Hydrogen Sulfide Analyzer

Model 330S & 331S (Patented)

Model 330SDS & 331SDS

User's Manual

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Envent
Knowledge by Analysis

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1.0 INTRODUCTION

1.1 About This Manual

This manual provides all the necessary information to install, operate and maintain the 330S, 330SDS, 331S and 331SDS model H_2S Analyzer units and the related options. This manual is intended for all technical level users.

The Envent 330S/331S hydrogen sulfide (H2S) Analyzer is a uniquely rugged and simple design that utilizes lead acetate-based detection which provides a linear and interference-free output of H2S concentration. This analyzer can measure a wide range of H2S concentrations from parts per billion (ppb) concentrations to parts per million (ppm) concentrations. With the addition of a dilution sample system, it can read high concentrations in percentage up to 30%. There are other options available such as the sample system for H2S analysis in liquids or the addition of a hydrogen reaction furnace for total sulfur measurements.

This document will be referring to models 330S and 331S. However, the information applies equally to the 330SDS and 331SDS (dual sensor), unless otherwise stated. To clarify, the difference between an S model and an SDS model analyzer is the second sensor. The "SDS" has the capability to measure H_2S from two different samples at the same time.

1.2 Warranty & Liability Statements

Products produced and supplied by the manufacturer (Envent Engineering Ltd), unless otherwise stated, are warranted against defects in materials and workmanship for up to 36 months from the shipping date or up to 24 months from the start-up date (whichever comes first). During the warranty period the manufacturer can choose to either repair or replace products which prove to be defective.

The manufacturer or its representative can provide warranty service at the buyer's facility only upon prior agreement. In all cases, the buyer has the option of returning the product for warranty service to a service facility designated by the manufacturer or its representative. The buyer shall prepay all shipping charges for products returned to a service facility. The manufacturer or its representative shall pay all shipping charges for the return of products to the buyer. The buyer may also be required to pay round-trip travel expenses and labour charges (at prevailing labour rates) if the warranty has been violated. The warranty may be considered violated for any of the reasons listed below.

1.2.1 Limitation of Warranty

The foregoing warranty shall not apply to defects arising from:

- Improper or inadequate maintenance of the product by the user
- Improper unpacking or installation procedures
- Inadequate site preparation
- Unauthorized modification or misuse of the product
- Operation of the product in unfavorable environments such as at high temperatures, high humidity, or in corrosive atmospheres
- Operation of the product outside of the published specifications

Envent Engineering Ltd carries no responsibility for damage caused during transportation or unpacking, unless otherwise specified in the incoterms.

An extended warranty may be available with certified start-up. Contact Envent Engineering Ltd for details.

Envent Engineering Ltd reserves the right to change the product design and specifications at any time without prior notice.

1.2.2 Disclaimer

No other warranty is expressed or implied. The manufacturer specially disclaims the implied warranties of merchantability and fitness for a particular purpose. The sole remedy of the buyer shall in no case exceed the purchase price of the analyzer. The manufacturer shall not be liable for personal injury or property damage suffered in servicing the product. The product should not be modified or repaired in any manner differing from procedures established by the manufacturer.

1.3 Safety Information

The procedures and settings outlined in this manual constitute what is considered proper use of the equipment in question. The equipment was designed and tested under the assumption that these procedures and settings will be adhered to. Applying values outside of the provided ranges (such as permitting excessive pressures) or modifying provided procedures is considered improper use of the equipment. Envent Engineering Ltd is not responsible for any injury or property damage caused by improper use of the equipment. Once in the field, the user is solely responsible for the safe operation of the equipment.

1.3.1 Key Symbols

The following symbols are used throughout the manual to call attention to important information. We recommend familiarizing yourself with them before reading further.

Indicates a potential hazard that, if not properly addressed, could result in damage to the equipment or injury to the operator.

Caution: hot surface.

Indicates additional information intended to help clarify an earlier statement or to aid in the reader's understanding of a given topic.

2.0 EQUIPMENT OVERVIEW

2.1 Theory of Operation

Envent's models 330S and 331S H_2S analyzers use ASTM D4084 – 07: Standard Test Method for analysis of hydrogen sulfide in gaseous fuels (Lead Acetate reaction rate method). This method uses lead acetate impregnated paper. Throughout this document the term lead acetate tape will be written as "H_2S sensing tape".

The H_2S sensing tape reacts when in contact with hydrogen sulfide by the compound relationship shown below. This tape does not react to any other sulfur compounds in the gas stream. This makes it free from interference when more than one sulfur compound is present in the sample stream. The H_2S reaction is visibly evident by a brown stain directly on the H_2S sensing tape.

$$H_2S + Pb(CH_3COO)_2 \xrightarrow{H_2O} PbS + 2CH_3COOH$$

Equation 1: H2S & Lead Acetate Reaction

The electronics built into the models 330S and 331S have been programmed to measure the rate of darkening over time which, in turn, gives the hydrogen sulfide concentration level. When no H_2S is in contact with the H_2S sensing tape, the analyzer sensor reads 1000 mV (+/- 100 mV).

The sensor block has an LED and a photodiode detector. The LED emits a red beam of light which is reflected off the H_2S sensing tape to the photodiode which detects the light intensity. The darker the H_2S sensing tape becomes, when in contact to H_2S, the less light the photodiode detector receives reducing the millivolt value, which in turn, increases the H_2S value. The "SDS" models uniquely measure the rate of change on both sides of the H_2S sensing tape, allowing for simultaneous readings of two separate samples.

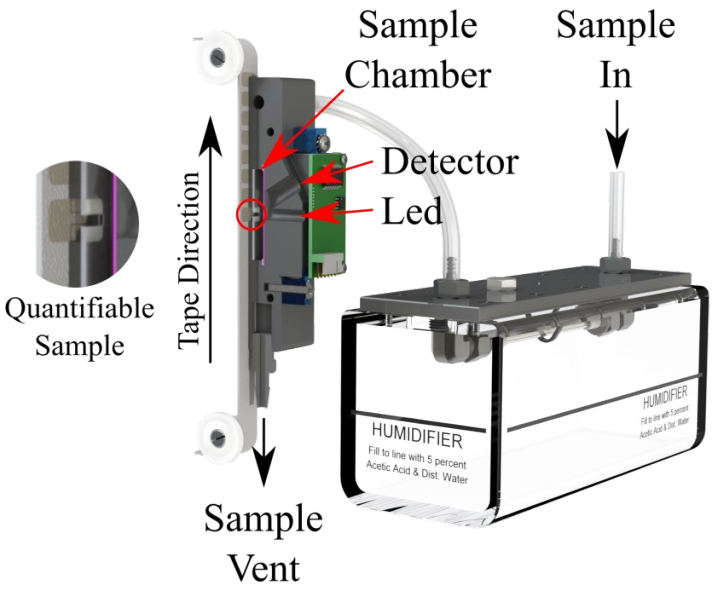

Figure 1: H2S Analyzer Principle of Operation

Figure 1 above, illustrates flow and pressure regulated, filtered sample gas passing through the humidifier to the sample chamber. An aperture in the sample chamber, which differs in sizes depending on the application, allows the gas to come into contact with the H_2S sensing tape, creating a brown stain.

Flow and pressure are the most important variables when measuring H2S and must be kept at a constant state for the analyzer to measure H2S properly. Pressure should be kept at a constant 15 psig, unless otherwise stated. The lowest pressure found to be tolerable for proper H2S measurement is 0.5 psig. Flow must be kept at a constant flow of 2 cm (approximately 83.63 cc/min).

2.2 Analysis Cycles

The analysis of the color rate of change on the H_2S sensing tape is measured in analysis cycles. An analysis Cycle lasts up to a maximum of 720 seconds (12 minutes).

CAUTION:
Do not change the Maximum Analysis Time, consult Envent Engineering Ltd.
Analyzers sold prior to Mid-August 2016 are set to have a 360 second analysis cycle.

Once an analysis cycle is complete, the motor moves the H_2S sensing tape giving the sensor block new tape surface area to start the analysis again. In normal operation, if the analyzer is being exposed to H_2S within its range, the analysis cycle should last between 150 to 210 seconds (1.5 to 2.5 min); the cycle lasts 720 seconds if no H_2S is present.

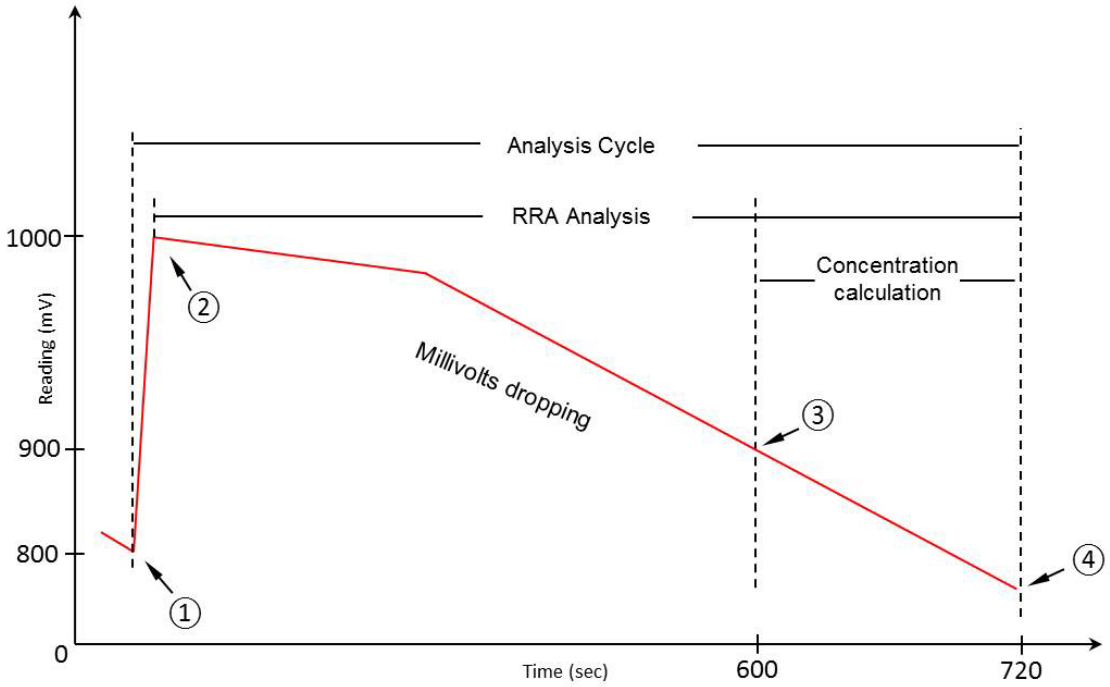

Figure 2: H2S Analysis Cycle

Figure 2 shows a complete analysis cycle from when the motor has finished advancing the H_2S sensing tape from a previous analysis (1) to the end of the current analysis (4). Once the H_2S sensing tape has finished moving and a new tape surface area is exposed, the reflection of light from the LED to the photodiode detector is at its maximum and results in a voltage output from the sensor block of 1000 mV (+/- 100 mV). This mV reading is captured by the analyzer, and it is referred to as the "Zero Sensor". The zero sensor will vary for each surface area of the H_2S sensing tape and will represent the starting point for the H_2S reading for that cycle.

From stage (2) to (4) the H_2S value starts increasing as the millivolt value drops from exposure to H_2S. This stage is called "RRA Analysis". The RRA stands for Rapid Response Algorithm, and it is the instantaneous H_2S readings calculated every 67 mS. As the H_2S sensing tape darkens, the RRA value starts increasing every second. Although the RRA values are calculated almost instantaneously, they are not as accurate as the final reading obtained at the "Concentration Calculation" stage (3) to (4). However, RRA values can be used as a trigger alarms setpoint in case the application requires a rapid response time (less than the RRA Analysis completion). The first part of the RRA Analysis (2) to (3) completes when the mV value drops 100 mV from the zero voltage. After the 100-mV drop, stage (3) to (4) "Concentration Calculation" starts.

On this stage, the H_2S slope is optimal for calculating the final H_2S value for that Cycle. Algorithms are used by the controller board to calculate as accurately as possible the H_2S final value. Once the final value is obtained, it will stay at that value (shown in the display and 4-20 mA analog outputs) until the next cycle has finished and updates the H_2S current reading. This stage will always be 1/5 of the amount of time it takes stage (2) to (3) to complete. Thus, if stage (2) to (3) took 600 seconds, then stage (3) to (4) will take 120 seconds.

CAUTION:

It is important that the analyzer is used for its calibrated H_2S range. Do not use this unit for an application that will require readings outside of its calibrated range. This will cause higher H_2S tape consumption and may cause less accurate readings. The range is determined by the aperture strip in the sample chamber. For more information analyzer ranges, refer to "Aperture Strip" under “3.3.6 Analyzer Components”.

2.3 Dual Sensor Analysis cycle (SDS)

Dual sensor analyzers have two sensors that simultaneously read H_2S from two different samples (example: Sensor 1: 0-20 ppm & H_2S Sensor 2: 0-200 ppm H_2S). The analysis cycle process is the same per sensor as explained earlier in this section; however, some extra algorithms have been implemented to help with the interaction between the two sensors and their analysis cycles' timing.

Analysis cycles for each sensor will always start at the same time. When the motor moves and a new H_2S sensing tape area is exposed, a new analysis cycle has started for both sensors. However, the analysis cycles from each sensor will finish at different times. Either sensor 1 or sensor 2 will finish its analysis cycle first. Regardless of which sensor finishes first, the analyzer will wait for the other sensor to complete its analysis cycle. Once both sensors have completed their analysis cycles, the motor will move and a new H2S sensing tape area is exposed for the next analysis cycle.

It is important to clarify that when the first sensor has finished its analysis cycle, even when it is waiting for the second sensor to complete its analysis cycle, it immediately updates any outputs associated with that sensor (Analog output 4-20 mA, alarms, display H2S value, etc.).

2.4 Technical Specifications

Analyzer Specification		
Measurement Method	ASTM D4084 - 07: Standard Test Method for Analysis of Hydrogen Sulfide in Gaseous Fuels (Lead Acetate Reaction Rate Method)	
Ambient Temperature	0-50 °C (standard) consult factory for other requirements, 0 to 90% humidity (non-condensing)	
Power	12-24 VDC @ less than 3W	
	Or, 100-240 VAC 50/60 Hz, 5W, (300W when total sulfur option is included)	
	Fuse Rating: 5 Amps, 250V, Slow blow, Size: 0.201'' Dia x 0.787'', Package/Case: 5 mm x 20 mm Battery (for 1d Controller Board only): Lithium 3.6V, Dia 0.571'' & 0.992'' Long	
Electrical Certification	330S-DS	Class I, Division 1 Groups B C D T3C Tamb 0 °C to + 50 °C
	331S-DS	Class I, Division 2 Groups B C D T3C Tamb 0 °C to + 50 °C
	For more information on Hazardous location certification, refer to the Envent's Website.	
Output Ranges	Standard ranges are between 10-100 ppb and 0-100 ppm	
Response Time	20 seconds to 90% of step change	
Accuracy	±1.5% of full range on channel 1 (for SDS Models, channel 2 has an accuracy of ± 2.0%). For dilution (option): ±2.5% For Total Sulfur (Option): ±2.0% For PPB (Option): Based on "base noise average"	
Display	Graphic Liquid Crystal Display menu is scrolled by internal button or magnetic wand (330S)	
Outputs	Two 4-20mA outputs (loop power required), optional 4-20mA powered output boards are available	
	Serial Communication: (1) RS-232 Modbus protocol (3) RS-485 Modbus protocol (One RS-485 for remote display option) IEEE 802.3 10BASE-T ethernet port as an optional feature.	
	4 SPDT relays (120 VAC 5A maximum)	
	4 solid state solenoid drivers	
Low Tape Sensor	Utilized for an alarm when the H2S sensing tape needs to be changed.	

Optional Features	
Total Sulfur	Utilized when all sulfur compounds need to be measured. A Total sulfur reaction furnace is added which allows the analyzer to measure total sulfur
Dilution Sample System	Utilized when the analyzer needs to measure ranges above 100 ppm. A permeable membrane dilution system permits the sample to be diluted to an appropriate range when dealing with high concentrations.
Liquid Sampling	Utilized when a liquid sample conditioning system is required to measure hydrogen sulfide in Liquids
Parts Per Billion	Utilized when analyzer requires to read in parts per billion (<1 ppm)
Low Pressure Switch	Utilized for alarming when sample pressure drops below 10 PSI
AO Powered Boards	Utilized for loop-powered analog outputs
Expander AO Board	Utilized when more than two analog outputs are required
Ethernet Port	Utilized for TCP/IP communication capabilities
Auto Calibration	Utilized to initiate a calibration based on time of day or manually

Table 1: 330S/331S H2S Analyzer Specifications

3.0 UNPACKING & INSTALLATION

3.1 Unpacking

Upon arrival, the packaging should be immediately inspected for any external damage that may have occurred during shipping. If any damage is present, please contact Envent Engineering Ltd and request that the carrier's agent be present when the analyzer is unpacked. If a disagreement arises, the incoterms agreed to by the seller and the customer will overrule any dispute.

Once the integrity of the packaging has been confirmed, open the shipping container, and remove the packing materials from the shipping box. Remove all provided components from the shipping container and inspect them for any damage that may have been sustained during shipping. Compare the provided components to the shipping manifest to ensure that all parts are present.

CAUTION:
The 330S H_2S analyzer with a standard sample conditioning system weight approximately 105 lb. Unpacking and transporting requires a minimum of two people.

Make sure the start-up kit is complete (refer to list below). For some special and more complex analyzers, there might be extra parts in the start-up kit (refer to packing slip).

