Total Sulfur Option

Operator's Manual

(Addendum to Model 330 & 331 H_2S Analyzers Operator's Manual)

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A. Introduction

A.1. About this Manual

The Total Sulfur Operator's Manual should be used in addition to the Model 330 & 331 Hydrogen Sulfide Analyzer Operator's Manual. This manual contains a comprehensive overview of Envent Engineering's Total sulfur Addition to their hydrogen sulfide (H_2S) analyzers as well as descriptve installation and startup instructions.

This manual should be read and referenced by the person who will install, operate, or have contact with the Total Sulfur 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.

A.2. Warnings and Cautions

CAUTION: Hydrogen is extremely flammable. Use Caution when handling

WARNING: Quartz reaction tube located in heating chamber

a) **Dual Seal MWP 2 PSI**

b) **Annunciation is visible indication observed from the flowmeter Model F65.**

i. **Lack of flow can indicate the possibility that a failed primary seal condition could exist in the Quartz Tube/heater assembly.**

CAUTION: Quartz reaction tube is fragile and is removed during shipping, handle with care when installing

CAUTION: Do not apply power, or hydrogen to the reaction furnace until the reaction tubee is installed and leak tested

CAUTION: Do operate the reaction furnace if a leak is present

B. Total Sulfur Option Overview

B.1. Principle of Operation

Envent Engineering's H_2S analyzers (Models 330 & 331) use H_2S sensing tape which reacts only when in contact with H_2S. The total sulfur option involves the addition of a total sulfur reaction furnace to a Model 330 or 331. The furnace converts all sulfur compounds into hydrogen sulfide (H_2S), allowing the H_2S analyzer to read total sulfur.

How it works:

1. A sample mixes with hydrogen,
2. The natural gas-hydrogen mixture flows through the reaction furnace, heated to 1000°C
3. The heat in the furnace forces the mixture to react, as shown in the equation below
    a. Hydrocarbon compounds will dissociate to methane
    b. Sulfur-hydrocarbon compounds, such as mercaptans, will dissociate to hydrogen sulfide.

$$R - S + H_2 + heat \rightarrow R - H + H_2S$$

The analyzer can be specified to analyze total sulfur only or to automatically switch between hydrogen sulfide and total sulfur mode.

A.1.1. Total Sulfur Reaction Furnace

The Total Sulfur option comes standard with furnace temperature control circuitry. It consists of reaction oven, flame arrestors, hydrogen and sample flow meters and an optional 3-way solenoid valve to allow user to measure both hydrogen sulfide and total sulfur on an alternating basis.

The furnace has a low temperature switch which will actuate the fail led and relay on furnace failure. The low temperature alarm may be present for up to one hour after applying power.

WARNING: Quartz tube located in heating chamber

c) Dual Seal MWP 2 PSI

d) Annunciation is visible indication observed from the flowmeter Model F65.

i. Lack of flow can indicate the possibility that a failed primary seal condition could exist in the Quartz Tube/heater assembly.

A.1.2. Hydrogen

The total sulfur analyzer requires UHP (ultra high purity) hydrogen at a flow of 200-300 cm³/min. UHP Hydrogen has a minimum specified purity of 99.9999%. Lower grades of hydrogen may contain sulfur compounds or other impurities which will cause inaccurate results. Consult the factory calibration sheet for the flow rates for your application.

One standard bottle of hydrogen will last approximately 18 days. It is advisable to have a least two bottles on site with dual regulators or a change over regulator set. The hydrogen regulators must be new and clean. Dual stage, high purity regulators are recommended. Regulators with an elastomer diaphragm (rubber or Buna) are not recommended as they will allow oxygen to diffuse into the hydrogen supply

CAUTION: Hydrogen is extremely flammable. Use Caution when handling

C. Installation and Start-up

Note1: The furnace power should be disabled by removing fuse on the main processor board.
Note 2: The power should be left off until the leak testing and hydrogen purging are complete.

