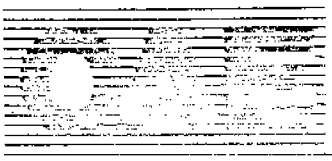
REVISED STACK TEST REPORT #2



[illegible] • Palatine IL 60067

AP-42 Section 9.12.1
Reference 6
Report Sect. 4
Reference 12

Note: This is a reference cited in *AP 42, Compilation of Air Pollutant Emission Factors, Volume I Stationary Point and Area Sources.* AP42 is located on the EPA web site at www.epa.gov/ttn/chief/ap42/

The file name refers to the reference number, the AP42 chapter and section. The file name "ref02_c01s02.pdf" would mean the reference is from AP42 chapter 1 section 2. The reference may be from a previous version of the section and no longer cited. The primary source should always be checked.

REPORT ON COMPLIANCE TESTING

Performed for:
COORS BREWING COMPANY
GOLDEN, COLORADO

CAE Project No: 6265-4
Revision 0: December 9, 1992
Revision 1: April 6, 1994

Clean Air Engineering

501 W. Wood St. • Palatine, IL 60067 • 708-991-3300

April 6, 1994

Mr. Fred Varani
Environmental Engineering
Project Manager
Coors Brewing Company
CE 290
Golden Colorado 80401

Dear Mr. Varani:

Enclosed are six revised copies of the report prepared by Clean Air Engineering for Coors Brewing Company on compliance testing at the facility located in Golden, Colorado on August 19, 1992. This report was revised because of an error in the original report, dated December 9, 1992. Theoretical flow calculations by the Coors Brewing Company, based on tank size and displacement time, were approximately twice the actual measured flow. After reviewing the data and the process, the Coors Brewing Company determined that instead of all six tanks venting into one common stack as the original report indicated, there were two identical ductwork systems, each venting three tanks.

You can reach me at 303/650-9745 if you have any questions about the data or comments about the report. We would also appreciate any comments you have regarding how we might better serve you in the future. A questionnaire has been enclosed for this purpose.

Respectfully submitted,

CLEAN AIR ENGINEERING

Michael Pierce
Manager, Denver Region

File Code Nos. 20105, 20106, 20204

COORS BREWING COMPANY
CAE Project No: 6265-4

CONTENTS

SUMMARY

INTRODUCTION

Clean Air Engineering was contracted by Coors Brewing Company to determine the levels of total hydrocarbon emissions at their facility located in Golden, Colorado for compliance purposes.

The testing took place at the Fill On Vent on August 19, 1992. Coordinating the field testing were:

F. Varani - Coors Brewing Company
M. Hynes - Clean Air Engineering

SUMMARY OF TEST RESULTS

The test conditions and results of analysis are presented in Table 1 on page 1-2.

To the best of our knowledge, the data presented in this report are accurate and complete.

Respectfully submitted,

CLEAN AIR ENGINEERING

Michael Pierce
Manager, Denver Region

David Perkins
Manager, Technical Communications

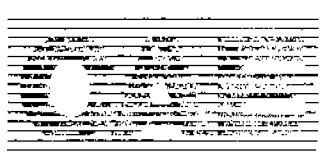
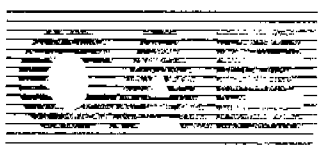


TABLE 1 - Summary of Test Results

EPA Method 25A
Fill On Vent

Run No.	1	2	3	4	Average
Date (1992)	August 19	August 19	August 19	August 19	
Start Time (approx.)	9:58 AM	11:39 AM	12:56 PM	2:16 PM	
Stop Time (approx.)	11:12 AM	12:45 PM	2:03 PM	3:36 PM	
Gas Conditions[1]					
Temperature (°F)	55	57	57	56	**56**
Moisture (volume %)	1.8	0.6	0.6	1.8	**1.2**
O_2 (dry volume %)	21.0	20.4	20.4	13.0	**18.7**
CO_2 (dry volume %)	1.4	3.2	3.2	38.1	**11.5**
Volumetric Flow Rate[1]					
acfm	31	41	41	37	**38**
dscfm	25	34	34	30	**31**
For Solvent Corrected:					
Total Hydrocarbons					
lb/hr, 6 tanks (as ethanol)[2]	0.067	0.121	0.614	1.35	**0.539**
ton/yr, 6 tanks (as ethanol)[2]	0.294	0.531	2.68	5.94	**2.361**
Total lb/fill, 6 tanks (as ethanol)					**3.077**
lb/fill, per tank (as ethanol)					**0.5129**
For Non-Solvent Corrected:					
Total Hydrocarbons					
ppm, dry, 3 tanks (as propane)	83	110	558	1,397	**537**
lb/hr, 6 tanks (as propane)[2]	0.028	0.052	0.260	0.574	**0.229**
ton/yr, 6 tanks (as propane)[2]	0.124	0.224	1.14	2.52	**1.00**

[1] Gas Conditions and Volumetric Flow Rate from Run 2 were used for Run 3.
[2] Value indicated is twice the 3 tank value calculated in the parameter section.



