AP42 Section:	11.7
Background Chapter:	4
Reference:	12
Title:	*Volatile Organic Compound Emission Testing, Golden Astro Furnace Exhaust, Coors Electronic Package Company, Chattanooga, TN, August 26, 1993*, Analytical Testing Consultants, Inc., Kannapolis, NC and Roswell, GA, September 1993.

AP-42 Section 11.7
Reference
Report Sect. 4
Reference 12

COPY

VOLATILE ORGANIC COMPOUND EMISSION TESTING GOLDEN ASTRO FURNACE EXHAUST

COORS ELECTRONIC PACKAGE COMPANY

CHATTANOOGA, TENNESSEE
AUGUST 26, 1993
REPORT # 5392

Temporary Operating Permit #
0090-30500899-80T

ANALYTICAL TESTING CONSULTANTS, INC.

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INTRODUCTION

This report presents the results of volatile organic compound (VOC) emissions testing performed on the Golden Astro Furnace exhaust in operation at Coors Electronic Package Company. Testing was conducted on August 26, 1993. These results are presented in the following RESULTS SUMMARY and RESULTS, CONCLUSIONS, AND COMMENTS.

The purpose of this test was to determine emission rates and compare those to permitted levels as established by the Chattanooga–Hamilton County Air Pollution Control Bureau and contained in the applicable provisions of the Chattanooga Air Pollution Control Ordinance.

The test was conducted by ANALYTICAL TESTING CONSULTANTS, INC. Kannapolis, N. C. and Atlanta, Georgia. Members of the test team were Richard Westbrook, team leader, John Welch, and James Whitlock.

SOURCE DESCRIPTION

A Golden Astro ceramic processing furnace (Model #CPF-2048-MS, serial #F860806) is utilized for curing of ceramic plates for computer chips. The furnace was originally scheduled to be charged with 48 pounds of product. However, the furnace would not hold that much. A full charge of 36 pounds was agreed upon by Hal Roach, representative of Chattanooga-Hamilton County, and Brent Floyd, representative of Coors Electronic Package Company. A normal charge for the furnace is approximately 12 pounds.

RESULTS SUMMARY

SYSTEM COORS ELECTRONIC PACKAGE CORPORATION
CPF EXHAUST

TEST DATE AUGUST 26, 1993

PARAMETER	RUN #1	RUN #2	RUN #3	AVERAGE
Qs, FLOW, ACFM	532.8	507.1	460.7	500.2
Qs dry, FLOW SCFM	502.4	465.6	417.2	461.7
MOISTURE, %M	2.05	2.41	2.83	2.43
Vm std, CUBIC FT.	33.29	32.86	32.68	
VOC, PPM CARBON	3.16	3.02	26.62	10.93
VOC, LBS/HR AS CARBON	0.0031	0.0029	0.0228	0.0096
ALLOWABLE, LBS/HR				1.54

RESULTS, CONCLUSIONS AND COMMENTS

A summary of some pertinent results appear in the preceding RESULTS SUMMARY. For additional information, please consult the CALCULATIONS and DATA SHEETS sections of this report.

Results showed the VOC emissions to be much less than the allowable of 1.54 lbs/hr. Near the end of the third run, a spike occured. Although the episode was continuing at the end of testing, emissions had already peaked. It was agreed that testing would remain as planned and was limited to the three one hour runs. The highest emission during the testing was 0.07 lbs/hr, so it is highly doubtful that any extension in testing would have created any excursions above the allowable.

SAMPLING AND ANALYTICAL PROCEDURES

The following test methods were utilized and approved prior to testing as part of the pre–test protocol and agreement. One variation was the use of EPA method 1 instead of 1a. The reason for stipulating EPA method 1a originally was based upon the assumption that the exhaust diameter was eight inches. Once on site, it was measured and found to be twelve inches. Therefore, EPA method 1 is applicable.

TEST METHODS

I. METHODS AND APPLICABILITY

A. Method 1 – Sample and Velocity Traverses for Stationary Sources

PRINCIPLE AND APPLICABILITY

a. Principle. To aid in the representative measurement ofpollutant emissions and/or total volumetric flow rate from a stationary source, a measurement site where the effluent stream is flowing in a known direction is selected, and the cross–section of the stack is divided into a number of equal areas. A traverse point is then located within each of these equal areas.

b. Applicability. This method is applicable to flowing gas streams in ducts, stacks, and flues. The method cannot be used when: (1) flow is cyclonic or swirling (see Section 2.4), (2) a stack is smaller than about 0.30 meter (12 in.) in diameter, or 0.071 m2 (113 in.2) in cross–sectional area, or (3) the measurement site is less than two stack or duct diameters downstream or less than a half diameter upstream from a flow disturbance.

