Standard Operating Procedure for H_2S Point Monitors

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1. Scope and Application

This document is the standard operating procedure (SOP) for the maintenance and calibration of the Teledyne T101 analyzer, which measures concentrations of ambient hydrogen sulfide (H_2S). The calibration system described herein presumes the use of a Teledyne T700 gas dilution calibrator, an external zero air generator, and a National Institute of Standards and Technology (NIST)-traceable H_2S gas cylinder. However, other suitable calibration equipment may be used for the purpose of performing maintenance and verification on the T101 analyzer.

2. Safety

This procedure requires the handling of hazardous compounds (H_2S and SO_2) in the forms of compressed gas cylinders, permeation tubes, and exhaust gas from the analyzer. H_2S and SO_2 must be discharged outdoors and away from all personnel after passing through a scrubber or filtration system. Improper handling may result in acute, long-term health impacts. Personnel must be properly trained and qualified prior to performing any procedure in this SOP.

3. Method Overview

The Teledyne T101 determines the concentration of H_2S by converting it to sulfur dioxide (SO_2), which is then measured by ultraviolet (UV)-induced fluorescence. Ambient air is drawn by an internal pump through a sample particulate filter to remove particles, a hydrocarbon scrubber to remove hydrocarbons, and finally an SO_2 scrubber to remove ambient SO_2 prior to the converter. The sampling flow rate is 700 standard cubic centimeters per minute (sccm). H_2S in the ambient air is converted to SO_2 through high-temperature catalytic oxidation, and the converter is most efficient at 315°C. The resulting SO_2 is exposed to UV light with a wavelength of 214 nm to create an excited-state molecule (SO_2*). The SO_2* molecule quickly returns to a lower energy ground state by releasing excess energy in the form a photon (at 330 nm). The amount of emitted light at 330 nm is directly related to the SO_2 concentration, which is used to quantify H_2S concentration. The system can also measure the SO_2 concentration present in the ambient air by bypassing the sampling flow from the SO_2 scrubber and the catalytic converter, if desired.

4. Equipment and Supplies

Before beginning the quality control (QC) check and maintenance, ensure you have the following:

- NIST-certified H_2S gas cylinder with regulator or H_2S permeation tube
- NIST-certified SO_2 gas cylinder with regulator or SO_2 permeation tube (for converter efficiency (CE) check)
- Gas calibrator

- Zero air generator
- Certified, NIST-traceable flow meter
- Technician's tool bag, including screwdrivers, pliers, wrenches, etc.
- Inlet filter opening wrenches
- Replacement particulate filters
- Replacement converter catalyst
- Pump rebuild kit

5. Maintenance Schedule

A list of regular maintenance activities, and the corresponding sections of the T101 user manual where they are described in detail, is listed in Table 1. Additional information regarding frequency of service is presented in the facility's Quality Assurance Project Plan (QAPP).

Table 1. QC and maintenance schedule for the T101 series H_2S analyzer.

Activity	SOP Section	User Manual Reference
Perform zero and span check	6.1	5.2
Review and verify test functions	6.2	6.72
Review and verify test functions	6.2	6.7.2
Inspect sample lines	6.3	--
Change inlet particulate filter	6.4	6.6.1
Perform flow check	6.5	6.6.9.3
Perform multipoint check	6.1	--
Replace SO_2 scrubber material and sintered filters	6.6	6.6.3
Check for H_2S -> SO_2 converter efficiency (CE), replace or service the converter if CE < 96%	6.7-6.8	6.6.5.2
Service the critical flow orifice assembly; replace as needed	6.9	6.6.7
Perform pump check and rebuild pump diaphragm as needed	6.10	6.6.9.1
Perform leak check	6.10	6.6.9.1
Adjust UV lamp	6.11	6.7.10.3
PMT sensor hardware calibration	6.12	6.7.10.4
Calibrate offset and slope	6.13	5.2

6. Field Operation and Maintenance

Common maintenance and QC activities are described below. Additional information about maintenance activities, troubleshooting, and fault codes can be found in the T101 user manual.[1]

For regulatory projects, the analyzer should never be taken offline or put into Maintenance Mode if ambient H_2S concentrations are elevated (>10 ppb), especially if they are approaching a public notification level. Report any observations of concern to the Project Manager immediately before performing maintenance.

6.1. Perform Zero/Span or Multipoint Check

A Z/S check evaluates analyzer performance without altering the response curve (slope and offset values) and is a recommended regular maintenance item. A multipoint check similarly evaluates performance across the analyzer's measurement range and shall be conducted only after the analyzer is calibrated. The multipoint check can be used to confirm the linearity of the analyzer's response.

6.1.1. Manual Verification

1. Verify that the ambient conditions are acceptable to take the system down for QC checks (i.e., ambient H_2S concentration is <10 ppb), prior to proceeding with gas verification. Put the H_2S channel into Maintenance Mode from the Field Tech Tool.
2. Connect the sources of zero and span (Z/S) gas as shown in **Figure 1**, depending on the instrument configuration. The zero air generator can be replaced by a zero air cylinder. If using the T700 dilution calibrator, make sure the calibrator contains the accurate gas standard concentration in the Cylinder Setup menu.
3. Generate the instrument zero using the zero air source.
4. When using NumaView software with the T101 analyzer, view the concentration and stability responses by clicking the Home Tab and the blue H_2S icon. Verify the T101 mode remains in SAMPLE in the lower-right corner of the display. This ensures the verification is conducted through the inlet probe.
5. Wait at least 15 min until the analyzer stability (STAB) is below 0.5 ppb (wait longer than 15 min if more time is needed for STAB to be < 0.5 ppb). Record the reading. If the stability threshold cannot be achieved, contact the Project Manager and proceed to additional troubleshooting steps.

