From SO_2 C.E.M.S. Manual – Rosemount.
(P.O. # 5010667 ?)

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SYSTEM DESCRIPTION

1.1 Introduction

The Sulfur Dioxide Monitoring System is designed to continuously analyze the following components in Roaster Offgas Emission Flue Gases.

Sulfur Dioxide	0-4%

The system will be exposed to the following gases and concentrations during start-up or upset conditions, but will not be expected to provide analysis. These conditions will not damage analyzer.

Oxygen (O_2):	17.846%
Carbon Dioxide (CO_2):	0.582%
Carbon Monoxide (CO):	0
Nitrogen :	78.563%
Water Vapor (H_2O):	3%
Particulates	Less than 250 mg/m^3
Temperature:	93.7 C
Pressure:	Atmospheric

1.2 Analyzer Description

The Model 880A is a microprocessor-controlled infrared analyzer utilizing the Luft detector technology. User-friendly software provides for ease of operation and calibration, with the convenience of complete set-up and operation from the front panel keyboard. A constant current source drive with quartz crystal-controlled chopper motor enhances stability and performance, providing complete isolation from power line frequency variations. An LCD display provides reading in either percent of full scale, or direct reading of component concentration when used in conjunction with the linearizer. Refer to Analyzer manual in Section 4 for further information.

1.3 System Design Features

The system incorporates the following features:

1. A high capacity thermoelectric cooler will allow sample flows to 4-5 liter/minute. The cooler will be continuously drained via multihead peristaltic pump. A sample pump is provided so that the system 90% response time for up to 70-120 foot of 3/8 inch O.D. sample line would be on the order of 30-60 seconds or less.

SYSTEM DESCRIPTION

2. Calibration gas introduction with correction is provided through entire Sample System on an automatic basis. For Maintenance purposes, zero and span gases may be introduced just prior to analyzer.

3. Multiple stage filtration:

   Primary - Sintered 316 SS on end of sample probe, 0.5 micron
   Secondary - Non metallic fiber element, 0.6 microns
   Guard - sintered metal, 7 micron element

4. Flowmeter is provided for analyzer in addition to a bypass flowmeter. The flowmeter allows adjustment of sample flow rate and system lag time, respectively. Calibration gas should be introduced to the system at essentially the same flow rate as sample.

5. A moisture sensor will detect carryover from thermoelectric cooler and will provide remote contact closure if there is any liquid carryover or if there is high temperature in thermocooler. (Above 9.6°C).

6. Materials in contact with the sample include 304 and 316 stainless steel, Alloy 20, Kynar, Viton, Teflon, and glass.

7. Indication for the following parameters is visible from the front of the system.

   A. Gas concentration from analyzer (Model 880A display)

   B. Pressure out from pump (Pressure Gauge)

   C. Heated Sample Lines & Heated Sample Probe Valve Box (Temperature Controller)

   D. Flow for analyzer (Sample Flowmeter)

   E. Bypass flow for system (Bypass Flowmeter)

   F. Sample Inlet Pressure to Pump (Pressure Gauge)

   G. Blowback Timer

   H. Enclosure Internal Temperature (Bi-Metal Temperature Indicator)

SYSTEM DESCRIPTION

8. A back pressure regulator, pressure gauge, and check valve will maintain constant pressure within the analyzer, and prevent any fluctuations due to changes in vent pressure.

9. A 4-20 mA analog output proportional to 0-4% Sulfur Dioxide is provided. It is the user's responsibility to coordinate the analog output with range and range change. Alarm contacts are included for thermocooler failure due to high temperature or moisture carryover, analyzer calibration in progress, analyzer in maintenance, and zero/span out of range.

10. A pitot style mass flow probe will be provided by others and combined with analyzer output to provide sulfur dioxide mass emissions.

11. Automatic blowback of sample probe is provided on a timed frequency (adjustable by user 1-30 hours) and on a timed duration (adjustable by user 12-120 seconds). Manual blowback may also be initiated by holding pushbutton switch for required duration. Frequency of blowback should be determined based on operating experience. Blowback of Pitot Tube will occur simultaneously with sample probe blowback.

