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Stationary Source Compliance Series

EPA

Field Inspection Notebook for Monitoring Total Reduced Sulfur (TRS) from Kraft Pulp Mills

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Field Inspection Notebook for Monitoring Total Reduced Sulfur (TRS) from Kraft Pulp Mills

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FIELD INSPECTION NOTEBOOK
TOTAL REDUCED SULFUR
CONTINUOUS EMISSION MONITORING SYSTEM

INTRODUCTION

This notebook is intended to assist the field inspector in the inspection of total reduced sulfur (TRS) continuous emission monitoring systems (CEMs). Contained in the notebook are checklists and data entry tables covering preparation for the inspection, preliminary review of records, preliminary on-site meeting with source personnel, and general guidelines for inspection of any type TRS CEM system. Specific audit procedures for three of the most common models of TRS CEMs:

- Sampling Technology Inc. Model 100 TRS CEM System (pg. 35);
- Barton Titrator TRS System (pg. 43); and
- Bendix Gas Chromatograph TRS System (pg. 51)

are provided as sectional inserts. In auditing these monitors the inspector should follow the specific procedure rather than the general guidelines given in the body of the field notebook.

Conscientious use of this notebook will aid the inspector in conducting a thorough audit of the TRS CEM system and provide a comprehensive original record of all phases of the inspection.

FIELD INSPECTION NOTEBOOK OBJECTIVE

This notebook is designed to provide a complete unit checklist for inspection of an TRS CEM system. The inspection procedures follow the control agency inspection program, dealing with the "phase" and "level" approach.

The "phase" process consists of administrative activities involved with initial CEM system application, performance testing and final approval. This enables the state agency to approve the monitoring system through established certification procedures. The type of activities at each phase are:

Phase I - Control agency initial approval of CEM application as required through source permit;

Phase II - Control agency observation of performance specification testing (PST) of the installed CEM system; and

Phase III - Control agency review of the PST report, with final approval or disapproval.

The "level" approach begins after completion of the "phase" evaluation. The levels of CEM system inspection extend from agency source records review (lowest level) to stack test compliance determination (highest level). The inspection determines or confirms compliance and identifies causes of excess emissions. The types of activities at each level are:

Level I - Control agency records review including excess emission reports, previous inspection reports, source "working" file and and permits;

Level II - On-site inspection involving review of monitor recordkeeping (maintenance, monitor and control equipment logs), monitor fault indicator, monitor internal zero/span check, strip chart review and electronic checks;

Level III - Evaluation of installed CEMS through external audit evaluation involving neutral density filters for opacity monitors and gas cylinders/permeation tubes for gas monitors;

Level IV - Comparative evaluation of installed CEMs through performance testing utilizing Federal Reference Methods or portable CEMs.

The "phase" and "level" audit procedure has been designed so that each activity indicates whether or not the CEM system has achieved the necessary level of compliance before starting the next phase.

The main objective, of this notebook is to cover in detail the inspection procedure covering the "level" section of a control agency CEM system inspection program. During the inspection the inspector may need to add comments, explanations or other notes to the notebook. To aid in referencing these comments, a column under the heading of Check or Comment has been provided along the right margin of all pages containing inspection data. These blank lines may be used to indicate action items or to enter code numbers referencing entries elsewhere in the notebook.

Once a thorough evaluation of the TRS CEM system has been accomplished, control agency personnel may want to perform the next inspection on a less compreshensive basis. To assist the control agency personnel, an abbreviated inspection procedure checklist has been developed. The abbreviated checklist is applicable to all TRS CEM systems. It does not address monitor specific inspection points, but does evaluate the TRS monitor on a system audit basis. The checklist is divided into three major areas:

- o Control agency records review;
- o Control agency records update; and
- o Source TRS CEM system review.

The control agency records review consists of a review of permits and/or any current enforcement actions to determine the purpose of the CEM. In addition, a review of the PST report and current EER is conducted to verify conformance with the appropriate performance specification and reporting requirements for EERs.

The control agency records update is conducted by telephone to verify that the records in agency files correctly describe the current CEM status.

Finally, the source TRS CEM system review evaluates a source's recordkeeping, data reduction procedures, monitor evaluation through zero/span checks and overall system review.

INSPECTION PROCEDURES

Concurrent with the "level" approach philosophy, the CEM inspection begins with a "thorough" working knowledge of the facility by reviewing the "permanent" and "working" file of the source in the agency office. Next, the inspection proceeds to the facility where other information is gathered to support the records review activity. While on the premises, the inspector reviews <u>all</u> records which would provide information associated with the monitoring system. Then, a review of the monitoring system is in order.

For a TRS extractive system, heat tracing, insulation, weather protection, transport lines, and connection material should be inspected. The field inspector should evaluate monitor location for ease of maintenance, representative sampling, and environmental factors such as vibration and temperature. The calibration gas interface with the sample system should be inspected and their relative proximity noted. The inspector should verify that during calibration the pressure of the calibrator gas at the interface is approximately equal to its pressure during sampling.

The inspector should observe CEM calibration procedures to confirm calibration reference values and provide a spontaneous quality assurance check. Documentation of calibration gas values by Protocol 1 traceability or triplicate reference method analysis should be available in plant records and verified during the field inspection.

Finally, the CEM control unit and signal recording device should be inspected. The inspector should review previous 24-hour emissions and zero/span check. He should initiate a zero/span check and compare to recorded values.

To assist the inspector, the front part of the notebook covers Levels I, II, III, and IV inspection procedures. These are generic in nature, adaptable to any TRS CEM system. The latter part of the notebook covers specific TRS CEM inspection procedures.

FIELD INSPECTION NOTEBOOK
TOTAL REDUCED SULFUR
CONTINUOUS EMISSION MONITORING SYSTEM

1.0 LEVEL I CHECKLIST

1.1 SOURCE IDENTIFICATION

Company Name ____________________

Mailing Address ____________________

____

Location of Facility ____________________

____
(Include County or Parish)

Personnel

	Name	Title	Phone
o Facility Manager	______	______	______
o Environmental Manager	______	______	______
o Facility Contact	______	______	______
o Confidentiality Statement Required	______	______	______

1.2 PREPARATION FOR INSPECTION

1.2.1 Source Notification

- o Has the appropriate representative of the source been notified of the time and date of auditor's intended visit? Yes___ No___

  By phone ______________

  By letter ______________

  Name of Representative ____________________

  Date contacted ____________________

  Record of notification filed ____________________

1.2.2 Review of Source's Permit to Operate

o Permit information pertinent to the CEM audit is contained in the following checklist.

CEM requirement due to: Permit ______

NSPS ______

SIP ______

Enforcement Action ______

Date CEM installation completed ____________________

Date CEM started up ____________________

Gases monitored TRS ______ Opacity ______ O_2 ______

Allowable emission rates TRS ____________________

Opacity ____________________

1.2.3 CEM Equipment Summary

	Pollutant	Manufacturer	Model/Type	Process
Monitor/Analyzer				
Data Recorder				
Data Processor				

1.2.4 Review of Performance Specification Test Report

o A CEM Performance Specification Test (PST) report should be on file. Information to be reviewed is contained in the following checklist.

Dates of Operational Test Period (OTP) (<30 days after performance test) ____________________

Date PST report submitted (<60 days after OTP)____________

Date of process startup (<180 days prior to OTP)____________

Date of initial full-load operation (<60 days prior to OTP)

Emission rate conversion formula(s)____________________

____

o PST Summary Results

	TRS	O_2	Opacity
Relative Accuracy		NA	NA
Response Time			
24 Hr. Span Drift			
24 Hr. Zero Drift			

1.2.5 Review of Excess Emissions Reports

o The following checklist summarizes pertinent information to be obtained from excess emissions reports.

Months covered by reports ______________________

Did each excess emission report document:

Date, time, and duration of excess emissions? Yes___ No ___

Magnitude of excess emissions? Yes___ No___

Reason for excess emissions? Yes___ No___

Corrective action taken to reduce emissions? Yes___ No___

Conversions factor/formula? Yes___ No___

Method for determining conversion or correction factors used in calculating emission rate.

____

____

____

____

Process downtime______________________ None ________

Monitor downtime______________________ None ________

If significant monitor downtime occurred, briefly discuss corrective action taken to return monitor to operation.

____

____

What percent availability did the CEM system achieve?____________

$$\% \text{ availability} = \frac{\text{Hours of monitor operation}}{\text{Hours of process operation}}$$

- Select one excess emission event and record:

  Date ________

  Time ________

  Magnitude ________

  Reason ________

  Corrective Action ________

This information is intended for use during Level II evaluation.

2.0 LEVEL II CHECKLIST

2.1 PRE-INSPECTION MEETING

Before the CEM inspection, the inspector should arrange to meet with source representatives directly responsible for CEM operation and maintenance, compliance, records and reports. The purpose of the opening conference is to inform facility official(s) of the purpose of the inspection, the authority under which it wil be conducted, and the procedures to be followed, and answer any questions they may have. The opening conference also offers the inspector the opportunity to completely discuss agency policy and inspection procedures, and to provide relevant information and other assistance. The inspector's effective execution of the opening conference often sets the tone of the remainder of the inspection.

During the opening conference, the discussion should cover the following items:

	COVERED
o Inspection objectives	________
o Inspection agenda	________
o Facility Information verification	________
o Review of records	________
o Maintenance	________
o CEM Operation Logbook	________
o Strip Charts	________
o Data Log	________
o Control Equipment Records	________
o Excess Emission Reports	________
o Source Permit	________
o Safety Requirements	________
o Scheduling of Source Personnel Interviews	________
o Inspection Techniques to Be Used	________
o Scheduling of Copying Needed Documentation	________
o Any Questions	________

In particular, the inspector should develop his or her understanding of the operation/maintenance of the audited system to ascertain whether the TRS CEM system has been operated according to permit condition since the last inspection. The inspector should be able to support any conclusions by:

- o Examination of CEM maintenance records;
- o CEM span and zero calibration checks over previous quarter;
- o Reviewing the CEM program;
- o Records comparison, i.e., correlation of excess emission reports, strip chart records, operations and maintenance records, and computer printouts (if available); and
- o Reviewing files to identify missing documents (if any).

The following checklists are provided to assist the inspector in conducting the preliminary meeting.

2.1.1 Personnel In Attendance

Name	Affiliation	Title/Responsibility	Phone Number

2.1.2 Review of CEM Maintenance Records.

o Describe significant CEM maintenance since last audit.

Description	Type*	Date/time Performed

*Routine, Preventive, Emergency, etc.

o Recurring Maintenance Problems (Last 12 Months)

____

____

____

____

____

2.1.3 Review of Calibration Frequency

	Zero	Span	Calibration Error*	Relative Accuracy*
Estimate of Calibration Frequency	_____	_____	_____	______

*Optional

o Describe Unusual or Persistent Monitor Calibration problems

____

____

____

2.1.4 General Review of CEM Program

- Is an alarm connected to CEM control panel or annunciator panel in process control room to signal excess emissions? Yes___ No___

- How often is CEM strip chart or computer output checked by an operator?

  ____

- What procedures are implemented during an excess emission incident to reduce emissions?______________________

  ____

  ____

  ____

  ____

  ____

  ____

- Do records contain process data needed for conversion of CEM output to units of the standard (i.e., moisture, velocity, oxygen correction)? Yes___ No___

- Are process data measurements conducted? Yes___ No___

- Do records contain current information on calibration reference materials (gases, permeation tubes, cells, filters)? Yes___ No___

- Are entries into Maintenance and Operations Logs made on monitor:

  Malfunction? Yes___ No___

  Calibrations? Yes___ No___

  Maintenance? Yes___ No___

  QA Checks? Yes___ No___

- Are charts/printouts for the past two years filed and readily retrievable? Yes___ No___

2.1.5 Internal Consistency of Records and Reports

It should be possible to relate the emission excursions reported in the Excess Emissions Report with the recorded CEM data showing the occurrence of excess emissions. Such excursions should also be documented in the CEM Log, which should include a report of the incident and the corrective action taken by the source. In those cases where a mechanical problem is cited as the cause of the excess emissions, maintenance records should show corrective action taken by the source. The inspector should try to determine the time between the measured excess emissions incident and the initiation of corrective action.

o Report of Excess Emissions (Enter data from Level I Review)

Date	Time From To	Pollutant	$\%O_2$	Magnitude (ppm)
______	________	__________	________	____________

o Description of Excess Emissions from CEM or operating Log on above date.

____

____

o Identification of Excess Emissions Incident in Chart Record

Above Date	Time	Last Zero Check	Last Span Check	Average (ppm)	Calculated equivalent (ppm) (O_2 corrected)

____

o Subsequent Corrective Action Described in Maintenance Log (if applicable), and date and time initiated

____

____

o Are dates and times of above records consistent in recording this excess emission event? Yes___ No___

o If No, explain____

____

____

____

2.2 TRS CEM FIELD INSPECTION

The general inspection procedures presented on the following pages cover extractive TRS CEM systems. These procedures should be followed when a monitor-specific procedure is unavailable.

Check or Comment

2.2.1 TRS CEM Operational Environment

- o Is the process monitored by the TRS CEM operating within normal limits as compared to the source performance test? Yes___ No___ _______

  (If process is not operating within normal limits, Inspector should delay any part of audit which requires normal process conditions.)

- o Process Capacity ______________________________ _______
- o Process Rate ______________________________ _______
- o Stack Gases Monitored: (Avg. Conc.) TRS__________ Opacity__________ _______
  O_2__________ _______
- o Stack Gas Temperature______________°F _______
- o Pollution Control Device______________________ _______
- o Is the analyzer unit subject to excessive heat? Yes___ No ___ _______
- o Is the analyzer unit subject to excessive vibration? Yes___ No ___ _______

  [Note: Excessive heat/vibrations are meaningful only if system (1) fails to satisfy the operations specified by vendor or (2) fail to meet PST 5.]

- o Frequency of sampling: ____________per hour_____ _______

2.2.2 Measurements and Data Handling

The following checklists are intended to assist the inspector in an analysis of the source's data handling and data reduction practices.

At some facilities data reduction is done by a computer programmed to convert stack gas concentrations directly and continuously to the units of the applicable emission standard. At other facilities manual calculations of emissions in units of the standard are only done for periods of excess emissions.