[1] https://www.teledyne-api.com/prod/Downloads/083730101B%20-%20MANUAL,%20USER,%20NVS,%20T101-T102.pdf

6. From the dilution calibrator, set the target H_2S span gas concentration(s) as defined in Section A.7 of the QAPP for both span and multipoint checks.
    a. Wait at least 45 min until STAB is below 0.5 ppb for each concentration level (wait longer than 45 min if more time is needed for STAB to be $<$ 0.5 ppb at each level). Record the readings. If the stability threshold cannot be achieved, contact the Project Manager and proceed to additional troubleshooting steps.
7. Refer to the facility's QAPP for the test acceptance criteria.
8. Purge the sampling line and the analyzer by generating a high flow of zero air for at least 5 min. This step helps the analyzer return to sampling ambient conditions.
9. At the conclusion of the check, put the calibrator into STANDBY mode.

   IMPORTANT: Failing to change the calibrator to STANDBY mode means the analyzer will continue to detect zero air or span gas fed to the inlet, resulting in INVALID ambient data.
10. Verify that the SAMPLE mode status of the T101 is reflected in the lower-right corner of the display.
11. Observe and make sure the H_2S reading has returned to ambient concentrations **before** putting the channel back to Normal Operations from the Field Tech Tool.

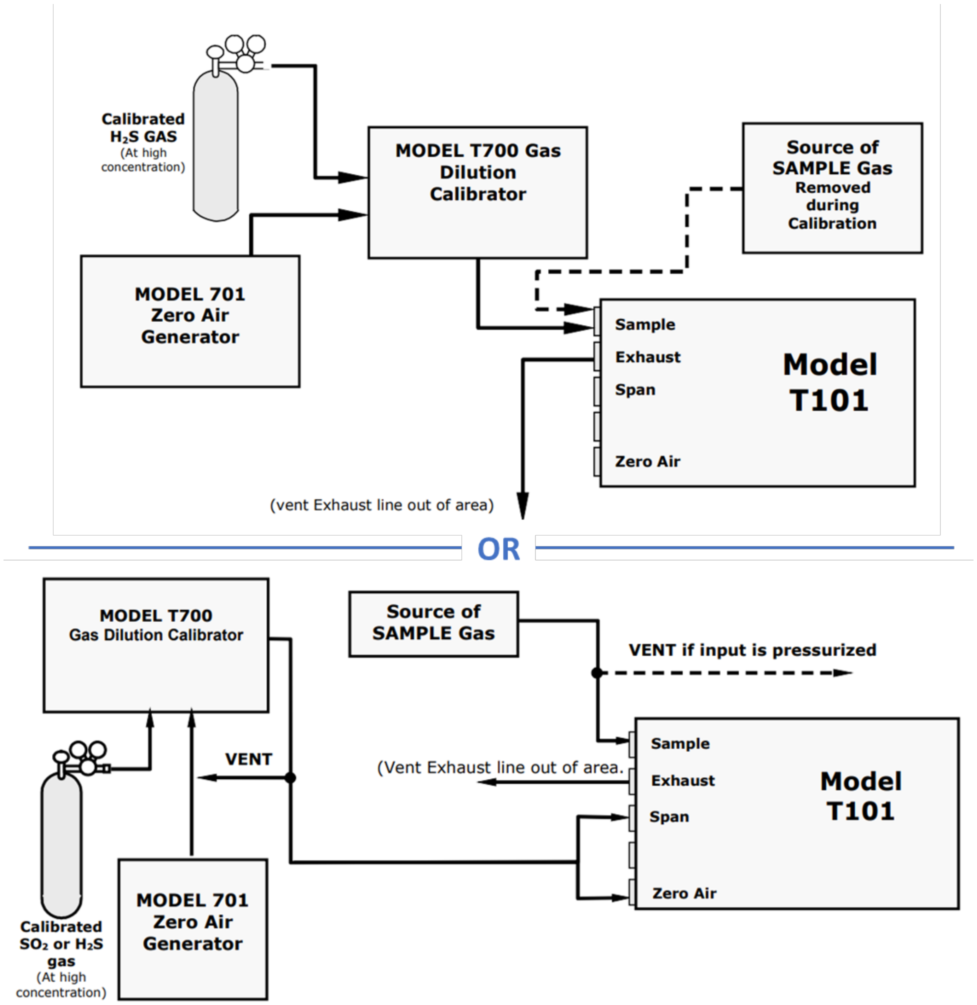

Figure 1. Connection setup for verification and calibration with basic configuration (top) or Z/S valves option (bottom).

6.1.2. Automated Verification

For some monitoring sites, automated verification may be configured and initiated manually. Note the following procedure is only applicable when the Teledyne T101 analyzer and T700 dilution calibrator are used together.

The preset sequences are set up such that an abundance of time (at least 15 min for a zero and 45 min for any non-zero concentration level) is built in to achieve stabilized readings from a properly functioning, calibrated analyzer.

1. Verify the ambient conditions are acceptable (H_2S < 10 ppb) to proceed with gas verification. Put the H_2S channel into Maintenance Mode from the Field Tech Tool.

2. Connect the Z/S gas sources as shown in Figure 1, depending on instrument configuration. The zero air generator can be replaced by a zero air cylinder. Make sure the T700 dilution calibrator contains the accurate gas standard concentration in the Cylinder Setup menu.
3. If the verification is to be initiated remotely via the NumaView Remote Software, open the software and launch the analyzer and calibrator of interest.
4. From the T700 dilution calibrator, go to **Generate** > **Sequence** to view a selection of preset sequences, as shown in Figures 2 and 3.
5. Select the sequence to be initiated and select Generate.
6. Verify that the calibrator is beginning the steps by observing the Instant Mode in the Generate menu or Mode in the lower-right corner of the display.

