TFS Analyzer

Operator's Manual

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TFS1

TFS2

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Envent
Knowledge by Analysis

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About this Manual:

The TFS Gas Analyzers are spectroscopic gas analyzers for use in remote locations, running unattended for extended periods of time. This User and Installation Manual provides information about the following Envent TFS Gas Analyzers:

- TFS1: Class I, Division 1 in an XP enclosure
- TFS2: Class I, Division 2 in a Nema 4X enclosure

This manual contains a comprehensive overview of Envent Engineering's TSF Analyzers and step-by-step instructions on:

- Installation and Start-up
- Operation
- Maintenance
- Troubleshooting

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

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

CAUTION: Before applying line pressure be sure that all pressure connections are secure and leak tight.

CAUTION: Do not apply more than 25 psig to analyzer. Damage to the analyzer may result.

WARNING: The analyzer enclosure must be affixed to a structure using the supplied brackets and 3/8" bolts and capable of supporting a minimum of 4 times the weight of the analyzer. 1-5/8" Unistrut or equivalent, bolted or welded to the building structure is recommended.

WARNING: Conduit must be properly DE-burred and anti-shorting bushings must be installed to protect wiring from damage. A minimum of 5 threads of engagement is required for rigid conduit in hazardous locations.

CAUTION: The user, through his own analysis and testing, is solely responsible for the product selection and ensuring all responsibility, safety and warning requirements of the application are met.

If the equipment is used in a manner not specified by Envent Engineering Ltd., the protection provided by the equipment may be impaired.

CAUTION: Do not use solvents, brake cleaner, soaps or detergents to clean the analyzer and sample conditioning system. CONTACT ENVENT ENGINEERING FOR CLEANING REQUIREMENTS

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

CAUTION: The analyzer should be mounted in an enclosed area in which it is not exposed to vibration and excessive pressure, temperature and environmental variations. The TFS1 is certified for Class I Div 1 hazardous locations. The TFS2 is certified for Class I Div 2 hazardous locations. Ensure that the analyzer received is suitable for the area classification of the installation.

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

WARNING: (DC Power) This unit requires a disconnect device rated 24 VDC and 5 A maximum, certified for the hazardous area of the installation and must be protected by a circuit breaker rated 24 VDC and 5 A maximum.

WARNING: (AC Power) This unit requires a disconnect device rated 240 VAC and 5 A maximum, certified for the hazardous area of installation and must be protected by a circuit breaker rated 240 VAC and 5 A maximum.

WARNING: (TFSYP) The user must provide a continuous supply of clean instrument air to the protected enclosure. The instrument air source must be located in a non-hazardous location.

WARNING: (TFS1 and TFSYP) Electrical connections to the analyzer must use an explosion proof connector or seal.

WARNING: (TFS-YP) A check valve must be installed in the sample inlet and sample outlet of the analyzer. Swagelok part number SS-2C-1/3 is recommended.

CAUTION: The analyzer power fuse holder covers must be secured by a wire tie to prevent unintended removal.

WARNING: The name plate affixed to the analyzer details warnings and cautions specific to the model supplied. Read and understand the nameplate warnings and cautions before installing the analyzer.

Principle of Operation:

The TFS Analyzer is a non-contact, light absorption based gas analyzer capable of percent level concentration monitoring of multiple gas compounds. The analyzer consists of a light spectrometer, a flow-through sample cell, a single-element photo-detector, and the supporting

electronics. The spectrometer uses a unique Tunable Fabry-Perot assembly that provides wavelength scanning with high optical throughput. An advanced spectral processing algorithm computed in the embedded electronics provides highly accurate and robust quantitative measurements.

The TFS Gas Analyzer is configured and calibrated for a specific wavelength analysis region(s) depending on the application for which it is intended. It is designed to be a dedicated on-line monitoring system that only requires periodic on-site span verification and zeroing every three months. The specific system configuration and calibration is denoted by a Factory Serial Number that can be found in the Final Span Calibration Verification Sheet delivered with the analyzer. Example applications of the TFS Analyzer include:

- Hydrocarbon gas composition monitoring
- Petrochemical process monitoring
- Specialty and chemical gas process and blending monitoring
- Catalysis and combustion process monitoring

Measurement Principle:

When a gas sample is introduced into the gas cell, the light radiation provided by a broadband light source is partially absorbed by the gas species present. The light absorption occurs at specific frequencies and magnitudes depending on the gas compound and the concentration of that compound. The TFS Gas Analyzer spectrometer module scans the wavelength and measures the true absorption spectra and compares them with the pre-loaded calibration spectra. The on-board analysis algorithm computes the predicted gas concentrations in real-time.

In principal, the absorption spectrum of each compound is unique which acts as a "fingerprint" for identification or speciation analysis. In addition, the magnitude of the absorption is a function of the number of molecules of the gas. With a known path length, pressure, and temperature, the magnitudes of the absorption spectra are then used to compute volumetric concentrations. This *first principle* based technique provides accurate and robust measurements with minimal span and baseline drifts.
The TFS Gas Analyzer employs an internal pressure transducer to measure the sample pressure in real-time enabling pressure variation corrections. The flow cell is heated to a constant temperature (default value is 60°C) with a sample preheat module to maintain both sample and optical sensor temperature at a constant calibrated temperature, thereby ensuring measurement accuracy and stability despite sample and environmental variations.