Check or Comment

2.2.2.1 Data Handling

- How is data reduction handled? Manually ____________ ________

  Electronically______ ________

- How many data points are used to calculate each average?____ ________

- Are these data points taken at equally spaced time intervals? ________________________ Yes ___ No ___ ________

- If yes, what is that time interval? ________________ ________

- If data reduction is manual, how often is it done? ________

  ____

- Who performs manual data reduction? ________________ ________

  ____

- Are the data adjusted to account for zero drift measurements?__________________________Yes ___ No ___ ________

- Are the data corrected to account for calibration (span) drift measurements? _____ Yes ___ No ___ ________

- Does the source arbitrarily edit the data before reduction? _________________________ Yes ___ No ___ ________

- If yes, what criteria is used to edit? _____________ ________

  ____

  ____

  ____

2.2.2.2 Electronic Data Reduction:

- Who wrote the program for calculating averages? ________

  ____

  ____

- Is the source's data processing system time shared or dedicated? ____________________________________ ________

- Was it installed with the monitoring system or added at a later date? __________________________________ ________

Check or Comment

- o Who installed the data processing system? __________ ________

  ____

- o At what interval does the data logger acquire CEM measurements? ______________________ ________

  ____

- o Does the system include a data recorder as well as a chart? ____________________ Yes ___ No___ ________

- o If yes, indicate which kind. ________
  - Magnetic tape ______
  - Paper tape ______
  - Paper print-out ______

- o If both automated data processing and chart recording are done, does the CEM value from the automated data processor agree with the value recorded on the chart? Yes ___ No ___ ________

- o If no, explain. ______________________ ________

  ____

  ____

- o Indicate which functions the automated data processing system performs. ________

  Data recording ______________________

  Data storage ______________________

  Averaging Period ______________________

  Hourly summary ______________________

  Daily summary ______________________

  Other summary (explain) ______________________

  ____

  Identification of excess emissions ______________

  Display instantaneous value ______________

  Alarm ______________________

Check or Comment

Records process equipment malfunction codes _____

Records pollution control equipment malfunction codes ____

Records excess emission codes __________________

2.2.2.3 Internal Zero/Span Check

o Write date and time on chart or data processor at start of inspection _______

o Record current emissions

	TRS (ppm)	O_2 (%)	Opacity (%)
Current Emissions	_______	_______	_______

o Request internal zero and upscale calibratrion, enter results below, and compare results to typical previous values.

Monitor Response	_______	_______	_______
Zero	_______	_______	_______
Span	_______	_______	_______
Calibration Value Zero	_______	_______	_______
Span	_______	_______	_______

o Review previous day's recording for typical emissions, repeated zero/span checks, etc. _______

	Yes	No
Emissions normal	_____	_____
Calibration normal	_____	_____
Exceedances above the standard	_____	_____
Calibrations noted on data processor and reviewed	_____	_____
Operator aware of emission limits	_____	_____

Check or Comment

2.2.3 Inspection of Monitor Control Unit

Although instrumentation differs among the various types and models of TRS CEM's, many will incorporate some or all of these control indicators or switches. The inspector should locate those in use and enter their position/status below.

	TRS	O_2	Opacity	
o Reference	______	______	______	______
o Calibration	______	______	______	______
o Alarm	______	______	______	______
o Temperature	______	______	______	______
o Sample gas	______	______	______	______
o Stack gas	______	______	______	______
o Heater	______	______	______	______
o Backpurge	______	______	______	______
o Request Calibration	______	______	______	______
o Operating Range	______	______	______	______
o Recorder Readout	______	______	______	______
o Operate	______	______	______	______
o Sample Flow Rate	______	______	______	______

2.2.4 Calibration Gas System

- o If system uses compressed gases to routinely calibrate system, note following gas cylinder information:

Gas Cylinder 1

Pollutant ______________________

Concentration __________________

Certification Date ______________

Cylinder Number _________________

Cylinder Pressure (psi) ___________ primary (>150psi)

___________ secondary (> 15psi)

Gas Cylinder 2

Pollutant ______________________________

Concentration __________________________

Certification Date ____________________

Cylinder Number _______________________

Cylinder Pressure (psi) ______________ primary (>150psi)
______________ secondary (> 15psi)

Gas Cylinder 3

Pollutant ______________________________

Concentration __________________________

Certification Date ____________________

Cylinder Number _______________________

Cylinder Pressure (psi) ______________ primary (>150psi)
______________ secondary (> 15psi)

Gas Cylinder 4

Pollutant ______________________________

Concentration __________________________

Certification Date ____________________

Cylinder Number _______________________

Cylinder Pressure (psi) ______________ primary (>150psi)

______________ secondary (> 15psi)

Check or Comment

2.2.5 Sample Transport System

- o Type of tubing ______________ ______
- o Internal diameter of tubing ________ inches ______
- o Enter the distance from sample point to analyzer __________feet ______
- o Is transport line heat traced? ____Yes___ No__ ______
- o If yes, how is temperature monitored?________

  ____

  ______________________________ ______
- o Enter the temperature of the transport line:

  ______________________________ ______

2.2.6 Sample Conditioning/Extractive Systems

For extractive systems the following checklists describe the sampling point, transport system, and sample conditioning system. ______

2.2.6.1 <u>Sampling Point</u> -

- o Location: Stack ______________ ______

  Duct Horizontal ______________

  Duct Vertical ______________
- o Is it downstream of pollution control device? Yes ___ No ___ ______
- o Type pollution control device(s) __________ ______
- o Estimate distance from nearest flow disturbance and record below. ______

  Downstream:__________feet

  Upstream: __________feet
- o Sketch the cross-section of the duct/stack at the sampling point and show the location of the sampling probe of CEM. Indicate dimensions. ______

Sketch of Duct/Stack and Sampling Probe Location

Check or Comment

- o On the following blank page sketch the components of the Extractive CEM, including the probe, filter, calibration gas interface, pump, moisture removal system, SO_2 scrubber system (where applicable), and analyzer. ______

2.2.6.2 Sample Probe -

- o Type Material: ______ ______
- o Singular or multi-point sampling? ______ ______
- o If multi-point sampling, enter number of sampling points ______ ______
- o Distance of each point from the wall: ______

Point No.	1	2	3	4	5	6	7
Inches from wall	___	___	___	___	___	___	___

- o If single point, enter distance from wall: ___ inches ______

Sketch of the Components of the Extractive CEM, Including the Probe, Filter, Calibration Gas Interface, Pump, Moisture Removal System, SO_2 Scrubber System (where applicable), Analyzer, and Calibration System.

Check or Comment

2.2.6.3 Filter -

- o Type: Internal _______ External _______ ________
- o Condition: ______________________________ ________
- o Is there a back purge on the sampling system to clean the probe? ____________ Yes___ No____ ________
- o If yes, how often is it activated? ____________ ________
- o Is the purge air dried prior to use? Yes___ No__ ________
- o Frequency of Replacement: ______________________ ________
- o Typical pressure drop across filter (if monitored): ______________________________ ________
- o Current pressure drop across filter (if monitored): ______________________________ ________

2.2.6.4 Moisture Removal (if applicable): -

- o Type of moisture removal equipment? _____________ ________

  Refrigerated or tube type condenser __________

  Permeation dryer ____________________________
- o Location: ____________________________________ ________
- o Sample Gas Temperature at Outlet During Audit:

  ____ ________

2.2.6.5 Sample Pump -

- o Type: ____ ________
- o Location: ____________________________________ ________
- o Flow Rate: ___________________________________ ________

2.2.6.6 Heater/Oven (if applicable) -

- o Location: ____________________________________ ________

  ____
- o Temperature of Gas at Outlet During Audit (if monitored) __________________ ________

Check or Comment

2.2.6.7 SO_2 Scrubber System -

o Location: ______________________________ ______

____

o Type: ______________________________ ______

____

o Frequency of change ______________________________ ______

____

2.3 CLOSING CONFERENCE

The closing conference enables the inspector to "close-out" the inspection with plant personnel. At this time, questions can also be answered relating to results of the inspection. In general, the following elements should be covered in the closing conference:

o Review of Inspection Data ____ ______

o Inspection Discussion ____ ______

o Confidential Information ____ ______

o Deficiencies in monitoring program ____ ______

o Recommendations ____ ______

3.0 LEVEL III CHECKLIST

3.1 INTRODUCTION

The Level III inspection, for the State inspector, is the most costly and labor intensive. Level III inspection becomes necessary only when the Level II inspection indicates deficiencies in the CEM system. The Level III inspection involves a complete evaluation of the monitoring system through a dynamic calibration procedure. Multiple concentration gases are injected, as close to the probe tip as possible, and the monitor response is compared to the certified gas values. From this evaluation, a calibration error is determined. If the error falls outside calibration drift performance specification values, then the monitoring system is "out-of-control." This would necesitate some form of corrective action.

3.2 CYLINDER GAS AUDIT

Check or Comment

3.2.1 Attach the proper gas line from the certified gas cylinder to as close to the probe tip as possible. Properly adjust the flow rate to manufacturers' specifications. ______

3.2.2 List Certified Gases

Gas Mixtures: Pollutant

	TRS	O_2	Other	
Gas A ______ ppm/%				
Cylinder No. ______				
Certification Date ______	______	______	______	______
Pressure (psi) ______ Initial ______ Final				
Gas B ______ ppm/%				
Cylinder No. ______				
Certification Date ______	______	______	______	______
Pressure (psi) ______ Initial ______ Final				

Gas C ____________ppm/%

Cylinder No. ________________

Certification Date ___________ ____ ____ ____ ______

Pressure (psi) ________ ______
Initial Final

Check or Comment

3.2.3 Inject each gas into the monitoring system, as close to the probe tip as practical. Record monitor response on Level III Field Data Sheet. ______

3.2.4. Calculate % Difference for each calibration gas by the following equation: ______

$$\% \text{ Difference} = \left[\frac{(\text{Avg. Monitor Response}) - (\text{Audit value})}{(\text{Audit Value})}\right] \times 100$$

LEVEL III
FIELD DATA SHEET
PERCENT DIFFERENCE DETERMINATION

Person Conducting Audit ____________________ Analyzer Manufacturer ____________________
Affiliation ____________________ Model/Serial No. ____________________
Date ____________________ Location ____________________

Audit Gas Concentration	Pollutant	Certification Date	Expiration Date
Low-Range ______	______	______	______
Mid-Range ______	______	______	______
High-Range ______	______	______	______

Run Number	Audit Gas Concentration	Instrument Response	Arithmetic Difference		
			Low	Mid	High
1-Low				-	-
2-Mid			-		-
3-High			-	-	
4-Low				-	-
5-Mid			-		-
6-High			-	-	
7-Low				-	-
8-Mid			-		-
9-High			-	-	
10-Low				-	-
11-Mid			-		-
12-High			-	-	
13-Low				-	-
14-Mid			-		-
15-High			-	-	-
		Arithmetic Mean			

3.3 MONITOR-SPECIFIC INSPECTION PROCEDURES

If calibration gases are not available, the inspector can evaluate the installed TRS CEM system through monitor-specific inspection procedures. This involves observing various operating parameters as indicated by valves, meters, pressure gauges or switches. Observed values are then referenced to the "baseline" values established during monitor certification.

To assist the inspector, monitor-specific inspection procedures have been developed for three commercially available TRS monitoring systems. They are:

- o Sampling Technology Inc. TRS CEM Model 100;
- o Barton Titration TRS CEM System; and
- o Bendix Gas Chromatograph TRS CEM System.

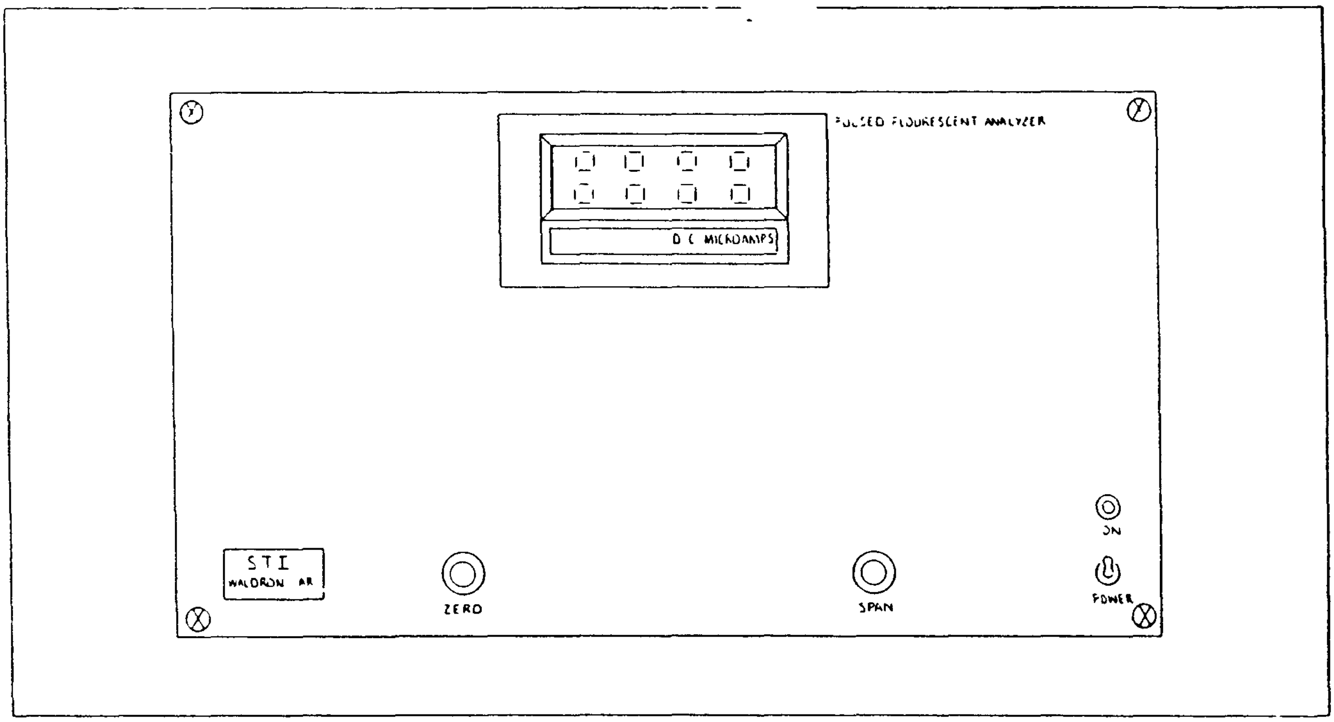
To insure that all information is obtained in an orderly fashion, the procedures are presented in the order they are normally encountered in the field, i.e., analyzer/computer system; calibration system, transfer system and probe/conditioning system.