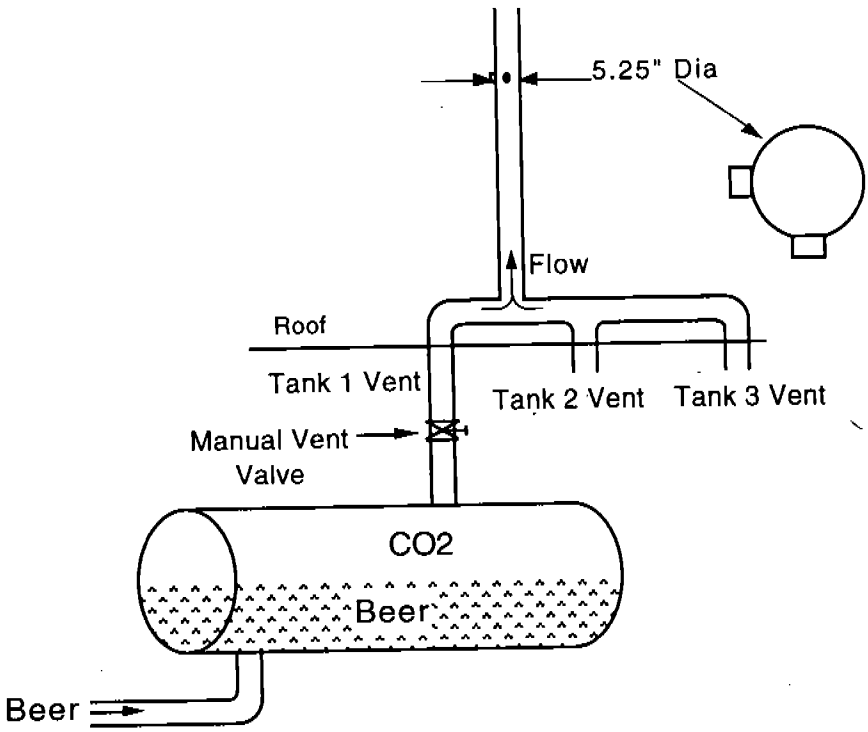
DESCRIPTION OF INSTALLATION

The Fill On Vent location is the ventilation system from six identical beer holding tanks. The combined capacity of the six tanks is 9,420 barrels. When empty after being cleaned, the tanks contain air. As beer fills the tanks, air, carbon dioxide and ethanol gases are displaced and are forced out the vent stack. Ductwork from three tanks combines in a common duct or stack before venting to the atmosphere. Identical ductwork is used for venting the remaining three tanks.

9420 bbl is tank volume. 11/15/94 conversation - Jere Zimmerman of Coors suggested using equivalent beer packaged/hr for process rate. 5400 bbl filled during 5.7 hr test.

The testing took place at the Fill On Vent on August 19, 1992.

A schematic the Fill On Vent is shown below.



SUMMARY OF PROCEDURES

SAMPLING PROCEDURES

The sampling followed procedures as detailed in U.S. Environmental Protection Agency (EPA) Methods 1, 1A, 2, 3, 4 and 25A. These methods are titled:

- Method 1 — "Sample and Velocity Traverses for Stationary Sources;"
- Method 1A - "Sample and Velocity Traverses for Stationary Sources with Small Stacks or Ducts;"
- Method 2 — "Determination of Stack Gas Velocity and Volumetric Flow Rate (Type S Pitot Tube);"
- Method 3 — "Gas Analysis for the Determination of Dry Molecular Weight;"
- Method 4 — "Determination of Moisture Content in Stack Gases;"
- Method 25A - "Determination of Total Gaseous Organic Concentrations using a Flame Ionization Analyzer (FIA)."

These methods appear in detail in Title 40 of the Code of Federal Regulations (CFR), Part 60, Appendix A.

Clean Air Engineering also adhered to the following EPA Methods and ASTM procedures:

- EPA 600/ 9-76-005 1976 Quality Assurance Handbook for Pollution Measurement Systems, Vol. I. Principles.
- EPA 600/ 4-77-027b 1979 Quality Assurance Handbook for Pollution Measurement Systems, Vol. III.

The sampling apparatus is shown in Figure 1 on page 3-2. All equipment was calibrated at the Clean Air Engineering laboratory prior to shipment to the job site.

The Fill On Vent has two ports. For velocity and moisture determination, and for total hydrocarbons testing, a single point was sampled from the center of the duct for various time intervals.

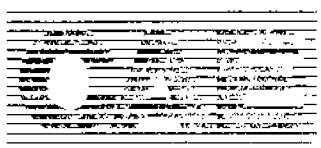
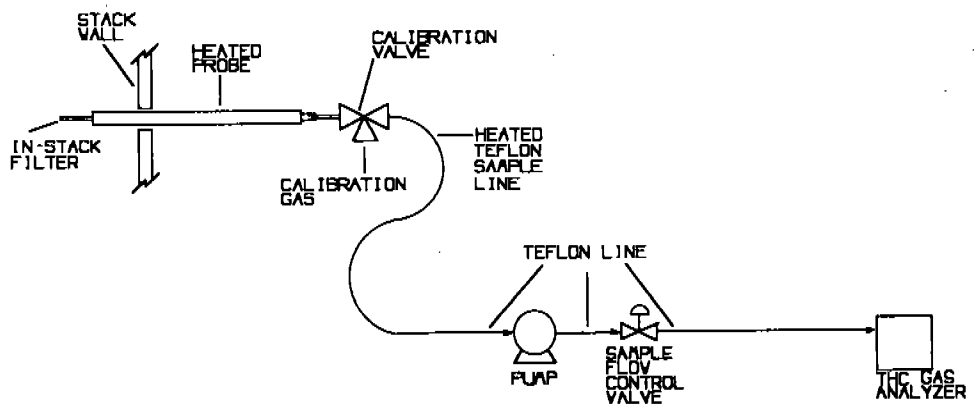


Figure 1

The EPA Method 25A sampling apparatus is shown.



SUMMARY OF PROCEDURES (Continued)

ANALYTICAL PROCEDURES

Continuous Emissions Monitoring

Total Hydrocarbons

The total hydrocarbons emission rate was determined using procedures detailed in EPA Method 25A. A sample was extracted continuously from the flue gas stream, and a portion was conveyed to a flame ionization analyzer.

Before and after each run, the monitor was zeroed and calibrated with a certified calibration gas. These calibrations were used to correct the raw data for zero and calibration drift occurring during the test runs.

QUALITY CONTROL PROCEDURES

Quality control procedures for all aspects of field sampling; sample preservation and holding time; reagent quality; analytical method; analyst training and safety; and instrument cleaning, calibration and safety were followed. These procedures are generally consistent with EPA guidelines documented in "Quality Assurance Manuals for Air Pollution Measurement Systems," Vol 3, "Stationary Source Specific Methods" (EPA-600/4-77-027b).

COMMENTS

Velocities in the duct were measured using a hot wire anemometer.

No deviations from standard U.S. EPA testing procedures were noted.