Technical Specifications:

Performance

Accuracy	+/- 0.2% of full scale per reading
Repeatability	<0.1%
Zero Drift	<0.2% of full scale per month

Application Data

Sample Temperature	0-50°C [(a)]
Sample Humidity	5 – 95% RH non-condensing
Sample Inlet Pressure	0 – 30 psig [(a)]
Sample Flow Rate	100 – 1000 cc/min [(a)]

Electrical & Communications

Input Voltages	24 VDC, 5.0 A max 120-240 VAC, 50/60 Hz, 5.0 A max [(b)]
Outputs	4-20 mA Analog Outputs (2 standard, optional 8 additional) Serial RS-232, 485 (Communications/Modbus standard) 120 VAC 5AMP Max Relays (4 standard) TCP/IP Ethernet (optional)
Archives	32 MB
Graphics Display	1 to 4 line primary data Scrolling alarm marquee Constant view marquee Scrolling menu system

Physical Specifications

Size	24" x 15" x 8" deep
Weight	<55 lbs (25 kg)

Area Classification

Certification	TFS1: Class I, Division 1 Groups B,C,D in an XP enclosure TFSYP: Class I, Division 1 Groups B,C,D in a Y purged Nema 4X enclosure TFS2: Class I, Division 2 Groups B,C,D in a Nema 4X enclosure TFSP: General Purpose

(a) Consult factory for alternative requirements

(b) The TFS analyzer AC option is only possible through the implementation of an 120VAC to 24VDC external power supply. Do not power the TFS analyzer directly using AC power.

Table 1: Specifications Table

The TFS Analyzer was configured, functionally tested and calibrated at the factory. All test and calibration data is documented in the Factory Calibration Report.

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

- The TFS-1, TFS-YP is certified for Class I Division 1 Groups B,C&D
- The TFS-2 is certified for Class I Division 2 Groups B,C&D

The analyzer will be shipped for wall mount or uni-strut floor mount (for additional options consult the factory).

Note: 3/8" x 1" bolts are recommended for installation.

CAUTION: Excessive temperature and environmental variations may affect the integrity of the calibration gas. Should heavier components condense into the liquid

phase, the composition of the bottles will change.

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

Sample Point Selection:

The sample to the 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. Sample transport, including sample probe assembly, is generally the responsibility of the end user.
A probe should be installed vertically on a horizontal section of pipe ensuring that the sample is drawn from between the middle and the top third of the pipeline.

An optional Genie GPR probe regulator may be included. 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. For installation instructions, refer to associated documents. Do not install the Genie probe regulator on a vertical pipe.

First Stage Pressure Reduction and JT Cooling Effect:

First stage pressure regulation is ideally done at the sample point with careful consideration given to the Joule Thompson Cooling Effect (JT Effect). The JT effect is loosely defined as the cooling effect on gases as a result of pressure reduction. A general rule of thumb to determine JT effect estimates a 7 °F cooling effect for every 100 psig of pressure reduction.

JT = Pressure Reduction/100 x 7 °F

Example: Joules Thompson Effect

- Line Conditions
  - Pressure = 510 psig
  - Gas Temp= 70°F
  - Ambient Temp= 50°F

- Calculate Joules Thompson Cooling Effect:

  If the first stage pressure reduction takes line pressure of 510 psig to 10 psig the cooling effect from first stage pressure reduction is:

  (510-10)/100 x 7 = 35°F

  So the gas is cooled by 35 °F as a result of Joules Thompson Effect.

- Calculate the Gas Temp:

  If the initial Gas Temp is 70°F and the Joules Thompson Cooling Effect is 35°F then:

70°F - 35°F = 35°F

So the Gas Temp traveling in the sample transport line to the analyzer Sample Conditioning System is 35°F after first stage pressure reduction.

There may be some recovery or further temperature reductions as a result of ambient temperature effects on the sample transport tubing and internal gas temperature, but the potential for 2 phases (C6+ condensation) is greatest at the coldest point.

It is critical to preserve the composition of the gas, so it is important to consider the detrimental effects that the Joules-Thompson effect may have on the sample. The sample temperature must be maintained above the hydrocarbon dew point to prevent high BTU components to drop out (liquefy) prior to analysis causing large errors in measurement.

The hydrocarbon dew point is the temperature (at a given pressure) at which the hydrocarbon components of any hydrocarbon-rich gas mixture, such as natural gas, will start to condense out of the vapor phase.

Sample Volume and Flow Rate:

Sample should be supplied to the TFS analyzer sample conditioning system (SCS) at 50-250 psig for each stream. For lean gas (BTU of 1050 or less and relative density of 0.6 or less), with pressure drops from line conditions of 500 psig or less and ambient temperature of 32 °F (0 C), this pressure can be reduced in one cut at the sample point-- ideally with 10-15 psig at the input of the conditioning system panel (SCS) with a second and final pressure regulator.

The sample should be supplied to the TFS analyzer at 10-15 psig and at a flow between 300-500 cc/min. A bypass sweep is recommended to reduce sample lag time in the sample line if it is at high pressure or it is longer than 15 feet. 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. Carbon steel sample line and/or fittings are not acceptable.