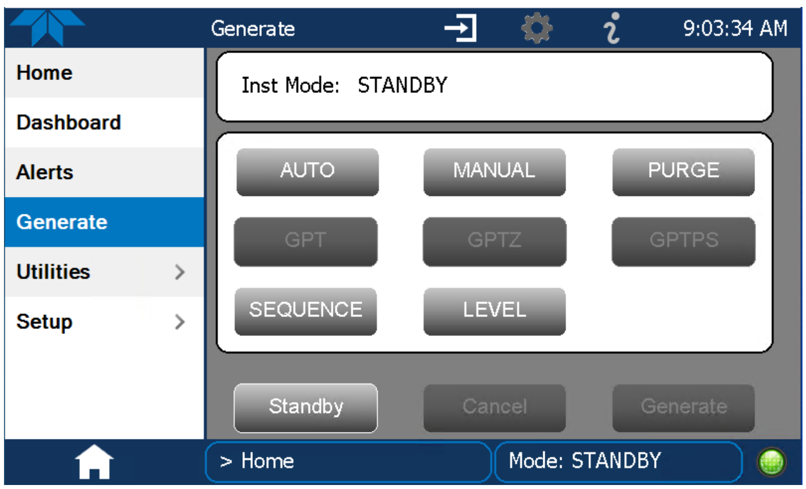

Figure 2. Screenshot of the Generate menu on the T700 calibrator.

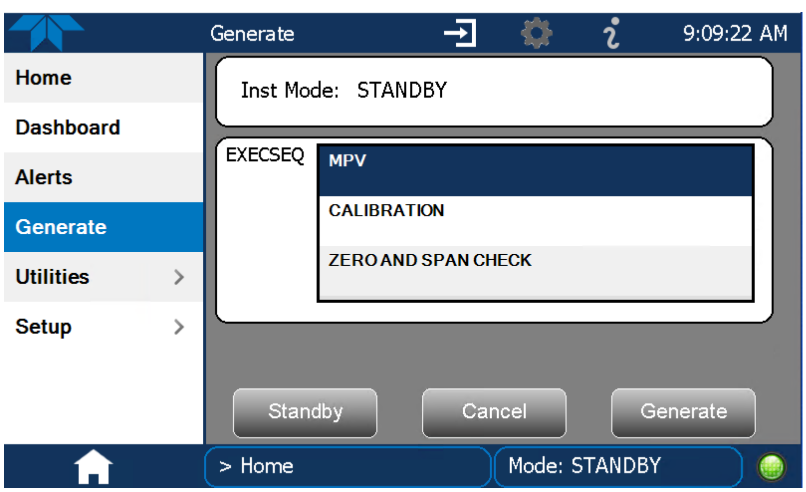

Figure 3. Screenshot of preset automated sequences on the T700 calibrator.

7. When using NumaView software with the T101 analyzer, view the concentration and stability responses by clicking the Home Tab and the blue H_2S icon. Verify the analyzer remains in SAMPLE mode during the Z/S check and multipoint check by looking in the lower-right corner of the display. This ensures the verification is conducted through the inlet probe.
8. Review the **entire** check results to confirm the completion of a Z/S check or multipoint check using Sonoma Technology's Insight data management system.
9. When the check is finished, verify the calibrator has been switched back to STANDBY mode and the analyzer has been switched back to SAMPLE mode.

   IMPORTANT: Failing to change the calibrator to STANDBY mode means the analyzer will continue to detect zero air or span gas that is fed to the inlet, resulting in INVALID ambient data.
10. Observe and make sure the H_2S value has returned to ambient concentrations **before** putting the channel back to Normal Operations from the Field Tech Tool.

6.2. Review and Verify Test Functions

Test functions on the Dashboard should be carefully reviewed and verified during each scheduled site visit. Minimally, operators should check and verify that major test functions remain within the nominal range listed in **Table 2** (also included on the maintenance checklist). Operators should also review active warning alerts to determine if troubleshooting or corrective actions are required.

Table 2. Major diagnostics for the Teledyne API T101 H_2S analyzer.

Diagnostic	Acceptable Value Range
H_2S Slope	1.0±0.3
H_2S Offset (mV)	< 250
Converter Temp (°C)	315±1
Sample Flow (sccm)	585-715 (650±10%)
Pressure (inHg)	~ 5 < ambient pressure
UV Lamp Signal (mV)	2,000-4,000
UV Lamp Ratio (%)	30-120

Refer to the T101 user manual for a detailed list of test functions, nominal values, and possible causes for out-of-range values. Additionally, the acceptable ranges for these functions of a specific analyzer can be found in the *Final Test and Validation Data Sheet* shipped with the instrument.

6.3. Inspect Sample Lines

Contaminated or kinked sample line can adversely impact sampling data over time. Check for any sample line flow restrictions or visible dirt or condensation accumulation along the sampling path between the sample inlet and the analyzer sampling port, as well as the calibration lines. Replace the sample and calibration lines as needed.

6.4. Change Sample Particulate Filter

The sample particulate filter inside this instrument needs to be changed monthly, even without obvious signs of dirt; filters with pore sizes of 1 and 5 µm can clog even when they look clean. A schematic of the particulate filter is shown in **Figure 4**.