3.1.1 Standard spare parts for 330S H_2S analyzers:

1. 330S Customer Binder
    - Customer Manual(s) and Addendums
    - Factory Calibration Certificate
    - Factory Configuration
    - Drawing Package
2. USB flash drive (containing all documentation)
3. 300' H_2S Sensing Tape**. Part No. 2000040**
4. 1 Liter Acetic Acid**. Part No. 2000035**
5. Funnel
6. Serial Comm. External Cable (USB to Mini USB). **Part No. 1300245**
7. Humidifier (uninstalled). **Part No. 3100006 (Part No. 3100007 for SDS)**
8. Bolts For explosion proof enclosure (x22)

3.1.2 Standard spare parts for 331S H_2S analyzers:

1. 331S Customer Binder
   - Customer Manual(s)
   - Factory Calibration Certificate
   - Factory Configuration
   - Drawing Package
2. USB flash drive (containing all documentation)
3. 300' H_2S Sensing Tape. **Part No. 2000040**
4. 1 Liter Acetic Acid. **Part No. 2000035**
5. Funnel
6. Serial Comm. External Cable (USB to Mini USB). **Part No. 1300245**
7. Humidifier (uninstalled). **Part No. 3100006 (Part No. 3100007 for SDS)**

Envent Engineering H2S Sensing Tapes are suitable for use, if stored in the original sealed package, for 10 years from date of manufacture. Tapes should be stored in a cold dry location. If the seal on the package has been broken in storage, the H2S Sensing Tape should be discarded.

3.2 Site Requirements

The model 331S & 331SDS are designed for cETLus Class 1, Division 2, Groups BCD, Temp Code T3C (Tamb 0°C to 50°C). These models are designed for indoor use only. Ensure that the analyzer received is suitable for the electrical classification of the installation site.

The model 330S & 330SDS are designed for cETLus Class 1, Division 1, Groups BCD, Temp Code T3C (Tamb 0°C to 50°C). These models are designed for indoor use only. Ensure that the analyzer received is suitable for the electrical classification of the installation site.

CAUTION:
Substitution of components may impair intrinsic safety and suitability for Class I, Division 1.

Substitution of components may impair suitability for Class I, Division 2.

The glass window on the XP enclosure must remain installed in order to maintain area classification.

3.3 Mounting Requirements

CAUTION:
The analyzer should be mounted in an enclosed area in which it is not exposed to vibrations, excessive pressures, extreme temperatures, or environmental variations.

The selected installation site should provide adequate room for maintenance and repair procedures.

The installation site should be as close as possible to the process stream being measured. The sample delivered to the analyzer must be representative of the stream and as such, should be taken from a point as close as possible to the analyzer. This proximity will prevent lag times and sample degradation in the lines.

No modifications or repairs to the flame paths are permitted.

Substitution of components may impair flameproof safety and suitability for Class I, Division 1.

All NPT thread entries must meet the minimum requirement of 5 threads.

XP enclosures must have conduit plugs installed for unused conduit entries.

Conduit seal(s) must be installed at a minimum distance of 18'' from any XP enclosure's conduit entries.

Conduit seals must be poured after wiring is completed and before powering up the unit.

The XP enclosure covers must be installed and fully engaged to maintain area classification. They must be secured with the provided 6/32 x ½ set screw. A 1/16 hex key is required for removal.

When operating in low temperatures the flame arrestors and sample inlet line must be properly insulated to prevent the cooling of the sample gas.

The analyzer's input voltage range shown in Certification Nameplate (e.g., 120 – 240VAC) is limited when installing external devices (e.g., Solenoids).

Before opening line pressure, be sure that all port connections, sample sweep and sample conditioning system are securely installed.

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

WARNING

IS (Intrinsic Safety) Grounding Requirements:

- **The 330S/330SDS intrinsic safety barrier must have the temporary ground removed and should be connected using an isolated ground connection to the main service panel.**

- **Failure to use a direct ground connection can lead to a voltage high enough to cause a spark along the ground path during a failure/fault condition. If the ground path goes through various enclosures and hazardous atmosphere areas instead of directly to the main ground, there is a potential for ignition. Therefore, a direct ground connection must be used.**

- **Do not use the same ground as the enclosure or analyzer power feed. Failure to use a proper separate ground may impair the hazardous location safety of the analyzer, leading to explosion, injury, or death.**

- **External IS Ground wiring must be a minimum of 12AWG (4mm^2) and must have a resistance not greater than 1Ω for the ground path.**

3.3.1 Space Requirements

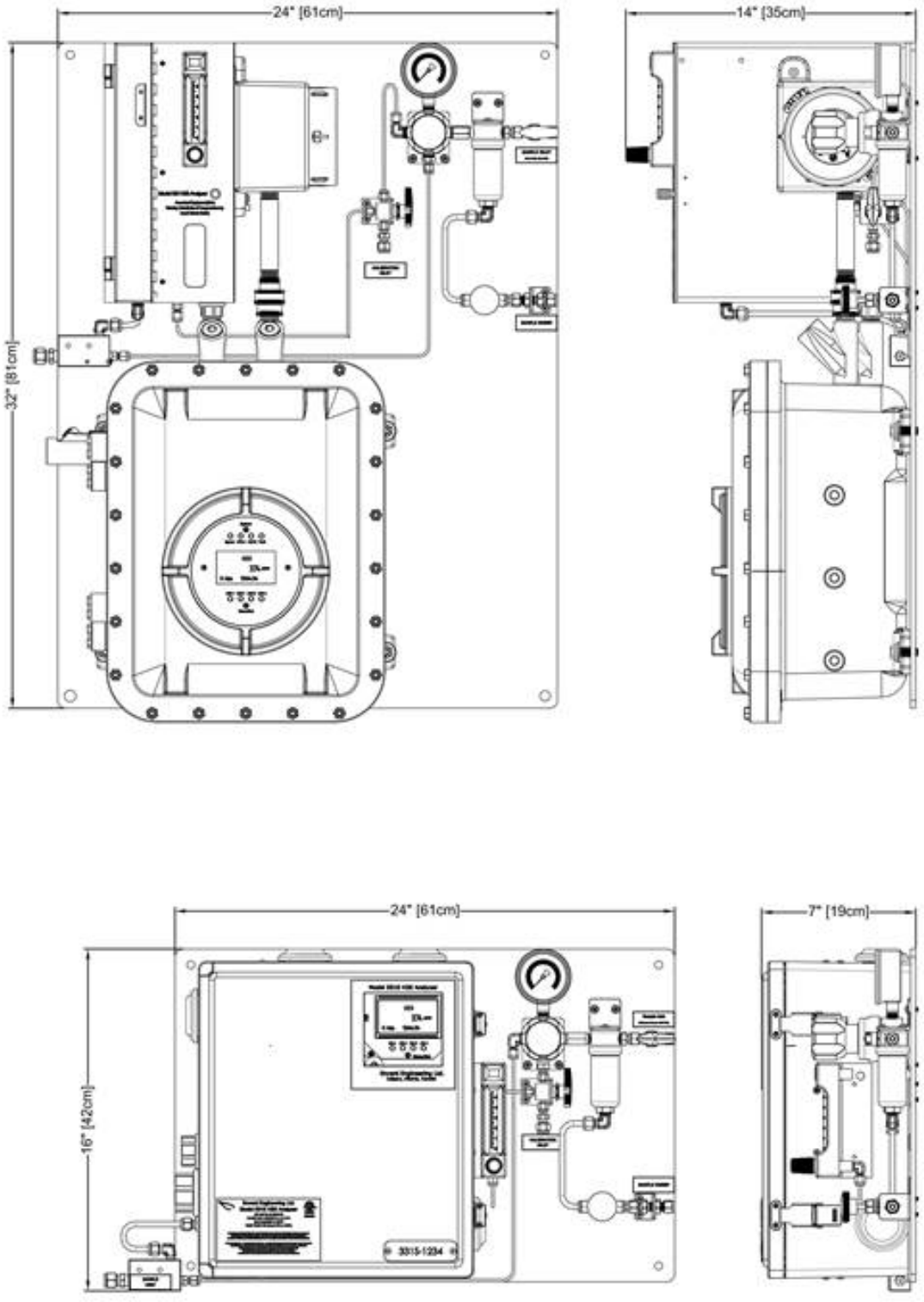

Figure 3: Space Requirements for the 330S & 331S H2S Analyzers

CAUTION:

Make sure to leave at least 1 foot of extra space on the left side of the 330S H_2S analyzer. This will allow proper opening of the side door located at the upper blue chassis where the H_2S sensing tape is located.

3.3.2 Sample Point Selection

The sample to the 330S/331S H_2S analyzer must be representative of the process stream and should be taken from a point as close as possible to the analyzer to avoid lag times and sample degradation in the tubing. A probe must be installed vertically on a horizontal section of pipe ensuring that the sample is drawn from the middle third of the pipeline.

An optional probe with a regulator may be used. The function of this probe is to ensure a clean dry sample to the analyzer and to reduce the pressure of the sample. The lower pressure will improve the response time of the analyzer. Refer to Figure 4.

CAUTION:

It is advisable that the probe is not installed on a vertical pipe.

3.3.3 Sample inlet & sample sweep

1/4-inch 316 stainless steel tubing and fittings are recommended for the sample inlet and sample sweep tubing. Sample sweep can be connected to a flare line if available. Refer to Figure 4.

1/8-inch 316 stainless steel tubing can also be used if the response time of the analyzer is of particular concern.

3.3.4 Vent line

3/8-inch stainless steel tubing and fittings are recommended for the vent line to a maximum of 6 feet in length. ½-inch stainless steel tubing should be used for vent lines exceeding 6 feet. The tubing should be installed with a slight downward slope and should be as short as possible. Refer to Figure 4.

CAUTION:

The sample vent line must be tubed to atmospheric pressure outside and cannot be connected to a flare line or header.

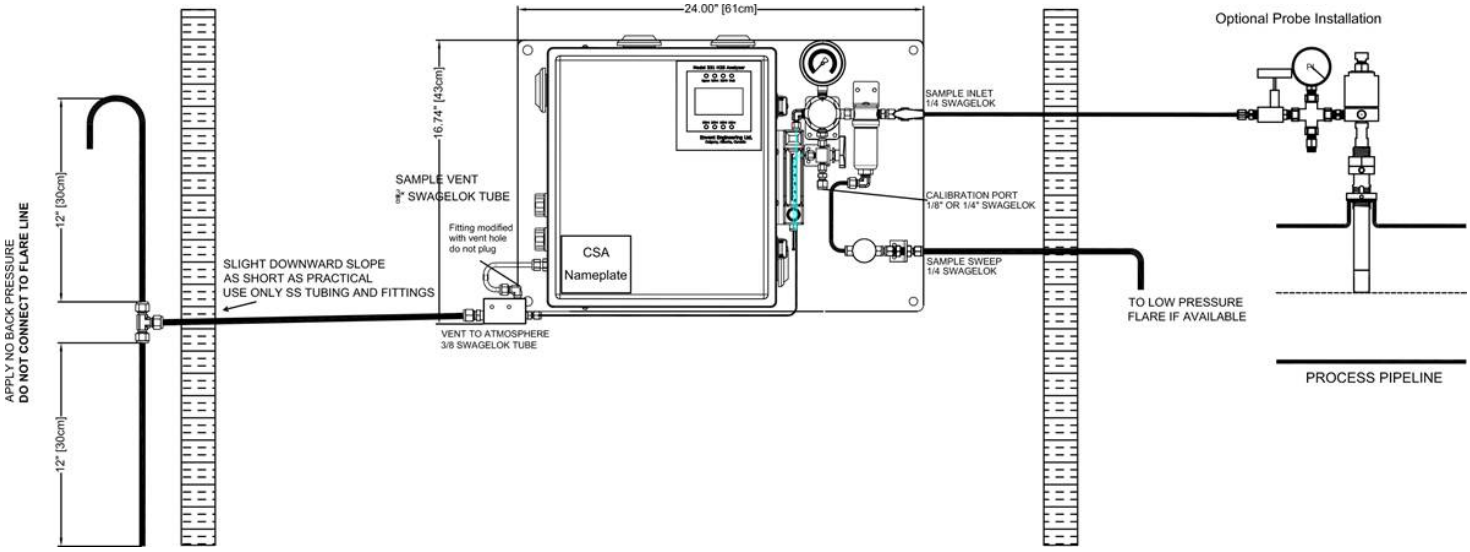

Figure 4: Recommended Venting for 331S (Same for 330S model)

3.3.5 Sample Volume & Flow Rate

The sample should be supplied to the 330S/331S H_2S analyzer at 10-15 psig and at a flow of 83.63 cc/min (set flowmeter at 2.0). A bypass sweep is recommended to reduce sample lag time in the sample line if it is at high pressure, has larger than 1/4" sample line diameter, or if it is longer than 15 feet (The Standard H_2S conditioning sample system has a bypass sweep). The standard sample tubing material is 1/4" 316 stainless steel; however, 1/8" stainless steel tubing can be used if the response time is critical (refer to Table 2: Sample Volume & Flow Rate).

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

Table 2: Sample Volume & Flow Rate

Carbon steel sample line and/or fittings are not acceptable.

3.3.6 Analyzer Components

In this section, the descriptions of the main components of the 330S & 331S H_2S analyzers are covered.

Total Sulfur and Dilution system options are not covered in this section. Please refer to Total Sulfur and Dilution manuals.

3.3.6.1 Controller Board

The H_2S controller board is a printed circuit board that holds all of the customer's connections such as communication ports, digital inputs, analog outputs, relay outputs solenoid outputs, and AC or DC power input. Refer to Figure 5.

There are AC or DC H_2S controller boards and will be specified by customer request. The controller board with an AC power supply has an input voltage range from 110 to 240 VAC (50-60 Hz) and the controller board with a DC power supply has an input voltage range from 10 to 32 VDC.

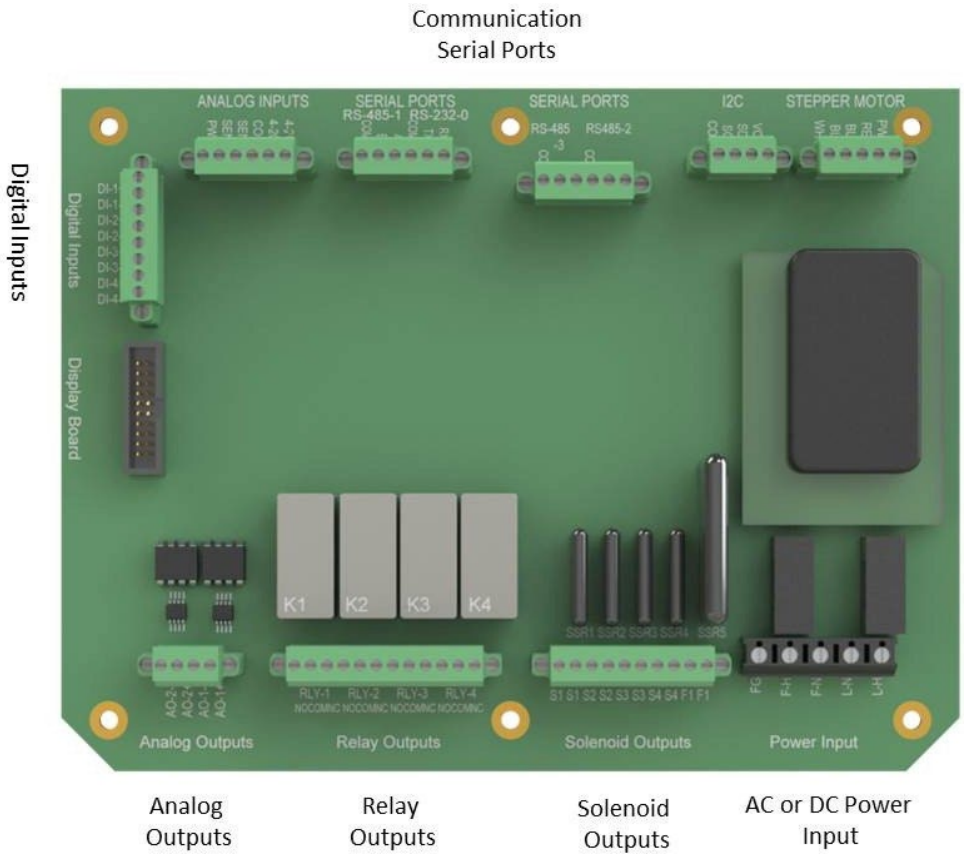

Figure 5: Controller Board

Solenoid Output Drivers & Furnace Output

The H_2S controller board has four solenoid driver outputs. They operate at the same voltage used to power the controller board and are used to directly drive solenoids for shutdown, auto-calibration, stream switching, etc. The connection F1-F1 is used to power up the furnace for Total Sulfur applications. Refer to Figure 6.

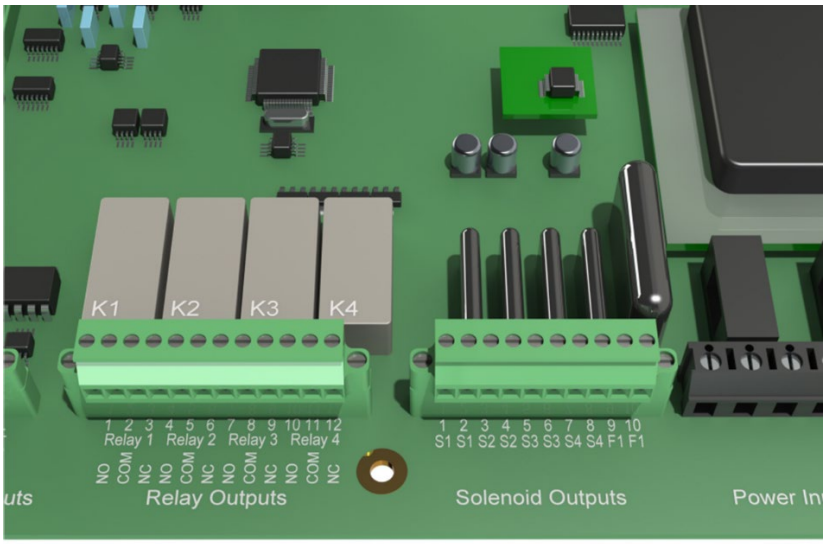

Figure 6: Relay and Solenoid Outputs

The H_2S controller board has four dry contact relays used as status outputs, to drive external relays or solenoids. They are rated for a maximum of 120 VAC 5 Amp.