CAUTION: Quartz reaction tube is fragile and is removed during shipping, handle with care when installing

CAUTION: Do not apply power, or hydrogen to the reaction furnace until the reaction tube is installed and leak tested

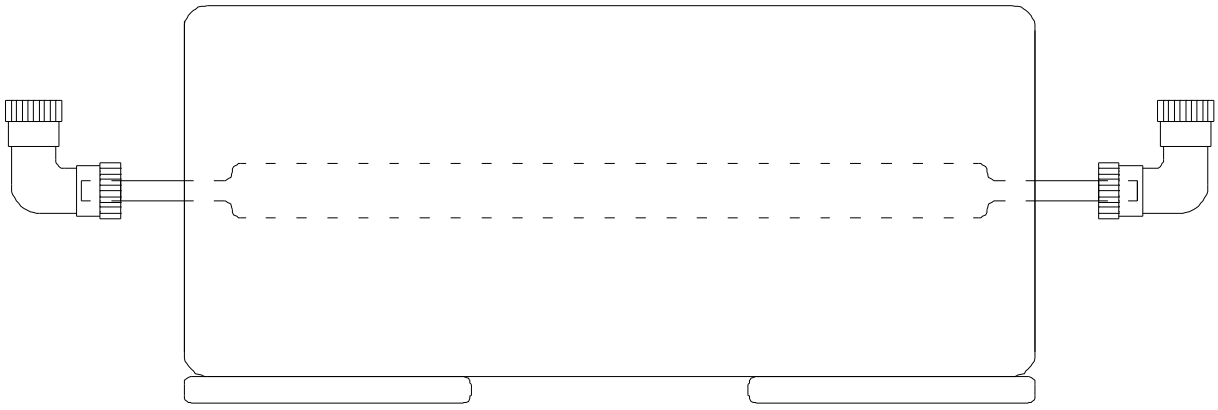


Figure 1: Inside view of total sulfur reaction furnace

C.1. Installing or Replacing the Combustion Tube

1) Remove the covers from the total sulfur furnace enclosure.
2) Slide the quartz (high temperature glass) tube into the fiber heater.
3) Insure the high temperature o-ring and ferrule are present and oriented correctly, as shown below.

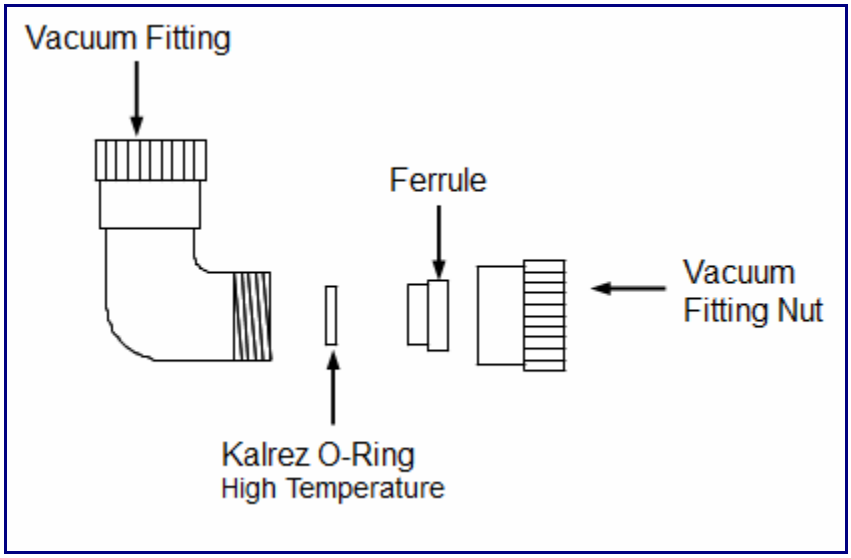


Figure 2: High Temperature O-Ring placement on vacuum fittings

4) Attach the vacuum fitting around Quartz tube and tighten the nut (FINGER TIGHT).
5) Cap the outlet of the furnace to begin the leak check.
   a) Set the pressure of inlet to 15 psig and open the flow meter all the way.
   b) When the ball in the flow meter drops to the bottom of the flowmeter tube, a seal has been established.
      ⇒ If the ball does not drop, a leak is present. Inspect and tighten all fittings, then repeat the previous steps until a seal has been established.