12. A multi tube (3) heat traced sample line will be provided. There will be two 1/4 inch O.D. Teflon tubes (sample and cal gas) and one 3/8 inch O.D. Teflon tube for instrument air. Tracer electrical wires and thermocouple wires for operation of heated probe box and remote valving are also included.

13. The system is assembled in a NEMA 3R enclosure with front and rear access doors. The enclosure is painted a textured Federal Standard 595B 26307 gray. Approximate dimensions of enclosure are 79" x 24" x 30" (HWD). System is designed to be located in a nonhazardous area. A heater will allow system to be located in an ambient temperature range of 50-70°F. Lifting eyes and channel bases are provided for ease of installation. Provision is made for attaching zero and span gas cylinders to side of enclosure.

SYSTEM DESCRIPTION

1.4 Customer Supplied Equipment

The following items are to be provided by customer for installation and operation of system:

A. 115 VAC 60 Hz single phase power, 60 amp (30 amps normal power consumption) circuit with a main disconnect

B. Zero and span calibration gas cylinders and dual stage regulators with interconnecting tubing.

C. Atmospheric pressure vent and drains to safe location.

D. Instrument air per ISA Standard S7.3; 80-100 psig at 6-8 SCFM.

E. 3 inch 150 lb. ASA RF Flange mounting on Stack For Probe Valve Box.

INSTALLATION PROCEDURE

3.1 Installation

Reference Drawings:

D-775267	Flow Diagram, Sulfur Dioxide Monitoring System
D-775268	Outline and Mounting Dimensions, Sulfur Dioxide Monitoring System
D-775269	Interconnect Wiring Diagram, Sulfur Dioxide Monitoring System
D-775270	Outline and Mounting Dimension Drawing, Sample Probe Valve Box
B-775287	Sample Probe

1. Move packaged System Enclosure to installation location. Unpack system and inspect for shipping damage. Install system in permanent location as required as shown on Outline and Mounting Dimensions Drawing. Install sample probe and sample probe valve box as required and supplied heat traced interconnecting sample line.

2. Leak check supplied heat traced interconnecting sample line(s) with 15 psig nitrogen (or clean, dry, oil-free air) from sample tap to enclosure at ambient temperature and at normal operating temperature. Eliminate all leaks. System must be leak tight or incorrect analyzer reading will result. A temporary pressure gauge may be installed on sample line. Pressure loss should be less than 1 psig (6.89 Kpa) per 16 hours.

3. Connect vent and drain line per Outline and Mounting Dimensions Drawing. Insure that connection is made to a pipe or tubing size equal to or larger than the fitting size supplied and is vented and drained to a pressure source at atmospheric pressure ±4 inches water column. Insure that drain or vent line will not freeze and plug up tubing with ice.

4. Verify the tightness of every tube fitting and pipe fitting in the system as they may have loosened in transit. The entire panel system should be leak checked at 15 psig. The system must be leak tight prior to attempting a system start-up. At this time, also verify that no foreign material is in any of the tubing or piping. You may want to blow out the lines with nitrogen or clean, dry, oil-free instrument air. Never use plant air for pressure checking or purging of sample lines as plant air may contain unacceptable amounts of oil and/or water.

5. Connect analog output signal as required per Electrical Interconnect and Outline and Mounting Dimensions Drawings. Connect Status ID contacts and System Alarm contacts as required.

INSTALLATION PROCEDURE

6. Connect 115 VAC 60 Hz single phase power (utility). Observe polarity when installing power - hot to black and neutral to white. Incorrect connections may cause damage to system. Provide grounding for power as required by local codes. Verify all wiring is per the Electrical Interconnect diagram referenced above.

7. Connect customer supplied zero and span calibration gas cylinders and dual stage regulators as required. Connect Instrument Air (per ISA Standard S7..3).

8. Also refer to all drawing NOTES for additional installation information.

9. System should now be ready for start-up by authorized personnel. Prior to start-up, the operating instructions should be read and thoroughly understood.