Analog Outputs

The H_2S controller board has two isolated loop power 4-20mA outputs which can be set up for different variable outputs. Loop power (10-32 Volts) sourced from the end device (PLC) is required for the analog to output. Figure 7 shows the different wiring set ups for the analog outputs.

The third wiring option shown in Figure 7 uses Envent's powered AO board(s) to provide self-powered analog outputs. These boards are available from Envent Engineering Ltd.

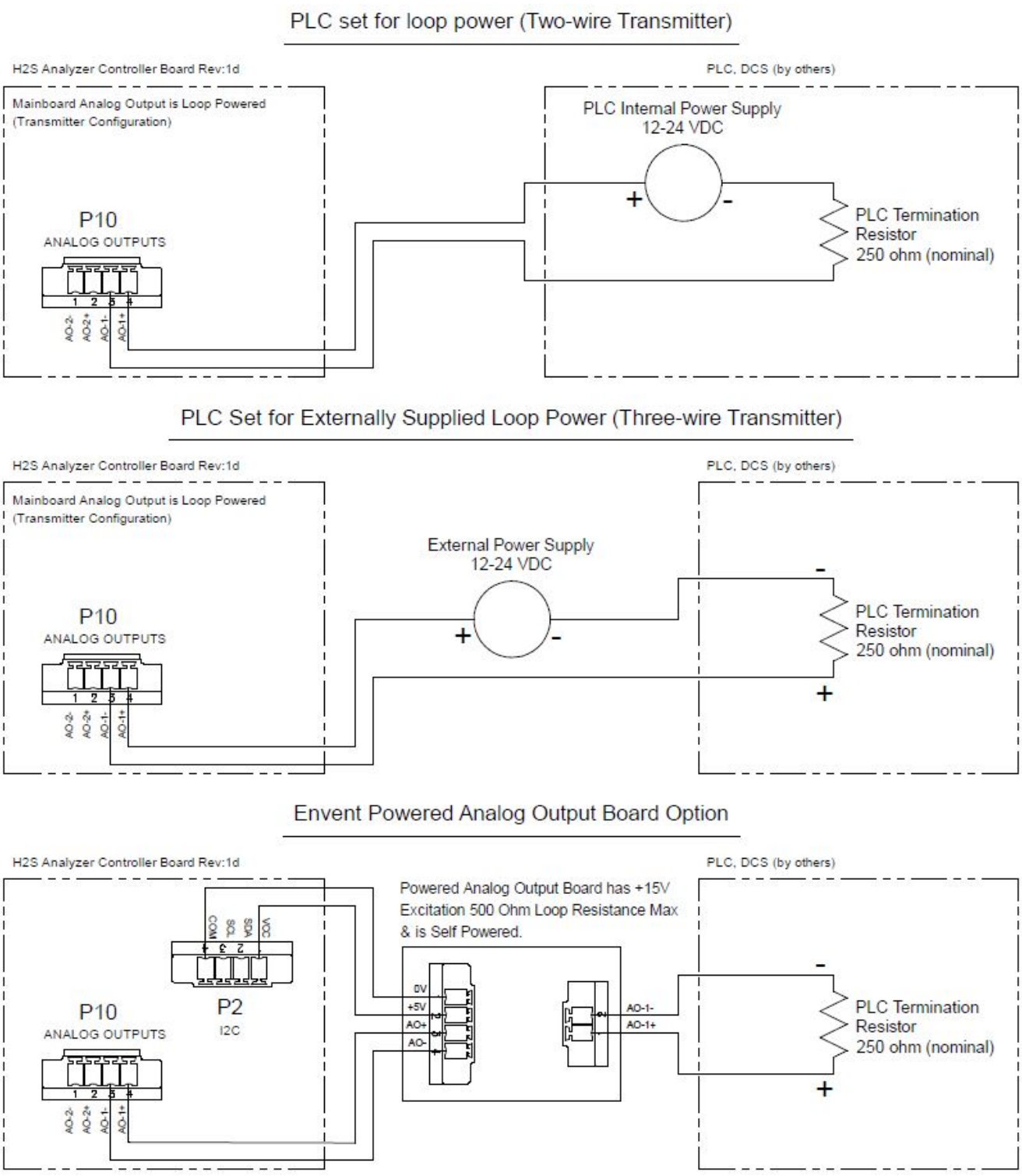

Figure 7: AO 4-20 mA Output Wiring Options

Digital Inputs

The H_2S controller board has four digital inputs used to signal the analyzer of a change of state from an external device, refer to Figure 5. As factory default, DI#1 is used for low H_2S sensing tape sensor and DI#2 is used for low pressure switch, if applicable. These two devices are installed to the analyzer only by customer request.

Serial Ports and I2C

The H_2S controller board has the communication capabilities for RS-232, RS-485 and Ethernet (Optional). The RS-232 Serial port is wired to a mini–USB Female connector for easy access with a communication cable (provided with analyzer) refer to Figure 8.

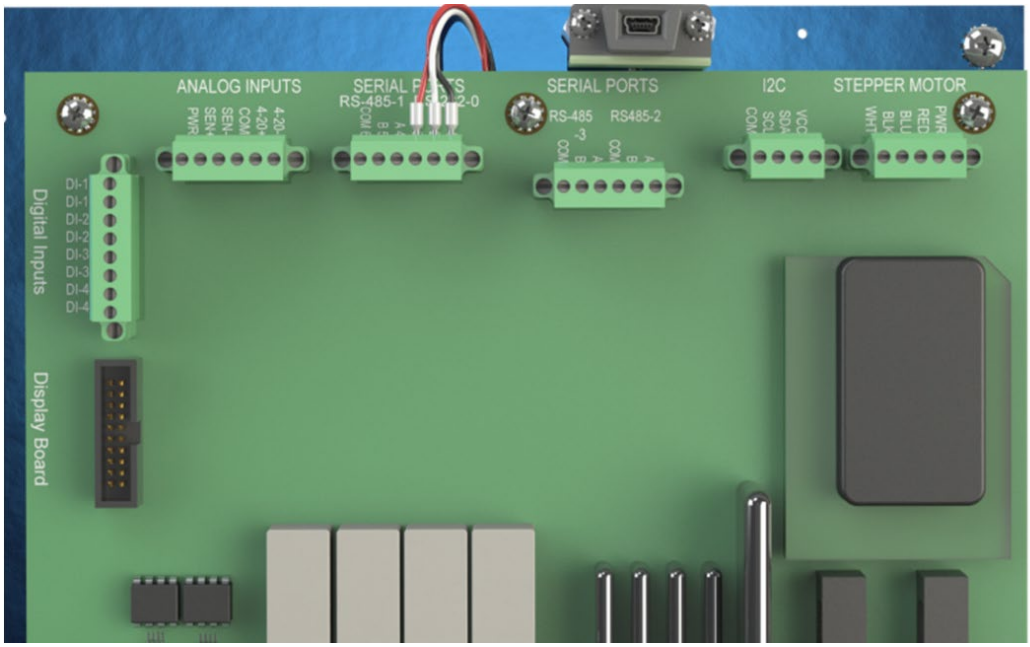

Figure 8: RS-232 Serial Port wired to a Mini-USB Female Connector

The TCP/IP communication is achieved via a communication electronics card which is connected to the I2C terminal block on the controller board. It does not come with the analyzer unless otherwise requested by the customer.

3.3.6.2 LCD Display Board

The LCD display board used for the H_2S 330S/331S models is a graphic backlit display with a direct tactile or magnetic interface, refer to Figure 9. The magnetic interface is only used on the 330S H_2S analyzers which are for Class I, Division 1 areas. The LCD display connects to the controller board with an IDC ribbon cable.

Figure 9: 330S & 331S H2S Analyzer Graphic Display

3.3.6.3 Sample Chamber

The sample chamber is the component that allows the H_2S sample to come in contact with the H_2S sensing tape which in turn is read by the sensor block. The sample chamber is made of the following components:

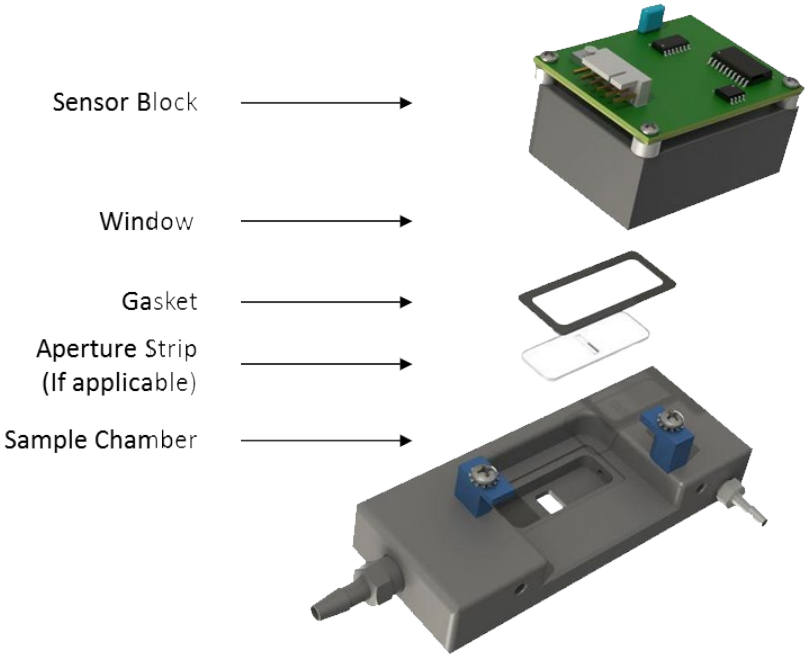

Figure 10: Sample Chamber (exploded view)

Sensor Block

The sensor block measures the intensity of the LED light reflected off from the H_2S sensing tape. It is composed of an electronic board, a red-light emitting diode, and a photodiode, refer to Figure 10. As the tape gets darker due to exposure to H_2S, the photodiode receives less light, thus causing the mV output to decrease. Less light translates to a lower mV signal (or output or reading) which means the tape was exposed to a higher H_2S concentration.

Window & Gasket

These two components seal the small compartment where the H_2S comes inside the sample chamber, refer to Figure 10. The window keeps a clear view for the LED and the photodiode to work properly and isolates them from the sample gas. The rubber gasket seals the Sample Chamber compartment preventing any leaks.

Aperture Strip

The sample chamber has a fixed size aperture of ¼ inch which is used for concentrations in between 1 ppm to 16 ppm.

For concentration applications below 1 ppm or above 16 ppm an aperture strip is installed behind the window in the Sample Chamber, refer to Figure 10. These aperture strips keep the analysis time to be approximately the same regardless of the range.

Various sizes of apertures match different measurement ranges. Table 3 shows the aperture size according to its range.

H_2S Range	Aperture Strip	Starting Gain	Envent PN
50 ppb to 1 ppm	ppb style	Consult Factory	2000033
1 ppm to 16 ppm	None (1/4" fixed aperture size)	2.7	N/A
16 ppm to 30 ppm	1/16"	7.5	2000026
30 ppm to 50 ppm	1/32"	12	2000025
50 ppm to 100 ppm	Pin Holes	18	2000023
100 ppm to 500 ppm	Laser Dot	Consult Factory	2000032
Over 500 ppm	Addition of a dilution panel. Consult Factory.		

Table 3: Aperture Strips & Ranges

Aperture strips can be changed to accommodate for a different range application. Refer to Table 3 shown above to select the best option on the new concentration application. Contact Envent Engineering Ltd to purchase an aperture strip.

Remember: gain and span values on analog outputs will have to change based on new range application. Please re-calibrate the analyzer. Refer to "4.3.1 H2S Gas Calibration".
The adhesive used to adhere the aperture strip in its place is RTV108 Translucent Adhesive. RTV102, RTV103, and RTV109 could also be used.

3.3.6.4 Trigger Slide

The trigger slide is the device that seals the H_2S sensing tape against the sample chamber. The pressure created by the two springs is enough to seal the sample chamber (greater than 3" WC). The head of the trigger slide is low friction which ensures the H_2S sensing tape can move smoothly preventing the tape from breaking. It also ensures that the stain on the tape has even and sharp edges. Refer to Figure 11.

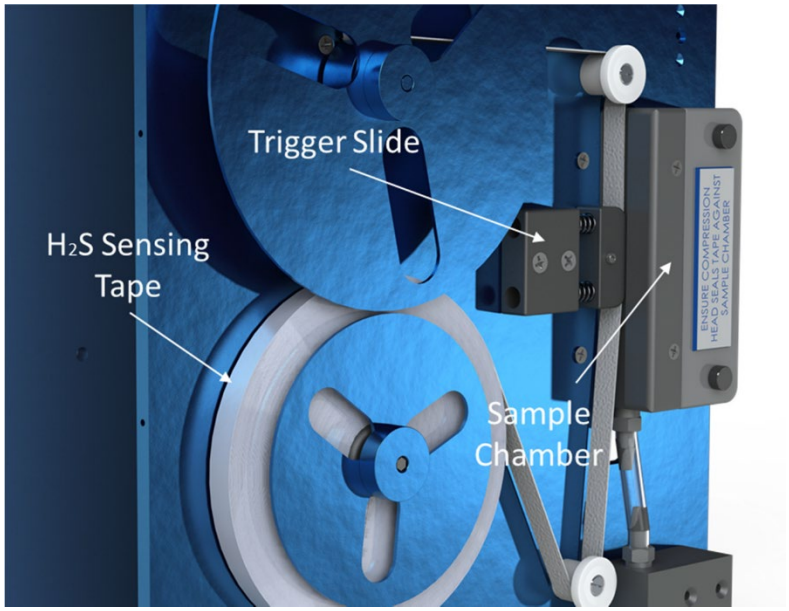

Figure 11: Trigger Slide Installed on a 330S H2S Analyzer (Applicable for 331S Analyzers)

3.3.6.5 Humidifier Unit

CAUTION:
The analyzer should not be exposed to ambient temperatures lower than 0 °C.
By default, all 330S/331S H_2S analyzers have a temperature alarm set to 0 °C descending.

For the H_2S to adhere to the surface of the H_2S Sensing tape, it needs to be humidified. The humidifier unit helps maintain constant moisture content in the sample which increases the chemical reaction on the H_2S Sensing tape. Envent Engineering Ltd offers a unique design of humidifiers meant to meet the requirements for humidification of the sample before it gets into contact with the H_2S sensing tape; refer to Figure 12.

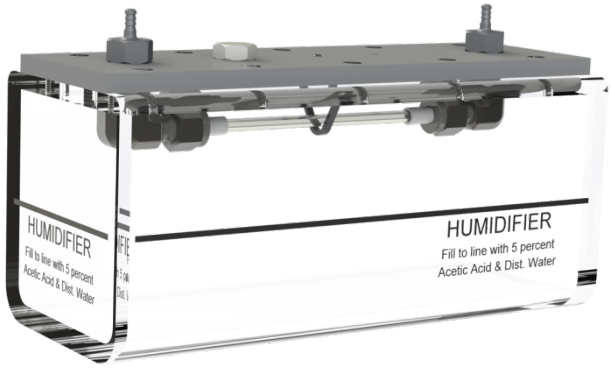

Figure 12: Envent's Humidifier for 330S & 331S (PN 3100006)

The humidifier works by using Nafion Tubing, which has the capability to transport water vapor from the most humidified medium to the driest medium. The sample gas traveling inside the Nafion tube is dryer than the outside of the tube, which is being saturated with water, thus humidifying the gas sample. It is important to have a constant flow to maintain constant humidity of the sample gas.

The humidifier unit should be filled with 5% Acetic Acid up to the indication line. The freezing point for water is 0 °C and -2 °C for 5% Acetic Acid, making it more reliable under freezing temperatures. Vinegar should not be used instead of Acetic Acid since the sweeteners contained in vinegar attract insects and could cause undesirable results.

For the SDS models, the humidifier has two inlet and two outlet ports. It is important to ensure that the tubing is connected to the correct port. The Vinyl tubes that connect to the humidifier are labeled with 1 and 2, make sure they are properly matched when installing them to the humidifier.

Figure 13 shows how to install the humidifier unit in a model 331S H_2S analyzer. The same principle applies for the model 330S H_2S analyzer.

Figure 13: Humidifier Unit Installed in a 331S H2S Analyzer

3.3.6.6 Eductor Block

The analyzer's reading can be affected by positive or negative pressure on the sample vent line. Pressure changes can be caused by strong winds blowing across or directly into the vent; or by mechanical venting (exhaust fan). The eductor will minimize any influence on the analyzer reading; refer to Figure 14.