Table 2: Sample Lag Time vs. Tubing Size

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

Sample Conditioning System (SCS):

The purpose of the SCS is to receive the sample from the sample transport system after first stage pressure regulation and to perform the following functions:

Isolation from line conditions and the sample transport system. Block valves on each stream
Provide clean and dry Sample Sample filtration and sample bypass
Control Pressure Second stage sample pressure regulation Third stage carrier pressure regulation
Preserve the composition of the Gas Heat traced sample transport or integral heated SCS to prevent heavier components from liquefying
Stream selection (in multi-stream applications)
Sample flow control and indication
Sample rotometer mounted after all stream switching

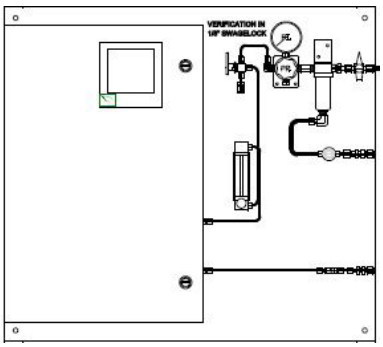


Figure 1: Typical TFS SCS

Installation:

Unpack the analyzer and check for damage.
Ensure that the analyzer power supply and range are suitable for the application.
Check that the hazardous location rating is suitable for the installation location.
Select an installation location that is close to the sample point.

- Ensure that the selected installation site provides adequate room for maintenance and repair

Bolt the analyzer to the wall or secure uni-strut to a solid surface.

Note: 3/8″ x 1" bolts are recommended for installation.

Wire power, analog outputs, discrete inputs & outputs and communications to the TFS Analyzer.

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

CAUTION: TFS-1, Seals Not Poured. Pour seals before energizing the circuit (see APPENDIX B)

Tube the sample inlet(s), calibration inlet, sample sweep(s) and sample vent.

- 1/4" 316 stainless steel tubing is recommended for the sample tubing
- 1/8" 316 stainless steel tubing can also be used if the response time of the analyzer is of particular concern
- All fittings in the sample and vent lines must be 316 stainless steel
- The vent line should be tubed in 3/8" stainless steel tubing to a maximum of 6'
- 1/2" 316 stainless steel tubing should be used for vent lines exceeding 6'

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

1. Turn on sample pressure, ensure sweep is slightly open and set pressure to 15 psig.
   α. Perform a Leak Test

CAUTION: All connections must be LEAKTIGHT to insure the effectiveness of the analyzer as well as SAFETY.

The user, through their own analysis and testing, is solely responsible for the product selection and ensuring all responsibility, safety and warning requirements of the application are met. If the equipment is used in a manner not specified by Envent Engineering Ltd., the protection provided by the equipment may be impaired.

Customer Connections:

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

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

All customer connections are indicated on the circuit board.

Note: The 4-20 mA output requires 12 to 24 VDC loop power.

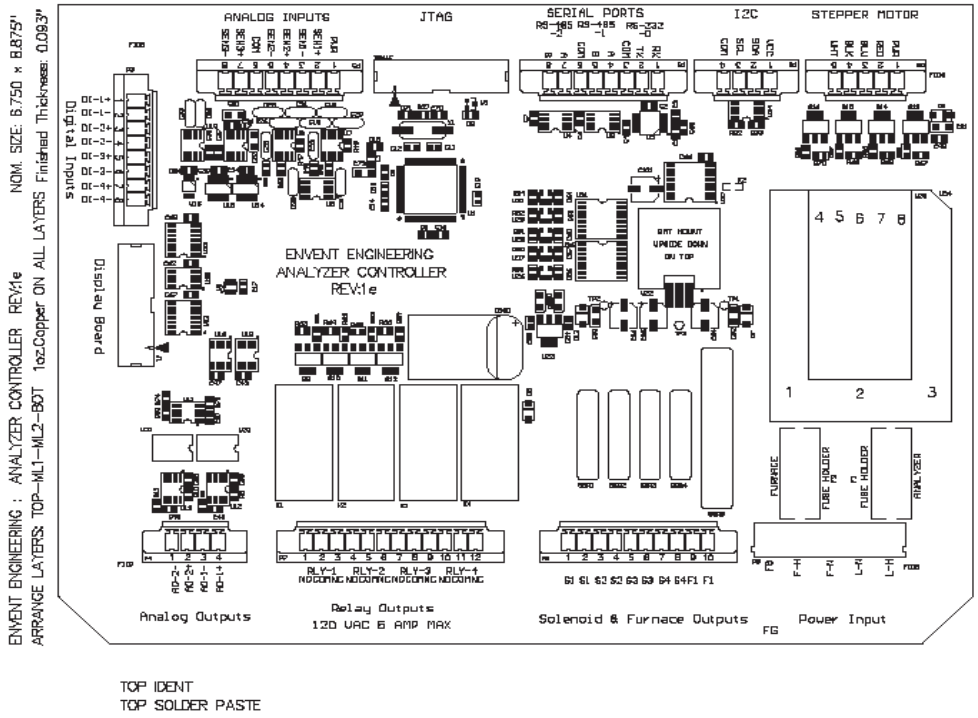


Figure 2: Controller Board Layout & Power Input

Table 3: Customer Connection Summary (See Figure Above)

Application	Positive	Negative/Neutral	Ground
AC (External power supply)	L-H & F-H hot	L-N & F-N neutral	FG
DC	L-H & F-H +	L-N & F-N -	N/A

Serial Communication:

In order to communicate with a TFS-2 analyzer, plug into the USB port located to the right of the mainboard.