START-UP AND OPERATION

SIMPLIFIED START-UP AND OPERATIONAL PROCEDURE

3.2 Start-up and Operation

1. Install System Enclosure, interconnecting heat traced sample line, conduit, and electrical cables per installation instructions.

2. Connect 115VAC 60 Hz single phase power to appropriate terminals as required. Turn on user supplied main disconnect and circuit breaker.

3. Verify that Temperature Controllers are configured as per configuration table. Apply power to heat traced sample line and to temperature control system for probe box. Apply power to Thermoelectric Cooler. Allow heated lines and box to stabilize at operating temperature prior to introducing sample.

4. Verify that Model 880A analyzer is configured for local operation and automatic calibration gas introduction. Set purge time at 4 or 5 minutes. This is the duration that zero and span gases are introduced prior to automatic correction.

5. Introduce zero gas locally to analyzer as it is warming to operating temperature. Calibrate analyzer through Model 880A control panel as recommended using solenoid valves prior to analyzer. Allow 12-24 hours for analyzer reading to stabilize.

6. Verify that Thermoelectric cooler is operating properly prior to starting sample pump. Allow sample to flow by applying power to sample pump (if not all ready powered.) Adjust BPR_1 for 8-10 psig. Adjust BPR-2 for 5 psig on NDIR Analyzer cell. Adjust sample flow to analyzer for 1000 cc/minute. Adjust bypass flow for 3-4 Liters/minute. Manually blowback sample probe. Setup blowback timer for frequency of once per 24 hours and duration of 60 seconds.

7. System should now be analyzing sample. The following are typical settings for various components:

ITEM	DESCRIPTION	NORMAL SETTING/ INDICATION
FI_1	Sample Flow	1000 cc/minute
FI_2	Bypass Flow	3-4 Liters/minute

START-UP AND OPERATION

SIMPLIFIED START-UP AND OPERATION PROCEDURE

ITEM	DESCRIPTION	NORMAL SETTING/ INDICATION
FI_3	Cal Gas Flow to Probe	3-6 Liters/minute (during remote cal gas introduction only)
PR_1/PI_1	Probe Blowback Air Pressure	30 psig
PI_2	Sample Inlet Pressure	2-10 inches Hg Vacuum
BPR_1/PI_3	Sample Pressure to Analyzer	8-10 psig
BPR_2/PI_4	Analyzer Cell Pressure	5 psig
	Nitrogen Zero Gas	10 psig
	3% Sulfur Dioxide in Nitrogen Span Gas	10 psig
TIC-1	Probe Box Cal Valve Enclosure	300°F±20°F
TIC-2	Heated Sample Line	300°F±20°F
TIC-3	Probe Box Solenoid Valve Enclosure	80°F±20°F
	Instrument Air	80-100 psig
TI_1	Enclosure Temperature	65°-100°F
	Heater	Adjust 65-70°F

8. Verify 4-20 mA output. Adjust as required. Refer to analyzer instruction manual. When switching ranges, it is the user's responsibility to insure that analyzer output is coordinated with range change.

START-UP AND OPERATION

SIMPLIFIED START-UP AND OPERATION PROCEDURE

9. Verify operation of Thermoelectric cooler high temperature, analyzer calibration in progress, analyzer in maintenance (blowback) moisture carryover and zero/span out of range contact closures. Contact will close on alarm. Clear any alarms by correcting problem.

10. User should determine actual blowback settings, based on operating experience. Initially the user may want to coordinate blowback with calibration, so that system will be on line for an optimum amount of time. If probe plugs up too often, try blowback once every 12 hours or once every 4-6 hours. Duration of blowback may be increased to 90 seconds.

START-UP AND OPERATION

SIMPLIFIED START-UP AND OPERATION PROCEDURE

3.3 Calibration

Analyzer may be manually calibrated locally or remotely, and automatically calibrated remotely.

Normally a calibration will be recommended once every 24 hours or as determined by user based on application requirements.