The requirements of this method must be considered before construction of a new facility from which emissions will be measured; failure to do so may require subsequent alterations to the stack or deviation from the standard procedure. Cases involving variants are subject to approval by the Administrator, U.S. Environmental Protection Agency.

B. Method 2 – Determination of Stack Gas Velocity and Volumetric Flow Rate (Type S Pitot Tube)

PRINCIPLE AND APPLICABILITY

a. Principle. The average gas velocity in a stack is determined from the gas density and from measurement of the average velocity head with a Type S (Stausscheibe or reverse type) pitot tube.

b. Applicability. This method is applicable for measurement of the average velocity of a gas stream and for quantifying gas flow.

C. Method 4 – Determination of Moisture Content in Stack Gases

PRINCIPLE AND APPLICABILITY

a. Principle. A gas sample is extracted at a constant rate from the source; moisture is removed from the sample stream and determined either volumetrically or gravimetrically.

b. Applicability. This method is applicable for determining the moisture content of stack gas.

b.1 Two procedures are given. The first is a reference method, for accurate determinations of moisture content (such as are needed to calculate emission data). The second is an approximation method, which provides estimates of percent moisture to aid in setting isokinetic sampling rates prior to a pollutant emission measurement run.

b.2 The reference method is often conducted simultaneously with a pollutant emission measurement run; when it is, calculation of percent isokinetic, pollutant emission rate, etc., for the run shall be based upon the results of the reference method or its equivalent. The reference method was employed for this source.

D. METHOD 25A– Determination of Total Gaseous Organic Concentration Using a Flame Ionization Detector.

APPLICABILITY AND PRINCIPLE

a. Applicability. This method applies to the measurement of total gaseous organic concentration of vapors consisting primarily of alkanes, alkenes, and/or arenes (aromatic hydrocarbons). The concentration is expressed in terms of propane (or other appropriate organic calibration gas) or in terms of carbon.

b. Principle. A gas sample is extracted from the source through a heated sample line, if necessary, and glass fiber filter to a flame ionization analyzer (FIA). Results are reported as volume concentration equivalents of the calibration gas or as carbon equivalents.

Heated sampling line was connected to the stainless steel sampling probe and the analyzer. The analyzer was calibrated prior to testing with EPA protocol 1 gases: 16.5 ppm, 30.6 ppm, 64.1 ppm, and 86.6 ppm, all propane mixtures in air.

II. APPLICATION OF METHODS TO COORS ELECTRONIC PACKAGE CO.

The test team from Analytical Testing Consultants consisted of Richard Westbrook, test team leader, John Welch, Sr. Technician, and James Whitlock, technician. After setup and preliminary data collection (upstreams, downstreams, cyclonic flow checks), the heated Ratfish (Model #RSCA 55, serial # 414291) flame ionization detector was calibrated with the above specified gases. Preliminary calibrations were acceptable and monitoring began. The protocol sheets for these gases are included in the calibration data section of this report.

Flows and moisture runs were conducted concurrently with the collection of CEM data. The moisture runs were one hour in length and indicated a stack moisture of approximately 2%. The flow data collected at the beginning of each run was utilized to calculate emissions. Flow variance among the three runs was within 14%.

REFERENCES

1. CODE OF FEDERAL REGULATIONS, Title 40, Part 60, Appendix A, July 1, 1992.

CALCULATIONS

Flow Rate Calculation
Moisture Calculation
VOC Calculations
Nomenclature
Calculation Formulae