CAUTION: Do operate the reaction furnace if a leak is present

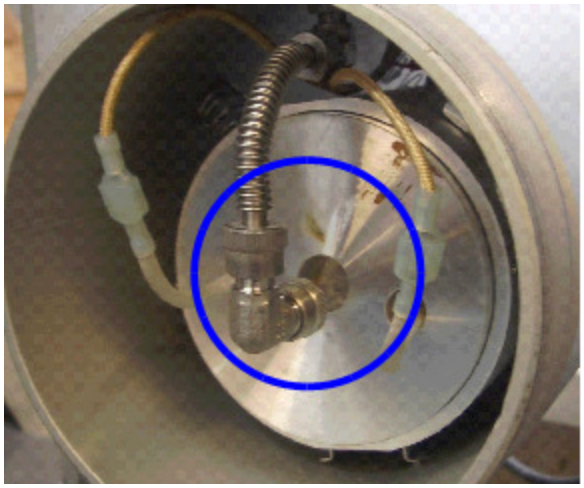


Figure 3: Vacuum fitting connected to Quartz Reaction Tube

Hand tighten only when replacing tube

C.2. Hydrogen Flow and Sample Flow

The figures below shows the typical sample conditioning system used for the 330 & 331 Total Sulfur Analyzers. The total sulfur reaction furnace, and an extra flowmeter, used to control the flow of hydrogen sample, is added to the standard sample conditioning system for H2S Analyzers. See Appendices for overview and dimensional drawings.

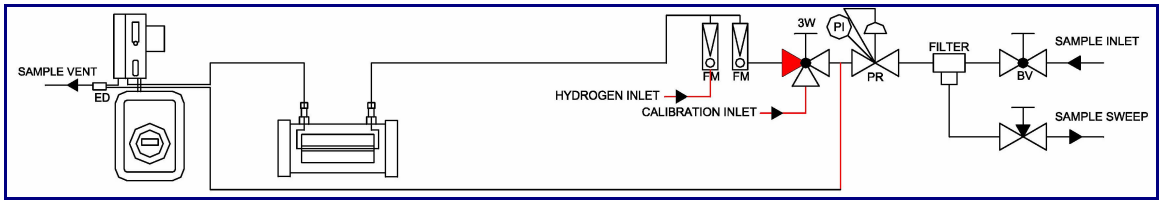


Figure 4: 330 Total Sulfur Analyzer Flow diagram (similar to 331)

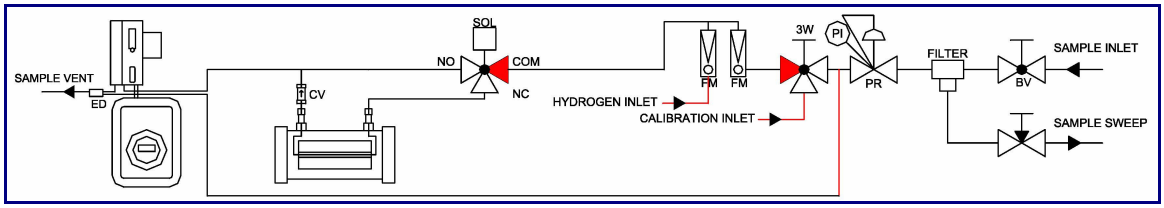


Figure 5: 330 H2S/Total Sulfur Analyzer Flow diagram (similar to 331)

Legend for figure above:

3W	3 way valve
PR	Pressure regulator
PI	Pressure indicator
BV	Block valve
NV	Needle valve
SOL	Solenoid
CV	Check valve

Consult the factory calibration sheet at the end of this manual for the correct sample and hydrogen flow rates. An indicator for insufficient hydrogen is a yellow discoloration appearing on the Tygon tubing connected to the humidifier. If this happens, increase the hydrogen flow.