3.3.1 SAMPLING TECHNOLOGY INC. TRS CEM SYSTEM INSPECTION PROCEDURES

3.3.1.1 Analyzer Evaluation

<u>Pulse Flourescence Analyzer</u>

	Check	Comment
o Observe reading of SO_2 as displayed in window (reading is % of monitor range). Compare to CRT display and computer printout. (Review diagram for inspection points)	____	______



	Check	Comment
o Observe that "on" light is illuminated.	____	______
o Check positions of zero/span pots (potentiometer) and compare to maintenance logs.	____	______

<u>O_2 Analyzer</u>

	Check	Comment
o Observe meter display and compare to CRT and computer printout.	____	______
o Note position of "Range" switch.	____	______

______
Range

	Check	Comment
o Note "sample flow" as indicated by rotameter. (Should be between 400-500 cc/min).	____	______

______
cc/min

	Check	Comment

Computer

- o Observe that power light (yellow) on key board is flashing. ______ ______
- o Observe that power light (red) on screen display is on. ______ ______
- o Observe that printer "power on light" is illuminated. ______ ______
- o Observe that screen "format" is updated every 4-6 seconds. ______ ______
- o Observe last computer readouts of TRS and O_2 and compare to instantaneous values as displayed on monitor meters.

TRS	O_2
________	________
________ meter	________ meter

- o Observe previous 12 hour report (see sample). ______ ______

****

TRS 12 HOUR REPORT - 12:00:48 JULY 11 1984

12 HOUR [TRS/O2 CORRECTED] AVERAGE VALUE (PPM)

RCVY BLR TRS	TRS	O2
00:00 TO 01:00	.3	5.2
01:00 TO 02:00	.3	5.0
02:00 TO 03:00	.3	5.0
03:00 TO 04:00	.3	4.8
04:00 TO 05:00	.3	4.7
05:00 TO 06:00	.2	5.2
06:00 TO 07:00	.2	5.2
07:00 TO 08:00	.3	5.7
08:00 TO 09:00	0.0	0.0
09:00 TO 10:00	0.0	0.0
10:00 TO 11:00	2.3	6.9
11:00 TO 12:00	.1	14.8
UNCORRECTED TRS AVERAGE	**.5**	
O2 CORRECTED TRS AVERAGE	**.4**	
O2 AVERAGE	**6.2**	

where:

C_{corr} = the average concentration corrected for oxygen;
C_{meas} = the average concentration uncorrected for oxygen for previous 12-hours;
X = the volumetric oxygen concentration in percentage to be corrected to (8 percent for recovery furnaces and 10 percent for lime kilns, incinerators, or other devices); and
Y = the measured 12-hour average volumetric oxygen concentration.

	Check	Comment
o Review previous 24-hour printouts observing stack gas concentration variation and consistency.	_____	_____
o Review previous 24 hour calibration drift report and compare to plant standard. (See printout below).	_____	_____
o Initiate an internal "zero/span" check or monitor system. Compare to gas cylinder valves.	_____	_____

TRS	O_2
______ Gas cylinder valves	______ Gas cylinder valves
______ Monitor response	______ Monitor response
______ % Off	______ % Off

	Check	Comment
o Request "Limits Factors" and compare to plant limits.	_____	_____

- o O_2 STD__________
- o TRS__________
- o O_2 cal gas valve

	Check	Comment

Dilution Air Conditioning System

	Check	Comment
o Open cabinet door.	_____	_______
o Insure pump is running with 30 lbs pressure.	_____	_______
o Air pressure regulator should indicate 60 lbs pressure.	_____	_______
o Listen to insure regenerative dryer working properly.	_____	_______

Calibration Gas Cylinder

	Check	Comment
o Check certification of gas cylinders valves and compare to maintenance logs and computer printout.	_____	_______
o Check cylinder numbers and compare to certification sheets.	_____	_______
o Observe primary/secondary pressure gauge and note setting. (Normal settings should be 300 psi primary and 40 psi secondary).	_____	_______

Gas Cylinder #1

Concentration_______________
Certificate date_____________
Gauge settings

Primary______________
Secondary____________

Gas Cylinder #2

Concentration_______________
Certificate date_____________
Gauge settings

Primary______________
Secondary____________

Recorder

	Check	Comment
o Observe emissions over previous day.	_____	_______
o Inspect previous zero/span readings and compare to gas cylinder valves.	_____	_______

Check Comment

3.3.1.2 SO_2 Scrubber System (located behind monitor racks)

- o Check moisture level in reservoir. ____ ____
- o Observe that scrubber is regenerating in a timely fashion (15 minutes). ____ ____
- o Review maintenance logs for possible drift problems associated with scrubber system. ____ ____

  Positive Drift - Release of SO_2 from packing. ____ ____

  Negative Drift - Retention of SO_2 during daily zero/span check. ____ ____

- o Review maintenance logs for periodic changing scrubber sieves (30 day intervals). ____ ____

Thermal Oxidizer

- o Check temperature display on front of panel. Should be between 1500-1600°F. (825-875°C). ____ ____
- o Observe that power light is on. ____ ____
- o Review maintenance logs for periodic adjustments of thermal oxidizer temperature. ____ ____

Analyzer Rack

- o Check for power on. ____ ____
- o Check all pressure regulators and relate setting to initial monitor certification setting in maintenance logs. ____ ____
- o Check sample by-pass rotameter (should be 1-2 lpm. However, this number depends upon length of sample line. Initial valve should be recorded in log book during certification testing). ____ ____

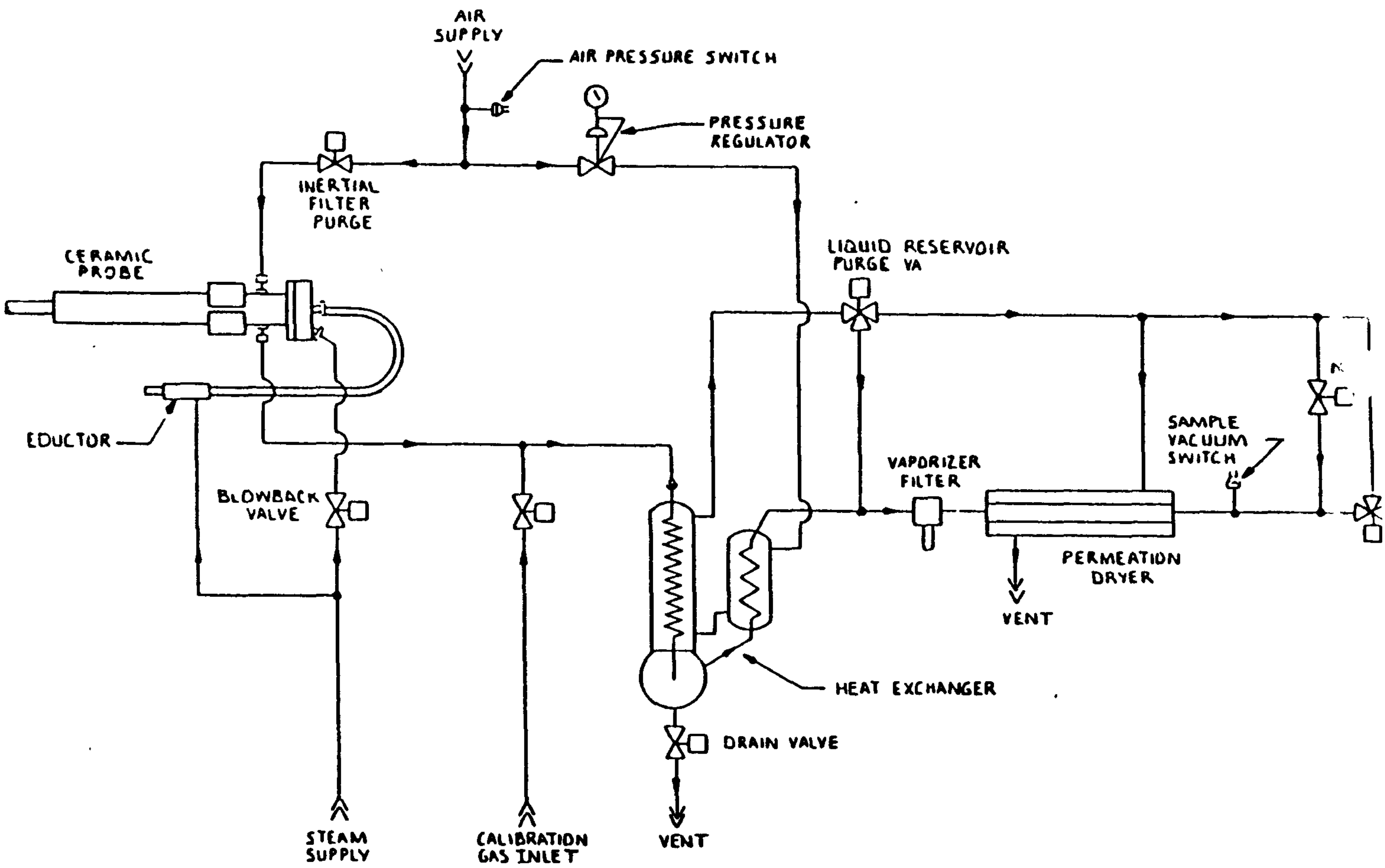
Switch Central Panel

- o Check to see all switches are in "auto" position. ____ ____
- o Observe if any red lights are lit indicating operating mode. ____ ____

Check Comment

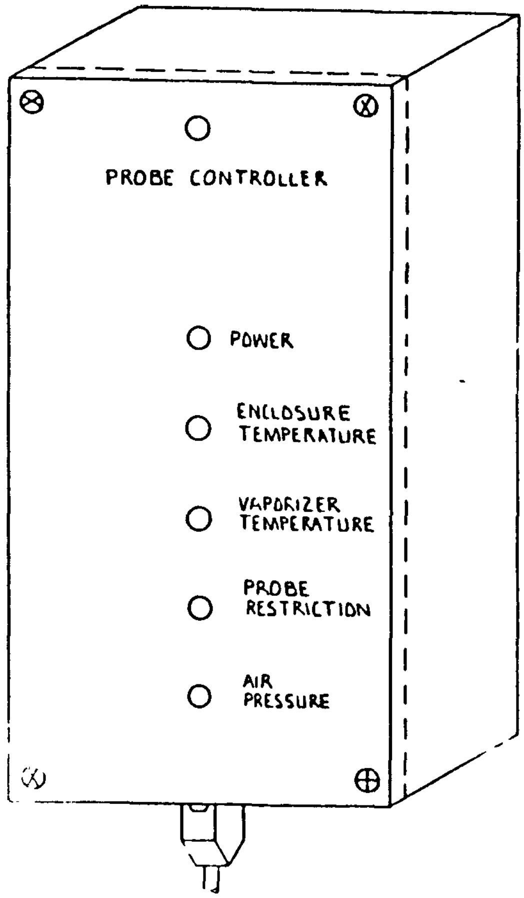
3.3.1.3 Probe/Conditioning System

The inspection of the probe/conditioning system involves both a review of the maintenance logs and a physical inspection of the unit itself. (Refer to the following diagram for inspection points). ____ ________



	Check	Commemt
o Observe overall condition of system.	____	______
Vibration Problems	____	______
Temperature Problems	____	______
Other____________	____	______
o Open cabinet and observe internal housekeeping.	____	______
Loose wires	____	______
Condenser dirty	____	______
Other____________	____	______
o Cal gas introduced at probe.	____	______
o Observe "back-purge" if applicable. Check drain for air/water.	____	______
o Observe automatic calibration cycle. (during automatic calibration cycle, the cal gas is under positive pressure to probe). If a leak in the system occurs, then the O_2 valve will never reach zero.	____	______
o Check "Fault Indicators" on probe controller box. Note. (Refer to following diagram for fault indicator location).	____	______
Indication / On/Off	____	______

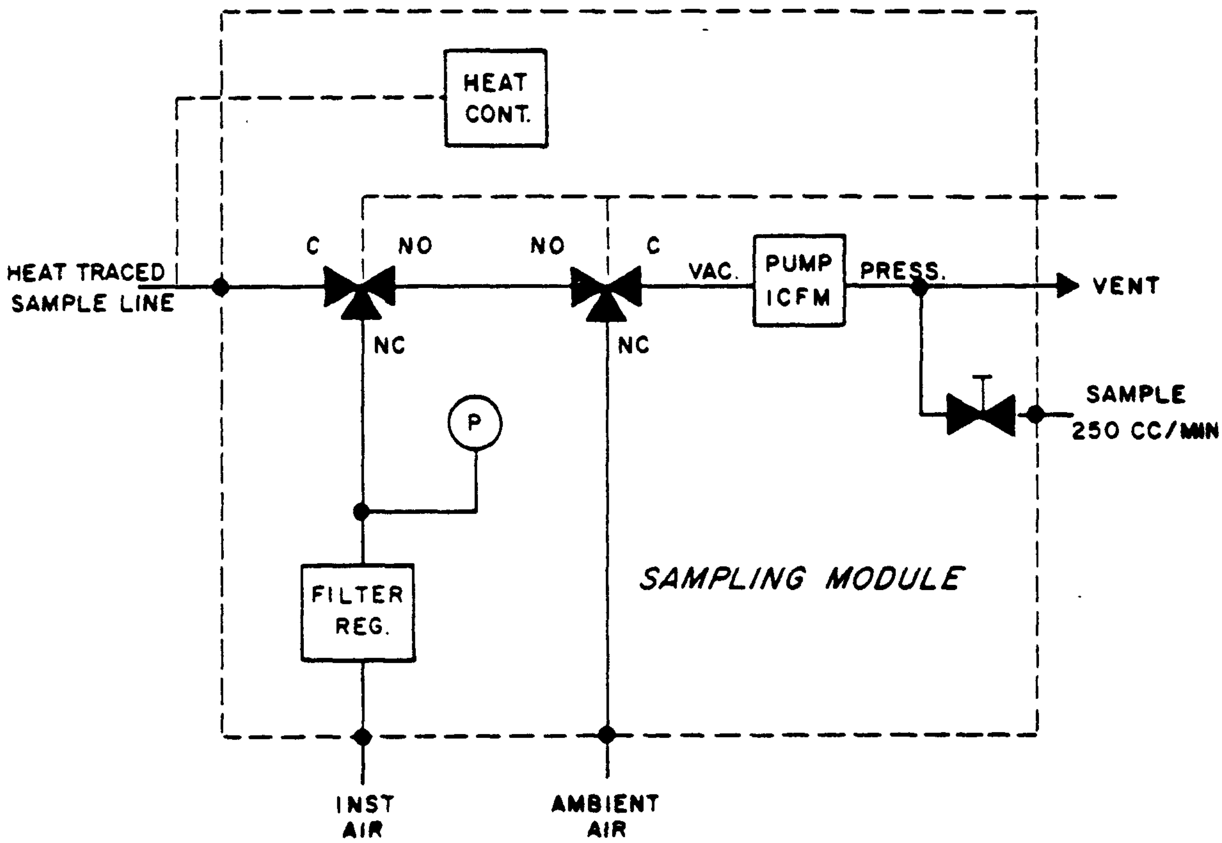
Indication	On/Off
Power	________
Enclosure Temperature	________
Vaporizer Temperature	________
Probe Restriction	________
Air Pressure	________