FLOW RATE AND MOISTURE CALCULATION

DATA/CALCULATION	RUN #1	RUN #2	RUN #3	AVERAGE
DATE	8/26/93	8/26/93	8/26/93	
AVG DH (IN H2O)	1.00	1.00	1.00	
P ATM (IN HG)	29.74	29.74	29.74	
PM (IN HG)	29.81	29.81	29.81	
PS (GUAGE)	0	0	0	
PS (IN HG)	29.740	29.740	29.740	
tM (DEG F)	87.83	105.17	110.17	
TM (DEG R)	547.8333	565.1667	570.1667	
VM (FT3)	34.66	35.3	35.42	
VM STD (FT3)	33.28632	32.86124	32.68379	
VLQ (ML)	14.8	17.2	20.2	
VV STD (FT3)	0.697341	0.810424	0.951776	
V STD (FT3)	33.98366	33.67166	33.63557	
%M	2.052	2.407	2.830	2.430
MD	0.979	0.976	0.972	
MWD	28.840	28.840	28.840	
M	28.618	28.579	28.533	
tS (DEG F)	86.50	99.17	104.50	96.72
TS (DEG R)	546.5	559.1667	564.5	556.7222
SUM SQRT DP	2.358	2.217	2.003	
N DP	12	12	12	
AVG SQRT DP	0.197	0.185	0.167	
CP	0.84	0.84	0.84	
VS (FT/SEC)	11.307	10.761	9.775	10.614
DS (IN)	12	12	12	
AS (FT2)	0.7854	0.7854	0.7854	
QS, ACFM	532.8113	507.0982	460.6504	500.1867
Q STD (FT3/MIN)	512.9429	477.1298	429.332	473.1349
Q STD DRY, SCFM	502.4174	465.646	417.1833	461.7489
%CO2	0.00	0.00	0.00	0.00
%O2	21.00	21.00	21.00	21.00
%CO	0.00	0.00	0.00	0.00
%N2	79.00	79.00	79.00	79.00

MOISTURE DATA

RUN #1

	1ST IMP.	2ND IMP.	3RD IMP.	4TH IMP.	TOTALS
BEGINNING	100	100	0	300	
ENDING	104	100	0	310.8	
NET	4	0	0	10.8	14.8

RUN #2

	1ST IMP.	2ND IMP.	3RD IMP.	4TH IMP.	
BEGINNING	100	100	0	300	
ENDING	100	100	2	315.2	
NET	0	0	2	15.2	17.2

RUN #3

	1ST IMP.	2ND IMP.	3RD IMP.	4TH IMP.	
BEGINNING	100	100	0	300	
ENDING	100	102	1	317.2	
NET	0	2	1	17.2	20.2

CALCULATIONS

DATE COORS ELECTRONIC PACKAGE CORPORATION

SOURCE GOLDEN ASTRO FURNACE

RUN # ONE

POINT #	Tm	Ts	DP	SQRT DP	dH	% O2	% CO2
A1	80	75	0.025	0.158114	1		
A2	80	75	0.03	0.173205			
A3	82	78	0.03	0.173205			
A4	84	74	0.03	0.173205			
A5	86	83	0.03	0.173205			
A6	88	92	0.03	0.173205			
A7				0			
A8				0			
A9				0			
A10				0			
A11				0			
A12				0			
B1	91	91	0.025	0.158114			
B2	93	93	0.025	0.158114			
B3	93	93	0.03	0.173205			
B4	91	93	0.03	0.173205			
B5	93	95	0.03	0.173205			
B6	93	96	0.025	0.158114			
B7				0			
B8				0			
B9				0			
B10				0			
B11				0			
B12				0			
	87.83333	86.5		2.358096	1	21	0
				% N2 (BY DIFFERENCE)			79

CALCULATIONS

DATE COORS ELECTRONIC PACKAGE CORPORATION

SOURCE GOLDEN ASTRO FURNACE

RUN # TWO

POINT #	Tm	Ts	DP	SQRT DP	dH	% O2	% CO2
A1	102	91	0.03	0.173205	1	21	0
A2	102	101	0.035	0.187083			
A3	101	101	0.035	0.187083			
A4	102	96	0.035	0.187083			
A5	103	100	0.035	0.187083			
A6	104	101	0.035	0.187083			
A7				0			
A8				0			
A9				0			
A10				0			
A11				0			
A12				0			
B1	106	97	0.03	0.173205			
B2	107	98	0.035	0.187083			
B3	107	100	0.035	0.187083			
B4	108	102	0.035	0.187083			
B5	110	102	0.035	0.187083			
B6	110	101	0.035	0.187083			
B7				0			
B8				0			
B9				0			
B10				0			
B11				0			
B12				0			
	105.1667	99.16667		2.217239	1	21	0
				% N2 (BY DIFFERENCE)			79