APPENDIX

NOMENCLATURE

Nomenclature

A	-	absorbance
A_n	-	cross sectional area of nozzle (ft^2)
A_s	-	cross sectional area of stack (ft^2)
B_{wo}	-	proportion of water vapor in the gas stream by volume (%)
B_{ws}	-	proportion of water vapor in the gas stream by volume (%) at saturated conditions
C_p	-	pitot tube coefficient (dimensionless)
D_f	-	dilution factor
F_d	-	ratio of dry gas generated to gross calories (dscf/MBtu)
F_c	-	ratio of gas generated
GCV	-	gross calorific value of fuel (Btu/lb)
$\overline{DH}$	-	average pressure drop across meter box orifice (in. H_2O)
$\overline{\sqrt{DP}}$	-	average square roots of velocity heads of stack gas ($\sqrt{\text{in. } H_2O}$)
DH@	-	meter orifice calibration coefficient (in. H_2O)
%I	-	percent of isokinetic sampling (acceptable: $90 \leq \%I \leq 110\%$)
K_p	-	pitot tube constant: 85.49 (ft/sec) $\frac{\sqrt{(lb/lb\text{-}mole)(in.\ Hg)}}{\sqrt{(^\circ R)(in.\ H_2O)}}$
K_c	-	spectrophotometer calibration factor
M_d	-	dry molecular weight of stack gas (lb/lb-mole)
M_s	-	molecular weight of stack gas, wet basis (lb/lb-mole)
M_n	-	total amount of particulate matter collected (gm)
N	-	normality of titrant (meq/ml)
P_b	-	barometric pressure (in. Hg)
P_f	-	final absolute pressure of flask (in. Hg)
P_i	-	initial absolute pressure of flask (in. Hg)
P_s	-	absolute stack gas pressure (in. Hg)
Q_a	-	volumetric flow rate, actual conditions
Q_{std}	-	volumetric flow rate, standard conditions, dry basis
std	-	standard conditions, 29.92 in. Hg, 68 ° F
T_f	-	final absolute temperature of flask (° R)
T_i	-	initial temperature of flask (° R)
T_m	-	average dry gas meter temperature (° F)

Nomenclature

CAL GAS	actual concentration of the upscale calibration gas
CAL I	initial system calibration bias check response for the upscale calibration gas, ppm
CAL F	final system calibration bias check response for the upscale calibration gas, ppm
ZERO I	initial system calibration bias check response for the zero gas, ppm
ZERO F	final system calibration bias check response for the zero gas, ppm
ppm	measured concentration as parts per million in the gas stream
ppm (drift calibrated)	concentration calibrated for drift as per Eq. 6C-1 of EPA Method 6C

SAMPLE CALCULATIONS

COORS BREWING COMPANY
CAE Project No : 6265 - 4

SAMPLE CALCULATIONS - RUN 1, FILL ON VENT

(Note : results are taken from computer analysis)

1. Volume of water collected

$$V_{wstd} = (0.04707\ ft^3/ml)\ (V_{lc})$$
$$= (0.04707)\ (12.2)$$
$$= 0.57\ wscf$$

2. Volume of gas metered, standard conditions

$$V_{mstd} = \frac{(17.64\ ^\circ R/in.\ Hg)\ (V_m)\left[P_b + \frac{DH}{13.6}\right]}{(460 + T_m)}(Y_d)$$
$$= \frac{(17.64)\ (39.97)\left[24.52 + \frac{1.0}{13.6}\right]}{(460 + 81)}(0.9946)$$
$$= 31.88\ dscf$$

3. Moisture content (actual)

$$B_{wo} = \frac{V_{wstd}}{V_{mstd} + V_{wstd}}$$
$$= \frac{0.57}{31.88 + 0.57}$$
$$= 0.0177$$
$$= 1.8\ \%$$

4. Molecular weight of dry gas stream

$$M_d = 0.44(\%CO_2) + 0.32(\%O_2) + 0.28(\%CO + \%N_2)$$
$$= 0.44(1.4) + 0.32(21.0) + 0.28(77.6)$$
$$= 29.06$$

5. Molecular weight of stack gas

$$M_s = M_d\ (1 - B_{wo}) + 18(B_{wo})$$
$$= 29.06\ (1 - 0.0177) + 18(0.0177)$$
$$= 28.87$$

6. Stack pressure (in. Hg)

$$P_s = P_b + \left(\frac{STATIC\ P}{13.6}\right)$$
$$= 24.52 + \left(\frac{0.0}{13.6}\right)$$
$$= 24.52$$

SAMPLE CALCULATIONS (Continued)

9. Total Hydrocarbons (as propane)

$$ppm_{wet,\ drift\ calibrated} = \left(C_{avg} - C_o\right)\frac{C_{ma}}{(C_m - C_o)}$$
$$= (88 - 1.5)\frac{251.4}{(269 - 1.5)}$$
$$= 81$$

C_{avg} = Average gas concentration indicated by gas analyzer, wet basis, ppm.
C_o = Average of initial and final system calibration bias check responses for the zero gas, ppm.
C_m = Average of initial and final system calibration bias check responses for the upscale calibration gas, ppm.
C_{ma} = Actual concentration of the upscale calibration gas, ppm.

$$ppm_{dry} = \frac{ppm_{wet,\ drift\ calibrated}}{1 - B_{wo}}$$
$$= \frac{81}{1 - 0.0177}$$
$$= 83$$

$$lb/dscf = \frac{(ppm_{dry})(MW)}{385.3 \times 10^{-6}}$$
$$= \frac{(83)(44)}{385.3 \times 10^{-6}}$$
$$= 9.47 \times 10^{-6}$$

$$lb/hr = (lb/dscf)(dscfm)(60)$$
$$= (9.47 \times 10^{-6})(25)(60)$$
$$= 0.014$$

$$lb/hr,\ Ethanol = (lb/hr)(Ethanol\ Correction\ Factor)$$
$$= (0.014)(2.36)$$
$$= 0.034$$

$$ton/yr,\ Ethanol = \frac{(lb/hr,\ Ethanol)(24\frac{hr}{day})(365\frac{days}{yr})}{2,000\frac{ton}{lb}}$$

$$= \frac{(0.034)(24)(365)}{2,000}$$
$$= 0.147$$

COORS BREWING COMPANY
CAE Project No: 6265-4

PARAMETERS

C

COORS BREWING COMPANY
Project No. 6265-4
Fill On Vent

MOISTURE AND VELOCITY PARAMETERS

Run No.	1	2	3
Date (1992)	August 19	August 19	August 19
Start Time (approx.)	10:00 AM	12:10 PM	2:20 PM
Stop Time (approx.)	11:00 AM	1:10 PM	3:20 PM
%CO2	1.4	3.2	38.1
%O2	21.0	20.4	13.0
Pb	24.52	24.52	24.52
STATIC P	0.0	0.0	0.0
As	0.15	0.15	0.15
Vlc	12.2	4.2	11.8
Vm	39.97	40.23	39.54
DH	1.0	1.0	1.0
Yd	0.9946	0.9946	0.9946
Tm	81	87	99
CALCULATED RESULTS			
Vwstd	0.57	0.20	0.56
Vmstd	31.88	31.73	30.52
Bwo	0.0177	0.0062	0.0179
AVG TEMP	55	57	56
Md	29.06	29.33	34.62
Ms	28.87	29.26	34.32
Ps	24.52	24.52	24.52
Vs*	3.42	4.59	4.11
Qa (acfm)	31	41	37
Qstd (dscfm)	25	34	30

* Velocity in the duct was measured using a hot wire anemometer.