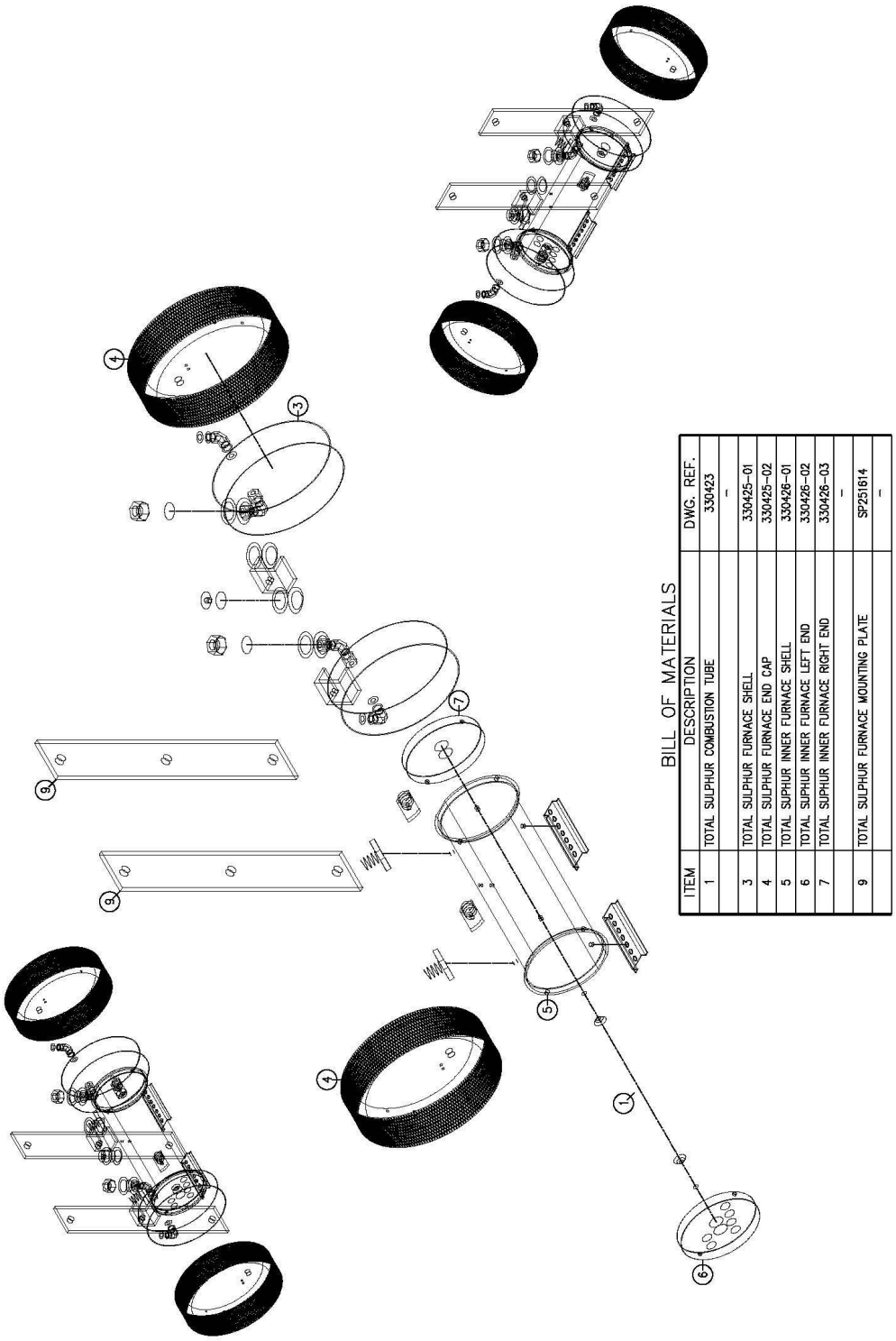
A significant shortage of hydrogen can cause coking (a black carbon material) in the furnace tube. A light coating of carbon is normal and will not cause any operational problems. Excessive coking can lead to the quartz reaction tube becoming plugged.

C.3. Hydrogen shutoff / Low hydrogen shut down option

The optional hydrogen shut off sample system is designed for dual stream H2S/Total Sulfur analyzers, flow diagram shown below. This system removes the flow of hydrogen when the analyzer is measuring hydrogen sulfide. A pressure switch can be used to ensure that if the hydrogen is less then 10 psig the analyzer will not switch to the total sulfur stream. This prevents coking of the combustion tube due to lack of hydrogen. See Appendices for overview and dimensional drawings.