CALCULATIONS

DATE COORS ELECTRONIC PACKAGING CORPORATION

SOURCE GOLDEN ASTRO FURNACE

RUN # THREE

POINT #	Tm	Ts	DP	SQRT DP	dH	% O2	% CO2
A1	108	90	0.025	0.158114	1	21	0
A2	109	81	0.03	0.173205			
A3	110	79	0.03	0.173205			
A4	110	81	0.03	0.173205			
A5	110	81	0.03	0.173205			
A6	111	83	0.025	0.158114			
A7				0			
A8				0			
A9				0			
A10				0			
A11				0			
A12				0			
B1	111	140	0.025	0.158114			
B2	111	135	0.025	0.158114			
B3	110	124	0.03	0.173205			
B4	110	125	0.03	0.173205			
B5	111	122	0.03	0.173205			
B6	111	113	0.025	0.158114			
B7				0			
B8				0			
B9				0			
B10				0			
B11				0			
B12				0			
	110.1667	104.5		2.003005	1	21	0
				% N2 (BY DIFFERENCE)			79

TOTAL VOC EMISSIONS MEASUREMENT
INSTRUMENTAL ANALYZER METHOD

COORS ELECTRONIC PACKAGING CORPORATION
CHATTANOOGA, TENNESSEE
GOLDEN ASTRO FURNACE EXHAUST

DATE 8/26/93
K= 1.08

RUN #1

TIME	CHART	PPM AS C3H8	PPM C	MG/M3 AS C	ACFM	LBS/HR AS C
900	0.9	0.972	2.92	1.45	532.8	0.0029
905	0.9	0.972	2.92	1.45	532.8	0.0029
910	0.9	0.972	2.92	1.45	532.8	0.0029
915	1	1.08	3.24	1.61	532.8	0.0032
920	1	1.08	3.24	1.61	532.8	0.0032
925	1	1.08	3.24	1.61	532.8	0.0032
930	1	1.08	3.24	1.61	532.8	0.0032
935	1	1.08	3.24	1.61	532.8	0.0032
940	1	1.08	3.24	1.61	532.8	0.0032
945	1	1.08	3.24	1.61	532.8	0.0032
950	1	1.08	3.24	1.61	532.8	0.0032
955	1	1.08	3.24	1.61	532.8	0.0032
AVERAGES			3.16	1.57		0.0031

RUN #2

TIME	CHART	PPM AS C3H8	PPM C	MG/M3 AS C	ACFM	LBS/HR AS C
1013	0.8	0.864	2.59	1.29	507.1	0.0024
1018	0.8	0.864	2.59	1.29	507.1	0.0024
1023	0.8	0.864	2.59	1.29	507.1	0.0024
1028	0.9	0.972	2.92	1.45	507.1	0.0028
1033	0.9	0.972	2.92	1.45	507.1	0.0028
1038	0.9	0.972	2.92	1.45	507.1	0.0028
1043	0.9	0.972	2.92	1.45	507.1	0.0028
1048	1	1.08	3.24	1.61	507.1	0.0031
1053	1	1.08	3.24	1.61	507.1	0.0031
1058	1	1.08	3.24	1.61	507.1	0.0031
1103	1.1	1.188	3.56	1.77	507.1	0.0034
1108	1.1	1.188	3.56	1.77	507.1	0.0034
AVERAGES			3.02	1.50		0.0029

TOTAL VOC EMISSIONS MEASUREMENT
INSTRUMENTAL ANALYZER METHOD

COORS ELECTRONIC PACKAGING CORPORATION
CHATTANOOGA, TENNESSEE
GOLDEN ASTRO FURNACE EXHAUST

DATE 8/26/93
K= 1.08

RUN #3

TIME	CHART	PPM AS C3H8	PPM C	MG/M3 AS C	ACFM	LBS/HR AS C
1125	1	1.08	3.24	1.61	460.7	0.0028
1130	1	1.08	3.24	1.61	460.7	0.0028
1135	1.1	1.188	3.56	1.77	460.7	0.0031
1140	1.3	1.404	4.21	2.09	460.7	0.0036
1145	1.8	1.944	5.83	2.90	460.7	0.0050
1150	2.1	2.268	6.80	3.38	460.7	0.0058
1155	26	28.08	84.24	41.85	460.7	0.0723
1200	22	23.76	71.28	35.41	460.7	0.0612
1205	14.5	15.66	46.98	23.34	460.7	0.0403
1210	10.8	11.664	34.99	17.38	460.7	0.0300
1215	9.2	9.936	29.81	14.81	460.7	0.0256
1220	7.8	8.424	25.27	12.56	460.7	0.0217
AVERAGES			26.62	13.23		0.0228