System will automatically introduce zero and span gas at sample point, through heated sample line, and through sample system. The user should periodically compare this value with zero and span gas admitted directly to analyzer to determine if the system is contributing a bias.

The sample system should contribute less than a 5% change. The cause of any larger deviation should be determined and corrected.

3.4 Routine Operation

The system should operate continuously unattended. Periodic visual inspection of system should be made to insure that operating parameters of system are correct. Automatic zero/span gas calibration recommended once per 24 hour period or as desired depending on application. This may be adjusted based on actual operating experience. Refer to Analyzer Instruction Manual for details.

For short term shutdown of system, introduce nitrogen or zero gas to analyzer(s) for 10-15 minutes. For long term shutdown of system, close sample inlet valve. Remove power from system. Shut off all zero and span gases and air to system.

START-UP AND OPERATION

SIMPLIFIED START-UP AND OPERATION PROCEDURE

3.5 Maintenance

Maintenance will consist of two types: preventive and corrective. Preventive consists of monitoring certain operating parameters at selected intervals and determining if corrective maintenance is required. Following are tables which define the expected preventive maintenance. Corrective maintenance will be performed on as needed basis due to an unexpected system failure.

Preventive Maintenance

Preventive maintenance activities have been developed to maximize system availability. These activities are extremely important to the overall quality of the monitoring system. All preventive maintenance activities shall be performed by maintenance personnel.

The performance of the monitoring system should be reviewed on a weekly basis for the initial six months of operation to determine if the preventive maintenance activities and schedule are effective. After six months, maintenance activities shall be added or deleted and the frequency adjusted, if necessary, to maintain a high level of data availability and accuracy.

Corrective Maintenance

Corrective maintenance shall be initiated to remedy any problems that may occur with the system. In order to determine the cause of a problem, maintenance personnel should refer to the trouble shooting sections of the Operation and Service Manual.

Maintenance Logs

All maintenance activities performed on the monitoring equipment shall be recorded on maintenance log sheets and stored with the monitoring system files.

The Sample Conditioning system is designed for minimum maintenance based on anticipated sample composition and conditions. A routine maintenance program will minimize system downtime. Following are expected service and maintenance intervals for the various system components - they should be inspected at this interval. Actual life may vary depending on operating conditions. If any component requires repair or replacement more frequently than listed below, then consideration should be given to providing a more reliable or more corrosion resistant component. Those components not identified are not applicable to this system.

WHERE USED	COMPONENT	MAINTENANCE ITEM	DAILY	WEEKLY	MONTHLY	EVERY 3 MONTHS	EVERY 6 MONTHS	EVERY 9 MONTHS	EVERY 12 MONTHS
	FILTERS								
ST_1	Primary sintered metal sample filters	Filter Element	B				I,C or R		
F_4	Sintered Metal Sample	Filter Element					I,C or R		
	Guard Filters	Seal Kit					I,R		
	Y-Strainers	Filter Element		B				I,R	
		Seal Kit						I,R	
	Disposable End-of-Line Filters	Element				I,R			
$F_{2,3}$	Sample Filters with	Filter Element			R				
	Non-Metallic Elements	Seal Kit					I,R		
	Sample Coalescing Filters with	Filter Element			R				
	Non-Metallic Elements	Seal Kit					I,R		
F_1	Instrument Air Filters with	Filter Element				I,R			
	Non-Metallic Elements	Seal Kit					I,R		
	VALVES								
	Regulating/Needle Valves/Toggle	Packing Adjustment				I,T			
	Valves	Seat and Seals							I,R
	Flow Regulators	Flexible Orifice						I,R	

A- Tighten as Required
B - Blowback/blowdown
C - Clean
I - Inspect - some disassembly may be required
R - Replace as Required
T - Test for proper function by simulating operating/alarm condition
V - Visually check