	Check	Comment
o Check water level in liquid resevoir, (should not be greater than one-fourth of bowl).	_____	_______
o Check steam panel regulator (should be between 20-30 psi).	_____	_______
o Check maintenance records for periodic maintenance on system.	_____	_______
o Inertial filter changes______		
Lime Kiln (2-4 weeks)	_____	_______
Recovery Boiler (monthly)	_____	_______
o Eductor removed/cleaned periodically	_____	_______

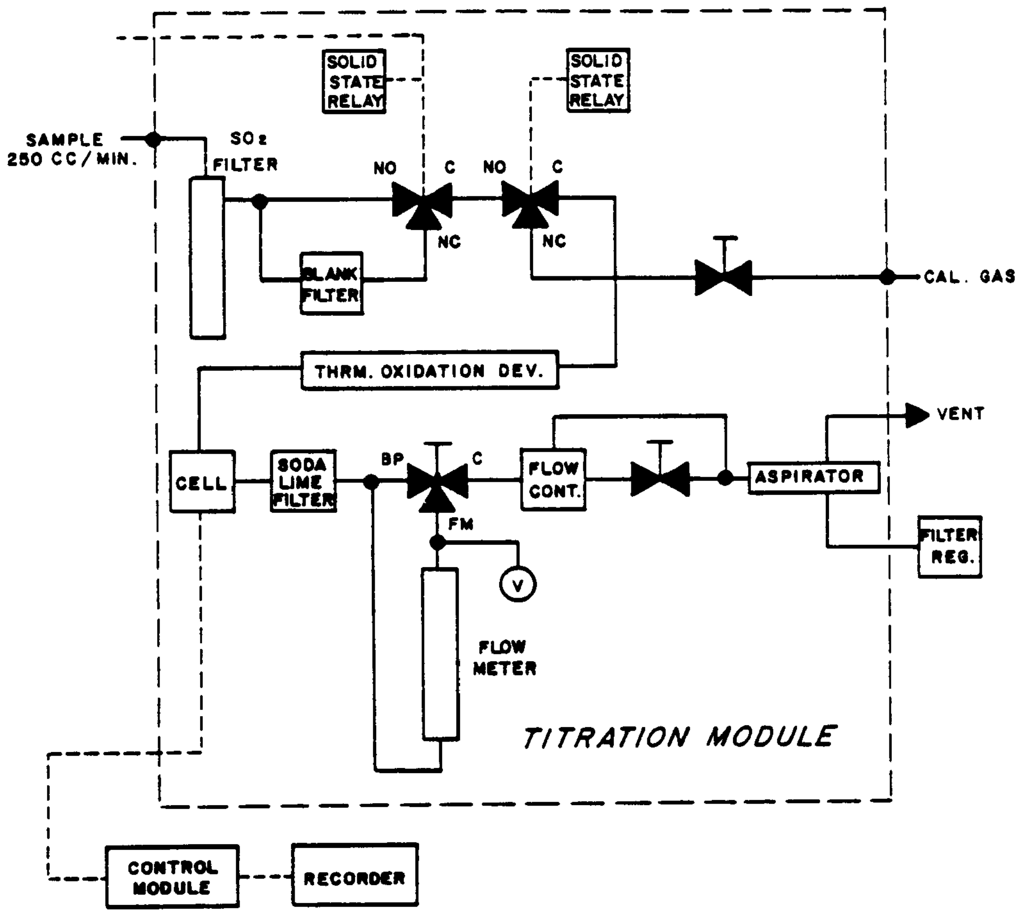
3.3.2 ITT BARTON TITRATION TRS CEM SYSTEM INSPECTION PROCEDURES

3.3.2.1 Sampling Module (Refer to following figure for inspection points).



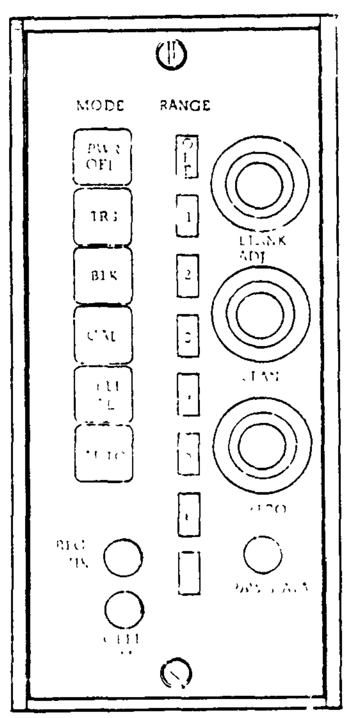
	Check	Comment
o Observe pressure of condensate resevoir regulator.	_____	_______
15 psi		
o Observe LED is lit on panel of heat trace line controller.	_____	_______
o Observe "reading" of heat-trace line controller as displayed by meter. (Temperature indication should be 10-20°F higher than the dew point of the sample gas).	_____	_______

Titration Module (Refer to following figure for inspection points).



	Check	Comment
o Insure the SO_2 scrubber solution is at the 500 ml mark.	____	______
o Insure the titration cell reservoir is between stamped lines on cell.	____	______
o Observe following setting of regulators.	____	______
o Vortex tube supply ____________ 80-120 psi		
o Aspirator Pressure ____________ 35-50 psi		
o Purge pressure regulator ________ 5-10 psi		
o Check high volume pump operation by observing flow at pump vent point.	____	______
o Verify heater operation by observing orange glow of the element through the observation point.	____	______
o Observe flowmeter setting and compare to calibration sheet to insure sample flow of 250 cc/mm.	____	______

<u>Control Module</u> (Refer to following figure for inspection points).



Check Comment

o Observe range switches. Note range monitor is on. _____ _______

____
Range

o Note settings from zero/span/blank. Compare to historical data. _____ _______

Zero _________ present _________ previous

Span _________ present _________ previous

Blank ADJ _________ present _________ previous

o Observe mode switches. Note which mode switch is illuminated. _____ _______

____
Mode

The mode switches (TRS, BLK, CELL CAL and AUTO) determine the characteristics of the sample reaching the detector cell. The mode switch functions are listed in the following Table.

SWITCH	SAMPLE CHARACTERISTIC
PWR OFF	Instrument power ON/OFF.
TRS	Sample gas passes through SO_2 scrubber, remainder oxidized to SO_2.
BLK	Ambient air passes through the charcoal filter.
CAL	Calibration gas injected at probe.
CELL CAL	Calibration gas injected just before cell.
AUTO	Automatically cycles instrument through modes.

o Press RAW DATA switch and REC CHK switch simultaneously. The recorder should go to min-scale. (Failure to do so indicates the existence of a program in either the recorder or the control power supply). _____ _______

RAW DATA Function

o Measure the raw data value in the BLANK mode. _____ _______

____
RAW DATA

o Is it within value range? _____ _______
_____ No _______ Yes

Check Comment

- o Measure the raw data values in either the TRS or CAL mode. _____ _______

____
TRS/CAL value

- o Subtract the lowest from the highest value. _____ _______

- o Observe range switch setting. _____ _______

- o From the following Table, obtain SO_2 conversion factor. _____ _______

Conversion Factor Data

RANGE SWITCH	SO_2 CONVERSION FACTOR	UNITY GAIN FULL SCALE	FULLSCALE RANGE	RAW DATA BLANK READING
1	0.035	3.5	1.0-5.0	20 ± 8
2	.82	8.2	5-15	12 ± 4
3	.26	26.	15-50	6 ± 3
4	.75	75.	50-150	3 ± 1.5
5	2.5	250.	150-500	2 ± .5
6	7.1	710.	500-1000	1.5 ± .8
7	23.	2300.	1000-3000	0.7 ± .4

- o Calculate concentration by multiplying difference between sample and blank values by the SO_2 conversion factor. _____ _______

ppm = (Sample Raw Data - Blank Raw Data) X Conversion Factor
= (-) X ( )
= ______________________

Value determined should be within ± 15%.

- o Press CELL CAL mode switch. _____ _______

- o Note monitor response and compare to gas cylinder value. _____ _______

______________ Monitor Response   ______________ Gas Cylinder Value

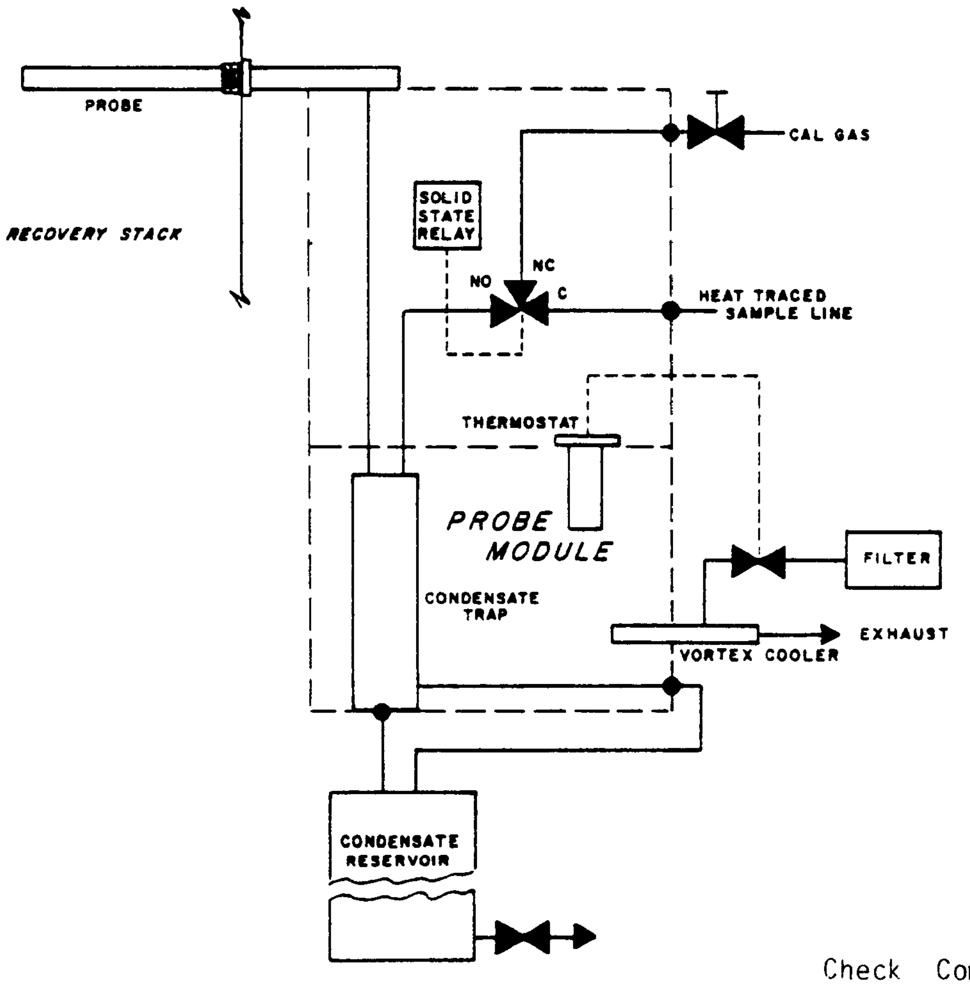
- o Calculate % calibration error by the following equation.

$$\frac{\text{(Monitor Response) - (Gas Cylinder Response)}}{\text{(Gas Cylinder Response)}} \quad X100$$

- o Calculated value should be ± 15%.

3.3.2.2 Probe/Conditioning System

The inspection of the probe/conditioning system involves both a review of the maintenance logs and a physical inspection of the unit itself. (Refer to following diagram for inspection points).



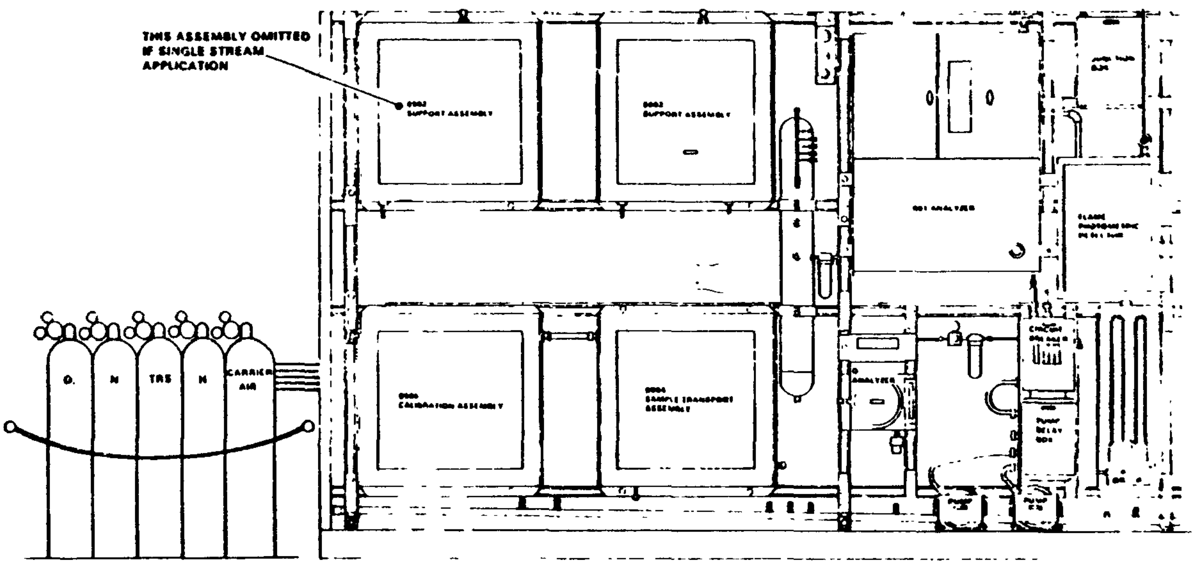
	Check	Comment
o Observe overall condition of system. Vibrational Problems ________ Temperature Problems ________ Other ________	____	______
o Open cabinet and observe internal housekeeping.	____	______

	Check	Comment
Loose wires ________________ Condenser trap dirty __________ Other _____________________		
o Observe condensate reservoir, if possible Observe emptying of condensate trap during "blank" mode of operation.	____	______
o During calibration mode, insure that calibration gas injection solenoid valve opens.	____	______
o Is condensate trap frozen?	____	______
o Observe that system back purges periodically.	____	______
o Note whether sample line is heat traced.	____	______

3.3.3 BENDIX TRS CEM SYSTEM INSPECTION PROCEDURES

3.3.3.1 Analyzer/Calibration Assemblies

The inspection of the above assemblies involves observing gauges/ flowmeters and comparing their indicated values to their "baseline" values. The observed values may change from week to week; but, reference should be made back to the "baseline" value. The following figure illustrates the assemblies we will be inspecting.