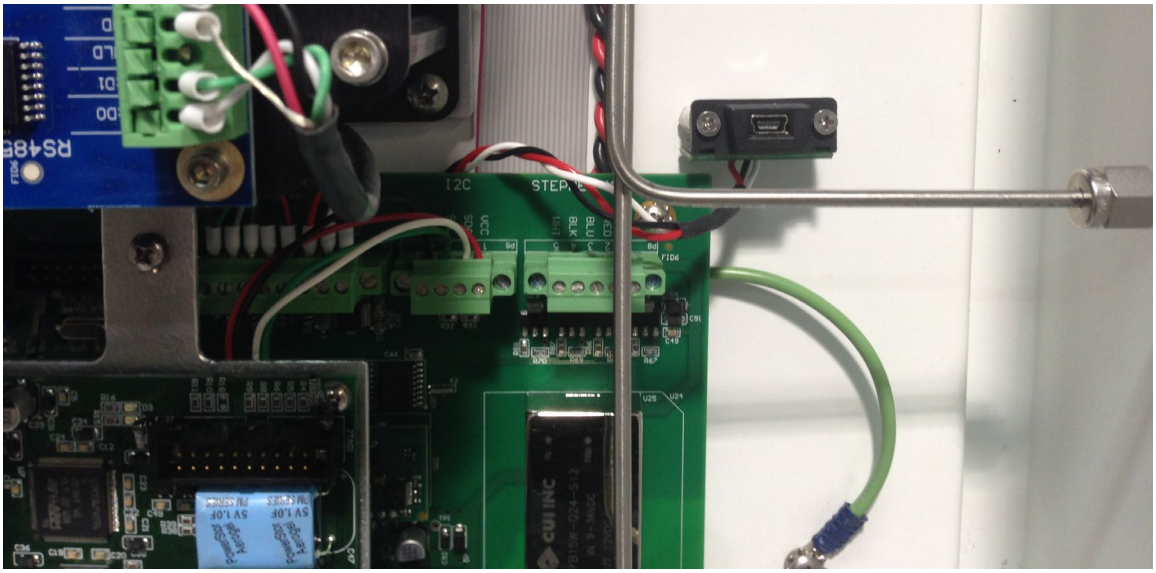
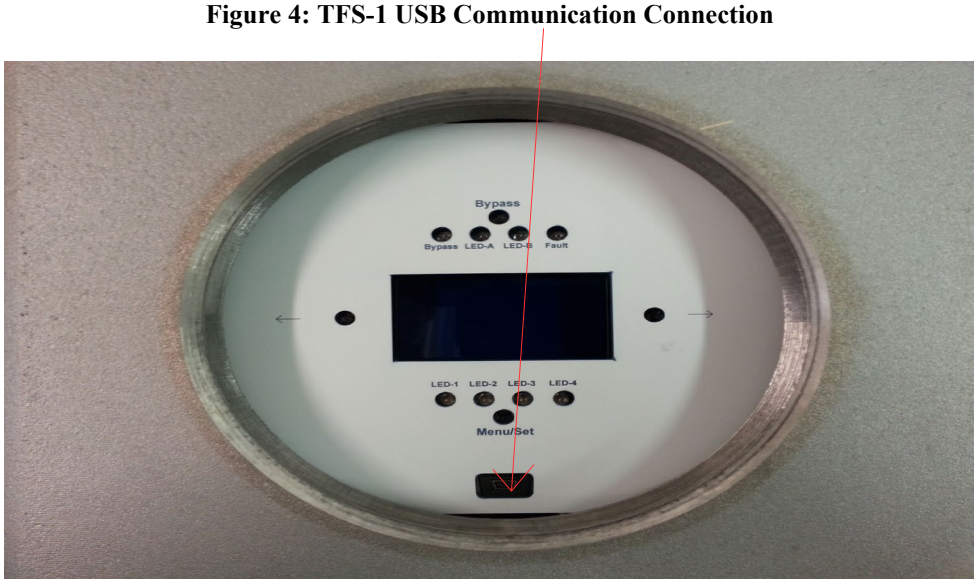


Figure 3: TFS-2/TFS-YP USB Communication Connection

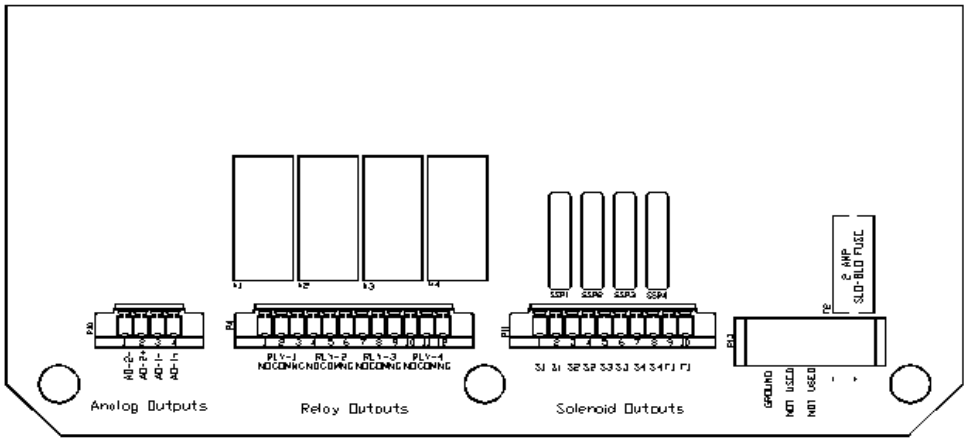
In order to communicate with a TFS-1, plug into the USB port located just behind the window.

Figure 4: TFS-1 USB Communication Connection



Relay Outputs and Solenoid Driver:

Four relays are provided as status outputs, to drive external relays or solenoids. Envent recommends use of the solenoid drivers for external loads. DO NOT supply external power to solenoid drivers.
Four solenoid drivers provided to directly drive solenoids for shutdown, auto-calibration or stream switching.
Unless otherwise specified the solenoid driver output is 24VDC.