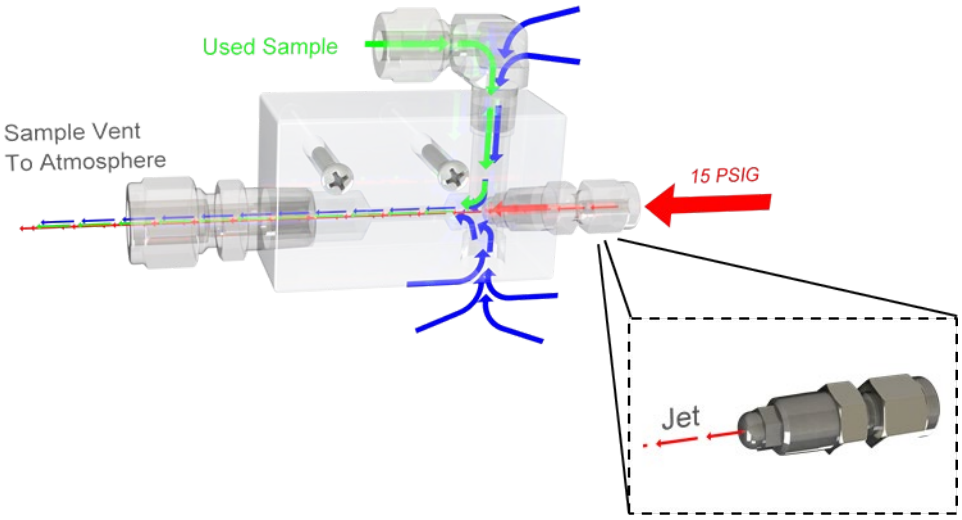

Figure 14: Eductor Block (Venturi Effect)

In cold climates, since the analyzer is venting a moist sample, freezing can occur. The eductor will help reduce freezing problems in the vent line due to the increased velocity and drying effect of the sweep gas. The eductor vent can be retrofitted to existing analyzers.

CAUTION:

In normal conditions, the eductor makes a noise similar to a gas leak. This noise is normal, and it is due to the 15-psig pressure being expelled through the restricted fitting creating suction from the gas vent line (Venturi Effect). DO NOT block the opening at the bottom of the eductor or the modified elbow fitting.

3.3.6.7 Sample Conditioning System

The function of the optional sample conditioning system is to regulate and filter particulates or free liquids from the sample, refer to Figure 15. Consideration must be taken of all potential conditions when designing the sample conditioning system. This section will only cover the 330S/331S standard conditioning system which can be divided into conventional (Refer to Figure 16) or alternative (Refer to Figure 17).

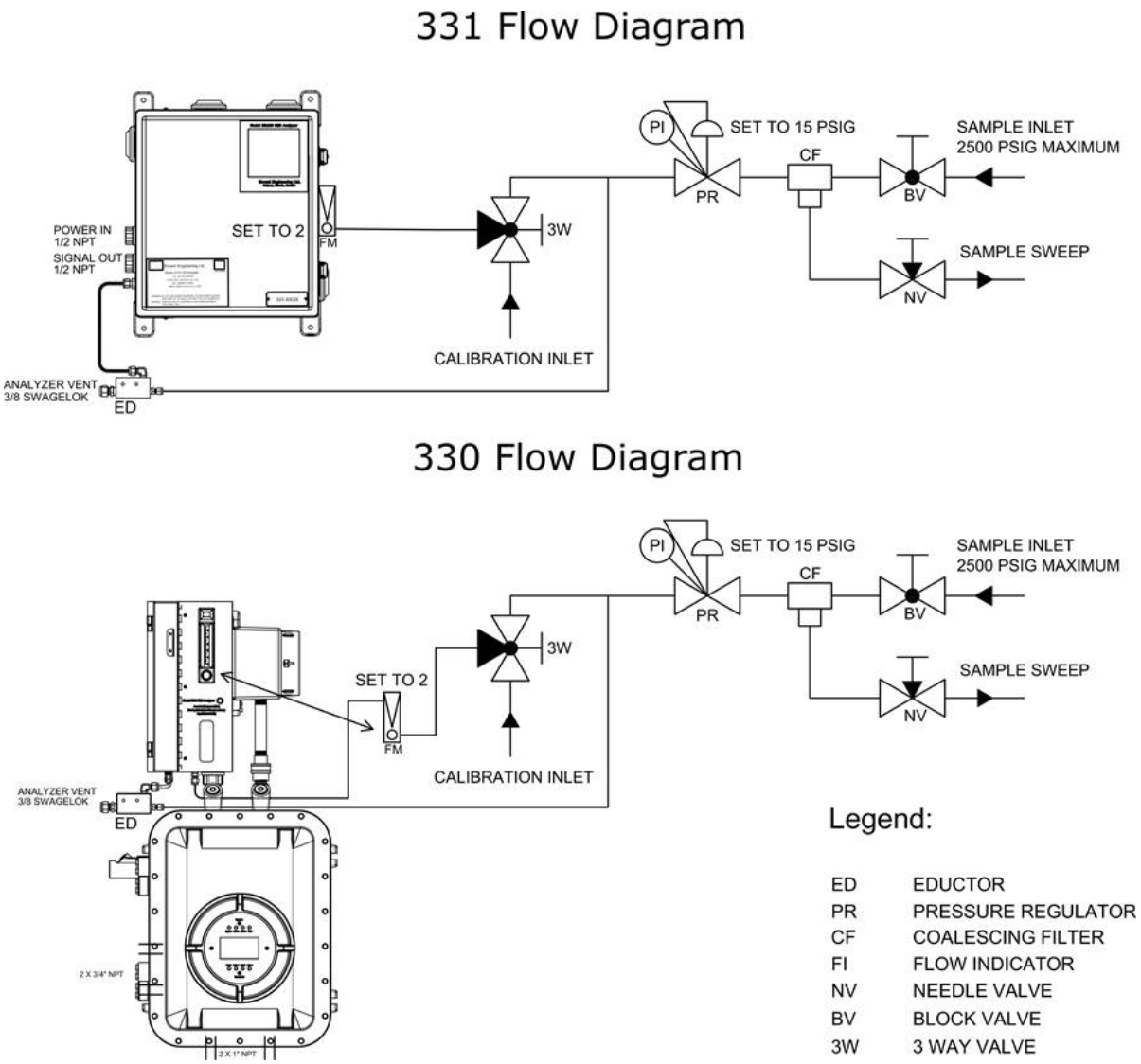

Figure 15: P&ID of Standard Sample System for 330S & 331S H2S Analyzers

Filter Housing

The filter housing is capable of withstanding up to 5000 psig. This filter is typically set as "Particulate" to remove solid particles from the gas sample. For wet/dirty systems, the filter is set as "Coalescent". The bonded microfiber filter element (**PN 2000048**) located inside the filter housing should be changed at least every 3 months or as required depending on the application.

Pressure Regulator

Inlet pressure can vary depending on application and design. The pressure regulator is used to maintain a consistent pressure supply to the analyzer flowmeter.

Pressure Gauge

The Pressure gauge has a range of 0-30 psig. The pressure should be maintained at 15 psig for normal operation. The lowest pressure found to be acceptable for proper H_2S measurement is 0.5 psig; however, it is not recommended to have a lower pressure than 10 psig.

Three-way Valve

The Three-way Valve allows the user to manually switch from sample gas to calibration gas.

Sweep Needle Valve

This needle valve works by draining any contaminants that may collect from the filter. It also reduces lag time in the sample piping. To learn more about lag time in the sample inlet please go to “3.3.5 Sample Volume & Flow Rate”

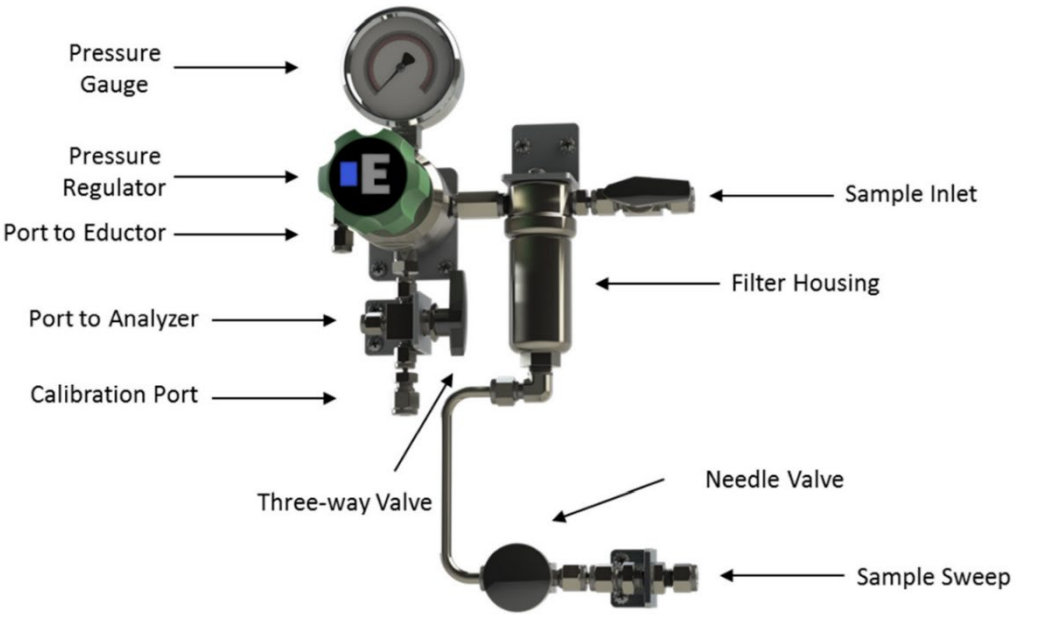

Figure 16: Conventional Standard Sample System

CAUTION:
Maximum pressure for the standard sample conditioning system (conventional) is 2500 psig.

Pressure Regulator and Filter Housing (Alternative)

The sample conditioning system comes with Envent's IFR regulator and filter housing unit. The maximum inlet pressure is 3600 psig and outlet is 0-25 psig. Refer to Figure 17.

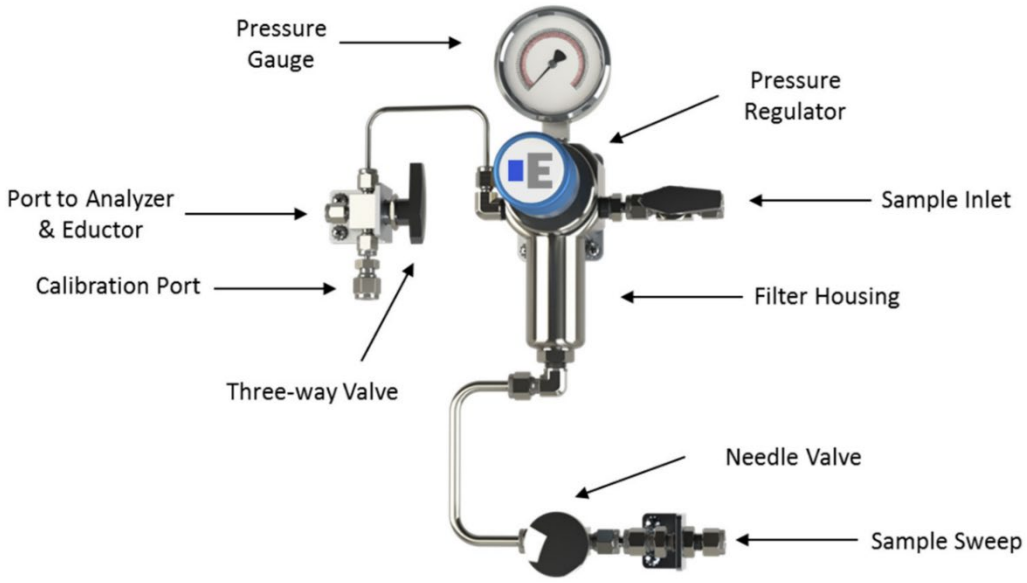

Figure 17: Alternative Standard Sample System

3.3.6.8 Low H2S Sensing Tape Sensor

Analyzers can automatically alarm when the H2S sensing tape is almost consumed and needs to be changed. It alarms when the tape has 1-2 days left remaining on the roll. This sensor is installed at customer request, or it can be obtained after purchase. Refer to figure 18.

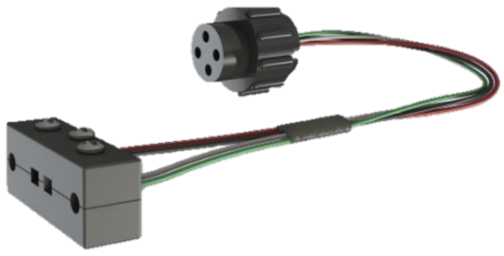

Figure 18: Low H2S Sensing Tape Sensor (PN 3100041)

3.3.6.9 Low Sample Pressure Switch

Analyzers with low pressure switches will alarm when the sample inlet pressure drops below 10 psig. Pressure switch or switches are installed at customer request.

Figure 19: Internal & External Pressure Switches

There are two types of pressure switches available. Internal pressure switch and external pressure switch; refer to Figure 19. Both styles can be used for both the 330S and 331S H_2S analyzers. If the internal switch is used on the 330S H_2S analyzer (division 1), a flame arrestor is used to comply with regulation standards.

3.3.6.10 Powered AO Boards

The 330S/331S H_2S analyzers have two isolated loop power 4-20mA Outputs. For self-powered AO, powered AO boards can be implemented at customer request; refer to Figure 20.

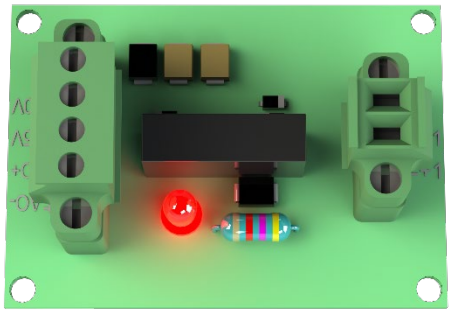

Figure 20: Analog Output Board

3.3.6.11 Ethernet Communication Card

For Ethernet (TCP/IP Protocol), at customer request, an optional communication card which is added/connected to the main board can be implemented, refer to Figure 21.

The communication card is compliant with IEEE 802.3 standards and has an RJ-45 jack for ethernet communication at 10Mbps.

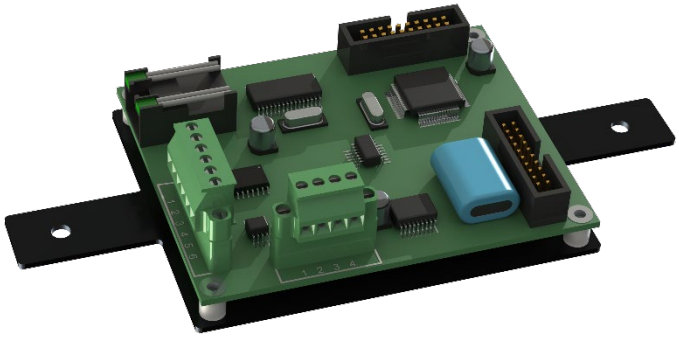

Figure 21: Ethernet Communication Card

4.0 OPERATION & CONFIGURATION

4.1 Start-up Procedure

The following steps should be followed for proper installation and start-up of the analyzer.

CAUTION:
Before commencing the start-up procedure for the analyzer, please ensure that all sections within "3.0 Installation" have been understood and addressed. Do not proceed until this is done as significant safety hazards can arise if the analyzer is not properly set-up prior to start-up.

During start-up, it is possible that the analyzer and/or the SCS will be contaminated with a scavenger solution or other contaminants if sample tubing is not properly purged. The flow meter should be inspected for liquids to ensure that the float moves freely.

1. Ensure there is enough H_2S Sensing tape.

2. Ensure the humidifier is filled up to the fill line with 5% acetic acid and that the fluid in the humidifier is up to the temperature of the room the analyzer will be operating in.

3. Apply power to the analyzer. The display will illuminate and the H_2S sensing tape will advance for a few seconds.

4. Press the menu button until "mV" is displayed. Check that the reading is 1000 mV (± 100 mV). Check "4.2 Analyzer Display Interface".

There are two mV values shown in the display, the "Zero Sensor" and the "mV" Values. Check for the "mV" Values.

For the SDS models, check for "Sensor 1 mV" and "Sensor 2 mV".

5. Make sure the sample inlet valve, sample sweep valve, and pressure regulator are completely closed. The pressure regulator is closed when the knob handle is counter clockwise.

6. Turn on the sample gas flow to the sample conditioning system and then open the sample inlet valve.

7. Open the sweep valve slightly (1/8 of a turn) and adjust pressure regulator to 15 psig and the flow meter to 2.0, unless otherwise stated. On a new commission, it is advised to let the sample sweep for 5-10 minutes before introducing gas to the rest of the sample system. This allows contamination from construction to be purged prior to entering the analyzer.

8. Allow twenty minutes for the analyzer to stabilize. The analyzer calibration can be verified if calibration gas is available. If no calibration gas is available, the analyzer may be operated using the factory calibration settings until calibration gas is available.

4.2 Analyzer Display Interface

By using the analyzer's display, the user can only view and/or change certain parameters set at the factory. The display is made up of a Graphic Display, four (4) pushbuttons and (8) LED's. Refer to Figure 22.

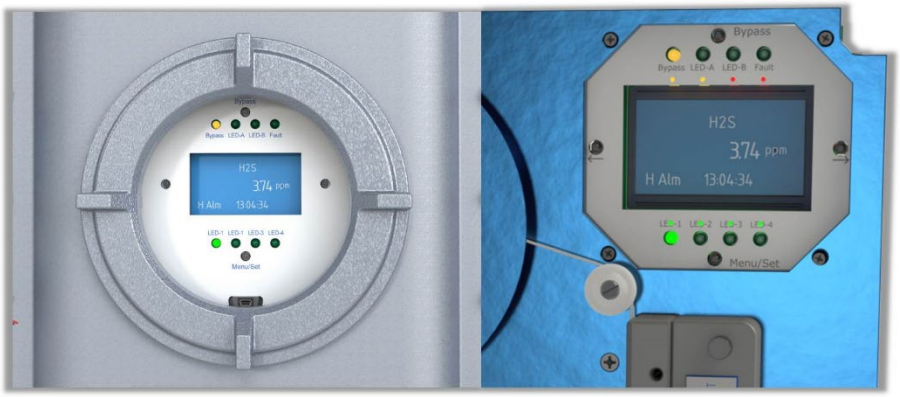

Figure 22: 330S Display (left) & 331S Display (right)

Button	Description/Function
Bypass	Used to inhibit all analyzer alarms to a non-alarm state and set the analog 4-20 mA output to 2 mA. The Bypass LED illuminates when Bypass mode is enabled. Bypass does not inhibit any Modbus or ethernet alarms.
Scroll Right [→]	Used to move the cursor to the right. Also used to SAVE configuration adjustments when moved all the way to the right of the screen.
Scroll Left [←]	Used to move the cursor to the left. Also used to CANCEL configuration adjustments when moved all the way to the left of the screen.
Menu/Set	Used to cycle through the menu options. Also used to increase numerical values when making configuration adjustments.