NOMENCLATURE

AN	(square inches), Cross sectional area of nozzle
AS	(square feet), Cross sectional area of stack
CP	Pitot tube calibration coefficient
% EA	Percent Excess Air
F	(scfd/10 6 BTU), F factor
DH	(inches of water) Average orifice meter reading
HI	(million BTU/hr), Heat Input Rate
% I	Percent Isokineticity
M	(lb/lb mole), Molecular Weight of wet gas
% M	Percent Moisture
MD	Mole fraction of dry gas
MWD	(lb/lb mole) molecular weight of dry gas
N DP	Number of sample points
P ATM	(in Hg), Local atmospheric pressure
PM	(in Hg), Absolute pressure in dry gas meter
PS	(in Hg), Absolute stack pressure
PS GAUGE	(inches of water), Measured static stack pressure gauge
P STD	(29.92 in Hg), Standard pressure

PMRA	(lb/hr), Pollutant mass rate based on ratio of areas
PMR AVG.	(lb/hr), Average pollutant mass rate
PMRC	(lb/hr), Pollutant mass rate based on concentration
PMRU	(lb/million BTU), Specific emission rate
DP	(inches of water), Velocity pressure
QS	(cubic feet/min.), Actual stack volume flow rate
Q STD	(cubic feet/min.), Stack volume flow rate at standard conditions
TM	(degrees R), Average dry gas meter temperature
TS	(degrees R), Average stack temperature
T STD	(528 degrees R), Standard temperature
VLQ	(ml), Liquid volume
VM	(cubic feet), Sample volume measured by dry gas meter
VM STD	(cubic feet), Sample volume at standard conditions
VS	(ft/sec), stack velocity
VV STD	(cubic feet), Volume of water vapor collected, corrected to standard conditions
WT	(gm), Total weight of particulate collected
TIME	(MIN.)Duration of test

CALCULATION FORMULAE

1. Absolute pressure in dry gas meter

$$\mathrm{PM = P\ ATM + DH/13.6}$$

2. Absolute Stack Pressure

$$\mathrm{PS = P\ ATM + PS\ gauge/13.6}$$

3. Sample volume at standard conditions

$$\mathrm{VM\ STD = (VM)\ (T\ STD/TM)\ (PM/P\ STD)}$$

4. Volume of water collected, corrected to standard conditions

$$\mathrm{VV\ STD = (.00267)\ (VLQ)\ (T\ STD/P\ STD)}$$

5. Total sample volume at standard conditions

$$\mathrm{V\ STD = VM\ STD + VV\ STD}$$

6. Percent moisture in stack gas

$$\mathrm{\%M = (100)\ (VV\ STD)/V\ STD}$$

7. Mole Fraction of dry gas

$$\mathrm{MD = (100-\%M)/100}$$

8. Molecular weight of the wet gas

$$\mathrm{M = (MWD)\ (MD) + 18(1-MD)}$$

9. Stack velocity

$$\mathrm{VS = (85.48)(CP)((TS/(PS)(M))^{1/2}((Sum\ DP)^{1/2}\ N\ DP))}$$

10. Stack volume flow rate

$$\text{QS} = (60)(\text{VS})(\text{AS})$$

11. Stack volume flow rate, standard conditions including moisture

$$\text{Q STD} = (\text{T STD}/\text{P STD})(\text{PS}/\text{TS})(\text{QS})$$

12. Stack volume flow rate standard conditions dry

$$\text{Q STD DRY} = (\text{Q STD})(1-\%\text{M})$$

13. Pollutant mass rate, concentration basis

$$\text{PMRC} = (.1323)(\text{WT})(\text{Q STD})/\text{V STD}$$

14. Pollutant mass rate ratio of areas basis

$$\text{PMRA} = (.1323)(\text{WT})(\text{AS})(144)/(\text{Time})(\text{AN})$$

15. Percent Isokineticity

$$\%\text{I} = (100)\ (\text{PMRA})/\text{PMRC}$$

16. Average pollutant mass rate

$$\text{PMR AVG} = (\text{PMRA} + \text{PMRC})/2$$

17. % EXCESS AIR

$$\%\text{EA} = \frac{(100)\ (\%\text{oxygen} - (.5)(\%\text{carbon monoxide})}{(.264)(\%\text{nitrogen}) - \%\text{oxygen} + (.5)\ (\%\text{carbon monoxide})}$$