WHERE USED	COMPONENT	MAINTENANCE ITEM	DAILY	WEEKLY	MONTHLY	EVERY 3 MONTHS	EVERY 6 MONTHS	EVERY 9 MONTHS	EVERY 12 MONTHS
CV_{1-6}	Check/Relief Valves	O-Ring Seal, Spring							I,R
	Manual or Remote-Operated	Seals						I,R	
	Ball Valves - 2, 3, 4, or 5- Way	Packing Adjustment				I,A			
AOV_1 V_1	Plug Valves - 2,3,4, or 5-Way, Manual or Remote-Operated	Plug Assembly							I,R
	Packless Valve (Diaphragm or Bellows Sealed), Manual or Remote-Operated	Seat and Seals							I,R
	Quick Connect Fittings	O-Rings							I,R
SV_{1-7}	Solenoid Valves	Coils							
		Valve Internals (check for cross leakage)						I,R	
		Valve Seats and Springs						I,R	
AOV_1	Valve Operators	Air Operators						I,R	
		Motorized Operators				I,R			
	INDICATORS								
FI_{1-3}	Flowmeters	Indication	V						
		O-Rings and Seals							I,R
PI_{1-4}	Pressure Gauges	Indication	V						
$SN_{1,2}$		Snubbers							I,R

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WHERE USED	COMPONENT	MAINTENANCE ITEM	DAILY	WEEKLY	MONTHLY	EVERY 3 MONTHS	EVERY 6 MONTHS	EVERY 9 MONTHS	EVERY 12 MONTHS
	PRESSURE ADJUSTMENT								
P_1	Diaphgram Pumps	Diaphragm				I,R			
	Piston Pumps	Valve/Valve Gasket							
	Rotary or Centrifugal Pump	Seals					I,R		
	Bellows Pump	Valves and Valve Seat				I,C			
		Bellows*				I			
P_2	Peristaltic Pump	Tubing			I,R				
$BPR_{1,2}$	Sample Back-,Differential-, and Pressure Regulators	Valve Seat and Diaphragm							I,R
PR_1	Air Service Pressure Regulators	Regulator							R
	DRYERS								
	Refrigerated Condenser	Coolant and/or Sample Temperature	V						
$RC_{1A,B}$	Thermo-Electric Cooler	Sample Temperature	V						
	Water Cooler/Water-Cooled Separator	Coolant and/or Sample Temperature	V						
	Ball Float Traps	Seats and Seals							I,C or R
	Perma-Pure Dryer	Check for Leaks			I				
	Regenerative Dryer	Solenoid Valve Coils and Internals						I,R	
		Columns/Refill with Mole Sieve							I,R

*Factory replacement of bellows as required by pump manufacturer only.

A - Tighten as Required
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WHERE USED	COMPONENT	MAINTENANCE ITEM	DAILY	WEEKLY	MONTHLY	EVERY 3 MONTHS	EVERY 6 MONTHS	EVERY 9 MONTHS	EVERY 12 MONTHS
	TEMPERATURE CONTROL								
	Heated/Vaporizing Pressure Regulating Stations	Heating Element		I					
$HL_{1,2}$	Heated Sample Line			I					
TI_1	Temperature Sensing Element, Bi-metal			I					
	Temperature Controllers, Self Operated	Valve and Seat							I,R
H_{1-4}	Enclosure Heaters			I					
	Enclosure Air Conditioners			I					
	Enclosure Vent Fans			I					
	Enclosure Heat Exchangers			I					
	Exhaust Blowers			I					
	ELECTRICAL								
	Purge Pressure Switches				T				
	Sample Pressure Switches						T		
	Loss of Pump Diaphragm Flow Switch				T				
	Sample Flow Switches						T		
	Temperature Switches						T		
MS_1	Level Sensor Switches						T		
RTC_1	Timers							I,T	

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WHERE USED	COMPONENT	MAINTENANCE ITEM	DAILY	WEEKLY	MONTHLY	EVERY 3 MONTHS	EVERY 6 MONTHS	EVERY 9 MONTHS	EVERY 12 MONTHS
K_{1-5}	Relays - Electromechanical							I,T	
$SSR_{1,2}$	Relays - Solid State								I,T
	Transducers - E to I						I,T		
	Dual Alarm Modules						I,T		
	Sample Hold Modules						I,T		
	DC Power Supply	Verify Voltage Out						I	