Table 4: Display Button Description/Function

LED	Description/Function
Bypass	Illuminates when the analyzer is in bypass mode.
LED A & B	Red LEDs that can be used for different alarm configurations. By default, these LEDs are left as spare.
Fault	Illuminates when there is a fault in the Analyzer. Fault is used for Board temperature, Sensor High/Low, Low H_2S sensing tape sensor, Pressure switch, etc.
LED 1 to 4	Green LEDs that can be used for different alarms or conditions. By default, H alarm activates LED-1 and HH alarm activates LED-2. (Refer to the LED Sticker on the analyzer door on the inside (331S) or to the right side of the blue chassis on of the XP enclosure).

Table 5: Display LED Description/Function

4.3 Calibration Procedure

4.3.1 H_2S Gas Calibration

Depending on the application, the 330S/331S H_2S analyzer will require more or fewer periodic calibrations. There is no specific time as to how often the H_2S analyzer should be calibrated. It will depend on the application, importance of accuracy for the application, and how dirty or clean the environment and sample are. Sample system and analyzer should be checked every three to four months. The following is the calibration procedure for the 330S/331S H_2S analyzer:

1. Source a calibration gas of H_2S in a balance of N2 (or CH4) regulated to 15 psi (check expiry date). H_2S concentration to be approximately 2/3 of full-scale range or close to the H_2S alarm set point.

If the unit was calibrated using an N2 or Air balance, introducing a methane-balanced stream will cause the analyzer to read higher than the actual value. While calibration with N2 or Air balanced gas confirms the analyzer's repeatability and stability, the most accurate measurements are obtained by calibrating the H2S analyzer with a calibration gas that closely matches the composition of the gas being analyzed. This approach enhances the accuracy of the readings and ensures consistent and reliable performance of the analyzer in its specific application.

2. Press the bypass button and verify the "Bypass" LED illuminates (alarms will be held in the non- alarm state). Bypass does not inhibit any Modbus or ethernet alarms.

3. Turn off all gas supplies to the analyzer and check that a sufficient amount of H_2S sensing tape is installed. Sample gas will be turned on again during step 7 prior to introducing the calibration gas.

4. Press the "Menu/Set" button until "Motor Run" is displayed. Press the right arrow [→], the H_2S sensing tape will advance for approximately 10 seconds.

5. Press the "Menu/Set" button until "mV" is displayed ("###mV"). If the mV reading is 1000mV (±100mV), proceed to the next step, otherwise re-zero. Refer to “4.3.2 Re-zero Sensor Procedure”.
6. Connect calibration gas to calibration port and turn the 3-way calibration valve 180°. The valve handle should be pointing towards where the gas bottle tubing is connected to (Calibration Inlet).

7. Turn on sample inlet valve, ensure that the sample regulator is supplying 15psig to the eductor (make sure there is suction from the eductor block). Adjust the flow meter to 2.0.

8. Wait until the H_2S reading has stabilized (20 to 30 minutes).

9. With calibration gas applied, if H_2S reading is satisfactory (±2% of analyzer full range) skip to step 16, if H_2S reading is not satisfactory a gain adjustment is required, continue to step 10.

10. Press the "Menu/Set" button until the gain setting is displayed ("### Gain").

11. Using the average of minimum 3 stable readings, calculate the new gain. The new gain value should be within approximately 25% of the gain installed at the factory.

$$\left[\frac{\text{Cal Gas Concentration}}{\text{Current Readings}}\right] \text{X (Current Gain) = (New Gain)}$$

Equation 2: Gain Calculation

12. To adjust the gain setting such that the analyzer displays the correct H_2S concentration, press the right [→] and / or left [←] arrows until the cursor is underneath the number you wish to change.

13. Adjust the number using the "Menu/Set" button (it will increase until "9" then will cycle back to "0").

14. Save the new gain value by pressing the right arrow [→] until "✓" appears or discard by pressing the left [←] arrow until "X" appears.

15. Allow the analyzer to complete at least two stable cycles using the new gain value. The H_2S reading should match the calibration gas concentration. Repeat step 10 if necessary.

16. Return to sample gas flow using the 3-way calibration valve.

17. Set the sample gas pressure to 15 psig and set the flow meter to 2.0, unless otherwise stated.

18. Close calibration gas bottle and allow it to bleed down through the analyzer prior to disconnecting it.

19. Wait 10 to 15 minutes to confirm the analyzer reads below the H_2S alarm set points.

20. Remove the analyzer from bypass mode by pressing the bypass button. Verify the "Bypass" LED turns off.

CAUTION:
Alarms are armed after removing the bypass mode.

4.3.2 Re-zero Sensor Procedure

1. Press the bypass button and verify that the "Bypass" LED illuminates. (Bypass does not inhibit any Modbus or ethernet alarms).

2. Turn off sample gas flow using sample inlet valve.

3. Press the "Menu/Set" button until "Motor Run" is displayed. Press the right arrow [→], the H_2S sensing tape will advance for approximately 10 seconds.

4. Remove the sensor cover.

5. Press the small pushbutton on the sensor block located on the lower left side next to the wire connector.
   - The sensor block will implement a "re-zero" procedure, indicated by a lit, red LED.
   - When the "re-zero" procedure is complete the LED light will turn green.

6. Initiate another motor run (Step 3).

7. Press the "Menu/Set" button until "### mV" is displayed.
   - Value should be 1000mV (±100mV)

8. Put on sensor cover.

9. Turn on sample gas flow using sample inlet valve.

10. Set the gas pressure to 15 psig and the flow meter to 2.0, unless otherwise stated.

11. Confirm the analyzer reads below the H_2S alarm set points.

12. Remove the analyzer from bypass mode by pressing the bypass button. Verify the "Bypass" LED turns off.

CAUTION:
Alarms are armed after removing the bypass mode.

5.0 MAINTENANCE

CAUTION:
Do not disconnect equipment unless power has been switched off or area is known to be non-hazardous.

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

Electrostatic Hazard – Backpan and Certification nameplate must be cleaned only with a damp cloth to prevent static charging hazard.

Hydrogen Sulfide and/or other hazardous gases may be present under normal operation – proper precaution and protective equipment is advised.

Incorrect configuration of the analyzer may cause incorrect operation. Injury and/or damage to facilities may occur. Check analyzer's functionality after configuration changes have been made.

Disassembly of the pressure regulator and solenoids in the field is not advised. Consult Envent Engineering Ltd if the regulator or solenoid appears contaminated.

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

Do not use solvents, brake cleaners, soaps, detergents or rubbing alcohol to clean up analyzer or sample system.

Substitution of components may impair intrinsic safety and suitability for Class I, Division 1.

Open circuit before removing cover.

The glass window on the XP enclosure must remain installed in order to maintain area classification.

Substitution of components may impair suitability for Class I, Division 2.

The 330S/331S H_2S analyzer will provide reliable service with very little attention. If the analyzer is kept clean there should be no requirement to recalibrate from factory gain settings. However, regular check-ups (at least every three months) will ensure that the analyzer is operating to specifications.

- Ensure that the H_2S sensing tape take-up and feed reels are tight.
- Ensure that the flow meters, humidifier tubing and sample chamber tubing are free of liquid or particulate contamination. If the sample conditioning system is flooded with liquid, refer to "5.2 Sample Conditioning System Cleaning Procedure".
- Ensure there is enough H_2S sensing tape, especially if a low H_2S sensing tape sensor is not installed. Refer to "5.1 H_2S Sensing Tape Change Procedure".
- Check the sample conditioning filter(s) every time the H_2S sensing tape is replaced. Replace the filter(s) as required.

5.1 H_2S Sensing Tape Change Procedure

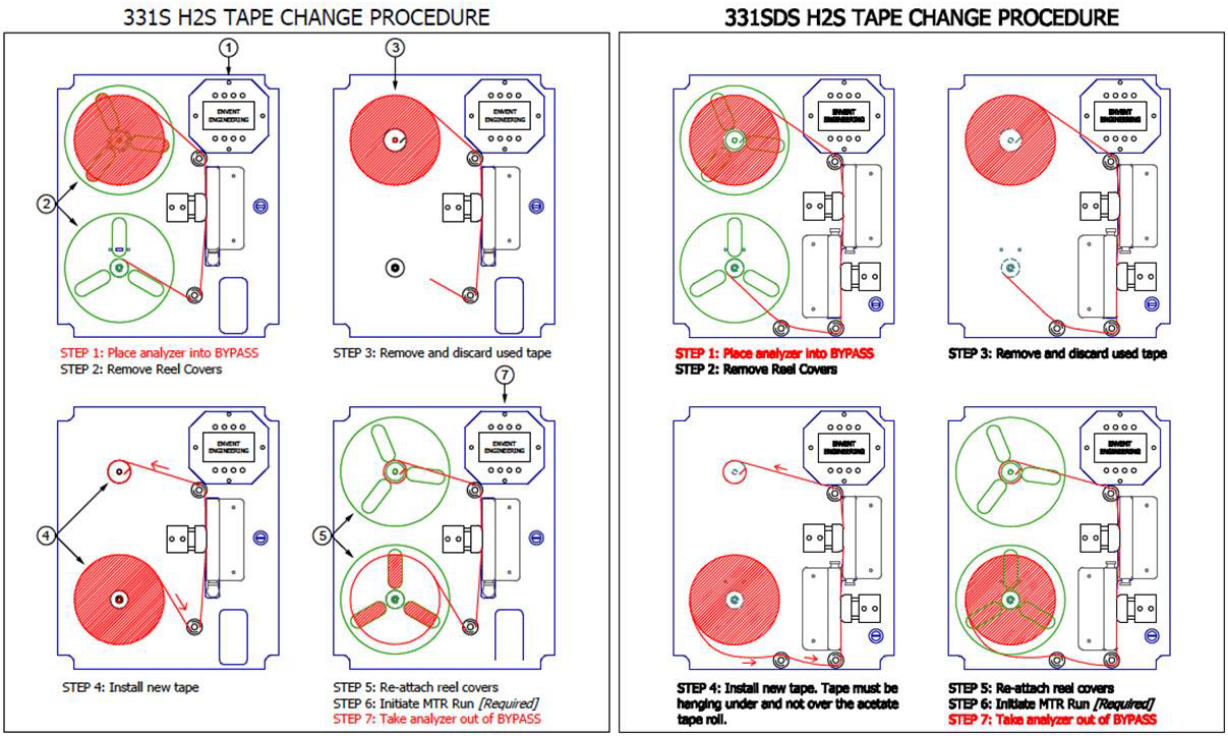

Figure 23. 331S & 331SDS Sensing Tape Change Procedure (Same as 330S & 330SDS models)

5.2 Sample Conditioning System Cleaning Procedure

During start-up or plant upset situations, the 330S/331S H_2S analyzer may become contaminated with amine or hydrogen sulfide scavenger solution. This may cause the analyzer to read low (this can be determined at calibration). If the analyzer reads low, it will require an increase in the gain to maintain calibration. Please refer to factory calibration sheet for factory set gain factor. If the scavenger solution is water soluble it should be relatively easy to clean.

5.2.1 Material List

Cleaning Kit Part Number: 3000011

- Alconox RBS Solid, powdered precision cleaner w/ MSDS (2.5 tbsp)
- **3000010** – Rear window and gasket
- **1300325** – Mini Aluminum Fitting, 1/8" tube x 1/4-28" UNF (x2)
- **1300328** – Mini Aluminum Fitting, 1/4" x 1/8" MPT
- **1300323** – 3/16" tube x 1/8" MPT, Mini Polypropylene Elbow
- **1300327** – Mini Aluminum Fitting, 1/8" x 1/4" MPT (x2)
- **1300343** – Male Threaded Plug Fitting, Straight, 1/4" NPT
- LT-2-4 (1/4" x 11") – Tubing for sample chamber to humidifier
- LT-2-4 (1/4" x 10") – Tubing for flow meter to humidifier
- LT-3-5 (3/16" x 10") – Tubing for sample chamber to vent block
- PFA (24") – Tubing for flowmeter to bulkhead

NOTE: An appropriate aperture may be required.

CAUTION:
Do not use solvents, brake cleaners, soaps, detergents or rubbing alcohol to clean up analyzer or sample system.

5.2.2 Cleaning Procedure

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

2. Sample line tubing
   - Shut off flow at the sample point prior to sample conditioning system.
   - Flush the sample line and components with cleaning solution.
   - Rinse with fresh water.
   - Flush with isopropyl alcohol.
   - Dry with clean, dry instrument air or gas.

3. Sample conditioning system
   - **Take pictures of SCS before disassembling.**
   - Remove filter elements from filter housings and discard.
   - Remove all sample conditioning system components and soak in cleaning solution.
   - Ensure valves are fully open when cleaning.
   - Flush sample components with fresh water.
   - Rinse with isopropyl alcohol.
   - Blow dry with clean compressed air or fuel gas.
   - If the clear Vinyl tubing appears discolored, replace the tubing.
   - Nafion tubing on humidifier should be replaced if it appears contaminated. **Do not clean Nafion tubing with isopropyl alcohol.**

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

4. Re-assemble Stainless Steel Tubing to analyzer according to analyzer drawing, refer to pictures taken before disassembling or refer to drawing package.
5. Once the sample conditioning system has been re-assembled, apply calibration gas to the analyzer. Refer to "4.3.1 H2S Gas Calibration".

6.0 TROUBLESHOOTING

H2S Readings Issues		
Problems	**Possible Reasons**	**Possible Solutions**
Erratic H2S Readings	Trigger slide and H2S sensing tape not seated properly	Ensure trigger slide and H2S sensing tape are seated in the groove of the sample chamber.
	Pressure in building changing from fan, exhaust, or wind	The eductor should counteract this effect; however, the eductor may be plugged, or the vent may be blocked. Check there is no blockage and that all vent tubing and fitting are 316 stainless steel, sized 3/8'' or larger on a downward slope.
	Sample vent/Eductor either blocked or frozen	Check there is no blockage on the vent and/or eductor. Check for vacuum in Eductor block. Vent tubing and fittings should be 316 stainless steel 3/8'' or larger on a downward slope. Possible heat trace required.
	Analog input 2 jumper removed	Re-install jumper in Analog Input across (+4-20 & -4-20) on the controller board.
	Sensor/ sensor wire failure	Re-zero sensor block. Refer to "4.3.2 Re-zero Sensor Procedure". If the procedure fails, sensor or sensor wire may require a replacement.
	Sensor did not zero on white H2S sensing tape	1. Check the H_2S Sensing tape, if not properly installed, refer to "5.1 H_2S Sensing Tape Change Procedure" or the sticker in the analyzer's door. 2. Perform a motor Run: Display>Press Menu Button until "Motor Run">Press right button. This will activate the motor and move the H_2S Sensing tape for a few seconds. 3. Re-zero sensor block if necessary. Refer to "4.3.2 Re-zero Sensor Procedure".

	Regulator not maintaining 15 psig (Changing flow rate to analyzer)	Replace Regulator, Consult Envent Engineering Ltd.
	Contaminants in sample chamber	Clean sample chamber, aperture, and window; replace if required. Contact Envent Engineering Ltd for replacement assistance.
	Contaminants or liquid carry over in sample conditioning system	If contaminants or liquid has carried over the sample system, refer to “5.2 Sample Conditioning System Cleaning Procedure”.
	Humidifier leaking	Humidifier needs to either be repaired or replaced. Consult Envent Engineering Ltd.
	Possible high pressure in flare line (Dilution option only)	Install a higher rated check valve.
Slow response	Aperture out of place or not optimized for required range	1. Remove the sample chamber. 2. Unscrew the sensor block and check the aperture to ensure it's in its correct position. 3. If necessary consult the section ("Aperture Strip") to determine the required aperture size. 4. If necessary, contact Envent Engineering Ltd to order a new aperture and to obtain assistance in installing the new aperture. 5. After installing the new aperture, follow the "4.3.1 H2S Gas Calibration" procedure to recalibrate the analyzer.
	Contaminants or liquid carry over in sample conditioning system	If contaminants or liquid has carried over the sample system, refer to “5.2 Sample Conditioning System Cleaning Procedure”.
Higher than Expected Readings	Sample vent/Eductor either blocked or frozen	Check for blockage in the vent and/or eductor. Check for vacuum in Eductor block. Vent tubing and fittings should be 316 stainless steel 3/8'' or larger on a downward slope. Possible heat trace required.

	Contaminants in sample chamber	Clean sample chamber, aperture, and window; replace if required. Contact Envent Engineering Ltd for replacement assistance.
	Aperture out of place or not optimized for required range	1. Remove the sample chamber. 2. Unscrew the sensor block and check the aperture to ensure it's in its correct position. 3. If necessary consult the section ("Aperture Strip") to determine the required aperture size. 4. If necessary, contact Envent Engineering Ltd to order a new aperture and to obtain assistance in installing the new aperture. 5. After installing the new aperture, follow the "4.3.1 H2S Gas Calibration" procedure to recalibrate the analyzer.
	Sensor/ sensor wire failure	Re-zero sensor block. Refer to "4.3.2 Re-zero Sensor Procedure". If the procedure fails, sensor or sensor wire may require a replacement.
	Gain set too high	Gain is too high for the current setup. Re-calibrate analyzer and refer to the factory gain. The difference between the factory gain and the new gain should not be greater than +/- 25%. If necessary, do a gas calibration. Refer to "4.3.1 H2S Gas Calibration".
	Higher than required pressure/flow	Adjust pressure regulator to 15 psig and flow meter to 2.0, unless otherwise stated.
	Dilution canister tubing loose (Dilution option only)	Tubing inside the canister leaking. Open canister (follow all safety procedures to bleed out all high H2S level concentrations) and re-connect the tubing to the fittings on canister lid. Contact Envent engineering Ltd for replacement if required.