18. Heat input rate

$$\text{HI} = ((.6)\ (\text{Q STD DRY})/\text{F})((20.9 - \%\text{oxygen})/20.9)$$

19. Specific emission rate

$$\text{PMRU} = \text{PMR AVG}/\text{HI}$$

DATA SHEETS

Moisture Run Data Sheets
Impinger Data Sheet
Flow Traverse Data Sheets
Orsat Data
System Calibration Error Data
Source Survey
Equal Area Determinations
Process Temperature Tracking
System Sketch
Calibration Information
Strip Chart

ANALYTICAL TESTING CONSULTANTS, INC.

KANNAPOLIS, N.C. ATLANTA, GEORGIA

MODULE SAMPLING DATA SHEET

CLIENT Coors Electronic

LOCATION Chattanooga, TN

TEST TEAM JW, RW, JW

DATE 8/26/93

SOURCE Furnace

RUN # 1

~~~~~~

Pbar 29.74

Ps 0

Method 4

MODULE A.T.C # 1

FILTER —

NOZZLE —

PITOT —

LEAK RATES

start .017 @ 15"

end .004 @ 5"

PITOT:

start
A — B —

end
A — B —

SETUP

N/A

g

Tm

% H_2O

NOZZLE

C

T_s

THEORETICAL PITOT

START TIME 9:00 AM FINISH TIME 10:00 AM

COMMENTS:

TIME	PT.	LINE VAC	T_M F°	T_S F°	V_P H_2O	P_M H_2O	V_M FT³	REMARKS
00	—	1.0	80	75	—	1.0	093.51	
05	—	1.0	80	75	—	1.0	096.23	
10	—	1.0	82	78	—	1.0	099.10	
15	—	1.0	84	74	—	1.0	101.98	
20	—	1.0	86	83	—	1.0	104.86	
25	—	1.0	88	92	—	1.0	107.77	
30	—	1.0	91	91	—	1.0	110.66	
35	—	1.0	93	93	—	1.0	113.58	
40	—	1.0	93	93	—	1.0	116.48	
45	—	1.0	91	93	—	1.0	119.32	
50	—	1.0	93	95	—	1.0	122.33	
55	—	1.0	93	96	—	1.0	—	
60 SHOT DOWN END RUN ——							128.17	
TOT/ AVG			87.8	86.5	2.3581	1	34.66	

FORM 16
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ANALYTICAL TESTING CONSULTANTS, INC.

KANNAPOLIS, N.C. ATLANTA, GEORGIA

MODULE SAMPLING DATA SHEET

CLIENT Coors Electronic
DATE 8/26/93
LOCATION CHATTANOOGA, TN
SOURCE FURNACE
TEST TEAM RW, JW, JW
RUN # 2

~~~~~~

Pbar 29.74
Ps 0
Method 4
MODULE A.T.C #1
FILTER —
NOZZLE —
PITOT —

LEAK RATES
start .012 @ 8"
end .008 @ 5"
PITOT:
start
A — B —
end
A — B —

SETUP
g
Tm
% H_2O
NOZZLE
C
T_s
THEORETICAL PITOT
N/A

START TIME 10:12AM
FINISH TIME 11:12AM
COMMENTS:

TIME	PT.	LINE VAC	T_M F°	T_S F°	V_P H_2O	P_M H_2O	V_M FT^3	REMARKS
00	-	1.0	102	91	-	1.0	128.41	
05	-	1.0	102	101	-	1.0	131.34	
10	-	1.0	101	101	-	1.0	134.28	
15	-	1.0	102	96	-	1.0	137.21	
20	-	1.0	103	100	-	1.0	140.14	
25	-	1.0	104	101	-	1.0	143.09	
30	-	1.0	106	97	-	1.0	146.02	
35	-	1.0	107	98	-	1.0	148.97	
40	-	1.0	107	100	-	1.0	151.90	
45	-	1.0	108	102	-	1.0	154.85	
50	-	1.0	110	102	-	1.0	157.90	
55	-	1.0	110	101	-	1.0	160.75	
60	SHUT	DOWN	END	RUN	—	—	163.71	
TOT/ AVG			105.2	99.2	2.2172	1	35.3	
~~~~~~

ANALYTICAL TESTING CONSULTANTS, INC.

KANNAPOLIS, N.C. ATLANTA, GEORGIA

MODULE SAMPLING DATA SHEET

CLIENT COORS ELECTRONIC

DATE 8/26/93

LOCATION CHATTANOOGA, TENN

SOURCE FURNALE

TEST TEAM RW, JW, JW

RUN # 3

Pbar 29.74

Ps 0

Method 4

MODULE A.T.C #1

FILTER -

NOZZLE -

PITOT -

LEAK RATES

start .010 @ 15"

end .004 @ 5"

PITOT:

start
A - B -

end
A - B -

SETUP N/A

g

Tm

% H_2O

NOZZLE

C

T_s

THEORETICAL PITOT

START TIME 11:25 AM

FINISH TIME 12:25 pm

COMMENTS:

TIME	PT.	LINE VAC	T_M F°	T_S F°	V_P H_2O	P_M H_2O	V_M FT³	REMARKS
00	-	1.0	108	90	-	1.0	164.06	
05	-	1.0	109	81	-	1.0	167.02	
10	-	1.0	110	79	-	1.0	169.97	
15	-	1.0	110	81	-	1.0	172.93	
20	-	1.0	110	81	-	1.0	175.88	
25	-	1.0	111	83	-	1.0	178.84	
30	-	1.0	111	140	-	1.0	181.79	
35	-	1.0	111	135	-	1.0	184.75	
40	-	1.0	110	124	-	1.0	187.70	
45	-	1.0	110	125	-	1.0	190.64	
50	-	1.0	111	122	-	1.0	193.59	
55	-	1.0	111	113	-	1.0	196.54	
60	SHUT	DOWN	END	RUN	—	—	199.48	
TOT/ AVG			110.2	104.5	2.003	1	35.42	

FORM 16

ANALYTICAL TESTING CONSULTANTS, INC.

IMPINGER DATA SHEET

JOB COORS ELECTRONIC LOCATION CHATTANOOGA, TN UNIT FURNACE

80% IPA - ΔWT = 83.4 G
3% H_2O_2 - " = 94.8 G

RUN #		DATE	CYCLONE	CONTENTS OF IMPINGERS 1	2	3	4 (cc)	TOTAL CONDENSATE V_{lc} EPA	(OR V_w) WF-5	LOCATION & REMARKS
1	START	8/26/93		100ML	100ML	DRY	300g SiO2			
	END	8/27/93		104mL	100mL	0	310.8			
	Δ			+4	+0	0	+10.8	14.8	ml	
2	START	8/26/93		100ML	100ML	DRY	300g SiO2			
	END	8/27/93		100 mL	100mL	2mL	315.2			
	Δ			0	0	+2	+15.2	17.2	ml	
3	START	8/26/93		100mL	100mL	DRY	300g SiO2			
	END	8/27/93		100mL	102mL	1mL	317.2			
	Δ			0	+2	+1	+17.2	20.2	ml	
	START									
	END									
	Δ								ml	
	START									
	END									
	Δ								ml	

Data by ________

Approved by ________

ANALYTICAL TESTING CONSULTANTS, INC. Form # 15

TRAVERSE DATA & FLOW COMPUTATION

Customer COORS ELECTRONIC Test No. BEFORE #1 Test Team RW, JW

Location CHATTANOOGA, TENN Date 8/26/93

Unit FURNACE Barometer 29.74 in. Hg.

Dry Bulb ______ F.

Wet Bulb ______ F.

Time [illegible]8 . [illegible] 50 [✓ AM] PM

SP 0 in WG / in Hg

Pitot Type SPECIAL

Fs for Pitot 0.84

SMPL POINT	Vp inches	$\sqrt{V_p}$	Temp. ts F.	ΔP 0°REF.	α#
A1	0.025		81		91°
2	0.03		81		90°
3	0.03		81		
4	0.03		81		
5	0.03		81		88
6	0.03		81		
B1	0.025		81		91
2	0.025		81		
3	0.03		81		89
4	0.03		81		
5	0.03		81		92
6	~~0.25~~		81		