	Check	Comment

Calibration Gas Cylinder

	Check	Comment
o Check certification of gas cylinders values and compare to maintenance logs and computer printout.	_____	_______
o Check cylinder numbers and compare to certification sheets.	_____	_______
o Observe primary/secondary pressure gauge and note setting. (Normal settings should be ∿ 300 psi primary and ∿ 40 psi secondary).	_____	_______
o Note following information on each gas cylinder.	_____	_______

Gas Cylinder #1

Pollutant_________________
Concentration_____________
Certificate date__________
Gauge settings

Primary____________
Secondary__________

Gas Cylinder #2

Pollutant_________________
Concentration_____________
Certificate date__________
Gauge settings

Primary____________
Secondary__________

Gas Cylinder #3

Pollutant_________________
Concentration_____________
Certificate date__________
Gauge settings

Primary____________
Secondary__________

Gas Cylinder #4

Pollutant_________________
Concentration_____________
Certificate date__________
Gauge settings

Primary__________
Secondary________

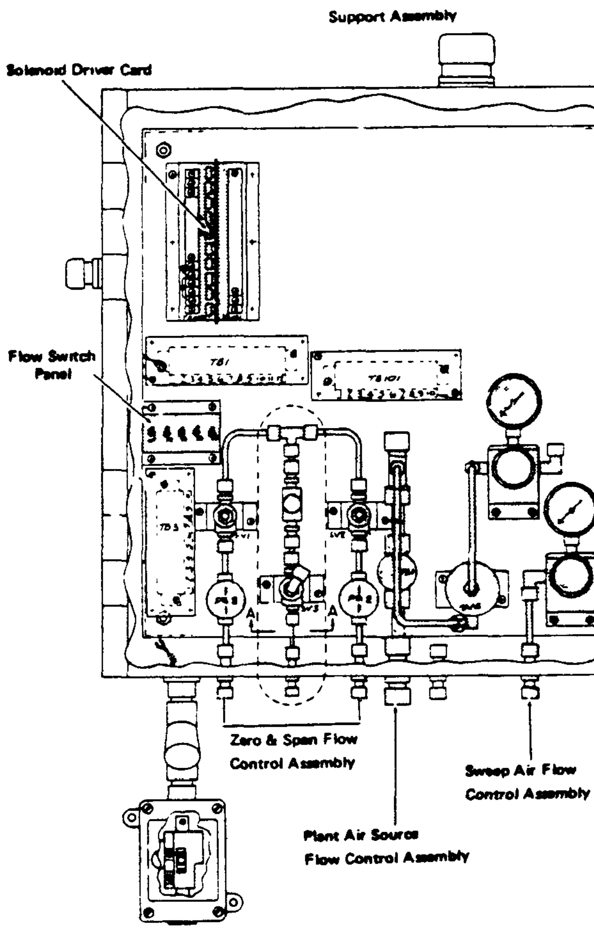
Gas Cylinder #5

Pollutant________________
Concentration____________
Certificate date_________
Gauge settings

Primary___________
Secondary_________

Support Assembly

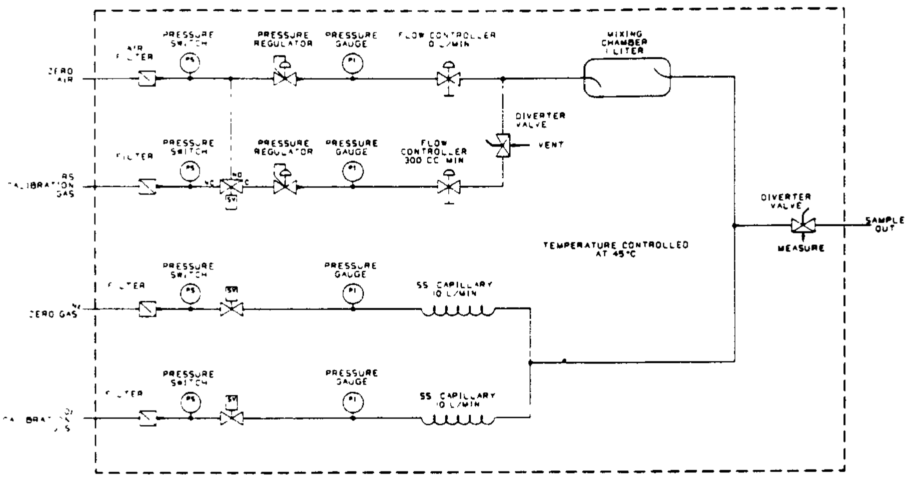
Observe the following gauges/meters as part of the Support Assembly. All observations should be referenced to "baseline" values. (Refer to diagram for inspection points).



	Baseline Value	Observed Value
Sweep Air Flowmeter (A)	______	______
Sweep Air Pressure Gauge (B)	______	______
Plant Air Pressure Gauge (C)	______	______

Calibration Assembly

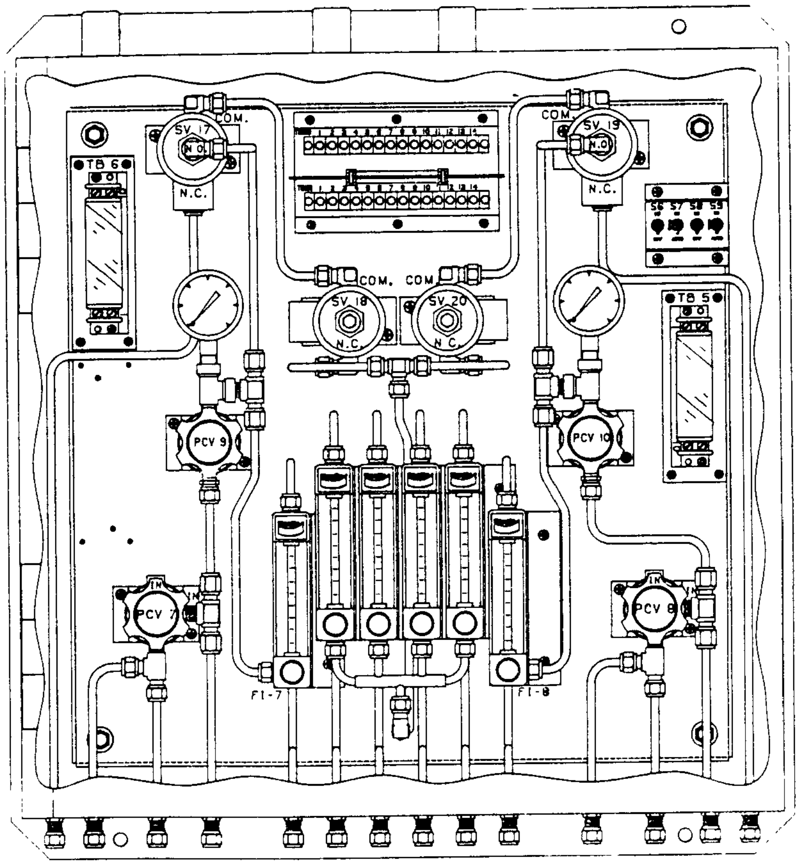
Observe the following gauges/meters as part of the Calibration Assembly. All observations should be referenced to "baseline" values. (Refer to diagram for inspection points).



	Baseline Value	Observed Value
Zero Air Pressure Gauge	________	________
Nitrogen Pressure Gauge	________	________
Calibration Gas Pressure Gauge	________	________
Oxygen Pressure Gauge	________	________
Dilution Pressure Gauge	________	________
Other	________	________

Sample Transport Assembly

Observe the following gauges/meters as part of the Sample Transport Assembly. All observations should be referenced to "baseline" values. (Refer to diagram for inspection points).



(Dual Gas Stream System Illustrated)

	Baseline Value	Observed Value
Oxygen Sample Flowmeter (D)	________	________
Gas Chromatograph Sample flowmeter (E)	________	________

Analyzer Controls and Indicators

Observe the following gauges/meters as part of the Analyzer Controls and Indicator Assembly. All observations should be referenced to "baseline" values.

	Baseline Value	Observed Value
Detector Purge Gauge	______	______
Plant Air Supply Gauge	______	______
Heater Air Pressure Gauge	______	______
S/P Valve Switch On	______	______
Hydrogen Supply Gauge	______	______
Column #1 Pressure Gauge	______	______
Column #2 Pressure Gauge	______	______
Analyzer Oven Temperature Gauge	______	______
Calibration Pump Gauge	______	______
Other	______	______
Other	______	______

Gas Chromatograph System

Type:______________________ Detection Technique:______________

Column 1. ____

2. ____

3. ____

Column Temperature (± 1°C) 1.______________________________

2.______________________________

3.______________________________

Sample Column Size:____

Detection Temperature:_____________________________________

Attenuation:____

Data Processor/Recorder

	Check	Comment
o Observe emissions over previous day.	_____	______

- o Consistent values?__________
- o Exceedances?______________
- o Problems?_________________

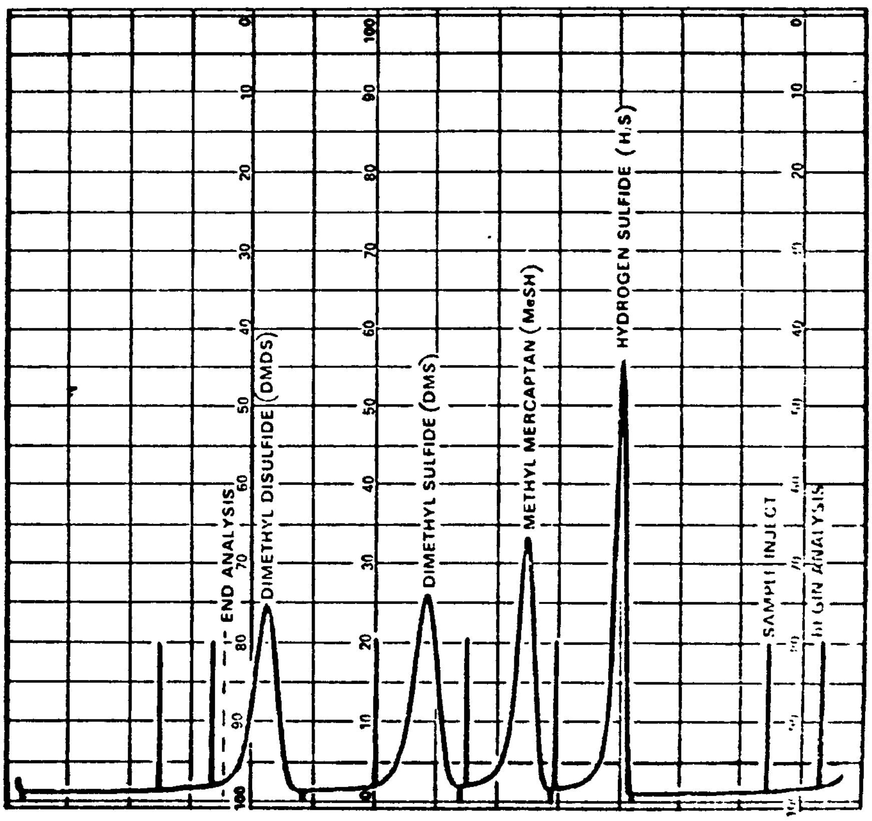
o Inspect previous zero/span calibration readings and compare to gas cylinder values.	_____	______

	Check	Comment
o Initiate an internal "zero/span" check of the monitor system. Compare to gas cylinder values.	_____	_______

	Cylinder Values	Monitor Response	% Calibration Error
H_2S	__________	__________	______________
CH_3SH	__________	__________	______________
$(CH_3)_2S$	__________	__________	______________
$(CH_3)_2S_2$	__________	__________	______________

(Are the calculated calibration errors < 20%?)

(A typical chromatograph of a zero/span check is illustrated below).



During the calibration, observe software report as recorded by the Data Printer. A "typical" printout follows:

	TRS COR (PPM)	TRS MEAS (PPM)	H2S (PPM)	CH3SH (PPM)	DMS (PPM)	DMDS (PPM)	O2 (%)	OPACITY (%)
STACK #1 CALCINER (PLANT 2)	200.	199.	100.	33.00	33.00	34.00	10.1	18.6
STACK # 2 LIME KILN (PLANT 2)	199.	199.	100.	32.00	33.00	34.00	10.1	21.[illegible]

GC CALIBRATION REPORT

DATE 1/21/79 00:06:04

UNIT 0001 STACK #1

CMPT	RT	OLD RF	NEW RF	(RF)%VAR	CC	% DRIFT
H2S	150	1.65	1.64	.6%	27	.5%
CH3SH	220	3.87	3.85	.5%	27	.[illegible]%
DMS	290	5.68	5.68	0%	27	.05%
DMDS	410	[illegible].12	7.13	.01%	27	.1%

o Observe if any hardware/software alarms have been observed over the previous 24 hours.