APPENDICES

Total Sulfur Furnace Drawing



BILL OF MATERIALS

ITEM	DESCRIPTION	DWG. REF.
1	TOTAL SULPHUR COMBUSTION TUBE	330423
		–
3	TOTAL SULPHUR FURNACE SHELL	330425-01
4	TOTAL SULPHUR FURNACE END CAP	330425-02
5	TOTAL SUPHUR INNER FURNACE SHELL	330426-01
6	TOTAL SUPHUR INNER FURNACE LEFT END	330426-02
7	TOTAL SUPHUR INNER FURNACE RIGHT END	330426-03
		–
9	TOTAL SULPHUR FURNACE MOUNTING PLATE	SP251614
		–

Total Sulfur Analyzer Wiring Diagram

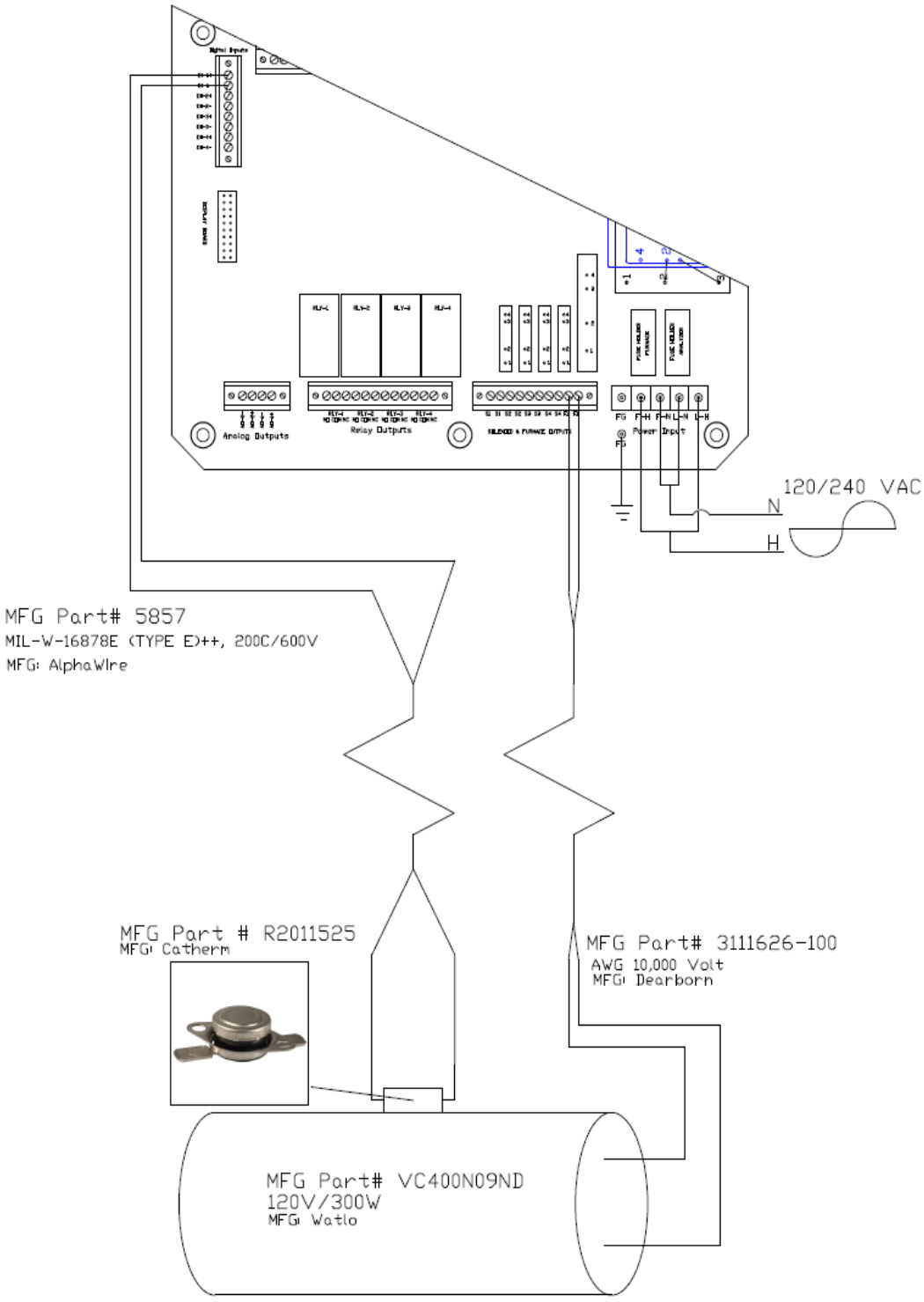


Figure 6: H2S Total Sulfur Analyzer wiring diagram

Standard 331 Total Sulfur Analyzer Drawing

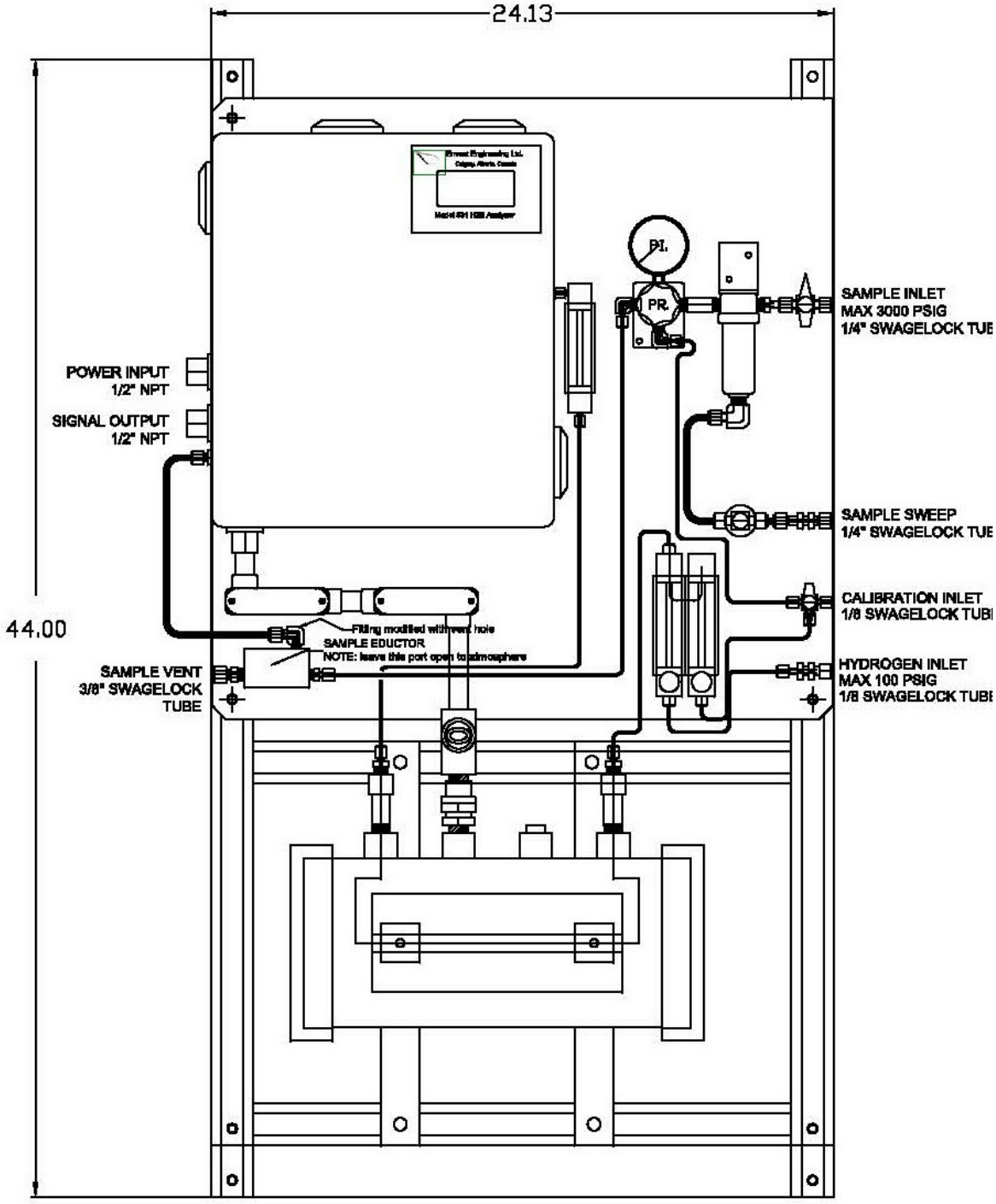