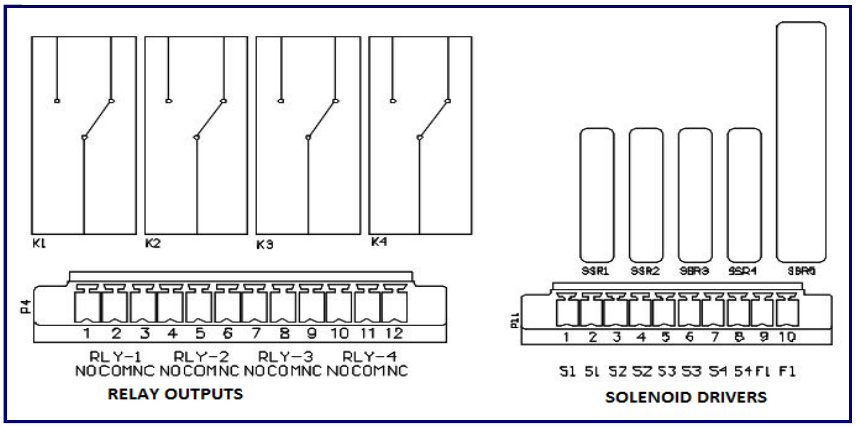


Figure 5: Relay Outputs & Solenoid Drivers

TFS Analyzer Start-up and Operation:

The purpose of this procedure is to verify span accuracy upon installation of the TFS Analyzer. This procedure is also performed at periodic intervals throughout the effective life of the analyzer. This procedure has three parts: Warm-up, Zeroing, and Span Verification. Zeroing is a

measurement on a zero (inert) gas. Span verification is a measurement on the customer's trusted certified mixture(s).

WARNING: DO NOT ZERO THE ANALYZER WITH SPAN CALIBRATION GAS: USE NITROGEN or INSTRUMENT AIR ONLY

TFS Analyzer Warm-up:

After the TFS analyzer is powered on it requires a twenty min warm-up period. During this time the display will show 100 Src% as well as any local alarms. These local alarms may include if so equipped, Lo Temp, Lo Src% Com Fail, Status and Lo Pressure.

TFS DOES NOT REPORT PROCESS DATA DURING WARM-UP PERIOD.

During TFS warm-up the operator should take note of the Cell Temperature. Using Men/Scroll button to scroll to Cell Temp on the TFS Display.Once the Cell Temperature reaches 60C the TFS analyzer is now ready for the zero procedure.

THE TFS ANALYZER CELL TEMPERATURE MUST BE AT ~60C FOR MEASUREMENT OF CALIBRATION OR PROCESS GAS. THIS IS SHOWN ON THE ANALYZER DISPLAY

Zeroing Procedure:

Before Starting the Zeroing Procedure the analyzer should be purged for 1hr with Nitrogen or Instrument air. If the analyzer is being used to sample Acid Gas the analyzer must be purged for 12hrs to pickle down H2S in TFS Sensor Cell

The TFS analyzer should be zeroed before measurement of process gas. The zeroing requires either Nitrogen or *CLEAN* instrument air. This TFS function can be initiated by the operator on the local TFS display using the MENU/Scroll and LEFT OR RIGHT push buttons. If TFS1 use the magnetic wand to operate the display cursor.

The operator should take note of the sample system operation before zeroing:

1. Turn the "Sample Inlet" valve 90 degrees on the SCS to stop the flow of process gas.
2. Source a cylinder of Nitrogen gas or Clean instrument air.
3. Connect appropriate pressure regulator to nitrogen cylinder.
4. Connect length of tubing from pressure regulator to the 3-way valve "Calibration Inlet" port on the TFS Analyzer SCS.

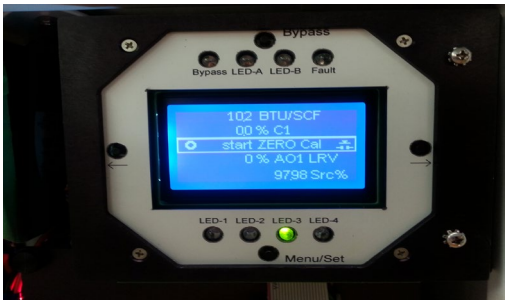
Note: The "Calibration Inlet" port fitting can allow for 1/8 or 1/4 connection.

5. Turn the 3-way "Calibration Inlet/Process Gas valve 180 degrees towards the "Calibration Inlet" port. This will allow calibration gas to flow to the TFS Analyzer.
6. Open the calibration cylinder main valve and set the pressure regulator to 15psi.
7. Set the TFS Analyzer flow meter to 4.0
8. The operator will then proceed to the local interface display to execute the Zero Calibration

Figure 6 shows the menu screen displaying the "start zero" Command prompt:

Using the Menu/Set push button scroll the display until the start ZERO Cal is within the box shown in Figure 6

Figure 6: start Zero Cal Command



TFS Analyzer in Zero Cal Mode with LED-3 Illuminated

By pressing either the left or right push buttons the TFS Zeroing will start. There will be a two minute purge time followed by LED# 3 on the lower part of the display lamacoid illuminating green. This indicates that the TFS Zero Cal has started and will not be completed until the LED -3 is not lit. The TFS will return to LED-1 which is the Process Stream when the Zero Cal is completed. The component zero specification is up to (+0.03) This is baseline noise.

The time to complete the TFS Zero Cal will depend on the TFS Analyzer analysis time. By default Zero Cal is done for five runs multiplied by the analysis time which is typically 60s or down to 10s

Once the LED-3 has gone out wait for 2 min before applying span gas or resuming process gas. This is to allow the Precisive sensor to finish its zeroing and adjust its baseline.

Span Verification:

Due to the variety of sample system conditions and to ensure proper span verification gas is being used it is recommended to consult the factory for support for this procedure.