Typical hardware alarms include the following:

- o Low Zero Gas
- o Low TRS Span Gas
- o Low O_2 Span Gas
- o Low Plant Air
- o Low Sweep Air
- o Probe Restriction

Chromatograph related hardware alarms are:

- o Low Carrier Gas
- o Low hydrogen
- o Oven Hi
- o Oven Lo
- o Low Purge Air
- o Flameout

Optional system alarms are:

- o Low Sample Flow
- o Low Sample Pump Vacuum

	Check	Comment

3.3.3.2 Probe/Conditioning Assembly

	Check	Comment
o Observe overall condition of system.	_____	_______
Vibration Problems	_____	_______
Temperature Problems	_____	_______
Other ______________	_____	_______
o Open cabinet and observe internal housekeeping.	_____	_______
Loose wires__________	_____	_______
Condenser dirty______	_____	_______
Other ______________	_____	_______
o Cal gas introduced at probe?	_____	_______
o Observe "back-purge" if applicable. Check drain for air/water.	_____	_______
o Observe automatic calibration cycle, (during automatic calibration cycle, the cal gas is under positive pressure to probe. If a leak exists, then the O_2 valve will never reach zero during cal gas introduction.	_____	_______
o Listen for air flow to heat exchanger.	_____	_______
o Observe reading of Dew Point meter, if applicable.	_____	_______
o Go to opposite side of port and observe probe.	_____	_______

4.0 LEVEL IV CHECKLIST

4.1 Introduction

A Level IV evaluation involves a recertification of the installed CEM system utilizing Performance Specification Test 5 and 3. The role of the inspector during this level is to observe that proper sampling and computation of emissions from the source during testing occurs. At this time, additional "baselining" of the control equipment and continuous emission monitoring system can be performed.

To assist the inspector, observation checklists have been developed for both Federal Reference Method 16 and 16A. The inspector should use these checklists when performiong a Level IV evaluation.

Federal Reference Method 16
Observation Checklist

Page___of___

____
Initial

Federal Reference Method 16
Observation Checklist

1.0 BACKGROUND INFORMATION

1.1 Source Name:______________________________

1.2 Location: ______________________________

1.3 Affected Facility:______________________________

1.4 Test Dates:______________________________

1.5 Test Team:______________________________

Leader:______________________________

Members:______________________________

1.6 Plant Contact:______________________________

1.7 Corporate Contact:______________________________

Phone #____________________

Title______________________________

2.0 PROCESS DATA

2.1 Process Tested:______________________________

2.2 Process Description:______________________________

____

2.3 Process Operating Data:______________________________

____

3.0 TEST EQUIPMENT

3.1 Sketch system used for sampling and analysis (including calibration system).

____
Initial

3.2 - TEST EQUIPMENT DESCRIPTION

3.2.1 Probe/SO_2 Scrubber System

3.2.1 Probe

Length:________________ID:______________________

Material of Construction:______________________

Filter Device: Out-of-stack____________________

In-Stack______________________________

Material______________________________

Heated?______________________________

3.2.1.2 SO_2 Scrubber

Impinger Technique:____________________________

Solution:_____________________________________

pH of Solution:_______________________________

3.2.2 Sample Lines/Pump

3.2.2.1 Lines:

I.D.:_____________________O.D.:__________

Material of Construction:_________________

Heated? ________________________________

3.2.2.2 Pump

Type:____

Material of Construction:______________________

Heated:_______________________________________

3.2.3 - Dilution System

Technique:____________________________________

Dilution Ratio: 1.______ 2.______ 3.____

Dilution Gas:_________________________________

Heated?_______________________________________

3.2.4 - Gas Chromatograph System

Type:________________________Detection Technique:____________

Column 1. ____

2. ____

Column Temperature (± 1°C) 1.________________________

2.________________________

3.________________________

Sample Column Size:____

Detection Temperature:____________________________________

Attenuation:____

Gas Flow:

H_2 Flow:____

Air Flow:____

N_2 Flow____

Accuracy Range:____

Detect 0.5 ppm for H_2S, MeSH, DMS and DMDS?____________

____

3.2.5 - Calibration System

3.2.5.1 - Permeation Technique

Pollutant	Certification Number	Permeation Rate	Certification Temperature	Traceability Technique
H_2S				
MeSH				
DMS				
DMDS				

Analysis Date	Vendor

H_2S = Hydrogen Sulfide; MeSH = Methyl Mercaptan; DMS = Dimethyl Sulfide; DMDS = Dimethyl Disulfide

____
Initial

Remarks:____

____

____

Constant Temperature Bath (± 1°C) of Permeation Tube Certification Sheet____

Flowmeter Calibrated?________________________________

Date________________________

Calibration Curve______________

Flow of Calibration System greater than demand of Analytical System?____

Bubble Meter used to monitor flow?________________________

Temperature indicator calibrated?__________________________

Carrier gas prepurified?__________________________________

____

Discuss____

____

Diluent Gas - 50ppb S compounds?__________________________

10ppm each of H_2O and HC:__________________________

Heated prior to mixing?__________________________

3.2.5.2 - Cylinder Gases

Pollutant (in Air)	Concentration	Traceability to NBS Permeation tube	Analysis Date	Expiration Date
______	__________	__________	______	______
______	__________	__________	______	______
______	__________	__________	______	______
______	__________	__________	______	______

Remarks____

____

______
Initial

Greater than 200 psi in gas cylinders?____________________

Vent valve utilized?____________________

3.2.6 - Integrator or Recorder

Type:____________________

Averaging Time:____________________

Attenuation:____________________

Last calibration:____________________

4.0 - SAMPLE PORT LOCATION

Stack/Duct Conditions (leaks, particle build-up, corrosion):

____

____

Number of stack diameters upstream from flow disturbance:__________

Number of stack diameters downstream from flow disturbance:__________

Velocity Traverses Performed:____________________

Number of points__________

Location__________

Avg. Δp__________

Pitot tube calibration factor____________________

Date Calibrated__________

Avg. Velocity__________

Stack Temperature Sensor:

Type:__________ Range:__________

Location in Stack:____________________

Date Calibrated:________ Calibration Papers Rec'd__________

Remarks:____________________

____

____

____
Initial

Location of CEM in reference to Sample Port Location:__________________

____

5.0 PRE-TEST ACTIVITIES

System set-up properly?______________________________________

System leak check (optional)__________________________________

2 inches Hg Vacuum for 1 minute_____________________________

Pass______________________ Failed ______________________

All components operating properly____________________________

Discussion:____

____

____

Pre-Test Recovery Determined (optional)_______________________

Discussion:____

____

____

5.1 Interference Determination

Chromatograph submitted of calibration gases with/without 10% CO_2?____

Agreement within 5%____

Chromatograph submitted showing separation of SO_2 from other peaks?____

or

SO_2 Scrubber System used to remove SO_2 prior to GC analysis

____

Initial

Chromatograph submitted showing resolution of Sulfur Dioxide (SO_2), Hydrogen Sulfide (H_2S), Methyl Mercaptan (MeSH), Dimethyl Sulfide (DMS) and Dimethyl Disulfide (DMDS):______________________________

____

____

Discussion:____

____

____

5.2 Calibration of GC/FPD and Dilution System

5.2.1 GC/FPD Calibration through SO_2 Scrubber
Dilution System prior to calibration?________________

Permeation tubes in bath 24 hours?________________

Calibration Curve developed from three injections of three known concentrations of H_2S, MeSH, DMS, and DMDS?________________

Calibration Curve developed in range data is being collected?

____

Precisions of injections for each known TRS within $\pm$ 5% of mean value?________________

Temperature of bath $\pm$ 0.1°C of certification tube temperature________________

Calibration Curve Generated?________________

5.2.2 Dilution System

Injection of H_2S in front of Dilution System?________________

Three injections?________________

Precision of three injections $\pm$ 5% of mean value?____________

Dilution factor calibrated for each stage?____________

Stage 1 Factor ________________

Stage 2 Factor ________________

6.0 STACK TEST

Port closed around probe?________________

Initial

Sample traversed at three points in source (16.7, 50.0 and 83.3%) of stack diameter?______

Sampling System conditioned 15 minutes prior to test?______

Sample run consists of a min. of 16 individual injections performed over a period of not less than 3 hours or more than 6 hours?______

______

Discussion:______

______

______

Orsat collected during sample run?______

______

Orsat collection technique and location______

GAS CHROMATOGRAPH INFORMATION

	Run 1	Run 2	Run 3
Date	______	______	______
Time Began	______	______	______
Time End	______	______	______
No. of Injections or Analysis (min 16)	______	______	______
Ave H_2S conc, ppm	______	______	______
Ave MeSH Conc, ppm	______	______	______
Ave DMS conc, ppm	______	______	______
Ave DMDS Conc, ppm	______	______	______
Ave TRS Conc, ppm as SO_2	______	______	______
Concentration of trace gas	______	______	______
Ave O_2 Conc, %	______	______	______

____
Initial

7.0 - POST TEST PROCEDURES

7.1 - Sample Line Loss - Correction Factor Known concentration of H_2S injected as close to probe tip as possible?_______________

____

____

Concentration of H_2S generated at level of standard ($\pm$ 20%)?____

____

____

H_2S Generated By:

Permeation System________________________________

Cylinder Gas Dilution____________________________

% Recovery

20%____________(Sample run not to be used)

20%____________(Sample run corrected)

Recovery Correction Factor________________________

____

7.2 - Recalibration of GC/FPD and Dilution System

7.2.1 - GC/FPD

Known concentration of H_2S injected into GC/FPD?______________________________

Compared to original calibration curve?______

____

Calibration Drift $\pm$ 10%?____________________

____

Highest sample values chosen if calibration drift 10%_____________________________

Discussion:____

____

____

____
Initial

7.2.2 - Dilution System

Known concentration of H_2S injected into front of Dilution System?______________________________

Compared to original calibration curve?______________

____

Calibration Drift $\pm$ 10%?______________________

____

7.3 - LEAK CHECK

Sampling system leak checked?____________________

Technique?________________________________

8.0 - CALCULATIONS

Individual concentrations of H_2S, DMS, DMDS and MESH Recorded? (Oxygen Corrected)

	Run 1 (avg. ppm)	Run 2 (avg. ppm)	Run 3 (avg. ppm)
H_2S	______	______	______
MeSH	______	______	______
DMS	______	______	______
DMDS	______	______	______
Total	______	______	______

9.0 - RELATIVE ACCURACY

9.1 Calculation

	TRS (ppm)		
	Run 1	Run 2	Run 3
Reference Method	____	____	____
TRS Conc. (%O_2 corrected)	____	____	____
CEM TRS Conc.	____	____	____
(%O_2 Corrected)	____	____	____
Difference	____	____	____
Avg. Differences	____	____	____

9.2 % Relative Accuracy = $\frac{|x| + C.I._{95\%}}{[RMavg]} \times 100$

= ________________ (_ 20%)

10.0 - SUMMARY

Are final results expressed in units which satisfy permit or Agency requirements?____

____

Does tester have documentation to support emission calculations (only required on smelt dissolving tank vents)?________________

____

____
Initial

Brief Summary of Test:______________________________

____

____

____

____

____

____

____

____

____

____

____

11.0 - AUTHORIZATION

11.1 - Regulatory Observer

Observer Signature______________________________

Title______________________________

Organization______________________________

Address______________________________

____

Telephone #__(______)______________________

11.2 - Company Observer

Company Observer Signature______________________

Title______________________________

Telephone #______________________________

TOTAL REDUCED SULFUR
FIELD CALIBRATION DATA SHEET
FEDERAL REFERENCE METHOD 16

Company ______________________ Date ______________

Address ______________________ Analyst ______________

______________________ Sampling Location ______________

______________________ ______________________

Company Contact ______________________

I. Permeation Tube Information

Information	Pollutant			
	H_2S	CH_3SH	$(CH_3)_2S$	$(CH_3)_2S_2$
Tube I. D. #:				
Permeation Rate (PR)				

II. Calibration Curve

Point #1

Time ______
Flow (Q) ______
Known Concentration (ppm)
H_2S: ______
CH_3SH: ______
$(CH_3)_2S$: ______
$(CH_3)_2S_2$: ______

	Area			
1				
2				
3				
Avg.				

Point #2

Time ______
Flow (Q) ______
Known Concentration (ppm)
H_2S: ______
CH_3SH: ______
$(CH_3)_2S$: ______
$(CH_3)_2S_2$: ______

	Area			
1				
2				
3				
Avg.				

Point #3

Time ________
Flow (Q) ______
Known Concentration (ppm)
H_2S: ____________
CH_3SH: ____________
$(CH_3)_2S$: ____________
$(CH_3)_2S_2$: ______

	Pollutant Area			
	H_2S	CH_3SH	$(CH_3)_2S$	$(CH_3)_2S_2$
1				
2				
3				
Avg.				