Figure 7: Standard 331 Total Sulfur Analyzer - Outline and dimensional drawing

Standard 330 Total Sulfur Analyzer Drawing

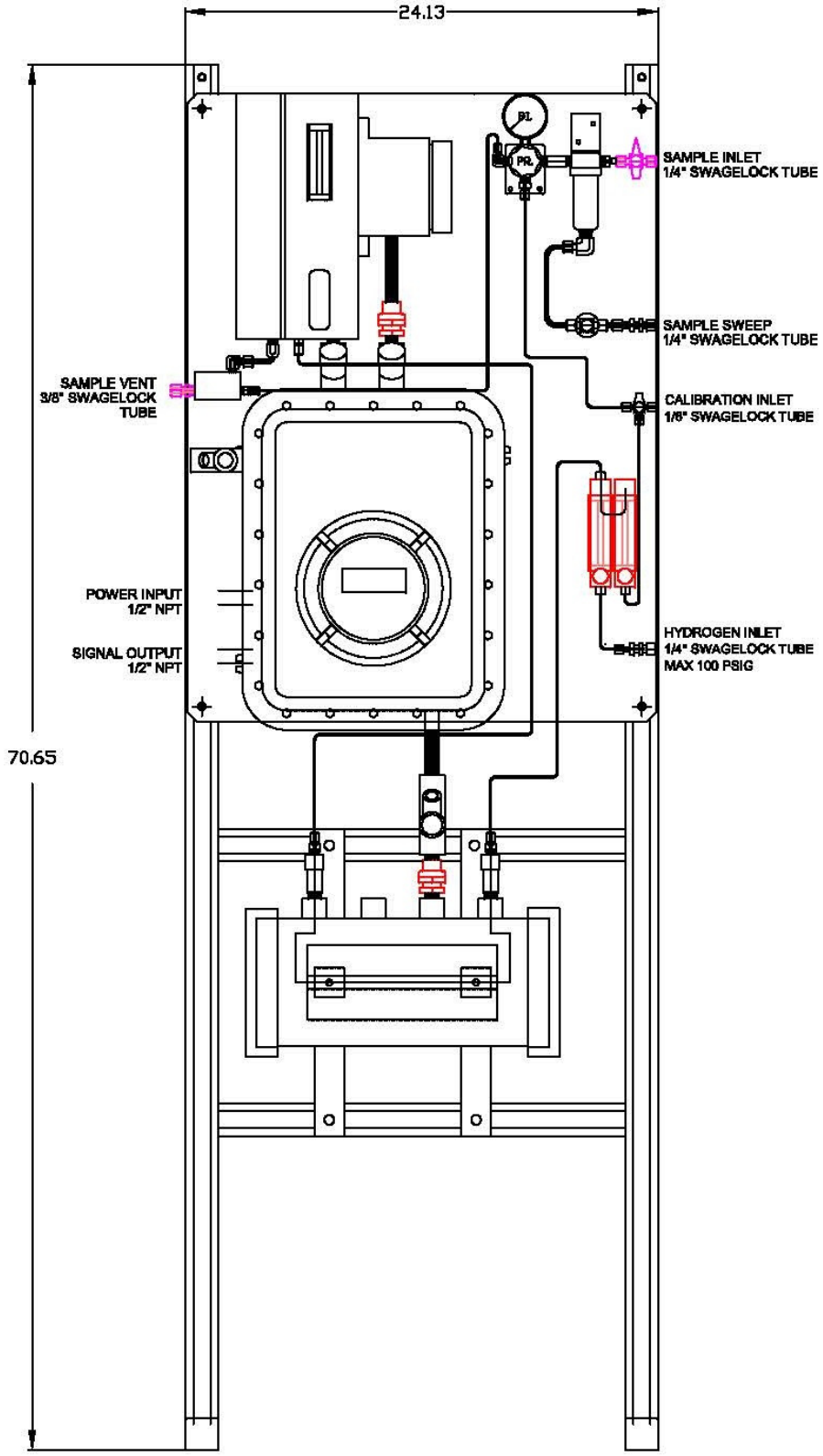


Figure 8: Standard 330 Total Sulfur Analyzer - Outline and dimensional drawing

Standard 330 H2S Total Sulfur Low Hydrogen Shutoff Option (similar to 331)