1. Turn OFF the analyzer to prevent drawing debris into the sample line.
2. Open the T101’s hinged front panel and unscrew the knurled retaining ring of the filter assembly.
3. Carefully remove the retaining ring, glass window, PTFE O-ring, and filter element.
4. Use a tweezer to carefully replace the filter element, centering it at the bottom of the holder. Alternatively, wear latex gloves if handling the filter to avoid contamination.
5. Re-install the PTFE O-ring with the notches facing up, replace the glass cover, screw on the hold-down ring, and hand tighten the assembly. **Inspect the (visible) seal between the edge of the glass window and the O-ring to ensure proper gas tightness.** This is critical for ensuring that the sample flow rate does not drop.
6. Restart the analyzer and perform a leak check.

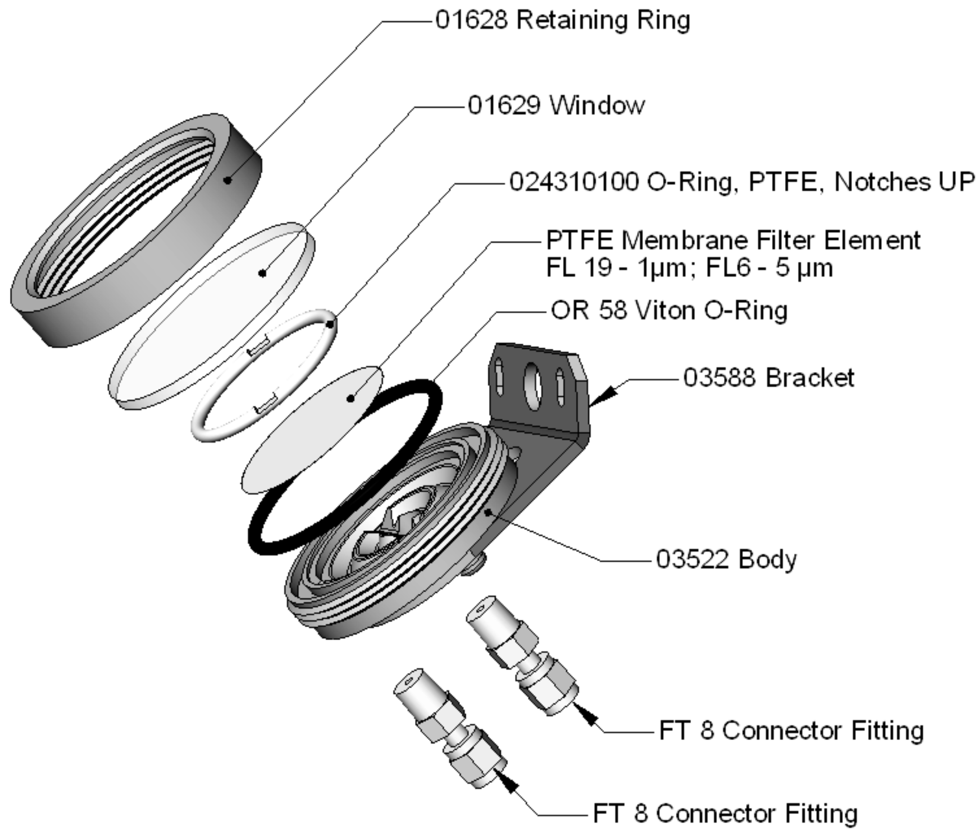

Figure 4. Particulate filter assembly.

6.5. Perform Flow Check

Use an external, calibrated NIST-traceable flow meter capable of measuring the instrument's flow specifications for this check. Do not use the built-in flow measurement viewable in the Dashboard as this value is only calculated, not measured. A decreasing sample flow may point to slowly clogging pneumatic paths, most likely critical flow orifices or sintered filters.

1. Disconnect the sample inlet tubing from the rear panel SAMPLE port.
2. Attach the outlet port of a suitable flow meter to the rear panel SAMPLE port.
3. The sample flow measured with the external flow meter should be within 585-715 sccm.

12. Record the sample flow reading from the external flow meter. If the flow is beyond the specified range, contact the Project Manager and proceed to additional troubleshooting steps. A passing flow check is required for normal instrument operations.

6.6. Change the SO_2 Scrubber (Activated Charcoal)

1. Input zero air for 5 min.

2. Turn off the analyzer.
3. Remove the instrument cover.
4. Locate the SO_2 scrubber cartridge in the front of the analyzer (it looks like a big white cylinder).
5. Undo the two 1/8" fittings on the top of the scrubber.
6. Remove the two screws holding the scrubber to the instrument chassis, and remove the scrubber.
7. Take the two Teflon™ fittings off the instrument.
8. Empty the SO_2 scrubbing material and discard the sintered filters into a hazmat bin.
9. If any SO_2 scrubber residual is visible in the line, disconnect the line and clear the line of powder with compressed air.
10. Fill each side of the scrubber with new SO_2 scrubber material until it is ½" from the bottom of the thread lines (about ½" from the top of the scrubber); do not fill it too high or the fitting will crush the material.
11. Install a new set of sintered filters. The filters should be leveled at the bottom of the fittings.
12. Remove the Teflon tape from both of the removed fittings, and retape them with new Teflon tape.
13. Install both fittings back onto the scrubber.
14. Put the scrubber back into the analyzer and replace the two screws on the bottom.
15. Screw the two 1/8" fittings back onto the top of the scrubber.
16. Return the analyzer to normal operation.

6.7. Check for H_2S -> SO_2 Converter Efficiency

1. Set the analyzer to SO_2 measurement mode.
2. Supply a gas with a known concentration of SO_2 to the sample gas inlet of the analyzer.
3. Wait until the analyzer's SO_2 concentration measurement stabilizes. This can be determined by setting the analyzer's display to show the SO_2 STAB test function. SO_2 STAB should be 0.5 ppb or lower before proceeding.
4. Record the stable SO_2 concentration.
5. Set the analyzer to H_2S measurement mode.
6. Supply a gas with a known concentration of H_2S, equal to that of the SO_2 gas used in steps 2-4 above, to the sample gas inlet of the analyzer.
7. Wait until the analyzer's H_2S concentration measurement stabilizes. This can be determined by setting the analyzer's display to show the H_2S STAB test function. H_2S STAB should be

0.5 ppb or lower before proceeding.