III. Equation

$$c = \frac{(PR)\left(\frac{24.46 \mu\ell/\mu\text{-mole}}{(M)\ \mu g/\mu\text{-mole}}\right)\left(\frac{T°K}{298°K}\right)\left(\frac{760\ \text{mm Hg}}{P\ \text{mm Hg}}\right)}{Q\ \ell/\text{min}}$$

Where: c = concentration, $\mu\ell/\ell$ or ppm by volume
T = temperature of the system, °K
P = pressure of the system, mm Hg
PR = permeation rate, $\mu g/min$
Q = total flow rate, liters/min
M = molecular weight of the permeating gas, $\mu g/\mu$-mole
24.46 = molar volume ($\overline{V}$) of any gas at 25°C & 760 mm Hg, $\mu\ell/\mu$-mole

c = ______________________________

IV. Remarks: ____

____

____

____

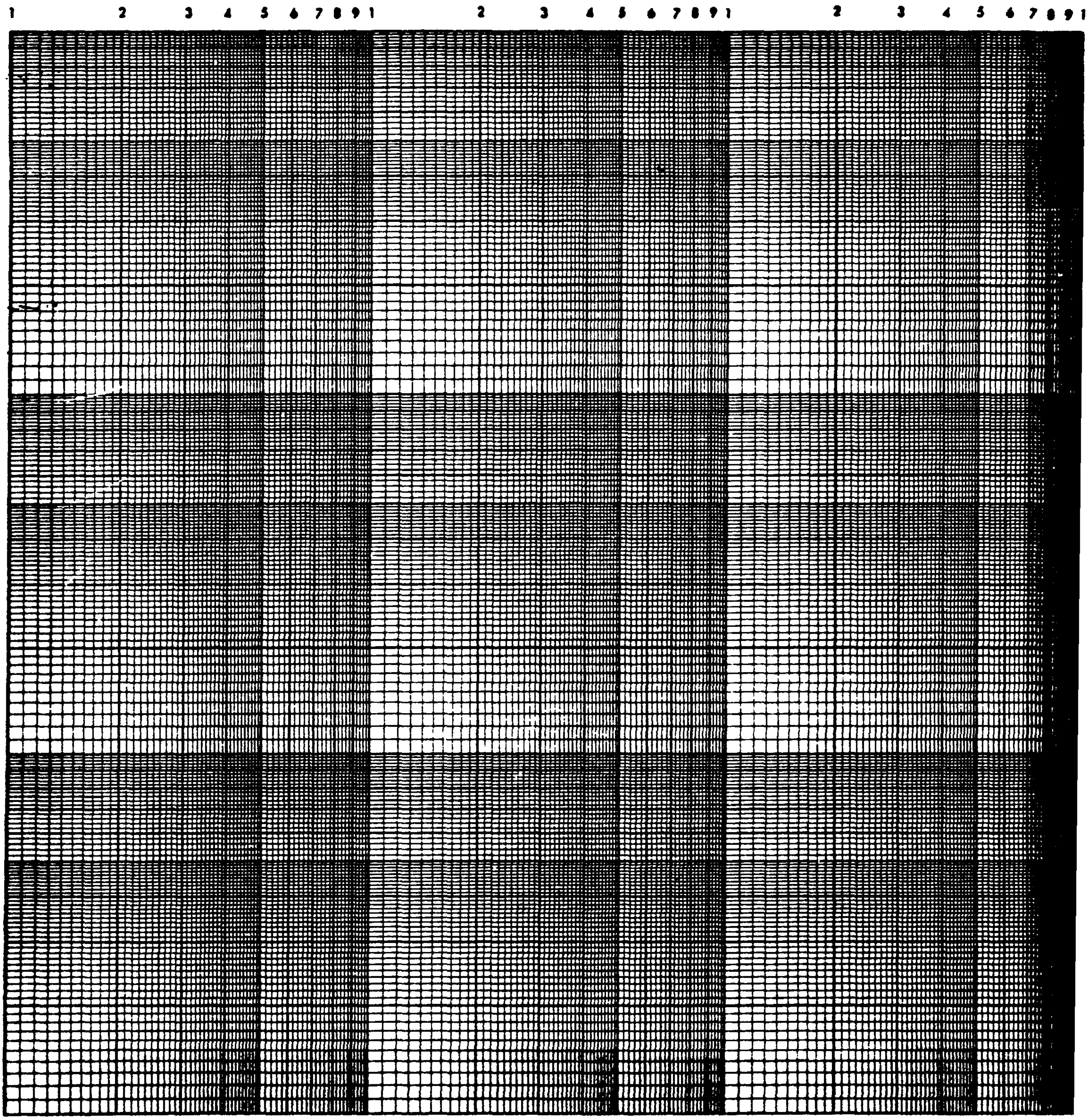
____

Page _____ of ____

____
Initial

V. Graph Calibration Curve

Using the graph paper below, graph either the peak area, peak height or available integrator information for each of the individual sulfur standards vs. concentration. Draw the best fit line through the plotted points and determine source sample concentration from the established calibration curve.



Federal Reference Method 16A
Observation Checklist

____
Initial

Federal Reference Method 16
Observation Checklist

1.0 BACKGROUND INFORMATION

1.1 Source Name:____

1.2 Location: ____

1.3 Affected Facility:____

1.4 Test Dates:____

1.5 Test Team:____

Leader:____

Members:____

1.6 Plant Contact:____

1.7 Corporate Contact:____

Phone #______________________

Title____

2.0 PROCESS DATA

2.1 Process Tested:____

2.2 Process Description:____

____

2.3 Process Operating Data:____

____

3.0 TEST EQUIPMENT

3.1 Sketch system used for sampling and analysis (including calibration system).

Page__ Of___

____
Initial

4.0 SAMPLE PORT LOCATION

4.1 Stack/Duct Conditions (leaks, particle build-up, corrosion):
____
____

4.2 Number of stack diameters upstream from flow disturbance:____

4.3 Number of stack diameters downstream from flow disturbance:__

4.4 Velocity Traverses Performed:________________________

Number of points______________

Location__________________

Avg. Δp____________________

Pitot tube calibration factor__________________________

Date Calibrated_______________

Avg. Velocity_________________

4.5 Stack Temperature Sensor:

Type:________________________ Range:__________________

Location in Stack:_____________________________________

Date Calibrated:__________ Calibration Papers Rec'd_____

4.6 Remarks:____
____
____

4.7 Location of CEM in reference to sample port location_______
____
____

5.0 SAMPLE TRAIN PREPARATION

5.1 - Probe
Material of Construction______________________________

Heated?_______________ Temperature___________________

5.2 - SO_2 Scrubber System
Type____

Citrate Acid Buffer Added?___________________________

Initial

pH of Solution________________________________

Location of Probe?________________________________

____

5.3 - Oxidizing Furnace

Type________________________________

Material of Construction________________________________

Tube Dimensions________________________________

Temperature________________________________

5.4 - SO_2 Impinger Train

Type________________________________

Hydrogen Peroxide added to Impingers ?________________

Quantity________________________________

Glass Wool plug used?________________________________

____

5.5 - Dry Gas Meter

Type________________________________

Volume________________________________

Correction Factor________________________________

Date Calibrated________________________________

Calibration Papers Revised?________________________

Temperature Measured?________________________

6.0 PRE-TEST ACTIVITIES

6.1 - Pre-test leak check (optional)

6.1.1 Complete sampling train checked:________________

____

6.1.2 Vacuum of 10 inches mercury?________________

____
Initial

6.1.3 Leak rate 40 cc/min?_______________________________
____

6.1.4 Pump leak checked?_________________________________
____

6.2 - System Performance Check

6.2.1 Sketch sampling train and gas dilution system.

6.2.2 List gases available, concentration, traceability, analysis date, expiration date and gas cylinder pressure (include information in both calibration gas and dilvent gas).

Initial

Pollutant	Concentration	Traceability	Analysis Date	Expiration Date	Cylinder Pressure

6.2.2.1 Dilvent gases contain 50 ppb total sulphur compound and 10ppm

6.2.2.2 Total HC?___

6.2.2.3 Calibration gases verified by Reference Method 11, GC/FPD or zinc acetate technique___

6.2.2.4 Rotometers used in dilution system calibrated?___

6.2.2.5 Dry gas meter used in Dilution System calibrated? ___

6.2.2.6 Flows measures by bubble meter?___

6.2.2.7 Concentrations generated?___

6.2.3 System Performance Check Form

6.2.3.1 Two thirty minute samples taken?___

Date				
Run I.D.				
Time Began				
Time Ended				
Dry Gas Meter Volume				

			Initial	
Volume of Solution (mm 1)	_____	_____	_____	_____
Volume of Solution Titrated (mm 1)	_____	_____	_____	_____
Volume of Titrant (mm 1)	_____	_____	_____	_____
Normality of Titrant	_____	_____	_____	_____
Conc. H_2S Determined	_____	_____	_____	_____
Conc. H_2S Generated	_____	_____	_____	_____
% Recovery	_____	_____	_____	_____

6.2.3.2 Within ± 15% of generated H_2S ______________________________

6.2.3.3 Two 30-minute samples within ± 5% of their mean value? ____

____

6.2.3.4 Notes/Remarks: ____

____

____

____

____

____

____

Initial

7.0 SAMPLING

7.1 - General

7.1.1 Leak check performed after system performance check?___

7.1.2 Sample extraction involving either: (1) three one hour samples at 20 liters/min?

(2) One three hour sample of 120 liters intermittently or continuous

7.1.3 Sampling involves traversing stack?

7.1.4 Oxidizing furnace maintained at 850°C?

7.1.5 Citrate buffer solution adequate?

[Note: The citrate buffer solution volume may change during sampling due to condensed water from sample stream and gas flow rate.]

7.2 - Field Data Required?

Date	____	____	____	____
Run I.D.	____	____	____	____
Time Began	____	____	____	____
Time Ended	____	____	____	____
Avg. Rotameter reading	____	____	____	____
Avg. Dry Gas Temperature	____	____	____	____
Dry Gas Meter volume (ft.)	____	____	____	____

7.2.1 Sampling rate performed 2.0 liters/minutes (± 10%)?

7.2.2 Post-Test leak check performed?

Initial

7.2.3 Impingers containing hydrogen peroxide recovered? ________

- sample recovery bottle labeled? ____________________

- fluid level indicated on side of bottle? ____________

7.2.4 Probe/Sample line to SO_2 scrubbers rinsed after each run?

____

8.0 - SAMPLE RECOVERY TEST

8.1 - General

8.1.1 Was a leak test performed prior to the sample recovery test?____

8.1.2 Were SO_2 impingers re-charged with hydrogen peroxide?

____

List gases available, concentration, traceability, analysis date, expiration date, date and gas cylinder pressure (include information in both calibration gas and diluent gas):

Pollutant	Concentration	Traceability	Analysis Date	Expiration Date	Cylinder Pressure

8.1.3 Diluent gases contain $\leq$ 50 ppb total sulfur compound?

____

8.1.4 Calibration gases verified by Reference Method 11, GC/FPD or Zinc Acetate technique?______________________________

8.1.5 Rotameters in dilution system calibrated? ______________

____

____

8.1.6 Dry gas meter in dilution system calibrated?____________

____

____

8.1.7 Flows measured by bubble meter?_________________________

____

8.2 Sample Recovery Test Field Data

Date				
Run I.D.				
Time Began				
Time Ended				
Dry Gas Meter Volume(ft^3)				

9.0 - ANALYSIS

9.1 Source Sample

Run Number				
Dry Gas Meter Volume (ft^3)				
Volume of Solution (ml)				
Volume of Solution Titrated (ml)				
Volume of Sample Titrant (ml)				
Normality of Titrant				
Volume of Blank Titrant				

9.2 Sample Train Recovery

Run Number				
Dry Gas Meter Volume (ft^3)				
Volume of Solution (ml)				
Volume of Solution Titrated (ml)				
Volume of Sample Titrant (ml)				
Normality of Blank Titrant				
Volume of Blank Titrant				

10.0 CALCULATIONS

10.1 Calculate the volume of gas sampled corrected to standard conditions, for each sample run utilizing the following equation (for Sample and Sample Train Recovery):

$$V_{m(std)} = 17.64\ (Y) \left(\frac{V_m P_{bar}}{T_m}\right)$$

Where: $V_{m(std)}$ = volume of gas sample through the dry gas meter at standard conditions, dscf

V_m = volume of gas sampled through the dry gas meter, (cu.ft.)

T_m = average dry gas meter temperature, (°R)(°F + 460)

$17.64 = \text{conversion factor} \left(\frac{°R}{\text{in. Hg}}\right)$

$= \frac{528°R}{29.92 \text{ in. Hg}}$

Y = dry gas meter calibration factor, dimensionless. For our source test, we will assume a dry gas meter calibration factor of Y = 1.

P_{bar} = barometric pressure, in. Hg

$$V_{m(std)} = (17.64)(1)\left[\frac{(\_\_\_\_\_)(\_\_\_\_\_)}{(\_\_\_\_\_)}\right]$$

$$= \_\_\_\_\_\_\_\_\_\_ \text{ dscf.}$$

10.2 Calculate concentration (ppm) of both source sample and Sample Train Recovery utilizing the following equation:

$$c_{SO_2} = K_2 \frac{N(V_t - V_{tb})\left(\frac{V_{soln}}{V_a}\right)}{V_{m(std)}}$$

Where: c_{SO_2} = emission rate of sulfur dioxide, ppm
V_t = volume of titrant required for sample (mL), $Ba(ClO_4)_2$
V_{tb} = volume of titrant required for blank (mL), $Ba(ClO_4)_2$
N = normality of $Ba(ClO_4)_2$ (meq/mL)
V_{soln} = total volume of sample (mL)
$V_{m(std)}$ = volume of sample corrected to standard conditions (dscf)
V_a = volume of aliquot titrated (mL)
K_2 = 424.30

$$c_{SO_2} = \left[424.30\right] \left[\frac{(\_\_\_)(\_\_\_ - \_\_\_)\left(\frac{\_\_\_}{\_\_\_}\right)}{(\_\_\_)}\right]$$

= ____________

____
Initial

10.0 - SUMMARY

Are final results expressed in units which satisfy permit on agency requirements?____

____

Does Tester have documentation to support emission calibrations (only required on smelt dissolving tank vents)?__________________

____

Brief Summary of Test____
____
____
____
____
____
____

11.0 - AUTHORIZATION

11.1 Regulatory Observer
Observer Signature____

Title____

Organization____

Address____
____

11.2 Company Observer____
Company Observer Signature_____________________________
Title____
Telephone #______________________________________

FIELD INSPECTION NOTEBOOK
TOTAL REDUCED SULFUR
CONTINUOUS EMISSION MONITORING SYSTEM
ABBREVIATED INSPECTION PROCEDURES

FIELD INSPECTION NOTEBOOK
TOTALS REDUCED SULFUR
CONTINUOUS EMISSION MONITORING SYSTEM
ABBREVIATED INSPECTION PROCEDURES

Once a thorough evaluation of the TRS CEM system has been accomplished, control agency personnel may want to perform the next inspection on a less comprehensive basis. To assist the control agency personnel, an abbreviated inspection procedure checklist has been developed. The abbreviated checklist is applicable to all TRS CEM systems. It does not address monitor specific inspection points, but does evaluate the TRS monitor on a system audit basis. The checklist is divided into three major areas:

- Control agency records review;
- Control agency records update; and
- Source TRS CEM system review.

The control agency records review consists of a review of permits and/or any current enforcement actions to determine the purpose of the CEM. In addition, a review of the PST report and current EER is conducted to verify conformance with the appropriate performance specification and reporting requirements for EERs.

The control agency records update is conducted by telephone to verify that the records in agency files correctly describe the current CEM status.

Finally, the source TRS CEM system review evaluates a source's record-keeping, data reduction procedures, monitor evaluation through zero/span checks and overall system review.