Ensure a suitable calibration gas and a clean stainless steel regulator with the correct CGA fitting is available. Check that the regulator is rated for calibration cylinder pressure.

- Check the expiry date on the calibration gas bottle before using
- The recommended calibration gas supplier is Air gas or Air Liquide

Note: the following instructions apply to analyzers with standard sample systems; however, the basic principles still apply.

Turn off sample gas flow using the 3-way "Calibration In" valve

1. Connect Span calibration gas bottle to the "Calibration In" valve
2. Set the calibration gas pressure to 15 psig and the flow meter to 4.0
3. Allow the analyzer reading to stabilize (10 to 15 minutes)
4. Verify the reading on the display. They should match the calibration gas concentration(s)
5. Turn on sample gas flow using the 3-way "Calibration In" valve
6. Set the sample gas pressure to 15 psig and the flow meter to 4.0

LCD Keypad Display:

CAUTION: The glass window on the TFS-1 must remain installed in order to ensure area classification is maintained

To configure the TFS, if the area is non-hazardous, the window can be removed for basic TFS operations available from the internal buttons or USB communication for complete TFS operations available through ICE. The TFS-YP & TFS-2 are configured in the same manner.

Basic TFS operations are configured by using the push-buttons as shown below.

Figure 6: TFS Standard Operator Interface

Table 4: Analyzer Display-button functions

Button	Description/Function
Bypass	Used to inhibit all analyzer alarms to a non-alarm state, and sets the analog 4-20 mA output to 2 mA. The Bypass LED illuminates when Bypass mode is enabled.
Scroll Right [→]	Used to move the cursor to the right. Also used to SAVE configuration adjustments.
Scroll Left [←]	Used to move the cursor to the left. Also used to CANCEL configuration adjustments.
Menu/Set	Used to cycle through the menu options. Also used to increase numerical values when making configuration adjustments

Recommended Maintenance Schedule:

The TFS Analyzer is designed to be maintenance free for extended periods of time. Regular check-ups will ensure that the analyzer is operating to specifications.

Recommended maintenance and operation verification of the analyzer consists of:

- Filter replacement (weekly to monthly depending on quality of sample gas)
- Re-zeroing should be done every three months with Nitrogen or clean instrument air
- Span Verification should be done yearly Spec is +/- 0.2% of full scale on all readings
- Light source replacement is required when the Lo Src% Alarm is indicating which means the source is below 40% output. This is a reminder that the source will need to be changed soon but not immediately.

Filter Replacement Procedure

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

Shut off the line pressure before changing elements. Ensure there is no pressure in the filter housing.
Remove the bowl, element retainer and filter element.Replace Filter element with Bonded Microfibre Coalescing Filter Element
Tightening the element retainer a ¼ to 1 turn after it first contacts the filter element securely seals the filter tube. The amount will depend on the housing type and element size. A mark on the end of the retainer can be used as a guide.
Before replacing the housing bowl ensure that the mating threads and sealing surfaces are clean and damage free. It is recommended that the threads and sealing faces be lubricated with a small amount of silicone grease before assembly. Stainless steel housings fitting with a solid PTFE gasket the bowl should be tightened to a torque of between 30Nm and 40 Nm.
Before resuming line pressure be sure that all the port connections, the drain plug, and the housing bowl are securely installed. All connections must be LEAKTIGHT to insure effective filtration as well as SAFETY.

Fuse Replacement

- Insert new fuse in fuse holder cover
- Place fuse and cover into fuse holder body
- Install wire tie under fuse holder body and over fuse Fuse holder cover
- Tighten wire tie to prevent unintentional fuse removal

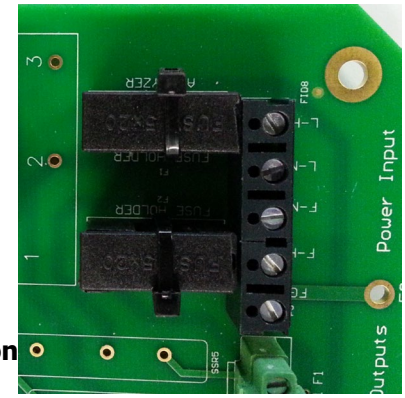


Figure 7: Fuse Installation

Sample Conditioning System Cleaning Procedure:

During start-up or plant upset situations, the TFS 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 incremental increases in the gain to maintain calibration. Please refer to factory calibration sheet for factory set gain factor. The scavenger solution is water soluble and therefore is relatively easy to clean.

Material List: Cleaning kit part number: 330900

- Alconox Laboratory cleaner or equivalent residue free cleaning agent
- Fresh water
- 100% Isopropyl Alcohol
- Large bucket to mix cleaning solution
- Rinse bottle