A - Tighten as Required
B - Blowback/blowdown
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Troubleshooting should be referred to qualified service technicians. Basic troubleshooting involves first isolating the fault to the failed component. Refer to the following symptom chart

WARNING - TAMPERING OR USE OF UNAUTHORIZED PARTS

TAMPERING OR UNAUTHORIZED SUBSTITUTION OF COMPONENTS MAY ADVERSELY AFFECT SAFETY OF THIS PRODUCT. USE ONLY FACTORY -DOCUMENTED COMPONENTS FOR REPAIR.

SYMPTOM	POSSIBLE CAUSE	CORRECTIVE ACTION
1. No flow or low sample flow to analyzer(s)	a. Sample Flow valves not adjusted properly	a. Adjust correct flow for analyzer(s)
	b. No sample pressure to analyzer(s)	b. Adjust BPR_1 for 8-10 psig
	c. System in other than sample mode	c. Place system in sample mode
	d. Sample or guard filters plugged	d. Inspect and replace as required
	e. Pump diaphragm or valves have failed	e. Replace pump diaphragm and check valve operation
2. Water carryover to analyzer(s)	a. Trap drain full	a. Verify that Peristaltic pump is operating properly.
	b. High thermoelectric cooler temperature (above 45°F/7.2°C)	
	1. Temperature setting is incorrect	1. Correct setting
	2. High ambient temperature	2. Ambient should be less than 90°F
	3. Failed thermoelectric elements	3. Inspect and replace as required
	4. Cooling fan not operating or heat exchanger blocked	4. Verify operation of fan and adequate ventilation around heat exchanger
3. Greater than 5% difference when introducing calibration gas in local mode and Remote mode (Sample System Bias)	a. Filter Element of $F_{2,3}$ contaminated	a. Remove element from system and retest. If reading is within tolerance now, then replace element with a new one.
	b. Sample line or Thermocooler contaminated.	b. Check operating temperature of all heated zones Purge/backflush system with HC-free air for 5-10 minutes. Retest. If still high, then sections of the system will have to be individually isolated and checked.
	c. Leak in system (prior to pump) which is diluting sample	c. Check sample line, pump diaphragm, Peristaltic Pump tubing.
	d. Insufficient flow of calibration gas to sample probe	d. Set flow of calibration gas so that sample inlet pressure is above 0 or analyzer reading is maximized.

3.7 EUROTHERM MODEL 91EPID TEMPERATURE CONTROLLER CONFIGURATION

	Mnemonic	TIC-1 Heated Probe/Cal Valve Enclosure	TIC-2 Heated Sample Line
Configuration Code	ConF	4253	4253
Alarm Configuration		Low	Low
Temperature Sensor		Type J T/C	Type J T/C
Display Units		F	F
Control Type		PID	PID
Output Action		Reverse	Reverse
Temperature Set Point		300 F	300 F
Alarm Set Point	AL.SP	250 F	250 F
Proportional Band (F)	ProP	4*	4*
Integral Time Constant (sec)	Int.t	10*	10*
Derivative Time Constant (sec)	dEr.t	1*	1*
Calibration Offset (F)	OFSt	0	0
Setpoint High Limit	SP.Hi	350	350
Setpoint Low Limit	SP.Lo	240	240
Heat Cycle Time (sec)	H.ct	5	5
Setpoint Ramp Rate (min)	SP.rr	Off	Off
Loop Break Time Constant (sec)	LP.br	10	10
Line Frequency (Hz)	LinE	60	60
Self Tune On Demand	tunE	Auto Tune "On"	Auto Tune "On"
		*Initial set values prior to Auto Tune procedure. Once Auto Tune is done, these values change and should not be corrected by user.	*Initial set values prior to Auto Tune procedure. Once Auto Tune is done, these values change and should not be corrected by user.