CALIBRATION DATA

D

METER BOX FULL-TEST CALIBRATION

Date: 03-27-97 Operator: JO

Meter Box No.: 0-4 | Meter Box ΔH@: 1.636 | Meter Box Yd: .9946 | Barometric Pressure: 24.71

				Standard Meter Gas Volume ft³			Meter Box Gas Volume ft³			Std. Meter Temperature °F			Meter Box Temperature °F					
Q	ΔH	ΔP	Yds	Initial	Final	Yds Net	Initial	Final	Yds Net	In	Out	Tds Avg	In	Out	Tds Avg	Time θ	Yd	ΔH@
.91	3.0	-13.0	1.000	0	10.005	10.005	292.581	302.724	5.540	70	70	70	92.5	86.5	85	9.05	1.0036	1.610
.91	3.0	-13.0	1.000	0	10.004	10.004	302.511	312.376	5.865	70	70	70	93	86	86.5	9.05	1.0015	1.610
.64	1.5	-7.2	1.000	0	10.001	10.001	312.779	322.953	10.174	70	70	70	95	86.5	90.5	12.91	.9952	1.635
.64	1.5	-7.2	1.000	0	10.001	10.001	322.953	338.153	10.200	70	70	70	95	87	91	12.93	.9931	1.632
.32	.5	-3.6	1.000	0	5.000	5.000	287.265	292.684	5.175	70	70	70	92	85	86.5	11.23	.9577	1.652
.36	.5	-3.6	1.000	0	5.000	5.000	302.294	307.511	5.163	70	70	70	92	86	86	11.27	.9516	1.647

Nomenclature

Pb	Barometric Pressure
Q	Flow Rate (cfm)
ΔH	Orifice Pressure Differential ("H_2O)
ΔP	Inlet Pressure Differential ("H_2O)
Vd	Volume Dry Gas Meter (ft^3)
Vds	Volume Dry Standard (ft^3)
Yd	Meter Correction Factor (unitless)
Yds	Standard Meter Correction Factor (unitless)
ΔH@	Orifice Pressure Differential that gave 0.75 cfm of air at 70°F and 29.92 "Hg ("H_2O)

Calculations

$$Yd = (Yds)\left[\frac{Vds}{Vd}\right]\left[\frac{Td + 460}{Tds + 460}\right]\left[\frac{Pb + \Delta P/13.6}{Pb + \Delta H/13.6}\right]$$

$$\Delta H@ = \frac{0.0317\,\Delta H}{Pb(Td + 460)}\left[\frac{(Tds + 460)\theta^2}{(Vds)(Yds)}\right]$$

$$Q = \frac{17.64\,(Yds)(Pb)}{(Tds + 460)\theta}$$

Vacuum Gauge Calibration

Standard (Hg)	Vacuum Gauge
5	5
10	10
15	15
20.5	20
max	24

Thermometer Calibration

Standard	Inlet	Outlet
60	60	60
80	80	80
100	100	100
120	120	120

[redacted]

1290 COMMERMERE STREET, TROY, MICHIGAN 48084 (313) 589-2950

Your P.O. # : 3114-71500

Expiration Date : 2-27-93

Customer :
C A E INSTRUMENT RENTAL
246 WOODWORK LANE
PALATINE, IL. 60067

CERTIFICATE OF ANALYSIS - EPA PROTOCOL GASES
PERFORMED ACCORDING TO SECTION 3.0.4

Certified Per Traceability Protocol # 1 — Procedure # G1

File # PD-1154

Cylinder Number ALM-023246

Cylinder Pressure 1900 psig

Certified Accuracy 1 % NBS Traceable

REFERENCE STD				GAS ANALYZER	
COMPONENT	CERTIFIED CONC	SRM # (CRM #)	CYLINDER NUMBER	CONC.	MAKE/MODEL/SERIAL #	LAST CALIBRATION DATE	ANALYTICAL PRINCIPLE
PROPANE	850.2 PPM	2646 (CRM #)	ALM-18432	973.2 PPM	BECKMAN/400/1002059	6-20-91	FLAME IONIZATION DETECTOR
		GMIS	IA-4258	279.7 PPM			

BALANCE GAS : NITROGEN

DATE : 8-27-91

ANALYSIS

ZERO GAS (mV)	TEST GAS (mV)	RESULTS PPM	REFERENCE GAS CONC.	REFERENCE GAS (mV)	RESULTS PPM
0.00	84.20	851.8	973.2 PPM	96.40	975.1
0.00	84.20	851.8		96.40	975.1
0.00	84.20	851.8		96.40	975.1

CALCULATED RESULTS 850.2
850.2
850.2

AVERAGE : 850.2 PPM

CALIBRATION CURVE 1 st DEGREE

SRM # (CRM #)	CONC. PPM	SPLIT PT (%)	DVM (mV)	FITTED VALUE	PERCENT ERROR
	1012	100	100.00	1012	0.00
2646	973.2	96	96.40	975.1	0.2
	799.8	79	79.10	800.3	0.0
	279.7	28	27.60	279.7	0.0
	189.2	19	18.60	188.7	-0.2
	0.0000	0	-0.01	0.0000	0.0
		0		0.00	0.0
	189.2	LOW	18.60	188.7	-0.2
2646	973.2	HIGH	96.40	975	0.2

1 NBS - GAS MANUFACTURER'S INTERNAL STANDARD

The only liability of this Company for any which fails to comply with this analysis shall be replacement thereof by the Company without extra cost.