8. Record the stable H_2S concentration.
9. Divide the H_2S concentration by the SO_2 concentration.
   EXAMPLE: If the SO_2 and H_2S reference concentration of the two test gases used is 500 ppb:
   Measured SO_2 Concentration = 499.1 ppb
   Measured H_2S Concentration = 490.3 ppb
   CE = 490.3 ÷ 499.1
   CE = 0.982 (98.2%)
10. It is recommended that the H_2S -> SO_2 converter catalyst material be replaced if the CE falls below 96%. Proceed to the next section to change the converter catalyst material.

6.8. Change H_2S -> SO_2 Converter Catalyst Material

The H_2S -> SO_2 converter is located at the center of the instrument. The converter is designed for replacement of the cartridge only; the heater with built-in thermocouple can be reused. A schematic of the H_2S-to-SO_2 converter assembly is shown in **Figure 5**.

1. Turn off the analyzer power, remove the cover, and allow the converter to cool down.
2. Remove the top lid of the converter and the top layers of insulation until the converter cartridge is visible.
3. Remove the tube fittings from the converter.
4. Disconnect the power and the thermocouple of the converter. Unscrew the grounding clamp of the power leads with a Phillips-head screwdriver.
5. Remove the converter assembly (cartridge and band heater) from the can. Make a note of the orientation of the tubes relative to the heater cartridge.
6. Unscrew the band heater and loosen it. Take out the old converter cartridge.
7. Wrap the band heater around the new replacement cartridge and tighten the screws using a high-temperature, anti-seize agent such as copper paste. Make sure to properly align the heater with respect to the converter tubes.
8. Replace the converter assembly, route the cables through the holes in the housing, and reconnect them properly. Reconnect the grounding clamp around the heater leads for safe operation.
9. Re-attach the tube fittings to the converter and replace the insulation.
10. Replace the instrument cover and power up the analyzer.

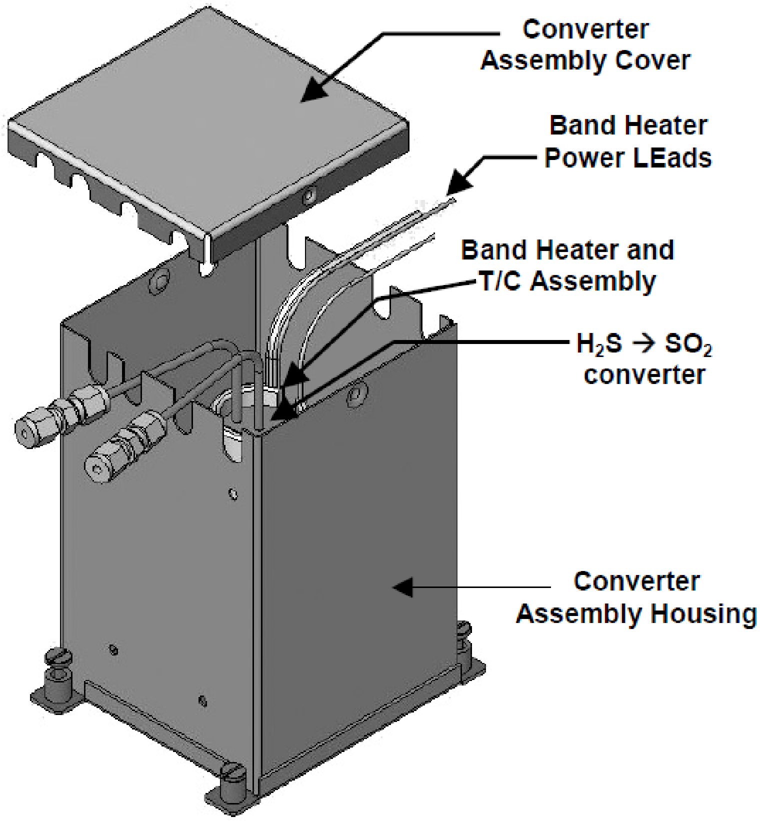

Figure 5. H_2S -> SO_2 converter assembly.

6.9. Service the Critical Flow Orifice Assembly

The critical flow orifice assembly shown in **Figure 6** can clog despite being protected by sintered stainless steel filters, particularly if the instrument operates without a sample filter or in an environment with very fine, submicron-sized dust.

1. Turn off power to the instrument and vacuum pump.
2. Locate the critical flow orifice on the pressure sensor assembly.
3. Disconnect the pneumatic line.
4. Unscrew the NPT fitting.
5. Remove the assembly components: one spring, one sintered filter, two O-rings, and one critical flow orifice. You may need to use a scribe or pressure from the vacuum port to remove parts from the manifold.
6. Discard the sintered filter. Inspect the two O-rings and replace as needed.
7. Inspect the critical flow orifice. Replace as needed.
8. Re-assemble the parts using a new filter and O-rings.

9. Reinstall the NPT fitting and connect all tubing.
10. Power up the analyzer and allow it to warm up for 60 min.
11. Perform a leak check.