	Total Sulfur's Hydrogen flow was decreased at the flow meter (Total Sulfur option only)	The flow of hydrogen mixed with sample gas has decreased. Either the hydrogen bottle is empty, or the flow was decreased through the flow meter adjustment. Adjust back to appropriate flow rate.
Lower than Expected Readings	Leaks in the sample system causing lower readings	Do a leak check on the sample system and humidifier. Use soap to detect the possible leaks in the system.
	Flow is too low	Make sure that the flow of sample gas coming into the analyzer is set to "2" (83.63 cc/min) at the flow meter.
	Gain set too low	Gain is too low for the current setup. Re-calibrate analyzer and refer to current gain (from factory). The difference between factory gain and new gain should not be greater than +/- 25%. If necessary, do a gas calibration. Refer to "4.3.1 H2S Gas Calibration".
	Not using the humidifier or humidifier leaking	A humidifier is not necessary if the sample gas inlet is already humidified. If the sample gas inlet is dry, a humidifier must be used. Make sure the humidifier unit is placed and installed correctly. Please refer to "3.3.6.4 Humidifier Unit". Humidifier Leaking: it needs to either be repaired or replaced. Consult Envent Engineering Ltd.
	Sensor/ sensor wire failure	Re-zero the sensor block. Refer to "4.3.2 Re-zero Sensor Procedure". If procedure fails, sensor or sensor wire may require replacement.
	Dilution Instrument air or carrier gas flow was increased (Dilution option only)	If the instrument air or the carrier gas is increased in flow, the readings will be lower. Make sure to keep a constant flow and pressure for the instrument or carrier gas.
	Hydrogen flow has been increased (Total Sulfur option only)	Lower the hydrogen flow to the specified on the flow meter.

Table 6. H2S Sensing Troubleshooting

H2S Sensing Tape Issues		
Problems	**Possible Reasons**	**Possible Solutions**
Tape does not advance	No tension on take up reel	Check setscrew in take up reel collars, if loose; tighten up with a 1/16" hex key. Do a manual advance on H2S sensing tape. To do a motor run: Display>Press Menu Button until "Motor Run">Press right button. This will activate the motor and move the H2S Sensing tape for a few seconds.
Tape breaking	High liquid content in sample gas	Probe and additional filtration may be required in sample conditioning system.
	Feed wheel not spinning freely	Dust and refuse build up between the feed wheel and chassis. Requires removal and cleaning of chassis.
	Tape reel plates pressing against H2S sensing tape	H2S sensing tape reel plate became warped. Needs to be flattened to not contact tape when on feed wheel bolt. If replacement needed, consult Envent Engineering Ltd.
	Trigger slide not seated properly	Ensure trigger slide is seated in groove of sample chamber.
Overlapping Stains	This is normal in the 1st 1/4 of a new H2S sensing tape. It should not cause any reading problems.	If it is causing reading problems, the "stop threshold" can be modified from 1,000,000 to 500,000. Please consult Envent Engineering Ltd before proceeding with this change.
Excessive H2S sensing Tape consumption	Sample vent either blocked or frozen	Check there is no blockage on the vent and/or eductor. Vent tubing and fittings should be 316 stainless steel 3/8'' or larger on a downward slope. Possible heat trace required.
	Contaminants in sample chamber	Clean sample chamber. Replace aperture, window and gasket if required. Contact Envent Engineering Ltd for replacement and assistance.

	The concentration at your process/sample point consistently exceeds the originally ordered analyzer range	You may need to adjust the range on your analyzer to align with the new concentration. New size aperture window and calibration may be required. Please contact the factory for assistance.
	Aperture out of place or not optimized for required range	1. Remove the sample chamber. 2. Unscrew the sensor block and check the aperture to ensure it's in its correct position. 3. If necessary consult the section ("Aperture Strip") to determine the required aperture size. 4. If necessary, contact Envent Engineering Ltd to order a new aperture and to obtain assistance in installing the new aperture. 5. After installing the new aperture, follow the "4.3.1 H2S Gas Calibration" procedure to recalibrate the analyzer.
	Sensor/ sensor wire failure	Try re-zeroing the sensor. Refer to "4.3.2 Re-zero Sensor Procedure". If procedure fails, Sensor or sensor wire may require replacement.
H2S sensing Tape coming out of sample chamber slot	Trigger slide not seated properly	Ensure trigger slide is seated in groove of sample chamber

Table 7. Sensing Tape Troubleshooting

Electronics Issues		
Problems	**Possible Reasons**	**Possible Solutions**
Fault LED (Sensor High)	Incorrect zeroing	Make sure the H2S Sensing tape is installed properly and do a motor run. To do a motor run: Display>Press Menu Button until "MTR Run">Press right button. This will activate the motor and move the H2S Sensing tape for a few seconds. The alarm should clear. Re-zero sensor block. Refer to Refer to "4.3.2 Re-zero Sensor Procedure
	Faulty Sensor	The sensor needs to be replaced. Contact Envent Engineering Ltd for replacement.
Fault LED (Sensor Low)	Sensor did not zero on white H2S sensing tape because H2S sensing tape came out of sample chamber slot	Re-install H2S Sensing tape. Refer to "5.1 H2S Sensing Tape Change Procedure" or the sticker in the analyzer's door. Re-zero sensor block. Refer to "4.3.2 Re-zero Sensor Procedure".
	Sensor/ sensor wire failure	Re-zero the sensor block. Refer to "4.3.2 Re-zero Sensor Procedure". If procedure fails, sensor or sensor wire may require replacement.
	IS Barrier failure (For 330S analyzer series only)	IS Barrier may need replacement. Consult Envent Engineering Ltd.
	Contaminants in sample chamber	Clean sample chamber. Replace aperture, window and gasket if required. Contact Envent Engineering Ltd for replacement and assistance.
Fault LED (Low H2S sensing Tape)	New H2S sensing tape is required	H2S Sensing tape requires change (Average of 2 to 3 days left, from the moment alarm goes off, for the tape to be completely used up).
	Low H2S sensing tape sensor failure	If the alarm does not clear once a new H2S sensing tape is installed, the low H2S sensing tape sensor, or its wires have failed and need to be replaced. Consult Envent Engineering Ltd to order a replacement. Low Tape Sensor Assembly Part #: **3100041**
Fault LED (Low Pressure)	Pressure of sample gas is lower than setpoint of	Inspect the sample inlet upstream to troubleshoot the problem.

	pressure switch (factory set to 10 psi descending)	
	Pressure switch failed	If pressure is above 10 psi and alarm continuous, the pressure switch setpoint might have changed. Set back to 10 psi descending. Also, check pressure switch wiring. If the problem persists, the pressure switch might need replacement. Contact Envent Engineering Ltd.
	Pressure regulator failed	Contact Envent Engineering Ltd for replacement and assistance.
Fault LED (Oven Fail)	Fuse not installed or blown.	The fuse for the furnace does not come installed in the controller board. Please check spare fuse bag and install fuse.
	Faulty temp switch	Temp Switch needs to be replaced. Contact Envent Engineering Ltd for replacement.
	Oven not working properly	The oven failed and the temperature has dropped below the optimal temperature. Please consult Envent Engineering Ltd.
Blank Display	Display not working properly	The display failed. Please consult Envent Engineering Ltd for replacement.
	Excessive ambient temperature	High temperatures may cause permanent damage to the display. Please consult Envent Engineering Ltd for replacement.
	Broken/malfunctioning cable.	Please consult Envent Engineering Ltd for replacement.
Analyzer not communicating with PC	Multiple reasons could be causing the analyzer to not communicate properly with the PC.	1. Check that the analyzer is ON and working properly. 2. Check that the communication cable is properly connected. 3. If the software application was open before connecting the communication cable from the analyzer to the computer, close the software and re-open it. 4. Try to enable communication again.

Analyzer not turning ON	Blown fuse	Check fuse in the controller board. Replace if required.
	Controller board malfunction	Consult Envent Engineering Ltd for a controller board replacement.
	Not using the appropriate voltage rating	Make sure to use the appropriate voltage to power the analyzer. DC controller boards can be powered with 12 - 24 VDC and AC controller boards can be powered with 110 to 240 VAC. Keep in mind that if solenoids are controlled by the controller board, the voltage must match the solenoids voltage rating.
Red LED on Sensor Block	Sensor block fault	Re-zero sensor block. Refer to "4.3.2 Re-zero Sensor Procedure". Check for green status led on sensor block once procedure is done. If sensor LED stays red, consult Envent Engineering Ltd for a replacement.
Analog Outputs (4-20 mA) not working	Not using an external power supply	The analog outputs in the controller board are loop powered and not self-powered unless AO boards were installed as per customer request. If AO boards were not requested, an external power supply must be used. Refer to "Analog Outputs" to see different wiring options.
	The system variable for output has been modified.	By factory configuration, the analog outputs (1 & 2) are configured to output based on H2S Sample 1. Make sure that if they are modified, that the right system variables are selected.
Not coming out of alarm	Alarms are latched	If alarms are latched, they need to be acknowledged. Go to the display> cycle through until "ACK" is reached> press the right button to acknowledge all latched alarms. To deactivate the latching on any alarm, use the ICE software, and connect to the analyzer and de-select latching on any alarm that is latched.

	The analyzer is in an alarm state	Make sure the alarm setpoint values are as desired and that the analyzer is below or above (like temperature setpoint) those setpoint values.

Table 8. Electronics Troubleshooting

Sample Conditioning System Issues		
Problems	**Possible Reasons**	**Possible Solutions**
Liquid Carried over in SCS	Sample too wet for current conditioning sample system.	If a one-time occurrence: Cleaning required for sample system, refer to "5.2 Sample Conditioning System Cleaning Procedure". If more than one time occurrence: Sample conditioning system may need a system for wet/dirty sample gas (extra filters set as coalescing, add liquid float stops, etc.). Consult Envent Engineering Ltd.
Regulator not maintaining 15 psi (erratic H2S readings)	Problems with the Regulator (over pressured)	Replace Regulator, Consult Envent Engineering Ltd.
	Liquid carried over into regulator	Clean, or replace regulator. Consult Envent Engineering Ltd for a replacement.
	Problems with the (50 psi) sample before the regulator at the sample point.	May need heated regulator at sample point to avoid liquid being pulled into the analyzer regulator.
Pressure gauge not working	Over pressured gauge	Replacement is required. Consult Envent Engineering Ltd for replacement.
Flowmeter not working	Liquid carried over into flowmeter	Clean or replace the flowmeter. Consult Envent Engineering Ltd for a replacement.
Frozen humidifier	Analyzer is being exposed to temperatures below 0 degrees °C (or - 2 degrees °C if 5% acetic acid is used)	Do not expose analyzer to temperatures below 0 degrees °C or - 2 degrees °C
Humidifier leaking liquid	The humidifier body cracked - Could be due to extreme temperature changes.	A replacement is required. Consult Envent Engineering Ltd for a replacement.

Table 9. Sample Conditioning System Troubleshooting

Calibration Issues		
Problems	**Possible Reasons**	**Possible Solutions**
Change in gain more than +/- 25% from original gain after calibration	Not using the right calibration concentration.	Make sure the calibration bottle is within the analyzer's range. For more accuracy it is recommended that the calibration gas used is close in value to the alarm's setpoint values.

Table 10. Calibration Troubleshooting

APPENDIX A - RECOMMENDED SPARE PARTS

Part Number	Quantity	Description
3100001 (330S) OR 3100002 (331S)	1	Eductor Block
3100008 (3100009 for SDS)	1	Humidifier Rebuild kit c/w Elbows, Nafion Tubing
3000010	2	Rear Window & Gasket
2000023 - 2000033	1 or (2 for SDS)	Aperture Strip (Associated to measurement range)
2000036	1	4-liter Containers of Acetic Acid
2000040	12	300' Lead Acetate Tape (H2S Sensing Tape)
2000048	1	Box of 10 Micro Filter Glass Fiber Element 12/19-57-50CSK
2000050	2	13'' Chubby Quartz Tube (Total Sulfur option only)
1100113	1	TS Ceramic Heater (Total Sulfur option only)
2000052	4	High Temp O-Ring (Total Sulfur option only)
3000011	1	Tubing, Cleaner, Fittings Maintenance Kit
3100041	1	Low Tape Sensor Assembly

Table 11: Recommended Spare Parts

Envent H2S Lead Acetate Tape Statement of Shelf Life:

Envent Engineering H2S sensing tapes are suitable for use, if stored in the original sealed envelope, for 10 years from date of manufacture.

Tapes should be stored in a cool dry location.

If the seal on the package has been broken in storage, the H2S sensing tape should be discarded.

APPENDIX B – SEALING FITTINGS

HUBBELL ELECTRICAL PRODUCTS
A Division of HUBBELL INC. (Delaware)
2112 Fenton Logistics Park Blvd.
Fenton, Missouri 63026 USA

INSTALLATION, OPERATION & MAINTENANCE DATA SHEET
ENY SEAL FITTINGS
For use in Zone Classified Hazardous Locations

ENY SEALING FITTINGS

CAUTION: Before installing, make sure you are compliant with area classifications, failure to do so may result in bodily injury, death and property damage. Do not attempt installation until you are familiar with the following procedures. All installation must comply with the applicable Electrical Code.

Make sure that the circuit is De-energized before starting installation or maintenance.

Verify that the installation is grounded. Failure to ground will create electrical shock hazards, which can cause serious injury and or death.

Technical information, advice and recommendations contained in these documents is based upon information that Killark believes to be reliable. All the information and advice contained in these documents is intended for use only by persons having been trained and possessing the requisite skill and know-how and to be used by such persons only at their own discretion and risk. The nature of these instructions is informative only and does not cover all of the details, variations or combinations in which this equipment may be used, its storage, delivery, installation, check out, safe operation and maintenance. Since conditions of use of the product are outside of the care, custody and control of Killark, the purchaser should determine the suitability of the product for his intended use and assumes all risk and liability whatsoever in connection therewith.

- For vertical and horizontal conduit installations use Killark "PF" Packing Fiber to build a dam at each conduit hub except for upper hubs in the vertical position as shown in Installation Drawings. Use a wooden stick to force the wires apart and pack the fiber tightly around all wires. The dam must be tight and strong enough to keep the sealing compound from leaking out before it sets up. The completed dam should be even with the conduit stops as shown.

- When using Killark Type "SC" Sealing Compound, mix the sealing compound with water at a rate of 3.3 parts of compound to 1-part water by volume (4 to 1 by weight). Use a clean mixing vessel for each batch. Sprinkle the sealing compound into water while stirring; continue mixing for at least 3 MINUTES. The proper consistency is just fluid enough to pour SLOWLY, like thick gravy (NOT WATERY) and should have a smooth silky shimmer in appearance when mixed correctly. Do not mix more material than can be poured in 15 minutes. Discard any sealing compound that has become too stiff to use. Never attempt to restore workability by stirring in more water. After the compound is mixed properly, slowly pour it into the sealing fitting. Make sure the wires are separated so the compound will completely surround them. Pour slowly to avoid trapping air bubbles in the compound and fill to the required level shown in Table 1.

CAUTION: *FOR GROUPS A, B, C & D*
Sealing compound to be mixed at a temperature no lower than 40°F/4°C and ONLY poured into fittings that have been brought to a temperature of 40°F/4°C. Seals must NOT be exposed to temperatures below 40°F/4°C for at least 72 hours. Compound MUST be allowed 72 hours to cure to full strength before energizing system.

CAUTION: *FOR GROUPS C & D*
Sealing compound to be mixed at a temperature no lower than 35°F/2°C and ONLY poured into fittings that have been brought to a temperature of 35°F/2°C. Seals must NOT be exposed to temperatures below 35°F/2°C for at least 8 hours.

SC SEALING COMPOUIND

CATALOG NO.	CONDUIT SIZE	POUR DEPTH (MIN.)	REQUIRED AMOUNT MIXED (OZ.)
ENY-1	½"	5/8"	1.0
ENY-2	¾"	¾"	1.5
ENY-3	1"	1"	2.5
ENY-4	1 ¼"	1 ¼"	5.5
ENY-5	1 ½"	1 ½"	7.5
ENY-6	2"	2"	10.5

TABLE 1

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- When using Killark KQS "CELOX" Sealing Compound, remove cap by twisting 90° counterclockwise for 50mL cartridge. For larger 250mL cartridge unscrew cap counterclockwise and remove plug (Plug can be saved for re-use of cartridge). Place mixing nozzle onto cartridge and lock into place by twisting 90° for 50mL and screw clockwise for 250mL cartridge. Place 50mL cartridge into the dual dispensing applicator and 250mL cartridge into a high ratio caulking tool. Prime mixing nozzle by depressing handle and pump a small amount of sealing compound through nozzle until a uniform mixture is dispensed.

- Insert mixing nozzle into the seal fitting and fill to the required level shown in Table 2. Make sure the wires are well separated so the compound completely surrounds them. Dispense slowly to avoid trapping air bubbles in the compound. Immediately wipe any spilled compound from conduit and threads, and close the fitting with close-up plug.