ANALYSE : [redacted]

APPROVED BY : Shapiro

COORS BREWING COMPANY
CAE Project No: 6265-4

FIELD DATA

E

Orsat Readings

Client	A. Coors	Project Number	6265
Plant	GoldenCo	Unit	C-17 FOV
Date	8-19-92	Fuel Type	—
Orsat ID	65 EXT-01	Leak Check?	✓

$F_o = \frac{20.9 - \%O_2}{\%CO_2}$

F_o = 1.083 to 1.230 (for bituminous coal)

Run Number	Location	Bag ID	Trial	Percent CO_2	Percent $CO_2 + O_2$	Percent O_2	F_o	Sample Time	Analysis Time	Analyst
R1	FOV C-17	R-1FOV	1	1.4	22.4	21.0		10-11AM	12p	[signature]
Fill on Vent			2	1.4	22.4	21.0				
			3	1.4	22.4	21.0				
			Avg.	1.4	22.4	21.0				
R-2	FOV C-17	R2FOV	1	3.2	23.6	20.4		12-1:00	130	[signature]
			2	3.2	23.6	20.4				
			3	3.2	23.6	20.4				
			Avg.	3.2	23.6	20.4				
			1							
			2							
			3							
			Avg.							
			1							
			2							
			3							
			Avg.							
			1							
			2							
			3							
			Avg.							
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			3							
			Avg.							
			1							
			2							
			3							
			Avg.							
			1							
			2							
			3							
			Avg.							

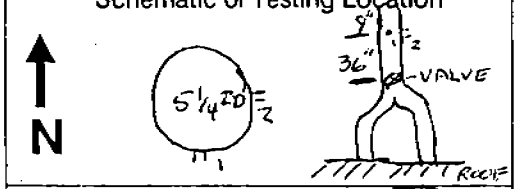
Location: FILL ON VENT Run: _____

Velocity Determination Field Data Sheet

Page _____ of _____

Client CURS BREWING CO	Project Number 626.5
Plant GOLDEN, CO.	Unit C17
Date 19 AUG 92	Inlet/Outlet (Stack)
Data Recorder M. HYNES	
Probe Operator M. HYNES	

Schematic of Testing Location



First point all the way IN (OUT)

Area (ft^2)	Port Len (in)	Gas Flow IN (OUT)
0.150	1/8"	

Ambient Temp. (°F) 75	Bar. Press. (in. Hg) 24.52
IGS Bag ID Number	
% O_2	% CO_2
% Moisture:	Assumed/Measured
Start Time AM/PM	Stop Time AM/PM

Pyrometer Number D-5	Pitot Cp NA
Pitot Leak Check: NA	Before / After
Static Pressure (inches H_2O) (+/-) 0.0	

START 10:00

Traverse Point Number	Velocity Head FPM ΔPs	Stack Temp (°F)	TIME MIN	Traverse Point Number	Velocity Head FPM ΔPs	Stack Temp (°F)	TIME MIN	Traverse Point Number	Velocity Head FPM ΔPs	Stack Temp (°F)	TIME MIN	Traverse Point Number	Velocity Head ΔPs	Stack Temp (°F)	TIME MIN	Notes
2-2.	205	55	0	2-2	209	55	95	2-2.	273	55	190	2-2	245	56	285	
	205	55	5		216	55	100		272	55	195		247	56	290	
	210	54	10		211	55	105		264	55	200		243	56	295	
	212	55	15		205	55	110		278	55	205		242	57	300	
	205	55	20		227	55	115		280	55	210		240	57	305	
	210	55	25		269	55	120		275	55	215		233	56	310	
	200	56	30		264	55	125		276	55	220	1526	239	57	315	
	205	56	35	RUN	258	55	130		276	55	225		234	57	320	TOTAL 2442
	200	56	40	2	263	55	135		272	55	230		200	57	325	680
	204	56	45	1210	259	55	140		277	57	235		172	57	330	AVE 203.5
	202	56	50		202	55	145		275	57	240		177	57	335	56.7
1	207	56	55		140	58	150		279	56	245	1	217	57	340	END OF FILL
	205	55	60		75	61	155		270	56	250		283	62	345	START FILL
	209	56	65		68	64	160		255	57	255		320	61	350	
	203	55	70		56	67	165	RUN	259	57	260		321	60	355	
	206	55	75		943	51	170	3	254	56	265		306	60	360	TOT 2173
	211	55	80		477	51	175	1420	252	56	270		312	60	365	243
	207	55	85		289	53	180		252	56	275		313	60	370	AVE 310.4
	207	55	90	1310	276	55	185		250	56	280	1	318	60	375	CO.4
Total	3912	1052			4908	1066			5080	1058						
Average	205.9	55.4			258.3	56.1			267.8	55.7						

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Location: FOV CELLAR 24 Run: R-2

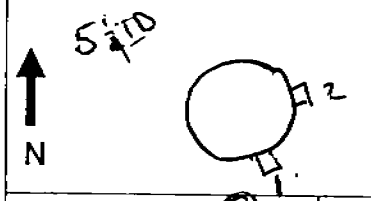
Moisture Determination Field Data Sheet

Client A.Coors	Project Number 6265
Plant Golden Co	Unit C-17 (COORS LITE)
Date 8-19-98	Inlet/outlet/stack
Meter Operator	JMOLINARO
Probe Operator	

Sample Box Number	KO
Pyrometer Number	DL
Meter Box Number	D4
Meter ΔH@ 1.636	Meter Y_d .9946

Leak Rate Before:	0	cc/m cf/m @ 15	"Hg
Leak Rate After:	0	cc/m cf/m @ 4	"Hg

Schematic of Testing Location



First point all the way (IN) OUT	Method 4	
Area (ft^2) .150	Port Len. (in.) 0	Gas Flow IN (OUT)
Filter Material		

Ambient Temp. (°F) 82	Bar. Press. (in. Hg) ~~24.46~~ 24.52
Assumed Moisture (%) 2%	

Heater Box Setting NA	Probe Heater Setting NA
Probe Length 1	Probe Number NA
Probe Material SS	

IGS Bag ID Number R-2 C-17-FOV	
% O_2 20.4	% CO_2 3.2
H_2O (ml) <2>	Silica Gel (gm) 6.2
Total V_{lc} 4.2	