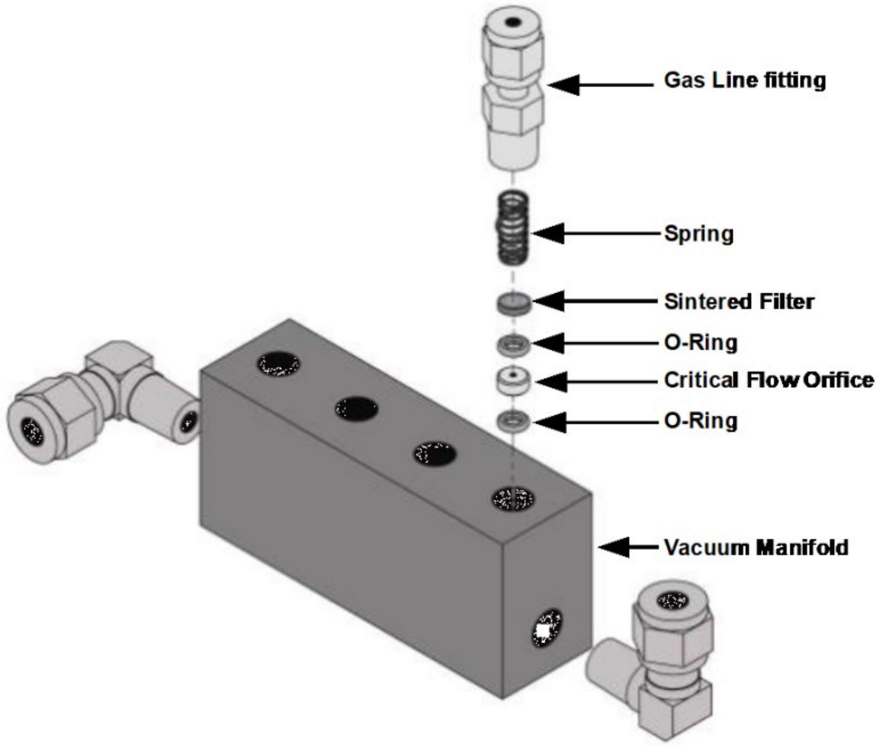

Figure 6. Critical flow orifice assembly.

6.10. Perform Leak Check/Pump Check

Leaks are the most common cause of analyzer malfunction. **A leak check should be carried out whenever the pneumatic flow path is disrupted.** Examples of such disruptions can include, but are not limited to, changing the sample inlet filter, changing the SO_2 scrubber materials, or opening the critical flow orifice assembly. The method described here is easy, fast, and detects (but does not locate) most leaks. It also verifies the sample pump condition, thereby acting as a pump check. An in-depth pressure leak check may also be performed with additional tools, and the protocol for that process can be found in the T101 user manual.

1. Turn the analyzer on if it is not already running and allow at least 30 min for flows to stabilize.
2. Cap the sample inlet port (cap must be wrench-tight).
3. After several minutes of stable pressures, go to the Dashboard to view the readings.

- If the Sample Flow is less than 10 sccm, the instrument is free of large leaks. If not, the leak point should be identified and rectified.
- If the Sample Pressure is less than 10 inHg, the pump is in good condition. If not, the pump diaphragm needs to be replaced.

4. When finished, switch off the pump and SLOWLY open the cap to the sample inlet port to minimize in-rush flow.

6.11. UV Lamp Adjustment and Calibration

The UV lamp output can be affected by a change in line voltage, an aging lamp, or lamp position. Two metrics need to be considered when assessing lamp life: UV lamp intensity and the lamp ratio. The lamp intensity should be 2,000-4,000 mV, and the lamp ratio should be 30-120%. These values will decrease over time. To optimize signal intensity, perform the following steps.

IMPORTANT: DO NOT grasp the UV lamp by the cap when changing the lamp's position—always grasp the main body of the lamp. Inattention to this detail could twist and potentially disconnect the lamp's power supply wires, which COULD DAMAGE THE INSTRUMENT AND VOID THE WARRANTY.

1. Let the instrument run for one hour to stabilize the UV lamp.
2. Set the Dashboard to show the UV LAMP function.
3. Slightly loosen the large brass thumbscrew located on the shutter housing so that the lamp can be moved.
4. While watching the UV LAMP reading, slowly rotate the lamp clockwise and counter-clockwise, and move the lamp up and down vertically until the UV LAMP reading is at its maximum.
5. Finger-tighten the thumbscrew.
6. Assess whether the lamp signal is within optimal intensity (i.e., 3,500±200 mV).
7. If the signal intensity is too high or too low, locate the UV reference detector adjustment potentiometer screw and turn the screw clockwise to increase the signal or counter-clockwise to decrease the signal until the signal intensity is optimal.

IMPORTANT: Increasing the UV reference detector adjustment potentiometer to its maximum introduces measurement noise, which renders the results unstable. If the potentiometer has to be maxed out to achieve an optimal signal, the lamp should be replaced.

A video of the lamp-adjustment process performed by the manufacturer can be found at: **https://www.youtube.com/watch?v=PF6MGK1FftQ**.

Now the optimal lamp signal is achieved, the lamp must be calibrated to reset the lamp ratio. Based on the lamp ratio, the T101 compensates for variations in the intensity of the available UV light by adjusting the H_2S concentration calculation. The lamp ratio is calculated by dividing the current UV lamp intensity by a value stored in the CPU's memory from the last lamp calibration. Once the lamp ratio is less than 30% or greater than 120%, the CPU can no longer compensate for the difference in the current signal from the last saved signal. Calibrate the lamp by doing the following:

1. From the Home page, navigate to **Utilities > Diagnostics > Lamp Cal**.
2. Press Calibrate, and the CPU will save the current lamp signal intensity automatically.
3. Confirm the lamp calibration is complete by checking if the lamp ratio is close to 100% (plus or minus the average fluctuation of the lamp intensity).
4. If the lamp ratio is not close to 100%, power the T101 off and then on again. The lamp ratio should be close to 100% and the lamp calibration is complete. If not, repeat the lamp calibration steps.