ABBREVIATED INSPECTION PROCEDURES
TOTAL REDUCED SULFUR CONTINUOUS EMISSION MONITORING SYSTEM
CONTROL AGENCY RECORD REVIEW

SOURCE NAME ______
SOURCE ADDRESS ______
SOURCE CONTACT ______
SOURCE TELEPHONE NO. ______
DATE ______

ACTION REQUIRED*

1 - PERMIT REVIEW

____ Is CEM required by permit? Yes___ No___
____ CEM requirement due to: NSPS ___
____ SIP ___
____ Enforcement Action ___

____ Is CEM installed? Yes___ No___
____ CEM Installation/startup date ______/______
____ Allowable emission rate ______
____ Date of source performance test ______

2 - CEM PERFORMANCE SPECIFICATION TEST (PST) REPORT REVIEW

____ Dates of PST (<30 days after performance test) ______
____ Date PST report submitted (<60 days after OTP[1]) ______
____ Date of process startup (<180 days prior to OTP) ______
____ Date of initial full-load operation (<60 days prior to OTP) ______
____ Emission Rate Conversion formula ______

CEM SUMMARY

	OPACITY	TRS	O_2
Analyzer			
Manufacturer			
Model			
Serial			
Recorder			
Manufacturer			
Model			
Serial			
Type [2]			

PST REPORT REVIEW

	OPACITY	TRS	O_2
Relative Accuracy			
Calibration Error			
Response Time			
24 Hr. Span Drift			
24 Hr. Zero Drift			

1 OTP= Operational Test Period
2 Magnetic Tape, Strip Chart, Data Logger, Other (describe).

CALIBRATION REFERENCE MATERIAL REVIEW

	OPACITY	TRS	O_2
Full Span Value			
Upscale Value			
Mid Span Value			
Calibration Value			
Gas Value Verification			
RM Triplicate Analysis/Date			
NBS Traceable (Protocol 1)			
Other			
Gas Cell Value Verification			
Manufacturer/Date			
Comparison to Gas/Date			
Agency Verification			
Other			

ACTION REQUIRED

____ Was stratification evaluated? ________ Discuss ________ ____

____

Describe monitor locations (diluent and pollutant) ________________

____

____

3 - EXCESS EMISSION REPORT REVIEW

Months reported ________________

Did each excess emission report document:

____ Date, time, and duration of excess emissions Yes ___ No ___

____ Magnitude of excess emissions Yes ___ No ___

____ Reason for excess emissions Yes ___ No ___

Corrective action taken to reduce emissions Yes ___ No ___

____ Conversions factor/formula ________________ Yes ___ No ___

____ Method for determing conversion or correction factors used in calculating emission rate.

Moisture content ________________

Gas velocity ________________

Temperatue ________________

Diluent gas concentration (O_2) ________________

____ Corrective action taken to reduce emissions Yes ___ No ___

Briefly discuss corrective action ________________

____

____

____ Process downtime Yes ___ No ___

____ Monitor downtime Yes ___ No ___

____ Corrective action taken to return monitor to operation Yes ___ No ___

Briefly discuss corrective action ________________

____

____

What percent availability did the CEM system achieve? ________________

(2190 - # hrs. downtime) /2190 = % availability

CONTROL AGENCY RECORDS UPDATE

FIELD REVIEW ______________________________
TELEPHONE REVIEW ______________________________
DATE ______________________________

ACTION REQUIRED

1 - SYSTEM OPERATION & MAINTENANCE

____ Is monitoring system currently operational? Yes ___ No ___

____ Is system calibration checked daily? ___ Automatic ___ Manual Yes ___ No ___

____ Are recommended maintenance schedules/procedures provided by the CEM manufacturer and followed? Yes ___ No ___

What group or person is responsible for CEM maintenance? ______________________________

____ Is manufacturer's recommended spare parts list in plant inventory; or on order? Yes ___ No ___

____ Are CEM system malfunctions documented to identify recurring failures of components or subsystems? Yes ___ No ___

2 - RECORDKEEPING AND DATA REDUCTION TECHNIQUES

What are the engineering units of the data recorded by the CEM system?
What data reduction procedure is used in calculating emission rates?
____

Over what time intervals are data averaged? ______________________________

Are chart speed, span value, date and time documented? Yes ___ No ___

Where is this data filed? On site ______________________________
Home office ______________________________
Other ______________________________

Is the following information filed for the previous two years:

Action required	Item	Yes	No
____	All system calibrations	___	___
____	All maintenance performed on the CEM system	___	___
____	All CEM system outages	___	___
____	Span gas certified	___	___
____	Triplicate reference method analysis of span gas	___	___
____	PST reports	___	___
____	Modifications to the CEM system	___	___
____	Excess Emission Reports	___	___
____	Performance Test Reports	___	___

____ Does span gas value (gas cell or neutral density filter) correspond to appropriate subpart requirements? Yes ___ No ___

____ Are zero and span calibration checks performed daily? Yes ___ No ___

____ Are drift values within performance specification requirements? Yes ___ No ___

SOURCE TRS CEM SYSTEM REVIEW

DATE ______________________________ SOURCE CONTACT ______________________________

1 - Review records and update inspection procedures.
Note all items to which unsatisfactory responses were received. Discuss each with source representative via telephone and note status below.

____
____
____
____
____
____
____
____
____
____

2 - Request copies of unreduced CEM system output including diluent gas and process parameter measurements necessary for conversion to emission rate which correspond to:
- o an excess emission,
- o a CEM system malfunction or outage, and
- o an interval of time during which no excess emission or CEM system malfunction occurred as determined by the EER review.

3 - Request a copy of CEM maintenance log corresponding to a CEM system malfunction and/or outage reported in EER.

4 - Request copies of zero and span calibration (generally shown on strip chart) check.
After receiving the requested information reduce CEM data to units of emission standard and compare to corresponding emission rates submitted on EER. Refer to appropriate subpart of 40 CFR 60, 40 CFR 51 Appendix P, operating permit or enforcement action for proper data reduction procedure and conversion factor. Review CEM output during reported process downtime, CEM calibration and monitor malfunction.

ACTION REQUIRED

ACTION REQUIRED			
____	Are EER and agency calculated excess emission rates the same?	Yes ___	No ___
____	Do agency calculations of data not reported as excess emissions indicate compliance?	Yes ___	No ___
____	Was CEM malfunction or outage caused by component or subsystem failure?	Yes ___	No ___
____	Was CEM outage scheduled for preventive maintenance?	Yes ___	No ___
____	Do source maintenance and operating records indicate monitor status and corrective action during outage?	Yes ___	No ___

Which if any of the following caused the outage:
- Calibration gas supply,
- Optical surface condition,
- Conditioning system,
- Air purge system,
- Optical alignment,
- Light source.
- Other (describe) ____
____

ACTION
REQUIRED

5 - TRS CEM SYSTEM INSTALLATION INSPECTION

_____ Is CEM sampling point in a nonstratified location (for gas monitors)? Yes ___ No ___
If so, how was non-stratification verified? __________
____

_____ If stratification exists, does sampling method and location of diluent gas sampling interface provide measurement of representative sample? Yes ___ No ___

_____ Is R.M. sampling point as close as possible to CEM sampling point? Yes ___ No ___

Describe access to sampling point. __________________
____
____
____

_____ Are CEM sampling and analyzing components free of excessive vibration and extreme ambient temperatures? Yes ___ No ___

Describe location of calibration gas bottles (if used).
____
____

_____ Are transport and conditioning systems designed and installed properly to deliver sample which meets analyzer requirements (temperature, wet, dry etc)? Refer to manufacturer's operation/maintenance manual Yes ___ No ___

_____ Is calibration gas introduced at or near the sample interface at the proper pressure? Yes ___ No ___

_____ Are control panel and recorder located in a controlled environment? Yes ___ No ___

_____ Is purge air supply clean and dry? Yes ___ No ___

Transport line details - Conditioning System

CEM SYSTEM OPERATION OBSERVATION

_____ Does calibration check indicate satisfactory drift? Yes ___ No ___

_____ Is automatic zero compensation employed? Yes ___ No ___

_____ If so, is zero compensation greater than 4% (opacity only) or does reference indicator (if used) show TRS CEM system zero signal to be within specified tolerance of zero reference signal? Yes ___ No ___

_____ Yes ___ No ___

_____ If calibration gases are used, are they introduced to the TRS CEM system at the sampling interface? Yes ___ No ___

_____ Are calibration references (gas cell, gas cylinder, neutral density filter) of the appropriate value? Yes ___ No ___

ACTION REQUIRED

___	Is recorder span set at value required by the appropriate subpart of 40 CFR 60, or by SIP?	Yes ___	No ___
___	Is pollutant concentration easily determined from recording device?	Yes ___	No ___
___	Is a zero offset employed?	Yes ___	No ___
	If not, how is negative zero drift quantified? ________		
___	Are any fault indications displayed on control panel?	Yes ___	No ___
	If so, discuss. ________________		

3 - CEM PROGRAM EVALUATION

___	Is an alarm connected to TRS CEM control panel to signal excess emissions?	Yes ___	No ___
	How often is CEM output checked by an operator? ________		
	What procedures are implemented during an excess emission incident to reduce emissions? ________________		
	Are process data measurements conducted according to the methods described in applicable NSPS/SIP regulation or permit?	Yes ___	No ___
___	Are changes in calibration reference materials (gas, cell, filter) documented?	Yes ___	No ___
___	How and how often is emission data reviewed for validity by the source? ________________		
___	Are entries into Maintenance and Operations Logs made in relation to monitor:		
	Malfunctions	Yes ___	No ___
	Calibrations	Yes ___	No ___
	Maintenance	Yes ___	No ___
	QA Checks	Yes ___	No ___

Conversion Factors

International Metric System: Le Systeme International d'Unites (SI Units)

Base Units of the International Metric System (SI)		
Quantity	**Name of the Unit**	**Symbol**
Length	meter	m
Mass	kilogram	kg
Time	second	s
Temperature	Kelvin	K
Amount of substance	mole	mol

Recommended decimal multiples and submultiples and the corresponding prefixes and names.

Factor	Prefix	Symbol	Meaning
10^{12}	tera	T	One trillion times
10^{9}	giga	G	One billion times
10^{6}	mega	M	One million times
10^{3}	kilo	k	One thousand times
10^{2}	hecto	h	One hundred times
10	deca	da	Ten times
10^{-1}	deci	d	One tenth of
10^{-2}	centi	c	One hundredth of
10^{-3}	milli	m	One thousandth of
10^{-6}	micro	μ	One millionth of
10^{-9}	nano	n	One billionth of
10^{-12}	pico	p	One trillionth of
10^{-15}	femto	f	One quadrillionth of
10^{-18}	atto	a	One quintillionth of

Conversion from ppm to g/m³ at STP

$T_{std} = 273.15\,°K$

$P_{std} = 1$ atm

$$\frac{g}{dscm} = \frac{ppm \times M.W. \left(\frac{g}{g\text{-mole}}\right)}{22.414 \frac{liters}{g\text{-mole}} \times 10^{-3} \frac{m^3}{10^3 L} \left(\frac{293.15\,°K}{273.15\,°K}\right)} \times \frac{1}{1 \times 10^6 \ ppm}$$

Atomic Weights and Numbers

Name	Symbol	Atomic Number	Atomic Weight
Arsenic	As	33	74.9216
Barium	Ba	56	137.34
Cadmium	Cd	48	112.40
Carbon	C	6	12.01115
Chlorine	Cl	17	35.453
Hydrogen	H	1	1.00797
Iodine	I	53	126.9044
Lead	Pb	82	207.19
Nitrogen	N	7	14.0067
Oxygen	O	8	15.9994
Phosphorous	P	15	30.9738
Potassium	K	19	39.102
Sodium	Na	11	22.9898
Sulfur	S	16	32.064

Volume

From \ To	cm^3	liter	m^3	in^3	ft^3
cm^3	1	0.001	1×10^{-6}	0.06102	3.53×10^{-5}
liter	1000	1	0.001	61.02	0.03532
m^3	1×10^{6}	1000	1	6.10×10^{4}	35.31
in^3	16.39	0.01639	1.64×10^{-5}	1	5.79×10^{-4}
ft^3	2.83×10^{4}	28.32	0.02832	1728	1

Temperature

°C = 5/9(°F − 32)	°F = 9/5 °C + 32	°K = °C + 273.2	°R = °F + 459.7

Conversion factors—ppm vs. $\mu g/m^3$.

Given unit \ Desired unit	Parts per million by volume					
	O_3	NO_2	SO_2	H_2S	CO	HC as methane
$\mu g/m^3$	5.10×10^{-4}	5.32×10^{-4}	3.83×10^{-4}	7.19×10^{-4}	—	—
mg/m^3	—	—	—	—	0.875	1.53

Given unit \ Desired unit	$\mu g/m^3$				mg/m^3	
	O_3	NO_2	SO_2	H_2S	CO	HC
ppm	1960	1880	2610	1390	1.14	0.654

To convert a value from a given unit to a desired unit, multiply the given value by the factor opposite the given units and beneath the desired unit.

TECHNICAL REPORT DATA
(Please read Instructions on the reverse before completing)

1. REPORT NO. 340/1-85-013b	2.	3. RECIPIENT'S ACCESSION NO.
4. TITLE AND SUBTITLE Field Inspection Notebook for Monitoring Total Reduced Sulfur (TRS) from Kraft Pulp Mills		5. REPORT DATE December 1984
		6. PERFORMING ORGANIZATION CODE
7. AUTHOR(S) William T. "Jerry" Winberry, Jr.		8. PERFORMING ORGANIZATION REPORT NO.
9. PERFORMING ORGANIZATION NAME AND ADDRESS Engineering-Science, 501 Willard Street, Durham, NC 27701		10. PROGRAM ELEMENT NO.
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15. SUPPLEMENTARY NOTES
Supplements Technical Assistance Document for Monitoring Total Reduced Sulfur (TRS) from Kraft Pulp Mills; EPA Task Manager-Sonya Stelmack, (202) 382-2851

16. ABSTRACT

Field performance audit procedures were developed for three of the most common total reduced sulfur (TRS) continuous emission monitoring systems (CEMS). These procedures were designed to assist state/federal field inspectors in the evaluation of TRS-CEMS. Contained in the notebook are checklists and data entry tables covering preparation for the inspection, preliminary review of records, preliminary on-site meeting with source personnel, and general guidelines for inspection of any type TRS-CEMS. Specific audit procedures for three of the most common models of TRS CEMS

- Sampling Technology Inc. Model 100 TRS CEM System;
- Barton Titrator TRS System; and
- Bendix Gas Chromatograph TRS System

are provided as sectional inserts. In auditing these monitors the inspector should follow the specific procedure rather than the general guidelines given in the body of the field notebook.

Conscientious use of this notebook will aid the inspector in conducting a thorough audit of the TRS CEMS and provide a comprehensive original record of all phases of the inspection.

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
Air Pollution	Opacity Monitoring Systems	
Monitoring	Audit Procedures	
Kraft Pulp Mills	TRS Continuous Emission Monitors	
Continuous Emission Monitoring		

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