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

Procedure

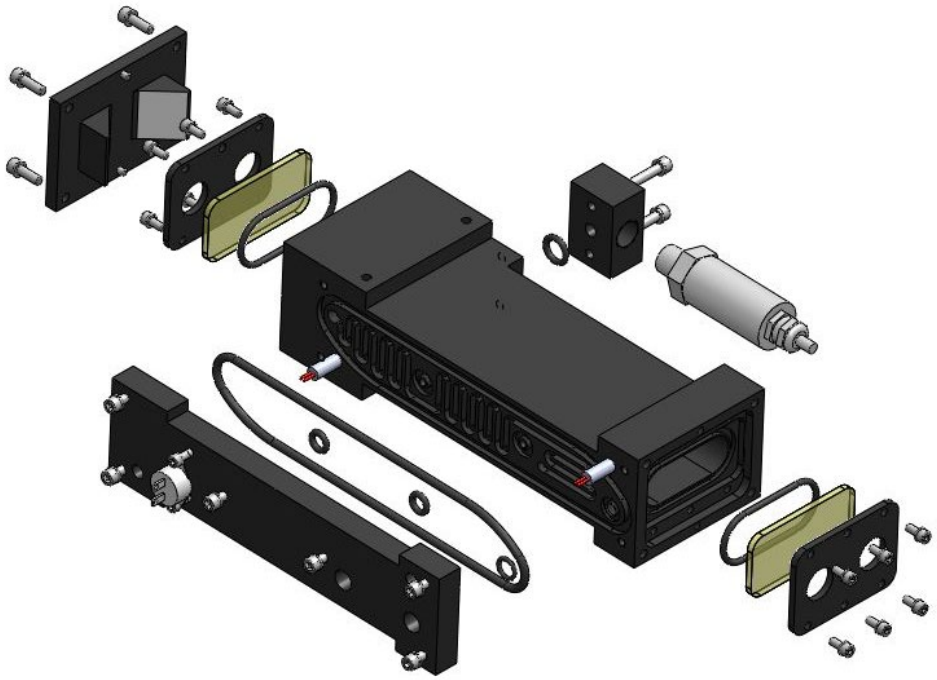
1. Mix a 1% (2-1/2 tbsp per gallon) of Alconox in warm water
2. Sample line tubing
    A. Shut off flow at the sample point prior to sample conditioning system
    B. Flush the sample line and components with cleaning solution
    C. Rinse with fresh water
    D. Flush with isopropyl alcohol
    E. Dry with clean, dry instrument air or gas
3. Sample conditioning system

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

Remove filter elements from filter housings and discard

A. Remove all sample conditioning system components and soak in cleaning solution
B. Ensure valves are fully open when cleaning
C. Flush sample components with fresh water
D. Rinse with isopropyl alcohol
E. Blow dry with clean compressed air or fuel gas
F. If the any clear (Tygon) tubing appears discolored, replace the tubing
G. Tubing on humidifier should be replaced if it appears contaminated

4. Re-assemble Stainless Steel Tubing to analyzer according to analyzer drawing
5. Once sample conditioning system has been re-assembled ensure accurate readings from dis



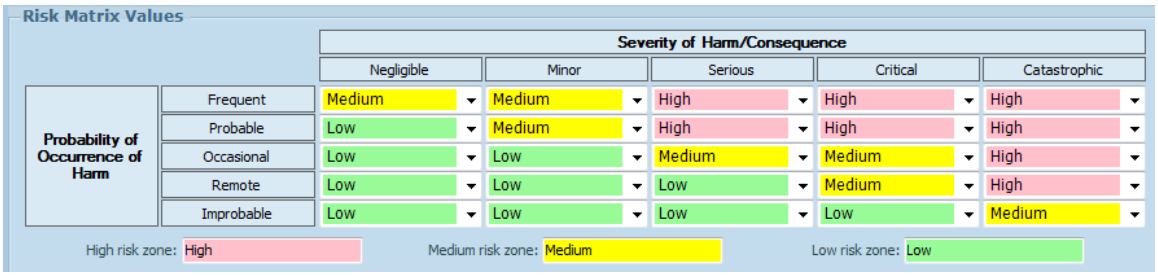
Gas Cell Dis-assembly Exploded View

Risk Assessment – Safety Information

Hydrogen Sulfide Properties	
Physical State	Usually encountered as a gas
Color	Colorless - No visible sign of H2S to warn you of its presence
Odor	Characteristic smell of rotten eggs at 0.5 ppb; paralyzes the olfactory nerve around 100 ppm
Vapor Density	Heavier than air (1.19 compared to 1.0 for air) > In gas mixtures, it will be present wherever the gas mixture is found > Gas mixtures may be heavier or lighter than air, depending upon their vapor density and temperature compared to the ambient atmosphere (i.e. usually air) > In its pure state, or as a high proportion of a gas mixture, it may flow or settle into low-lying areas, such as pits, trenches and natural depressions
Flammability	Flammable

	Flammable at 4.3 - 46 percent vapor concentration in air, by volume Burns with a blue flame and gives off Sulphur dioxide (SO2) gas SO2 is also hazardous and irritates the eyes and the respiratory system
Solubility	Soluble in water and oil, solubility is inversely proportional to fluid temperature
Common Locations for H2S	Piping systems, pipelines, wellheads or wellbores, vessels, production facilities, tanks, pits and low spots, confined or enclosure spaces, shacks or buildings, bermed or diked area, sour spills.