6.12. PMT Sensor Hardware Calibration

At times when the instrument's slope and offset values exceed the acceptable range (see Table 2 in Section 6.2) and all other more obvious causes for this problem have been eliminated, the PMT sensor may be calibrated to reset the PMT output.

1. Set the instrument reporting range to SINGLE.
2. Perform a zero calibration using zero air.
3. Run a UV lamp calibration (Section 6.11). This protocol is required to ensure proper scaling of the NORM PMT value.
4. Locate the pre-amplifier board installed on top of the PMT assembly.
5. Locate the following components on the pre-amplifier board (**Figure 7**):
    a. High-voltage power supply (HVPS) coarse adjustment switch (range 0-9, then A-F)
    b. HVPS fine adjustment switch (range 0-9, then A-F)
    c. Gain adjustment potentiometer (full scale is 10 turns)

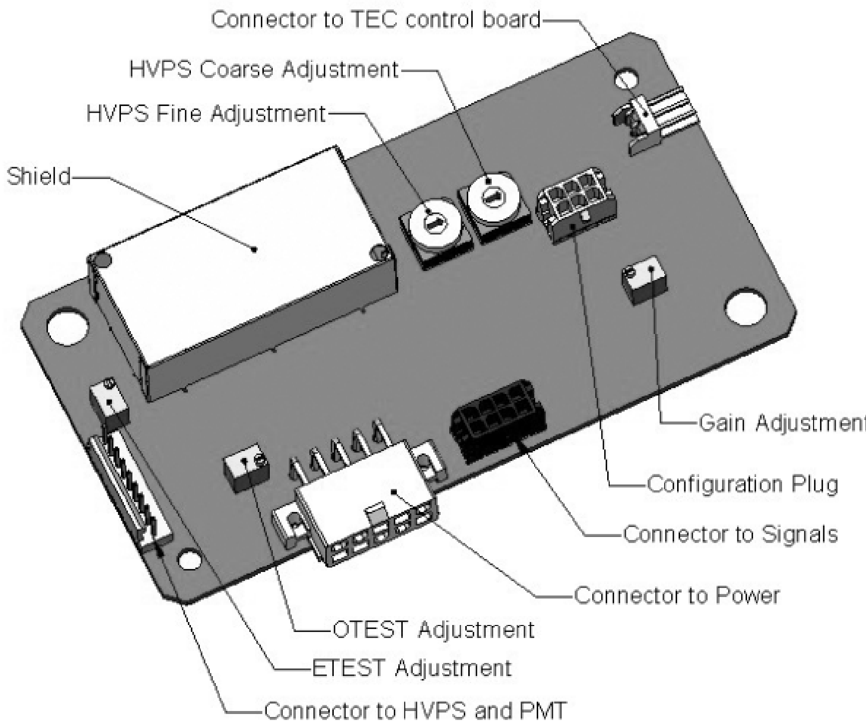

Figure 7. Pre-amplifier board layout.

6. Turn the gain adjustment potentiometer 12 times counter-clockwise to its minimum setting and then four turns clockwise to have some voltage to work with.
7. While feeding at least 80% of measurement range value to the analyzer and waiting until the STAB value is below 0.5 ppb, calculate the target concentration by multiplying the span concentration by the analyzer slope. For example, target concentration = 400 ppb H_2S × 1.25 = 500 ppb H_2S.
8. Note the position of the two HVPS adjustment switches. Carefully use a flathead or Phillips-head screwdriver to adjust the HVPS coarse and fine adjustments until the instrument concentration reads close to the target concentration calculated in the previous step.
9. **IMPORTANT:** DO NOT overload the PMT by accidentally setting both adjustment switches to their maximum setting (i.e., mark F). Start at the lowest setting and increase slowly.
10. Perform a span calibration. The slope should now be close to 1.0 and the concentration should be close to the span gas concentration.
11. Use the Dashboard or Home page to review the NORM PMT value. This value should be double the span gas concentration (in ppb), such that 400 ppb H_2S corresponds to a NORM PMT value of 800 mV on a properly calibrated analyzer.
12. Review and record the new slope and offset as part of the calibration procedure.

6.13. Calibrate Offset and Slope

Generally, a calibration is required when Z/S or multipoint check results fail or are marginal, and after major part repairs. Care should be taken to troubleshoot and eliminate all other more obvious causes for the check failures before proceeding with calibration.

Navigate to the Calibration menu as shown in Figure 8 to perform a calibration. On units with a Z/S valve option installed, select the calibration gas source (Zero or Span) accordingly. Detailed screenshots can be found in the T101 user manual.

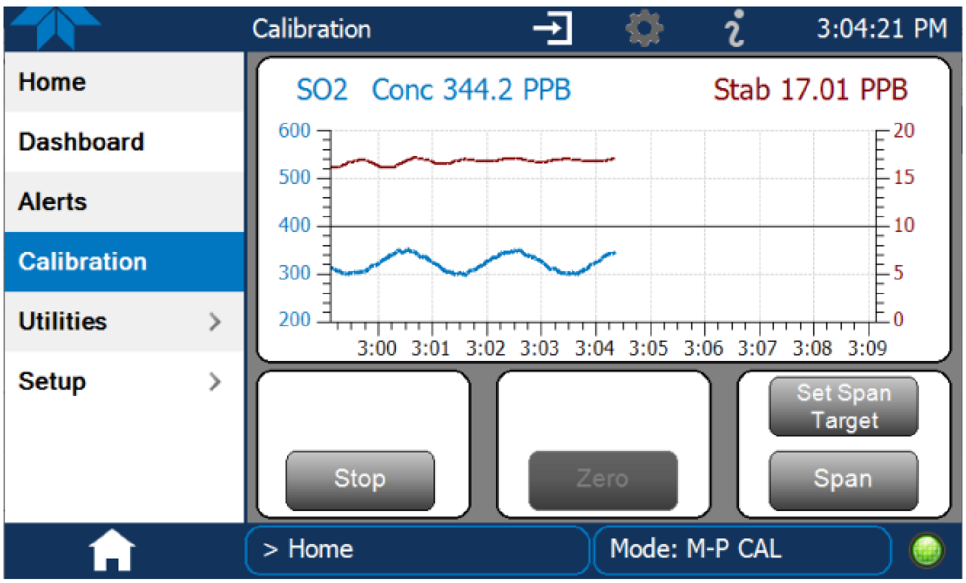

Figure 8. Calibration page.