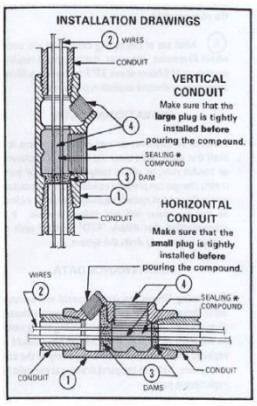
CAUTION: ***FOR GROUPS A, B, C & D (LOW AMBIENT TEMPERATURES)***
KQS Sealing Compound is to be dispensed at temperatures no lower than 40°F/4°C and ONLY poured into fittings that have been brought to a temperature of 40°F/4°C. Seals must not be exposed to temperatures below 40°F/4°C for at least 8 hours. Compound MUST be allowed 8 hours to cure (See KQS Cure Time vs. Temperature Chart 1).

CAUTION: ***TO PREVENT PERSONAL INJURY & IGNITION OF HAZARDOUS ATMOSPHERES***
KQS sealing compound releases heat energy from exothermic reaction after dispensing. The sealing compound is to be fully cured before handling and exposing to hazardous atmospheres. (See KQS Cure Time vs. Temperature Chart 1)

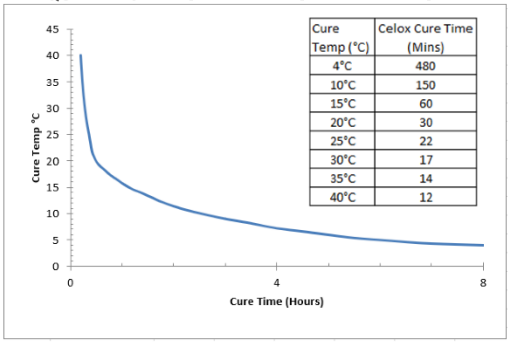
KQS SEALING COMPOUND

CATALOG NO.	CONDUIT SIZE	POUR DEPTH MINIMUM (in)
ENY-1	½"	1.38
ENY-2	¾"	1.62
ENY-3	1"	1.94
ENY-4	1 ¼"	2.19
ENY-5	1 ½"	2.90

TABLE 2



KQS "CELOX" CURE TIME VS TEMPERATUR



Cure Temp (°C)	Celox Cure Time (Mins)
4°C	480
10°C	150
15°C	60
20°C	30
25°C	22
30°C	17
35°C	14
40°C	12

CHART 1

KIL00921491 FORM NO. K1491 R10/19 ECO 8-023-19

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EYS SEALING FITTINGS

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Verify that the installation is grounded. Failure to ground will create electrical shock hazards, which can cause serious injury and or death.

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- When using Killark Type "SC" Sealing Compound, mix the sealing compound with water at a rate of 3.3 parts of compound to 1-part water by volume (4 to 1 by weight). Use a clean mixing vessel for each batch. Sprinkle the sealing compound into water while stirring; continue mixing for at least 3 MINUTES. The proper consistency is just fluid enough to pour SLOWLY, like thick gravy (NOT WATERY) and should have a smooth silky shimmer in appearance when mixed correctly. Do not mix more material than can be poured in 15 minutes. Discard any sealing compound that has become too stiff to use. Never attempt to restore workability by stirring in more water. After the compound is mixed properly, slowly pour it into the sealing fitting. Make sure the wires are separated so the compound will completely surround them. Pour slowly to avoid trapping air bubbles in the compound and fill to the required level shown in Table 1.

CAUTION: ***FOR GROUPS A, B, C & D***
Sealing compound to be mixed at a temperature no lower than 40°F/4°C and ONLY poured into fittings that have been brought to a temperature of 40°F/4°C. Seals must NOT be exposed to temperatures below 40°F/4°C for at least 72 hours. Compound MUST be allowed 72 hours to cure to full strength before energizing system.

SC SEALING COMPOUIND

CATALOG NO.	CONDUIT SIZE	REQUIRED AMOUNT MIXED (OZ.)
EYS-1 & 2	½"	2
EYS-3	1"	5.5
EYS-4	1 ¼"	6
EYS-5	1 ½"	13
EYS-6	2"	20.5
EYS-7	2 ½"	33
EYS-8	3"	38.5
EYS-9	3 ½"	51
EYS-0	4"	51

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- Insert mixing nozzle into the seal fitting and fill to the required level shown in Table 2. Make sure the wires are well separated so the compound completely surrounds them. Dispense slowly to avoid trapping air bubbles in the compound. Immediately wipe any spilled compound from conduit and threads and close the fitting with close-up plug.

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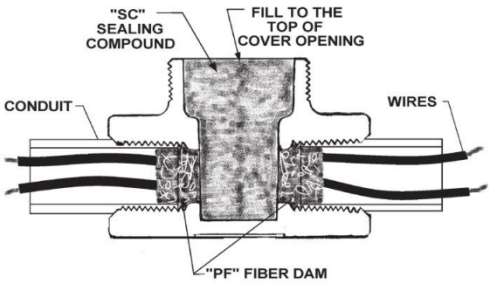
CAUTION: ***TO PREVENT PERSONAL INJURY & IGNITION OF HAZARDOUS ATMOSPHERES***
KQS sealing compound releases heat energy from exothermic reaction after dispensing. The sealing compound is to be fully cured before handling and exposing to hazardous atmospheres. (See KQS Cure Time vs. Temperature Chart 1)

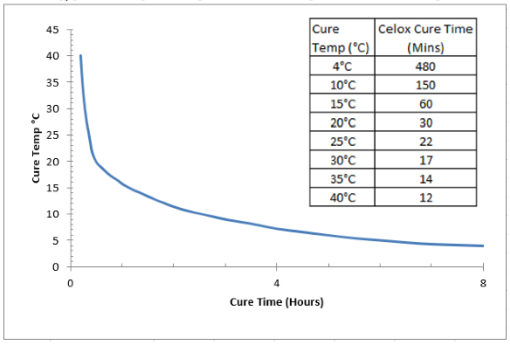
KQS SEALING COMPOUND

CATALOG NO.	CONDUIT SIZE	POUR DEPTH MINIMUM (in)
EYS-1 & 2	½" & ¾"	1.025

TABLE 2



KQS "CELOX" CURE TIME VS TEMPERATURE



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10°C	150
15°C	60
20°C	30
25°C	22
30°C	17
35°C	14
40°C	12

CHART 1

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Verify that the installation is grounded. Failure to ground will create electrical shock hazards, which can cause serious injury and or death.

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- For vertical and horizontal conduit installations use Killark "PF" Packing Fiber to build a dam at each conduit hub except for upper hubs in the vertical position as shown in Installation Drawings. Use a wooden stick to force the wires apart and pack the fiber tightly around all wires. The dam must be tight and strong enough to keep the sealing compound from leaking out before it sets up. The completed dam should be even with the conduit stops as shown.

- When using Killark Type "SC" Sealing Compound, mix the sealing compound with water at a rate of 3.3 parts of compound to 1-part water by volume (4 to 1 by weight). Use a clean mixing vessel for each batch. Sprinkle the sealing compound into water while stirring; continue mixing for at least 3 MINUTES. The proper consistency is just fluid enough to pour SLOWLY, like thick gravy (NOT WATERY) and should have a smooth silky shimmer in appearance when mixed correctly. Do not mix more material than can be poured in 15 minutes. Discard any sealing compound that has become too stiff to use. Never attempt to restore workability by stirring in more water. After the compound is mixed properly, slowly pour it into the sealing fitting. Make sure the wires are separated so the compound will completely surround them. Pour slowly to avoid trapping air bubbles in the compound and fill to the required level shown in Table 1. When no more compound flows from the drain opening, remove the temporary plastic plug and install the drain/breather.

CAUTION: ***FOR GROUPS A, B, C & D***
Sealing compound to be mixed at a temperature no lower than 40°F/4°C and ONLY poured into fittings that have been brought to a temperature of 40°F/4°C. Seals must NOT be exposed to temperatures below 40°F/4°C for at least 72 hours. Compound MUST be allowed 72 hours to cure to full strength before energizing system.

SC SEALING COMPOUIND

CATALOG NO.	CONDUIT SIZE	POUR DEPTH (MIN.)	REQUIRED AMOUNT MIXED (OZ.)
EYD-50	½"	0.55"	1
EYD-75	¾"	0.72"	2
EYD-100	1"	0.77"	4

TABLE 1

HUBBELL ELECTRICAL PRODUCTS
A Division of HUBBELL INC. (Delaware)
2112 Fenton Logistics Park Blvd.
Fenton, Missouri 63026 USA

INSTALLATION, OPERATION & MAINTENANCE DATA SHEET
ENY SEAL FITTINGS
For use in Zone Classified Hazardous Locations

- When using Killark KQS "CELOX" Sealing Compound, remove cap by twisting 90° counterclockwise for 50mL cartridge. For larger 250mL cartridge unscrew cap counterclockwise and remove plug (Plug can be saved for re-use of cartridge). Place mixing nozzle onto cartridge and lock into place by twisting 90° for 50mL and screw clockwise for 250mL cartridge. Place 50mL cartridge into the dual dispensing applicator and 250mL cartridge into a high ratio caulking tool. Prime mixing nozzle by depressing handle and pump a small amount of sealing compound through nozzle until a uniform mixture is dispensed.

- Insert mixing nozzle into the seal fitting and fill to the required level shown in Table 2. Make sure the wires are well separated so the compound completely surrounds them. Dispense slowly to avoid trapping air bubbles in the compound. Immediately wipe any spilled compound from conduit and threads and close the fitting with close-up plug.

CAUTION: ***FOR GROUPS A, B, C & D (LOW AMBIENT TEMPERATURES)***
KQS Sealing Compound is to be dispensed at temperatures no lower than 40°F/4°C and ONLY poured into fittings that have been brought to a temperature of 40°F/4°C. Seals must not be exposed to temperatures below 40°F/4°C for at least 8 hours. Compound MUST be allowed 8 hours to cure (See KQS Cure Time vs. Temperature Chart 1).

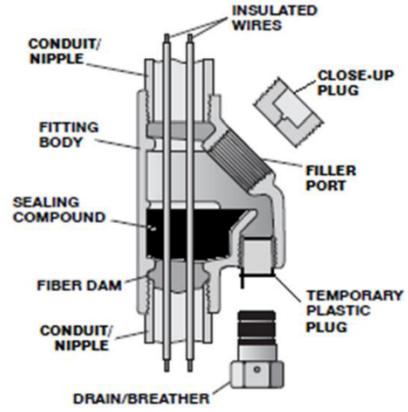
CAUTION: ***TO PREVENT PERSONAL INJURY & IGNITION OF HAZARDOUS ATMOSPHERES***
KQS sealing compound releases heat energy from exothermic reaction after dispensing. The sealing compound is to be fully cured before handling and exposing to hazardous atmospheres. (See KQS Cure Time vs. Temperature Chart 1)

KQS SEALING COMPOUND

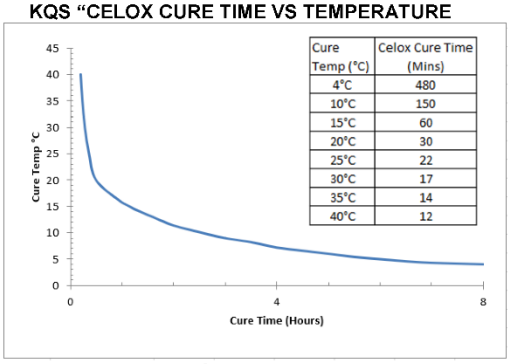
CATALOG NO.	CONDUIT SIZE	POUR DEPTH MINIMUM (in)
EYD-50	½"	0.91
EYD-75	¾"	1.00
EYD-100	1"	1.15

TABLE 2

INSTALLATION DRAWING



KQS "CELOX CURE TIME VS TEMPERATURE



Cure Temp (°C)	Celox Cure Time (Mins)
4°C	480
10°C	150
15°C	60
20°C	30
25°C	22
30°C	17
35°C	14
40°C	12

CHART 1

APPENDIX C – SAFETY DATA SHEET FOR H_2S SENSING TAPE

Envent
Knowledge by Analysis

SAFETY DATA SHEET (SDS)
Global Harmonization System

SECTION 1: CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

1.1 Product Identifier / Product Name

REF (Product Code)	90746
Product Name	Lead Acetate Impregnated Paper Tape

1 x roll Lead acetate paper

1.2 Relevant identified uses of the substance or mixture and uses advised against

Relevant identified uses
Product for Analytical Use.
The Exposure scenario is integrated into sections 1-16.
Uses advised against
not described

1.3 Details of the supplier and of the safety data sheet

Manufactured by:

Envent Engineering Ltd.
2721 Hopewell Place NE
Calgary, AB, CANADA
Tel.: 1-403-253-4012

E-mail:
info@enventengineering.com

1.4 Emergency telephone number

For Chemical Emergency
Spill, Leak, Fire, Exposure, or Accident
Call Envent Engineering **1-403-253-4012**

SECTION 2: HAZARDS IDENTIFICATION

2.1 Classification of the substance(s) or mixture(s)

Lead acetate paper

GHS Directive
Hazard Symbols

GHS08

Signal Word DANGER

Hazard Identification	Hazard Classes/Categories
H360Df	Reproductive Toxicity cat. 1B
H412	Hazardous to the aquatic environment - chronic cat. 3

2.2 Safety, health and environmental regulations/legislation specific for the substance or mixture

According to **GHS** inner packages must be only labelled with symbol(s) and product identifier.

Lead acetate paper

GHS Directive
Hazard Symbols:

GHS08

Signal Word: DANGER

H360Df
May damage the unborn child. Suspected of damaging fertility.

P202, P280sh, P308+313, P405
Do not handle until all safety precautions have been read and understood. Wear protective gloves/eye protection.
If exposed or concerned: Get medical advice/attention. Store locked up.

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2.3 Other hazards

Possible Hazards from physicochemical Properties

Information pertaining to particular Risks to Human and possible Symptoms
Can accumulate within the body.

Information pertaining to particular Risks to the Environment
—

Other Hazards
—

SECTION 3: COMPOSITION/INFORMATION ON INGREDIENTS

3.1 Substances or 3.2 Mixtures

Lead acetate paper tape
Chemical: lead(II) acetate (trihydrate) — Correlation Factor: x 0.546 (=%Pb)
Weight Percent: 10%
Chemical Formula: C4 H6 O4 Pb .3H2 O
Toxic Substance Control Act (TSCA) Inventory: not listed
Registry of Toxic Effects of Chemical Substances (RTECS): OF8050000
EC No.: 206-104-4 — Indice No: 082-005-00-8
acc. 1999/45/EC: R33-52-53-61 — acc. GHS: H360Df, H412

Chemical : filter paper (cellulose CAS 9004-34-6)
Weight Percent: 80-100%
Chemical Formula: (C6 H10 O5)n
Toxic Substance Control Act TSCA Inventory: listed
Registry of Toxic Effects of Chemical Substances (RTECS): FJ5691460
EC No.: 232-674-9
acc. 1999/45/EC: - — acc. GHS: not necessary

3.3 Remarks

List of R and H phrases: see section 16

SECTION 4: FIRST AID MEASURES

4.1 Description of First aid measures

Place insured person out of danger zone to fresh air immediately. Ensure quiet, warmth, and provide resuscitation if necessary. If necessary, contact medical advice.

4.1.1 **After SKIN Contact**
Remove dust with wetted tissue. Remove contaminated clothing. Rinse the affected skin or mucous membrane thoroughly under running water.

4.1.2 **After EYE Contact**
Rub dust with teardrops from eyes or: After contact with the eyes rinse thoroughly under running water with the eyelid wide open with eye washing bottle, eye douche or running water (protect intact eye).

4.1.3 **After INHALATION of Vapors**
After inhalation of dust fresh air should be inhaled.

4.1.4 **After ORAL Intake**
After oral intake lots of water should be drunk after it has been ingested.

4.2 Most important symptoms and effects, both acute and delayed
—

4.3 Indication of any immediate medical attention and special treatment needed

SECTION 5: FIREFIGHTING MEASURES

5.1 Extinguishable Media
Fire extinguishers appropriate to the fire classification, and, if applicable, a fire blanket must be available in a prominent location in the work area. All extinguishers like WATER FOG, WATER SPRAY, alcohol-resistant FOAM, DRY CHEMICAL, CARBON DIOXIDE can be used.

5.2 Special hazards arising from the substance or mixture

5.3 Advice for firefighters
No, for listed product. Product package burns like paper or plastic.

5.4 Additional Information
—

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Global Harmonization System

SECTION 6: ACCIDENTAL RELEASE MEASURES

6.1 Personal Precautions, Protective equipment and Emergency procedure
Regular staff training is necessary.

6.2 Environmental precautions
—

6.3 Methods and material for containment and cleaning up

6.4 Reference to other sections
—

SECTION 7: HANDLING AND STORAGE

7.1 Precautions for safe handling
Handling in accordance with the test instruction, that comes with the product.

7.2 Conditions for safe storage, including any incompatibilities
The original product package of Envent Engineering allows a safe storage.
Storage class: see section 12.1

7.2.1 Conditions for safe storage, including any incompatibilities
Keep original product packages tightly closed during handling and storage.

7.3 Specific end use(s)
—

SECTION 8: EXPOSURE CONTROLS / PERSONAL PROTECTION

8.1 Control parameters

Lead acetate paper

Chemical:	*lead(II) acetate (trihydrate)*		CAS No.: 6080-56-4
Canada CEPA 1999:	not listed		
TSCA Inventory:	not listed	California Prop. 65 List:	listed cancer
NIOSH:	NTP Report on Carcinogens (RoC) List Yes (Lead compound - Reasonably anticipated to be a human carcinogen)		
OSHA:	not listed		
EU carcinogen:	R_E 1, R_F 3		
EU value:	0.15 Pb mg/m³		
Chemical:	*filter paper (cellulose CAS 9004-34-6)*		CAS No.: -
Canada CEPA 1999:	DSL yes		
TSCA Inventory:	listed	California Prop. 65 List:	not listed
NIOSH:	not listed		
OSHA:	not listed		

8.2 Exposure controls
The highest level of cleanliness must be maintained at the workplace.

8.2.1 Respiratory Protection
Only if additional recommendations in test instruction or packing insert.

8.2.2 Hand Protection
Yes, gloves (permeation time >30 min - level 2), consist of PVC, Natural latex, Neopren, or Nitril. Use for short times chemical resistant Latex gloves f.ex. with code EN 374-3 level 1.