Start Time: 12:10 AM / (PM) Stop Time: 1:10 AM / PM

Traverse Point Number	Min/pt 5 / Clock Time	Pump Vacuum (in. Hg)	Stack Temp, Ts (°F)	Bath Temp, (°F)	Orifice Setting ΔH (in. H_2O)	Initial Volume 992.90 / Gas Sample Volume V_m Circle one: (L) (ft^3)	Gas Sample Temperature at Dry Gas Meter: Inlet $T_{m\,in}$ (°F)	Gas Sample Temperature at Dry Gas Meter: Outlet $T_{m\,out}$ (°F)	Probe Temp. T_p (°F)			Notes
X-1	5	1.0	55	40	1.0	996.23	82	82	NA			V=31.71
	10	1.0	55	40	1.0	999.61	84	82				H_2O = .6%
	15	1.0	55	42	1.0	1002.98	87	83				
	20	1.0	55	42	1.0	1006.32	89	83				
	25	1.0	55	42	1.0	1009.68	90	83				1009.68
	30	1.0	55	44	1.0	1013.035	90	83				
	35	1.0	61	44	1.0	1016.49	92	84				
	40	1.0	67	44	1.0	101984	92	85				
	45	1.0	67	44	1.0	1023.17	93	86				
	50	1.0	53	46	1.0	1026.43	94	86				
	55	1.0	53	44	1.0	1029.78	95	87				
	60	1.0	53	42	1.0	1033.13	95	87				
Average		1.0		43	1.0		81.25					
Total						40.13						

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COORS BREWING COMPANY
CAE Project No: 6265-4

FIELD DATA PRINTOUTS

F

COORS BREWING COMPANY
CAE Project No: 6265-4
Fill On Vent
Runs 1, 2, 3 and 4
August 19, 1992
9:58 AM

Time sec	ppm	ppm, corrected	flow(fpm)	flow(dscfm)	lb/hr(propane)	
9:58 AM	86	81	205	26	0.015	Start Run 1
9:59 AM	86	81	205	26	0.015	
10:00 AM	83	78	205	26	0.014	
10:01 AM	84	79	205	26	0.014	
10:02 AM	84	79	210	27	0.015	
10:03 AM	84	79	210	27	0.015	
10:04 AM	84	79	210	27	0.015	
10:05 AM	85	80	210	27	0.015	
10:06 AM	82	77	210	27	0.014	
10:07 AM	82	77	212	27	0.014	
10:08 AM	84	79	212	27	0.015	
10:09 AM	83	78	212	27	0.015	
10:10 AM	84	79	212	27	0.015	
10:11 AM	83	78	212	27	0.015	
10:12 AM	84	79	205	26	0.014	
10:13 AM	84	79	205	26	0.014	
10:14 AM	85	80	205	26	0.014	
10:15 AM	86	81	205	26	0.015	
10:16 AM	86	81	205	26	0.015	
10:17 AM	87	82	210	27	0.015	
10:18 AM	86	81	210	27	0.015	
10:19 AM	86	81	210	27	0.015	
10:20 AM	86	81	210	27	0.015	
10:21 AM	86	81	210	27	0.015	
10:22 AM	87	82	200	26	0.014	
10:23 AM	86	81	200	26	0.014	
10:24 AM	86	81	200	26	0.014	
10:25 AM	86	81	200	26	0.014	
10:26 AM	86	81	200	26	0.014	
10:27 AM	86	81	205	26	0.015	
10:28 AM	86	81	205	26	0.015	
10:29 AM	86	81	205	26	0.015	
10:30 AM	86	81	205	26	0.015	
10:31 AM	86	81	205	26	0.015	
10:32 AM	87	82	200	26	0.014	
10:33 AM	87	82	200	26	0.014	
10:34 AM	86	81	200	26	0.014	
10:35 AM	86	81	200	26	0.014	
10:36 AM	87	82	200	26	0.014	
10:37 AM	87	82	204	26	0.015	
10:38 AM	87	82	204	26	0.015	
10:39 AM	87	82	204	26	0.015	
10:40 AM	87	82	204	26	0.015	
10:41 AM	88	83	204	26	0.015	
10:42 AM	88	83	202	26	0.015	
10:43 AM	88	83	202	26	0.015	
10:44 AM	88	83	202	26	0.015	
10:45 AM	89	84	202	26	0.015	
10:46 AM	89	84	202	26	0.015	
10:47 AM	89	84	207	26	0.015	
10:48 AM	89	84	207	26	0.015	
10:49 AM	90	85	207	26	0.015	
10:50 AM	89	84	207	26	0.015	
10:51 AM	90	85	207	26	0.015	

COORS BREWING COMPANY
CAE Project No: 6265-4
Fill On Vent
Runs 1, 2, 3 and 4
August 19, 1992
9:58 AM

Time sec	ppm	ppm, corrected	flow(fpm)	flow(dscfm)	lb/hr(propane)
11:46 AM	100	96	205	26	0.017
11:47 AM	100	96	227	29	0.019
11:48 AM	100	96	227	29	0.019
11:49 AM	100	96	227	29	0.019
11:50 AM	101	97	227	29	0.019
11:51 AM	100	96	227	29	0.019
11:52 AM	100	96	269	34	0.022
11:53 AM	101	97	269	34	0.023
11:54 AM	101	97	269	34	0.023
11:55 AM	101	97	269	34	0.023
11:56 AM	103	99	269	34	0.023
11:57 AM	103	99	264	33	0.023
11:58 AM	102	98	264	33	0.023
11:59 AM	102	98	264	33	0.023
12:00 PM	104	100	264	33	0.023
12:01 PM	105	101	264	33	0.023
12:02 PM	105	101	258	33	0.023
12:03 PM	106	102	258	33	0.023
12:04 PM	107	103	258	33	0.023
12:05 PM	107	103	258	33	0.023
12:06 PM	108	104	258	33	0.023
12:07 PM	108	104	263	33	0.024
12:08 PM	109	105	263	33	0.024
12:09 PM	110	106	263	33	0.024
12:10 PM	111	107	263	33	0.024
12:11 PM	111	107	263	33	0.024
12:12 PM	112	108	259	33	0.024
12:13 PM	112	108	259	33	0.024
12:14 PM	113	109	259	33	0.025
12:15 PM	114	110	259	33	0.025
12:16 PM	114	110	259	33	0.025
12:17 PM	113	109	202	26	0.019
12:18 PM	115	111	202	26	0.019
12:19 PM	115	111	202	26	0.019
12:20 PM	116	112	202	26	0.020
12:21 PM	118	114	202	26	0.020
12:22 PM	118	114	140	18	0.014
12:23 PM	120	116	140	18	0.014
12:24 PM	121	117	140	18	0.014
12:25 PM	123	119	140	18	0.014
12:26 PM	124	120	140	18	0.015
12:27 PM	126	122	75	9	0.008
12:28 PM	128	124	75	9	0.008
12:29 PM	130	126	75	9	0.008
12:30 PM	132	128	75	9	0.008
12:31 PM	133	129	75	9	0.008
12:32 PM	135	131	68	9	0.008
12:33 PM	138	134	68	9	0.008
12:34 PM	138	134	68	9	0.008
12:35 PM	139	135	68	9	0.008
12:36 PM	139	135	68	9	0.008
12:37 PM	139	135	56	7	0.007
12:38 PM	137	133	56	7	0.006
12:39 PM	138	134	56	7	0.006

