) so that the "Chico A" sealing compound, while fluid, cannot leak out of the sealing chamber.

Use the EYS-TOOL-KIT to pack a proper fiber dam **(do not use metal tools)**. Proceed as follows:

1. Force the conductors forward.
2. Pack fiber into each conduit hub behind the conductors.
3. Push the conductors backward and force them apart.
4. Pack fiber between and around the conductors in each conduit hub. It is important that the conductors be permanently separated from each other, so that the sealing compound will surround each conductor.
5. Pack fiber into each conduit hub in front of the conductors.

> **⚠CAUTION:**
> Do not leave shreds of fiber clinging to side walls of sealing chamber or to the conductors. Such shreds when imbedded in the compound may form leakage channels. The completed dam should be even with the conduit stop.

6. If the Condulet is of a type or size that has a separate work opening, this should be closed by its cover before pouring the seal.

COMPOUND:

Follow these instructions carefully:

Use a CLEAN mixing vessel for every batch. Particles of previous batches or dirt may spoil the seal. The recommended proportions are, by VOLUME– 2 parts of Chico A compound to 1 part of clean water. Do not mix more than can be poured in 15 minutes after water is added. Use cold water. Warm water increases speed of setting. Stir immediately and thoroughly.

> **⚠CAUTION:**
> If a batch has started to set, do not attempt to thin it by adding water or by stirring. Such a procedure may spoil the seal. Discard partially set material and make up fresh batch. After pouring, immediately close the pouring opening.

FOR APPLICATIONS INVOLVING GROUPS C AND D

> **⚠CAUTION:**
> Sealing compound to be mixed ONLY at temperatures above 35°F (2°C) and ONLY poured into fittings that have been brought to a temperature above 35°F (2°C). Seals must NOT be exposed to temperatures below 35°F (2°C) for at least 8 hours.

FOR GROUP B APPLICATIONS

> **⚠CAUTION:**
> Sealing compound to be mixed ONLY at temperatures above 40°F (4.4°C) and ONLY poured into fittings that have been brought to a temperature above 40°F (4.4°C). Seals must NOT be exposed to temperatures below 40°F (4.4°C) for at least 72 hours.

KEEP compound dry by having container cover tightly closed when not in use.

NOTE: For additional details see IF 287 packed with sealing fitting.

APPENDIX D

VAC Customer Connections

For 100-240 VAC 50/60Hz connections, a CUI inc VSK-S15-24U-T Switching Mode Power Supply is used to convert the VAC power supply to a 24 VDC power supply.

Figure APPENDIX D-15: CUI inc VSK-S15-24U-T Switch Mode Power Supply

Characteristics:

- Over temperature protection
- Overload protection
- Inrush current limiting

Specifications:

Input Voltage Range	100-240 VAC
Power (W)	15
Output Voltage (VDC)	24
Output Current (mA)	625
Dimensions (LxWxH)	3.78x2.17x1.26
Packaging	Encapsulated PCB

The Factory will connect the (+/–)Vout terminals from the switching mode power supply to the VIN/0V terminals on the mainboard.

The Factory will connect three 48” wires from the AC(N) and AC(L) terminals from the switching mode power supply for the customer to connect the 100-240 VAC 50/60Hz power supply connections respectively.

Note: The 4-20 mA output requires a 24 VDC power loop, which can be supplied by the analyzer.

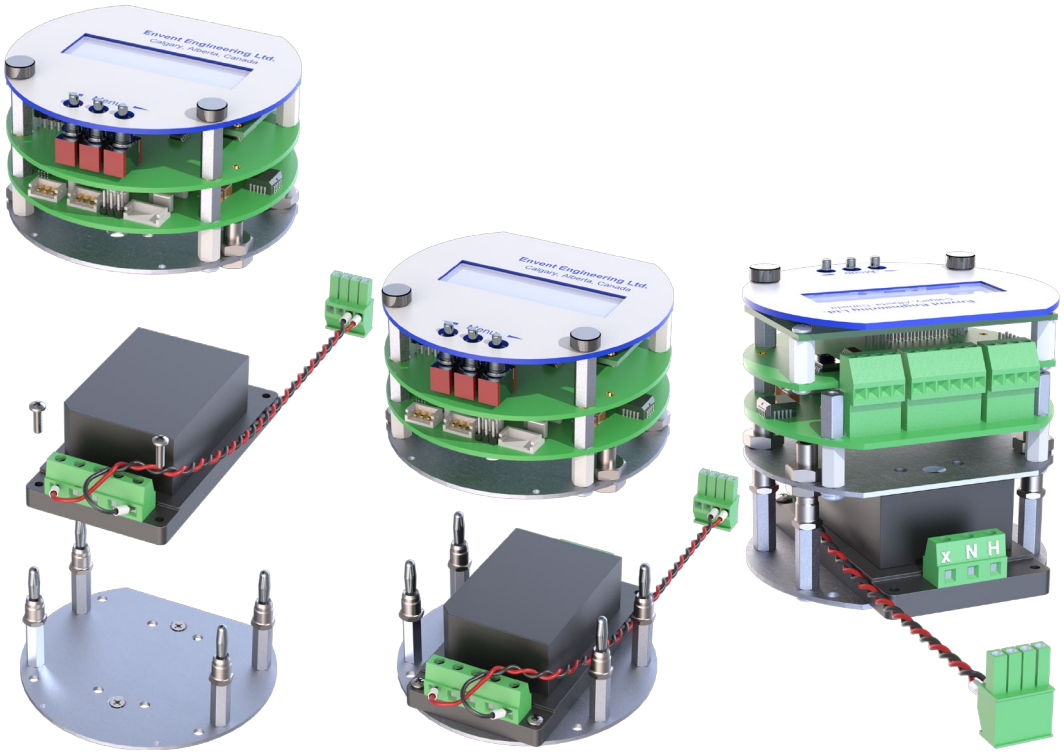
CAUTION: This unit requires a disconnect device rated 240 VAC and 5 Amax, must be protected by a circuit breaker rated 240 VAC and 5 Amax, and is to be installed in accordance with local electrical codes.

CAUTION: Turn off power before servicing. Ensure breakers are off before connecting or disconnecting supply power.

APPENDIX E

Controller board and Display Assembly

CAUTION: Turn off power before servicing. Ensure breakers are off before connecting or disconnecting supply power.



This document has been continuously improved and revised over time; see the table below for revision (rev) information.

Rev No.	*Rev Date*	*Rev Description*
02	30/05/11	Changed format, added warnings as per safety regulation standards
03	5/12/11	Auto-Zero added with updated safety warnings and procedures
04	12/04/15	Removed Table 7: Dew point temperature of natural gas vs lbs/mmscf
05	04/27/16	Updated Figures E-8, F-9, F-10, F11, and F-12, Updated Spare parts list, Updated Appendix D.
06	11/07/16	Updated Inlet Pressure ratings.
6.1	04 Jul 18	N/A
6.2	22 Oct 18	Updated Envent's Address
7.0	30 Nov 18	Update Intertek Certification to 61010 Ed. 3
8.0	16 Mar 21	Added Group B
8.1	17 July 2021	Added Surge and Running wattages
8.2	15 Sep 2021	Change Auto Cal pressures from 60-80psig to the standard 10-15psig
8.3	26 Nov 2021	fixed spelling, and in recommended parts, changed the desiccant from the silica to 3A Mol Sieve

For further information, or a copy of our most recent operating manual, please visit us at www.envent-eng.com. Envent Engineering Ltd. reserves the right to change product design and specifications at any time without prior notice

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