Title: Standard Operating Procedure for H_2S and SO_2 Converter		
Procedure No: SOP-001	Revision No: 1.0 January 24, 2011	Page No.: 1 of 6

1. INTRODUCTION AND SCOPE

This procedure describes the operation and configuration of heated converters used in continuous ambient measurements of H_2S and TRS coupled with a continuous SO_2 fluorescence analyzer.

This method adheres to the requirements of the current Air Monitoring Directive (AMD). In some cases the limits and specifications exceed the requirements of the current AMD. It should be considered that the current and any future amendments of the AMD will be used as the benchmark for requirements and criteria for ambient air monitoring practices conducted in the Province of Alberta. Information used to write this procedure was also taken from sources identified in the reference section.

2. PRINCIPLE OF THE METHOD

Currently H_2S/TRS is measured using thermal oxidation to convert H_2S or TRS molecules to SO_2. The converted SO_2 molecules are then analyzed using continuous fluorescent SO_2 analyzers.

H2S

H_2S molecules will be oxidized to SO_2 in the presence of Oxygen and heat. This is accomplished by diverting the sample flow, after a scrubber to remove hydrocarbons, through the H_2S converter. The converter is a Stainless Steel body heated to at least 320 degrees centigrade. Prior to the converter, the sample flow passes through a scrubber to remove all SO_2, and allow only the H_2S molecules to pass through to enter the H_2S converter. The H_2S molecules are then converted to SO_2 as illustrated in the following equation.

Specifically;

$$H_2S + O_2 + heat \rightarrow SO2 + H_2O$$

The converted SO_2 molecules then return to the standard SO_2 analyzer for detection and are reported as H_2S.

TRS

Total Reduced Sulphur compounds include a variety of airborne compounds that contain Sulphur. Some of the common ones found in Alberta are; Carbonyl Sulphide (COS), Carbon Disulphide (CS_2) and Methyl Mercaptan (CH_3SH). Similar to H_2S, TRS molecules will be oxidized to SO_2 in the presence of Oxygen and heat. The difference between H_2S and TRS is that the TRS conversion requires a higher temperature. This is accomplished by, diverting the sample flow, after the hydrocarbon scrubber, through a TRS converter. The TRS converter is a Quartz tube heated to a minimum of 800 degrees centigrade. Prior to the converter, the sample flow must pass through a scrubber to remove all SO_2, and allow only the TRS molecules to pass through to enter the TRS converter. The TRS molecules are then converted to SO_2 as illustrated in the following equation.

Specifically;

$$TRS + O_2 + heat \rightarrow SO2 + H_2O$$

The converted SO_2 molecules then return to the standard SO_2 analyzer for detection and are reported as TRS.

3. MEASUREMENT RANGE AND SENSITIVITY

H_2S and TRS converters are capable of converting concentrations in the range of most current systems, typically 0 to 100 ppm.

If the converter is running with all parameters in the range they should be, the sensitivity of the converter is generally better than the analyzer measuring the concentrations.

4. EQUIPMENT AND APPARATUS

The following are available commercial converters configured specifically for the measurement of H_2S and TRS, are suitable for used in this method and are currently in use in the AENV network:

- Thermo Environmental Instruments model 340 H_2S converter
- CD Nova model CDN 101 TRS converter

This list does not exclude the use of other equipment that has received the USEPA Reference and Equivalent Method designation.

5. INTERFERENCES

See manufacturer's specification .

6. PRECISION AND ACCURACY

The analyzer measuring the SO_2 concentrations governs precision and accuracy for these systems.

The measurement precision is generally considered to be the "repeatability of the measurement". Precision of the data output by the analyzer is established by the manufacturer, but confirmed during daily span checks and monthly calibrations. See section 10.0 in this document for information on daily calibration checks.

The accuracy of the sensor is generally considered the "deviation from true". This means how close it is to what it should be. The benchmark of "what it should be" is provided by the Alberta Environment Audit Program staff and the use of transfer standards such as those available from the National Institute of Standards and Technology (NIST). As with precision, accuracy is confirmed by the daily span checks and monthly calibrations. Refer to the sections identified above for further information on accuracy relating to calibration and audit procedures

7. SITE REQUIREMENTS

Site location for SO_2 monitoring should be determined according to the intended application of the monitoring data. Detailed requirements for selection of sites for monitoring ambient SO_2 can be found in "Optimum Site Exposure Criteria for SO_2 Monitoring" EPA-450/3-77-013. Requirements for the immediate surroundings of ambient monitoring sites can be found in Air Monitoring Directive.

8. INSTALLATION REQUIREMENTS

All the installation requirements are specified by the manufacturer in the installation procedures of the manual. General requirements listed below must also be followed. Considerations for siting requirements can be found in the reference listed in section 7.0 above.

Site location for H_2S and TRS converters is considered as to where they should be installed in the instrument rack. As both the H_2S and TRS converters are heated, they should not be located close to any other instrumentation in the rack. This is so the heat from the converter does not affect the performance of other analyzers in the rack.

When installing the converter, follow the instructions found in the operation manual. One consideration is to keep the tubing from the analyzer and back to the analyzer as short as possible.

8.1. Converter Optimization – after the analyzer has been installed, the converter temperature must be optimized. This process should be completed annually. This task involves the following steps:

8.1.1. Have the analyzer running and all connections made

8.1.2. Connect the calibration gas source using a calibrator capable of generating selected concentrations

8.1.3. Generate a concentration of H_2S at 80% of full scale and wait for the analyzer response to stabilize

8.1.4. Increase the converter temperature at increments of 5 degrees, and wait for stable response between each change. The response will start to drop once the optimum temperature has been passed.

8.1.5. Decrease the converter temperature at increments of 5 degrees, and wait for stable response between each change. The response will start to drop once the optimum temperature has been passed.

8.1.6. The median temperature between these two points is where the converter should be operated

9. OPERATIONAL REQUIREMENTS

The operational requirements for H_2S and TRS converters follow the requirements outlined in the H_2S/TRS operating procedure. See this procedure for details.

10. CALIBRATION

The calibration procedure for H_2S/TRS converters is to check the temperature of the heated block or tube with an external temperature measuring device. This temperature is compared to the displayed temperature on the setpoint display. If the temperatures agree within the specified range given in the operations manual, then no action needs to be taken. If they differ, follow the troubleshooting steps in the operations manual.

11. APPLICABLE DOCUMENTS

- **EM-001a** Thermo Environmental Instruments (TEI) Model 340 H2S Converter Operating Manual
- **EM-001b** CD Nova model CDN101 TRS Converter Operating Manual

12. LITERATURE REFERENCES

None

13. REVISION HISTORY

Revision 0 (new document)

Revision 1 – Grammatical changes.

14. APPROVAL

Approved by: **Harry Benders** **Date:** January 24, 2011

Title: **Air Monitoring Manager**