COORS BREWING COMPANY
CAE Project No: 6265-4
Fill On Vent
Runs 1, 2, 3 and 4
August 19, 1992
9:58 AM

Time sec	ppm	ppm, corrected	flow(fpm)	flow(dscfm)	lb/hr(propane)	
1:34 PM	613	611	276	35	0.146	
1:35 PM	623	621	276	35	0.149	
1:36 PM	634	632	276	35	0.151	
1:37 PM	642	640	276	35	0.153	
1:38 PM	652	650	276	35	0.156	
1:39 PM	664	662	276	35	0.158	
1:40 PM	672	670	276	35	0.160	
1:41 PM	682	680	276	35	0.163	
1:42 PM	693	691	272	34	0.163	
1:43 PM	702	700	272	34	0.165	
1:44 PM	715	713	272	34	0.168	
1:45 PM	722	720	272	34	0.170	
1:46 PM	734	732	272	34	0.173	
1:47 PM	745	743	277	35	0.179	
1:48 PM	756	754	277	35	0.181	
1:49 PM	767	765	277	35	0.184	
1:50 PM	777	775	277	35	0.186	
1:51 PM	797	795	277	35	0.191	
1:52 PM	799	797	275	35	0.190	
1:53 PM	816	814	275	35	0.194	
1:54 PM	826	824	275	35	0.197	
1:55 PM	837	835	275	35	0.199	
1:56 PM	848	846	275	35	0.202	
1:57 PM	857	856	279	35	0.207	
1:58 PM	869	868	279	35	0.210	
1:59 PM	886	885	279	35	0.214	
2:00 PM	895	894	279	35	0.216	
2:01 PM	921	920	279	35	0.223	
2:02 PM	929	928	270	34	0.217	
2:03 PM	863	862	270	34	0.202	Stop Run 3
2:04 PM	18	0	270	34	0.000	
2:05 PM	9	0	270	34	0.000	
2:06 PM	318	0	270	34	0.000	
2:07 PM	265	0	255	32	0.000	
2:08 PM	261	0	255	32	0.000	
2:09 PM	422	0	255	32	0.000	
2:10 PM	879	0	255	32	0.000	
2:11 PM	862	0	255	32	0.000	
2:12 PM	995	0	259	33	0.000	
2:13 PM	2433	0	259	33	0.000	
2:14 PM	2438	0	259	33	0.000	
2:15 PM	1287	0	259	33	0.000	
2:16 PM	1065	1079	259	33	0.245	Start Run 4
2:17 PM	1094	1108	254	33	0.247	
2:18 PM	1103	1117	254	33	0.249	
2:19 PM	1107	1122	254	33	0.250	
2:20 PM	1106	1121	254	33	0.250	
2:21 PM	1105	1119	254	33	0.250	
2:22 PM	1121	1136	252	32	0.251	
2:23 PM	1128	1143	252	32	0.253	
2:24 PM	1135	1150	252	32	0.255	
2:25 PM	1148	1163	252	32	0.258	
2:26 PM	1157	1173	252	32	0.260	
2:27 PM	1155	1170	252	32	0.259	

COORS BREWING COMPANY
CAE Project No: 6265-4
Fill On Vent
Runs 1, 2, 3 and 4
August 19, 1992
9:58 AM

Time sec	ppm	ppm, corrected	flow(fpm)	flow(dscfm)	lb/hr(propane)	
3:22 PM	1553	1576	172	22	0.238	
3:23 PM	1535	1558	172	22	0.235	
3:24 PM	1619	1644	172	22	0.248	
3:25 PM	1660	1685	172	22	0.255	
3:26 PM	1674	1700	172	22	0.257	
3:27 PM	1681	1707	177	23	0.265	
3:28 PM	1686	1712	177	23	0.266	
3:29 PM	1691	1717	177	23	0.267	
3:30 PM	1698	1724	177	23	0.268	
3:31 PM	1705	1731	177	23	0.269	
3:32 PM	1706	1732	217	28	0.330	
3:33 PM	1706	1732	217	28	0.330	
3:34 PM	1707	1733	217	28	0.330	
3:35 PM	1705	1731	217	28	0.330	
3:36 PM	1713	1739	217	28	0.332	Stop Run 4

	ppm	ppm, dry corrected	ppm, dry corrected, average	avg flow(dscfm)	avg lb/hr (as propane)
Run 1 (75 minutes)	6582	6201	83	25	0.014
Run 2 (67 minutes)	7658	7400	110	34	0.026
Run 3 (69 minutes)	38734	38547	565	34	0.132
Run 4 (81 minutes)	111731	113339	1372	30	0.282
Missed 126 minutes at beginning of batch by inference*	11088	10419	83	26	0.015
Total (418 minutes)	175793	175907	421	29	0.083
lb/fill, as propane					0.652

Total time to fill tank was 466 minutes.

* Based on information obtained during a 2 hour test fill during another run.

PROCESS DATA

G

Coors Brewing Company
Golden, Colorado

STORAGE BEER CONTROLLER SHIFT REPORT

CI—393-1-C

AGING DEPARTMENT

CONTROLLER	SHIFT	BEGINNING OF SHIFT	END OF SHIFT	DATE
Jerry B	Days	0655	1855	8-19-92

BEER RECEIVED FROM FERMENTING START OF SHIFT

BRAND	START FILL TIME	TANKS	VOLUME	SPEED	MIDNIGHT READING	LINE	TIME
C		14F 10/15	1380	800		16-1	0730
L		17A 1/3 22/24	1460	800		17-1	0725
Y		18C 7/9 16/18	770	600		16-2	0735

BEER RECEIVED FROM FERMENTING END OF SHIFT

BRAND	START FILL TIME	TANKS	VOLUME	SPEED	MIDNIGHT READING	LINE	TIME

BEER SENT TO BLENDING START OF SHIFT

BRAND	START DROP TIME	TANKS	VOLUME	SPEED	MIDNIGHT READING	LINE	TIME
C		16F 9/6 19/21	430	DN		us#1	0730
L		19A 7/9 16/18	290	800		S.	0737
Y		18E 10/15	910	300		Sp	0730