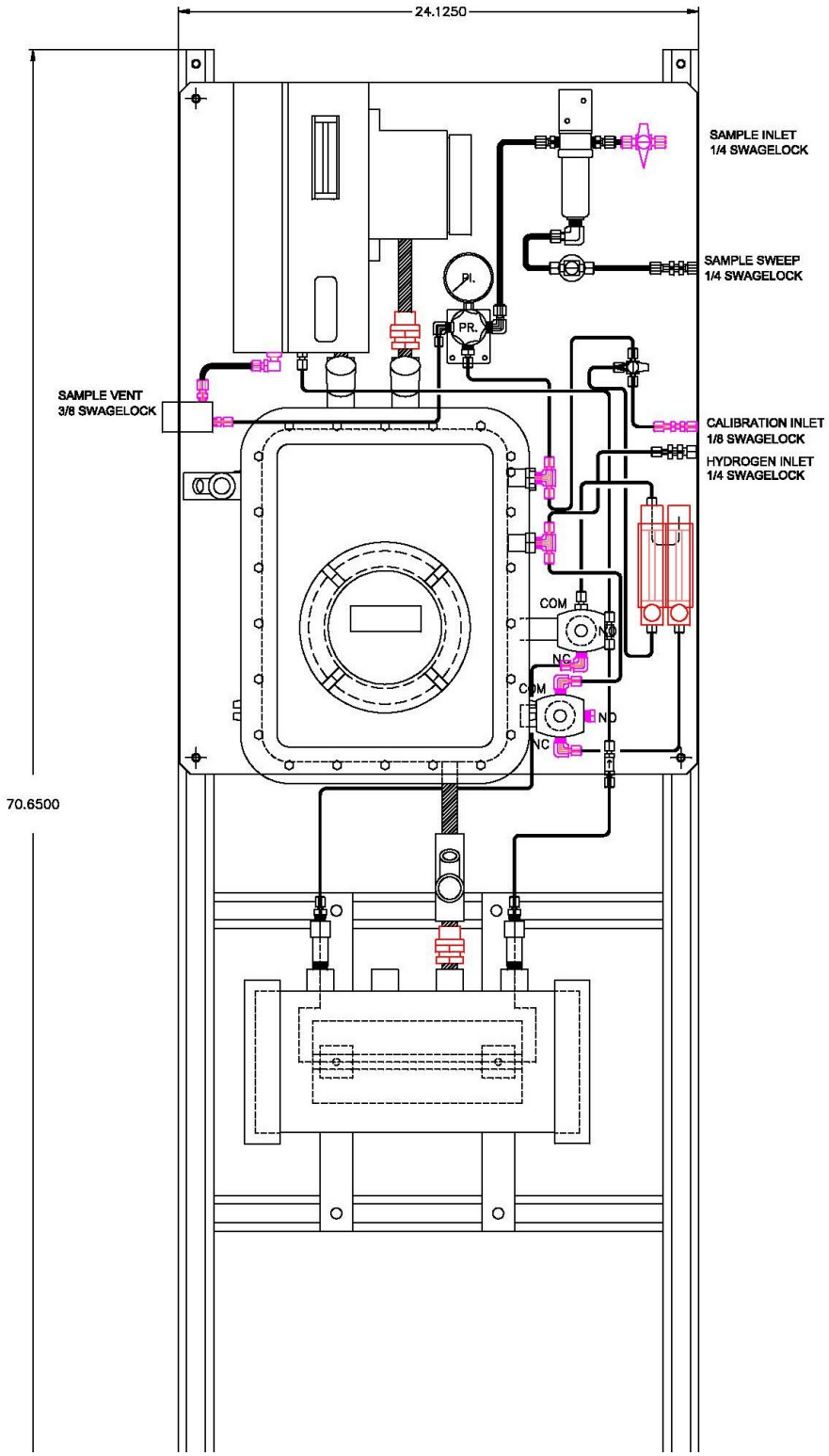


Figure 9: 330 H2S/Total Sulfur analyzer with low hydrogen shutoff drawing

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

Rev No.	*Rev Date*	*Rev Description*
01	12-Jan-12	Changed format, added information

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