6.13.1. Manual Calibration

IMPORTANT: Before any calibration, record the as-found slope and offset on the maintenance form. <u>You will NOT be able to retrieve these values once the analyzer is calibrated.</u>

NOTE: If the ZERO or SPAN buttons are not displayed during the Z/S calibration, the measured concentration value is too different from the expected value and the analyzer does not allow for zeroing or spanning the instrument.

Zero calibration:

1. From the calibrator, generate the zero air.
2. From the analyzer, select **Calibration > Start**.
3. Wait until the analyzer stability (STAB) is below 0.5 ppb.
4. Click Zero to calibrate.

5. Click Stop and verify the reading.

Span calibration:

6. From the calibrator, generate the desired span gas concentration.
7. From the analyzer, select **Calibration > Start**.
8. Wait until the analyzer stability (STAB) is below 0.5 ppb.
9. Click Set Span Target and enter the actual reading from the calibrator and then click Done. Use the target concentration if the actual reading is not available.
10. To perform calibration (i.e., adjust the slope and offset), click Span.
11. Click Stop and verify the reading.
12. At the conclusion of the Z/S calibration, verify that the new slope and offset are within the acceptable range listed in Table 2. If the values are beyond the acceptable range, some parts may be causing the slope and offset to overcompensate, and corrective action is needed.
13. Record the new slope and offset on the maintenance form.
14. Proceed to Section 6.1 to perform a post-calibration multipoint check.

    IMPORTANT: On units with a Z/S valve option installed, DO NOT rely on the Sample dropdown option in the Calibration page to return to the sampling mode. Instead, navigate to the Home page to ensure the analyzer is back in SAMPLE mode.

6.13.2. Automated Calibration

For some monitoring sites, automated calibration may be configured and initiated manually. Note the following procedure is only applicable when the Teledyne T101 analyzer and T700 dilution calibrator are used together.

The preset calibration sequence is set up such that an abundance of time (at least 15 min for a zero and 45 min for any non-zero concentration) is built in to achieve stabilized readings before the analyzer is automatically calibrated.

Due to the similarity between the automated verification and automated calibration feature, this section describes only the major steps involved in initiating an automated calibration sequence. Read this section thoroughly before proceeding to Section 6.1.2 to perform an automated calibration.

- Before any calibration, record the as-found slope and offset on the maintenance form. <u>You will NOT be able to retrieve these values once the analyzer is calibrated.</u>
- Make sure the T700 dilution calibrator contains the accurate gas standard concentration information in the cylinder setup menu.
- Once the calibration sequence is initiated, verify the calibrator begins the steps by observing the Instant Mode in the Generate Menu or Mode at the lower right corner of the display.

- At the conclusion of the Z/S calibration, verify the new slope and offset are within the acceptable range listed in Table 2. If not, some parts may be causing the slope and offset to overcompensate, and corrective action is needed.
- Record the new slope and offset on the maintenance form.
- Proceed to Section 6.1 to perform a postcalibration multipoint check.

7. Maintenance Form Template

Examples of the maintenance checklist and response summary are shown in **Figures 9 and 10**. These documents may be used as templates to be customized to meet specific monitoring project goals.

H2S Monitor - Teledyne - T101

Instrumentation SNs	
H_2S Teledyne T101	
Calibrator (Teledyne T700)	
Gas Cylinder	
Gas Cylinder Expiration Date	
ZAG (Teledyne 701)	

Maintenance Notifications	
Notify field operations	☐
Enable missing data alerts	☐
Disable maintenance mode	☐

Verification Type	
Verification Type	Monthly

Maintenance Checklist		
		Completed?
BOTH Analyzer and Calibrator cleared of all active alerts?		☐
Perform Zero/Span gas test for analyzer response. If the test fails, investigate the root cause, and calibrate as needed.		☐
Inspect sample line tubing and inlet.		☐
Inspect and empty out water trap.		☐
Replace inlet particulate sample filter.		☐
Perform multi-point gas test for analyzer response. If the test fails, investigate the root cause, and calibrate as needed.		☐
Perform a flow check.		☐
Replace SO2 scrubber media.		☐
Perform zero air generator and dilution calibrator maintenance.		☐

Figure 9. Example T101 H_2S analyzer checklist.

Instrument Diagnostics	
As Found H_2S Slope As Left	
As Found H_2S Offset As Left (mV)	
Concentration (ppb)	
H2S STB (ppb)	
Sample Flow (sccm)	
Sample Pressure (in Hg)	
UV Lamp (mV)	
Lamp Ratio (%)	
HVPS (V)	
Box Temperature (°C)	
Converter Temperature (°C)	

Span Test	
Measured Zero (ppb)	
H2S STB (ppb)	
Expected Concentration (ppb)	
Measured Concentration (ppb)	
H2S STB (ppb)	
% Error	
Pass/Fail	

Figure 10. Example T101 H_2S diagnostics and span test summary.