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



Risk Assessment

Hazard Identification - Task	Who might be harmed by this hazards	Health and Safety Risks	Initial Risk	Hazard Control Recommended	Residual Risk
Maintenance: Changing filter in SCS	Operator(s)	Potential safety risk - release of gases at a high pressure level can cause serious injuries	Occasional – Critical (High)	Due to the fact that the filter is located before the pressure regulator, the operator could be dealing with pressures up to 3600 PSI. The operator must isolate the sample system before changing the filter As an overall practice when doing maintenance into an TFS analyzer, the operator should carry a personal H2S monitor, wear a hard hat, hearing protection (if applicable), safety glasses, hand protection, steel toed boots. Depending on the location of the TFS analyzer analyzer, appropriate breathing device might be required such as SCBA (Self-contained Breathing Apparatus) and SABA (Supplied Air Breathing Apparatus)	Improvable – Critical (Low)
Leakage or rupture due to high pressure	Operator(s)	Potential safety risk - release of gases at a high pressure level can cause serious injuries	Remote – Critical (Medium)	Depending on the sample conditioning system, the inlet maximum pressure varies. Please consult document package to find out about maximum pressure for the sample system. Do not apply more pressure than the one specified, as this can cause damage to the analyzer and can cause safety risks.	Improbable – Critical (Low)
H2S Exposure (Atmosphere)	Operator(s)	Potential safety and health risk - Death - Consult Table Hydrogen Sulfide Quantities and Health Effects.	Remote – Critical (Medium)	For atmospheres where there is H2S, depending on the levels and company policy, the operator must wear the appropriate equipment before servicing an TFS analyzer As an overall practice when doing maintenance into an TFS analyzer, the operator should carry a personal H2S monitor, wear a hard hat, hearing protection (if applicable), safety glasses, hand protection, steel toed boots. Depending on the location of the TFS analyzer,	Improvable – Critical (Low)

				appropriate breathing device might be required such as SCBA (Self-contained Breathing Apparatus) and SABA (Supplied Air Breathing Apparatus)	
H2S Exposure (Leakage - Overpressure)	Operator(s)	Potential safety and health risk - Death - Consult Table Hydrogen Sulfide Quantities and Health Effects.	Remote – Catastrophic (Medium)	In case of a leakage, follow company's health and safety policies on how to deal with an H2S leak. Depending on the application and location of the TFS analyzer, the operator might have to use the proper breathing equipment As an overall practice when doing maintenance into an TFS analyzer, the operator should carry a personal H2S monitor, wear a hard hat, hearing protection (if applicable), safety glasses, hand protection, steel toed boots. Depending on the location of the TFS analyzer, appropriate breathing device might be required such as SCBA (Self-contained Breathing Apparatus) and SABA (Supplied Air Breathing Apparatus)	Improvable – Catastrophic (Medium)
Exposure to other gases	Operator(s)	Potential safety and health risk – Explosion, Oxygen deprivation, Death	Remote – Catastrophic (Medium)	In case of a leakage, follow company's health and safety policies on how to deal with gas leak. Depending on the application and location of the TFS analyzer, the operator might have to use the proper breathing equipment As an overall practice when doing maintenance into a M-Series analyzer, the operator should carry a personal H2S monitor, wear a hard hat, hearing protection (if applicable), safety glasses, hand protection, steel toed boots. Depending on the location of the TFS analyzer, appropriate breathing device might be required such as SCBA (Self-contained Breathing Apparatus) and SABA (Supplied Air Breathing Apparatus)	Improvable – Catastrophic (Medium)

Flooding the Sample system & analyzer	Operator(s)	Not immediate safety and health concern	Occasional – Minor (Low)	If the analyzer is flooded, the analyzer needs to be immediately isolated, turned off and cleaned. As an overall practice when doing maintenance into an TFS analyzer, the operator should carry a personal H2S monitor, wear a hard hat, hearing protection (if applicable), safety glasses, hand protection, steel toed boots. Depending on the location of the TFS analyzer, appropriate breathing device might be required such as SCBA (Self-contained Breathing Apparatus) and SABA (Supplied Air Breathing Apparatus)	Remote – Minor (Low)
Voltage hazards	Operator(s)	Immediate safety and health risk.	Remote – Critical (Medium)	It is important that the operator is trained on handling the analyzer when it is on. The analyzer does not need to be off when it goes into maintenance. However, it is very important that the operator is aware of the danger of an electric shock	Improvable – Critical (Low)
Electrostatic hazard - Explosion hazard	Operator(s)	Immediate safety and health risk.	Remote – Catastrophic (High)	Electrostatic Hazard – Backpan and Certification nameplate must be cleaned only with a damp cloth to prevent static charging hazard which could result in an explosion	Improbable – Catastrophic (High)
Analyzer heavy Weight	Operator(s)	Body Injury	Remote – Serious (Low)	Unpacking and transporting requires a minimum of two persons.	Improbable – Low (Low)
Re-configuring the GC Analyzer configuration file and or physical configuration to the analyzer and or sample conditioning system	Operator(s)	Potential safety risk	Remote – Critical (Medium)	Do not modify physically the TFS analyzer or sample conditioning system as this void hazardous location certification. Software configuration can be changed by the user. Before changing the TFS analyzer configuration file, familiarize yourself with the software through this manual. If any questions or concerns arise, consult Envent Engineering Ltd.	Remote – Critical (Medium)

APPENDIX A: Recommended Spare Parts List

Part Number	Part Description
100040	Sample flow meter 0-600 cc/min
F-00002	Fuse
330407	Coalescing Filter Element
800801	Gas Cell Window and Gaskets
800800	Light Source Assembly

APPENDIX B: Chico A Sealing Compound For Sealing Fittings in Hazardous Locations

Installation & Maintenance Information

INSTALLATION

DAM:

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

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

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

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

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

COMPOUND:

Follow these instructions carefully:

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

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

FOR APPLICATIONS INVOLVING GROUPS C AND D

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

FOR GROUP B APPLICATIONS

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

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

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

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

Rev No.	*Rev Date*	*Rev Description*
1	08/05/2014	Updated majority of content
2	04/22/2016	Updated majority of content including photos specs procedures
2.1	22 Oct 2018	Updated Envent's Address
3.0	30 Nov 2018	Update Intertek Certification to 61010 Ed. 3
3.1	26 Nov 2021	Deleted Gas cell flush and purge section
3.2	2 Sep 2022	Clarification on AC powered TFS analyzers (page 7 and 12)

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

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