8.2.3 Eye/face Protection
Yes, Splash Goggles.

8.2.4 Skin Protection
Recommended.

8.2.5 Hygiene measures
Eating, drinking, smoking, taking snuff and storage of food in work areas and at outdoor workplaces is prohibited. Avoid contact with the skin, eyes and clothing. Rinse any clothing on which the substance has been spilled, and soak it in water. Wash hands thoroughly with soap and water when stopping work and before eating, and then apply protective skin cream.

SECTION 9: PHYSICAL AND CHEMICAL PROPERTIES

9.1 Information on basic physical and chemical properties

Lead acetate paper

Appearance : solid	Color : colorless	Odor : acetic
pH: 5-7		

9.2 Other information
—

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SAFETY DATA SHEET (SDS)
Global Harmonization System

SECTION 10: STABILITY AND REACTIVITY

10.1 Reactivity
no data available

10.2 Chemical stability
no data available

10.3 Possibility of hazardous reactions
no data available

10.4 Conditions to avoid

10.5 Incompatible materials
Only avoid contact with concentrated acids.

10.6 Hazardous decomposition products
In the original package all parts/all reagents are safety and separated stored. Decompositions are not observed during the expiration period under recommended conditions.

SECTION 11: TOXICOLOGICAL INFORMATION

11.1 Information on toxicological effects
Following information is valid for pure substances.

Lead acetate paper

Chemical: $LD50_{orl\ rat}$:	*lead(II) acetate (trihydrate)*	CAS No.: 6080-56-4
	4665 mg/kg	
$LC\_Low_{orl\ hmn}$:	714 mg/kg	
Chemical:	*filter paper (cellulose CAS 9004-34-6)*	CAS No.: -
$LD50_{orl\ rat}$:	>5000 mg/kg	
$LC50_{ihl\ rat}$:	>58004h mg/m³	
$LD50_{drm\ rbt}$:	>2000 mg/kg	

SECTION 12: ECOLOGICAL INFORMATION

12.1 Toxicity
Following information is valid for pure chemicals.

Lead acetate paper

Chemical:	*lead(II) acetate (trihydrate)*	CAS No.: 6080-56-4
Chemical:	*filter paper (cellulose CAS 9004-34-6)*	CAS No.: -

12.2 Persistence and degradability
no data available

12.3 Bioaccumulative potential
no data available

12.4 Mobility in soil
no data available

12.5 Results of PBT and vPvB assessment
no data available

12.6 Other adverse effects
no data available

SECTION 13: DISPOSAL CONSIDERATIONS

Please observe local regulations for collection and disposal of hazardous waste and contact waste disposal company, where you will obtain information on laboratory waste disposal (RCRA Code D002/D003, EU waste code number 16 05 06).

13.1 Waste treatment methods

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Global Harmonization System

SECTION 14: TRANSPORT INFORMATION

No dangerous goods according to IATA transport regulations

14.5 Environmental hazards

low, small amounts

14.6 Special precautions for user

not necessary

14.7 Transport in bulk according to Annex II of MARPOL73/78 and the IBC Code

not applicable

SECTION 15: REGULATORY INFORMATION

15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture

U.S. Federal Regulations
OSHA "A Guide to The Globally Harmonized System of Classification and Labelling of Chemicals (GHS)"
https://www.osha.gov/dsg/hazcom/ghs.html
29 CFR 1910.1200 Hazard communication.
NIOSH Workplace Safety & Health Topics
TSCA Inventory
U.S. State Regulations
California Prop 65, Safe Drinking Water and Toxic Enforcement Act of 1986
Canada
Canada CEPA 1999 - Domestic Substances List (DSL), List of Toxic Substances (Schedule 1)

15.2 Chemical safety assessment

—not necessary for these small amounts

SECTION 16: OTHER INFORMATION

16.1 List of R and H Phrases

16.1.1 List of relevant R Phrases

R33	Danger of cumulative effects.
R52/53	Harmful to aquatic organisms, may cause long-term adverse effects in the aquatic environment.
R61	May cause harm to the unborn child.

16.1.2 List of relevant H Phrases

H360Df	May damage the unborn child. Suspected of damaging fertility.
H412	Harmful to aquatic life with long lasting effects.

16.2 Training Advice

Multiple safety training of staffs about danger and protection by using hazards in working area.

16.3 Recommended Restriction on Use

Only for Professional User.
An individual package of this product or test kit has a moderate hazardous potential.

16.4 Further Information

Envent Engineering Ltd. provides the information contained herein in good faith being up-to-date of own realizations at revision time. This document is intended only as a guide to the appropriate precautionary handling of the material by a properly trained person using this product. Individuals receiving the information must exercise their independent judgement in determining its appropriateness for a particular purpose.
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16.5 Sources of Key Data

GHS: EU Regulation 1272/2008/EC on Classification, Labelling and Packaging of Substances and Mixtures, amending and repealing EU Directives 67/548/EEC and 1999/45/EC, and amending EU Regulation 1907/2006/EC
MSDS: EU Regulation 453/2010/EU REACH - Requirements for the Compilation of Safety Data Sheets
KÜHN, BIRETT (German), Data Sheets of Hazardous Substances

Updated: December 2021

APPENDIX D – SAFETY DATA SHEET FOR ACETIC ACID

Envent

Safety Data Sheet

Section 1. Identification		
Product Identifier	**5% Acetic Acid**	**Version: 2** **Effective Date:** 25 January 2021
Other Means Of Identification	None	
Initial Supplier Identifier	Envent Engineering Ltd. 2721 Hopewell Place NE Calgary, AB T1Y 7J7 Tel: 403-235-4012	
Recommended Use and Restrictions On Use	Industrial acid, reactant, chemical intermediate. No restrictions.	
Product Family	Blend	
Emergency Phone	1-855-887-2055 Monday - Friday 8:00am - 4:30pm MST	

Section 2. Hazard Identification	
Hazard Classification	Not a regulated product
Signal Word	None
Hazard Statement	None
Precautionary Prevention Statement	Non Hazardous
Precautionary Response Statement	Non Hazardous
Precautionary Disposal Statement	Non Hazardous
Precautionary Storage Statement	Non Hazardous
Other Hazards	None

Section 3. Composition / Information on Ingredients			
Chemical Name	**Common Name or Synonyms**	**CAS No. and Other Unique Identifiers**	**% by weight**
Acetic Acid		64-19-7	4 - 6

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Envent

Safety Data Sheet

Section 4. First-Aid Measures	
Eye Contact	Flush eyes with water for 15 minutes. Seek medical attention.
Skin Contact	Wash skin with water.
Inhalation	Remove victim to fresh air. If there is difficulty breathing, seek immediate medical attention.
Ingestion	Rinse mouth with water if conscious. Do not induce vomiting. Lay victim on left side to prevent aspiration of any vomit. Seek immediate medical attention.
Most Important Symptoms and Effects Both Acute and Delayed	May cause slight eye irritation.
Immediate Medical Attention and Special Treatment	Rinse with plenty of water.

Section 5. Fire-Fighting Measures	
Suitable and Unsuitable Extinguishing Media	Use dry chemical, CO_2, water spray (fog), or foam.
Hazardous Combustion Products	Oxides of carbon.
Specific Hazards Arising From the Product	None known
Special Protective Equipment and Precautions For Fire-Fighters	Firefighters should wear self-contained breathing apparatus and full protective clothing. Use water spray to cool containers and structures exposed to fire.

Section 6. Accidental Release Measures	
Personal Precautions, Protective Equipment and Emergency Procedures	Protective equipment is not required under normal conditions of use. Good housekeeping practices should be employed. Ensure adequate ventilation. Secure area. Surface might become slippery.
Environmental Precautions	Not environmentally hazardous.
Methods and Materials For Containment and Clean-Up	Neutralize with sodium carbonate or crushed limestone. Absorb with an inert dry material and place in an appropriate container for waste disposal. Flush area with water to remove trace residues.

Envent

Safety Data Sheet

Section 7. Handling and Storage	
Precautions For Safe Handling	Handle with care. Good housekeeping practices should be employed.
Conditions For Safe Storage	Store in a cool, dry, well ventilated area. Keep containers closed when not in use. Store out of direct sunlight and on an impermeable floor.

Section 8. Exposure Controls / Personal Protection				
Control Parameters	**TWA: 8 Hr**	**STEL: 15 min**	**Ceiling**	**IDLH ***
Acetic Acid	10 ppm OSHA	15 ppm		50 ppm
	* Immediately Dangerous to Life and Health			
Exposure Controls	Local exhaust ventilation			
Appropriate Engineering Controls	Ensure eye wash station is available			
Individual Protective Measures				
Eye / Face Protection	Wear chemical safety goggles			
Skin Protection	Gloves			
Respiratory Protection	Not required under normal conditions of use			

Section 9. Physical and Chemical Properties	
Appearance	Clear, colourless, liquid
Odour	Vinegar odour
Odour Threshold	Not applicable
pH	2.4
Flash Point	>100 °C
Boiling Point and Boiling Range	100 °C
Melting Point and Freezing Point	-2.2 °C
Evaporation Rate	Not determined
Flammability (solid, gas)	N/A
Upper and Lower Flammability or Explosive Limits	No data
Vapour Pressure	No data
Vapour Density	2.1
Relative Density	1.01
Solubility	Soluble
Partition co-efficient, n-Octanol/Water	No data
Auto-ignition Temperature	No data

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Safety Data Sheet

Decomposition Temperature	No data
Viscosity	No data

Section 10. Stability and Reactivity	
Reactivity	Reacts with carbonates
Chemical Stability	The product is stable
Possibility of Hazardous Reactions	None
Conditions to Avoid	Contact with common metals will produce flammable hydrogen gas.
Incompatible Materials	Oxidizing agents, common metals (not aluminium), chromic acid, sulphuric acid, hydrogen peroxide, alkalis, carbonates, strong bases, amines, phosphorus trichloride
Hazardous Decomposition Products	Under normal storage condition decomposition will not occur.

Section 11. Toxicological Information			
Component Toxicity	**LD50 Oral**	**LD50 Dermal**	**LC50 Inhalation**
Acetic Acid	47.286 g/kg (Rat)	15.143 g/kg (Rabbit)	
Likely Routes of Exposure			
Skin:	None expected.		
Eyes:	None expected.		
Inhalation:	None expected.		
Ingestion:	None expected.		
Acute Toxicity Estimates (ATE)	Not toxic		
STOT (Specific Target Organ Toxicity) – Single Exposure	Not classified		
Aspiration Toxicity	Not classified		
STOT (Specific Target Organ Toxicity) – Repeated Exposure	Not classified		
Skin Corrosion / Irritation	Not classified		
Serious Eye Damage / Irritation	May cause mild irritation		
Respiratory or Skin Sensitization	Not classified		
Carcinogenicity	Not listed.		
Reproductive Toxicity			

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Safety Data Sheet

- **Sexual Function and Fertility**	Not classified
- **Development of Offspring**	Not classified
- **Effects on or via Lactation**	Not classified
Germ Cell Mutagenicity	Not classified
Interactive Effects	None known
Other Adverse Effects	Nine known

Section 12. Ecological Information	
Ecotoxicity	Acetic acid: LC50: 423 mg/l (Goldfish) LC50: 75 mg/l (Bluegill sunfish) LC50: 88 mg/l (Fathead minnow).
Persistence and Degradability	Will not persist
Bioacumulative Potential	Will not accumulate
Biodegradability	This product is biodegradable
Mobility in Soil	No data,
Special Remarks	BOD: 5 day = 63 – 81 %
Other Adverse Effects	None known

Section 13. Disposal Considerations	
Disposal Considerations	Dispose of contents/containers in accordance with local regulations.

Section 14. Transport Information	
UN Number	None
UN Proper Shipping Name	None
Transport Hazard Class(es)	None
Packaging Group	None
Environmental Hazards	Not applicable
Bulk Transport	Not applicable
Special Precaution	Not applicable
DOT Erg#	Not applicable

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Safety Data Sheet

Section 15. Regulatory Information	
Canada – DSL Inventory	All components of this product are either on the Domestic Substances List (DSL), Non-Domestic Substances List (NDSL), or exempt
TSCA	All components of this product are either on the Toxic Substances Control Act (TSCA) Inventory List or exempt
Additional Information	None

Section 16. Other Information	
NFPA Rating	Health-0/ Flammability-0/Reactivity-0/Special Hazard-Not applicable
HMIS Rating	Health-0/Flammability-0/Reactivity-0/Personal Protection-See Section 8.
Prepared by:	Envent Engineering Ltd., Technical Department
Date Prepared:	25 January, 2019
Date of Latest Revision:	25 January 2021

Disclaimer

Notice to reader

To the best of our knowledge, the information contained herein is accurate. However, neither the above named supplier nor any of its subsidiaries assumes any liability whatsoever for the accuracy or completeness of the information contained herein. Final determination of suitability of any material is the sole responsibility of the user. All materials may present unknown hazards and should be used with caution. Although certain hazards are described herein, we cannot guarantee that these are the only hazards that exist.

Envent Engineering Ltd. expressly disclaims all expressed or implied warranties of merchantability and fitness for a particular purpose with respect to the product provided.

APPENDIX E – RISKS & SAFETY INFORMATION

Hydrogen Sulfide Properties	
Gas Properties	**Description**
Physical State	Gaseous above 60˚C
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 (usually air) > In its pure state, or in 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 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.

Table 12. Hydrogen Sulfide Properties

Hydrogen Sulfide Quantities and it's Health Effects	
H2S Exposure	**Possible health Effects**
<1ppm	- No known health effects - Can be smelled
10-20 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
>700ppm	> Immediate loss of consciousness > Permanent brain damage and death in a few minutes even if removed to fresh air at once

Table 13. Hydrogen Sulfide Quantities & Health Effects

	Severity of Impact and/or Consequence					
Likelihood of Event		Negligible	Minor	Moderate	Serious	Critical
	Very Likely	Medium	Medium	High	High	High
	Likely	Low	Medium	High	High	High
	Possible	Low	Low	Medium	High	High
	Unlikely	Low	Low	Low	Medium	High
	Very Unlikely	Low	Low	Low	Medium	Medium

Table 14: Risk Assessment Matrix

Risk Assessment					
Hazardous Situation	**At Risk Personnel**	**Health and Safety Risks**	**Initial Risk Assessment**	**Mitigation Strategy**	**Residual Risk Assessment**
Maintenance: Changing the H2S sensing Tape (Lead Acetate Tape)	Operator(s)	Long term exposure (through skin and inhaling) could potentially cause cancer and other health problems.	Likely-Moderate (High)	Due to the long-term health effects of lead, which is contained in the H2S Acetate tape, the operator is recommended to wear gloves & mask when handling the tape. If gloves are not worn, hands must be properly washed with soap and water.	Very Unlikely-Moderate (Low)

Maintenance: Changing filter in SCS	Operator(s)	Release of gases at a high-pressure can cause serious injuries.	Possible-Serious (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.	Very Unlikely-Serious (Medium)
H2S Exposure (Atmosphere)	Operator(s)	H2S exposure is a potential lethal health/safety risk. Consult Table 13 for more information.	Unlikely-Serious (Medium)	For atmospheres where there is H2S, depending on the levels and company policy, the operator must wear the appropriate equipment before servicing an H2S analyzer.	Very Unlikely-Serious (Medium)
H2S Exposure (Leakage - Overpressure)	Operator(s)	H2S exposure is a potential lethal health/safety risk. Consult Table 13 for more information.	Unlikely-Critical (High)	In case of a leakage, follow the company's health and safety policies on how to deal with an H2S leak. Depending on the application and location of the H2S analyzer, the operator might have to use the proper breathing equipment.	Very Unlikely-Critical (Medium)
Flooding the Sample system & analyzer	Operator(s)	No immediate safety and health concern	Possible-Minor (Low)	If the analyzer is flooding, the analyzer needs to be immediately isolated, turned off and cleaned. Refer to "5.2 Sample Conditioning System Cleaning Procedure".	Unlikely-Minor (Low)
Voltage hazards	Operator(s)	Risk of electric shock.	Unlikely-Serious (Medium)	It is important that the operator is trained in 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.	Very Unlikely-Serious (Medium)

TS Enclosure Heat	Operator(s)	Burns to skin from direct contact.	Possible-Serious (High)	The inside of the Total Sulfur Enclosure can get up to 900 °C, however, the outside walls will only reach approximately 150 °C. Do not touch the surface of the TS enclosure when operating. If the TS enclosure needs to be serviced, allow 1 hour after powering down the analyzer to cool down	Possible-Negligible (Low)
Electrostatic hazard - Explosion hazard	Operator(s)	Risk of bodily harm due to explosion.	Unlikely-Critical (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.	Very Unlikely-Critical (Medium)

Table 15: Risk Assessment

As an overall practice when doing maintenance on an H2S analyzer, the operator should carry a personal H2S monitor, wear a hard hat, hearing protection (if applicable), safety glasses, hand protection, and steel toed boots. Depending on the location of the H2S analyzer, an appropriate breathing device might be required such as SCBA (Self-contained Breathing Apparatus) and SABA (Supplied Air Breathing Apparatus).

CONTACT US

In the event that a situation arises that is not covered by this manual, we encourage you to contact us so that we can help you resolve any issues you may have. Please have this manual readily available when calling for assistance.

For further information on our products or to access our most recently updated manuals and product catalogues, please visit our website at www.enventengineering.com.

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