BEER SENT TO BLENDING END OF SHIFT

BRAND	START DROP TIME	TANKS	VOLUME	SPEED	MIDNIGHT READING	LINE	TIME

TANKS FILLED

TANKS	TIME	BALLING	TEMPERATURE	FILL LEVEL
17A 1/3 22/24	0750	.6	11.0	1565-1565
18C 7/9 16/18	1145	.8	11.0	1560-1560

TANKS FILLED

TANKS	TIME	BALLING	TEMPERATURE	FILL LEVEL
14F 10/15	0835	3.2	10.0	1570-1565
17F 4/6 19/21	1540	.8	11.0	1570-1570
19A 7/9 16/18 0945 3C 6/3 16F 4/6 19/21 1555 3C 3/3				

REMARKS 17F 4/6 19/21 STARTED FILLING 0750 FINISHED AT 1540. TOTAL VOLUME WAS 9420 BBLS.

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CAE Departments

CAE Analytical
CAE Combustion
CAE Diagnostic
CAE Europe
CAE Express
CAE Instrument Rental
CAE Seminars
CAE Source Testing
CAE VOC Services

CAE Express

Our products department specializes in the design and manufacture of the most technologically advanced environmental sampling equipment, related parts and supplies. The input from our experienced field testers enables us to refine and make our products the most reliable, durable and user friendly. CAE also will assemble custom equipment to meet your needs. Our technicians will consult with you on the best and most efficient design for your specific use. We also offer convenient overnight shipping of our large inventory of standard equipment and supplies.

CAE Instrument Rental

CAE Instrument Rental offers a diversified line of gas monitors of gas monitors for both source and ambient air applications including O_2, CO_2, CO, NOx, SO_2 and THC. A variety of industrial hygiene and personal survey tools are available as well as data acquisition systems, calibration materials and sampling supplies.

Our equipment includes:

- ❑ Source gas monitors
- ❑ Ambient air monitors
- ❑ Source gas sampling equipment
- ❑ Industrial hygiene tools
- ❑ Field screening equipment
- ❑ Calibration materials

CAE Source Testing

CAE engineers are professional experts in air pollution emission measurements. They possess an in-depth understanding of both the emission sources as well as the control equipment being evaluated. Our engineers select the significant variables to be measured during a test program in order to provide the most meaningful data. CAE can help clients develop a plan for evaluating and controlling emissions to meet legislative standards. CAE utilizes the most appropriate EPA, ASME or NIOSH method depending upon situational requirements.

These services include:

- ❑ Compliance planning and status determination
- ❑ Pollution control device performance evaluation
- ❑ Emission inventories (O_2, CO, CO_2, SO_2, SO_3, NOx, TRS, multi-metals and particulates)
- ❑ Visual emissions monitoring
- ❑ Velocity and temperature traversing
- ❑ CEMS PST audits
- ❑ In situ resistivity and particle sizing measurements

CAE VOC Services

Because of the complexity of characterizing volatile organic compounds, CAE has developed this speciality testing department. CAE VOC Services engineers have the necessary skills to develop testing plans for evaluating and controlling organic emissions to meet legislative, process control, or industrial hygiene requirements.

VOC Services include:

- ❑ Portable gas chromatography
- ❑ Compliance planning & status determination
- ❑ Total hydrocarbon determination
- ❑ Capture and destruction efficiency determination
- ❑ Portable gas chromatography
- ❑ Identification & characterization of VOCs
- ❑ Analysis of unstable compounds
- ❑ Total reduced sulfur (TRS) characterization & EPA Methods 15 & 16
- ❑ Ambient emissions testing for OSHA & NIOSH compliance
- ❑ Fugitive emissions determination

CAE Analytical Services

CAE's in-house laboratory provides technically accurate and timely chemical analysis. We can perform analyses for a variety of organics and inorganics including NOx, SO/SO_2, H_2S, VOCs and chlorides. Our comprehensive quality control program guarantees the accuracy of any analysis. CAE Analytical prides itself on providing clients with the most modern, accurate and cost-effective sample preparation and analysis available. We offer a full range of qualitative and quantitative analytical services including:

- ❑ Air quality
- ❑ Water quality
- ❑ Toxic and hazardous waste identification
- ❑ Occupational safety and health

The staff uses a variety of instrumental and wet chemical methods including:

- ❑ Chemical spectroscopy
- ❑ Gas chromatography of air, liquids, soil and water samples
- ❑ Atomic absorption spectroscopy of water soluble analytes
- ❑ EPA Method 25 analysis

CAE Combustion

CAE has developed this specialty testing department due to the regulatory and operational complexity of incinerators. This group provides a wide variety of engineering consulting services for municipal incinerators, hospital waste incinerators and RCRA/TSCA incinerators. CAE is highly experienced in all phases of compliance testing for combustion systems from development of the sampling and analytical matrix to performance of all data reduction, validation and reporting.

The combustion group provides engineering consulting services for:

- ❑ Trial burn assistance
- ❑ DRE determination
- ❑ Municipal refuse incinerator testing
- ❑ Boiler efficiency studies
- ❑ HVT sampling
- ❑ Continuous emission monitoring consulting
- ❑ Design calculations
- ❑ Air pollution control permits
- ❑ Energy recovery design
- ❑ Multi-metals sampling
- ❑ Volatile/semi-volatile organics
- ❑ RCRA/TSCA incinerator testing
- ❑ Air toxic assessments
- ❑ Hospital waste incineration

CAE Diagnostic Services

CAE Diagnostic Services offers performance diagnosis and troubleshooting services for electrostatic precipitators and flow control of directing devices. This group provides computer modeling, laboratory resistivity measurements, physical flow modeling, field testing and particulate characterization. Computer modeling applications include resistivity, precipitator performance and gas flow. Three-dimensional scale models of pollution control equipment, system ductwork or stacks can determine the gas flow distribution, pressure drop and proper vaning for overall system efficiency.

Furthermore, the Diagnostic department performs the following:

- ❑ Inspection and evaluation of precipitator characteristics
- ❑ Laboratory resistivity studies
- ❑ 3-D gas flow modeling
- ❑ Particulate characterization: resistivity, size, density, chemistry
- ❑ Field flow measurement
- ❑ ESP evaluation and consulting
- ❑ Selection of coals
- ❑ Fluid dynamics