	0.025 JW				
AVERAGE					

Sketch (if applicable)

1. t_s (Avg.) = ______ + 460=

______ T_s (Rankin)

2. Duct Area = A = ______ =

______ Sq.Ft.

3. P_s= Barometer ± SP =

______ in. Hg.

4. G.D.= $\rho_s(\frac{530}{T_s})(\frac{P_s}{29.92})$=

______ lbs/cu.

5. K=Constant= $\frac{1096.5}{\sqrt{G.D.}}$= ______

6. V=Velocity=K F_s $\sqrt{V_p}$ Avg.

______ ft/mi

7. VOLUME average =AxV =

______ ACF

8. SCFM = Volume $(\frac{530}{T_s})(\frac{P_s}{29.92})$

______ SCFM

ρ_s = Spec. Wt. of Air = .075 lbs/ft^3

#α= angle in degree of to yield 0ΔP

ANALYTICAL TESTING CONSULTANTS, INC. Form # 15

TRAVERSE DATA & FLOW COMPUTATION

Customer Coors Electronic

Test No. Before #2

Test Team RW, JW

Location Chattanooga, Tenn

Date 8/26/93

Unit Furnace

Barometer 29.74 in. Hg.

Dry Bulb _____ F.

Wet Bulb _____ F.

Time 10 . 06 [✓ AM] PM

SP 0 in WG / in Hg

Pitot Type Special

Fs for Pitot 0.84

SMPL POINT	Vp inches	$\sqrt{V_p}$	Temp. ts F.	ΔP 0°REF.	α#
A1	0.03		87		90
2	0.035		87		90
3	0.035		87		89
4	0.035		87		91
5	0.035		87		
6	0.035		87		89
B1	0.03		87		92
2	0.035		87		91
3	0.035		87		87
4	0.035		87		91
5	0.035		87		90
6	0.035		87		89
AVERAGE			2.2172		

ρ_s = Spec. Wt. of Air = .075 lbs/ft^3

#α = angle in degree of to yield 0ΔP

Sketch (if applicable)

1. ts (Avg.) = _____ + 460 = _____ T_s (Rankin)

2. Duct Area = A = _____ = _____ Sq.Ft.

3. P_s = Barometer ± SP = _____ in. Hg.

4. G.D. = $\rho_s\left(\frac{530}{T_s}\right)\left(\frac{P_s}{29.92}\right)$ = _____ lbs/cu.

5. K = Constant = $\frac{1096.5}{\sqrt{G.D.}}$ = _____

6. V = Velocity = K F_s $\sqrt{V_p}$ Avg. _____ ft/mi

7. VOLUME average = AxV = _____ ACF

8. SCFM = Volume $\left(\frac{530}{T_s}\right)\left(\frac{P_s}{29.92}\right)$ _____ SCFM

ANALYTICAL TESTING CONSULTANTS, INC. Form # 15

TRAVERSE DATA & FLOW COMPUTATION

Customer COORS ELECTRONIC Test No. BEFORE #3 Test Team RW, JW

Location CHATTANOOGA, TENN Date 8/26/93

Unit FURNACE Barometer 29.74 in. Hg.

Dry Bulb ____ F.

Wet Bulb ____ F.

Time 11 . 19 [✓ AM] PM

SP 0 in WG in Hg

Pitot Type SPECIAL

Fs for Pitot 0.84

SMPL POINT	Vp inches	$\sqrt{V_p}$	Temp. ts F.	ΔP 0°REF.	α#
A1	0.025		98		89
2	0.03		98		88
3	0.03		98		91
4	0.03		98		90
5	0.03		98		
6	0.025		98		90
B1	0.025		99		
2	0.025		99		
3	0.03		99		90
4	0.03		98		
5	0.03		98		81
6	0.025		98		89
AVERAGE					

ρ_s = Spec. Wt. of Air = .075 lbs/ft^3

#α= angle in degree of to yield 0ΔP

Sketch (if applicable)

1. t_s (Avg.) = ____ + 460= ____ T_s (Rankin)

2. Duct Area = A = ____ = ____ Sq.Ft.

3. P_s= Barometer ± SP = ____ in. Hg.

4. G.D.= $\rho_s(\frac{530}{T_s})(\frac{P_s}{29.92})$= ____ lbs/cu.

5. K=Constant= $\frac{1096.5}{\sqrt{G.D.}}$= ____

6. V=Velocity=K F_s $\sqrt{V_p}$ Avg. ____ ft/mi

7. VOLUME average =AxV = ____ ACF

8. SCFM = Volume $(\frac{530}{T_s})(\frac{P_s}{29.92})$ ____ SCFM

ANALYTICAL TESTING CONSULTANTS, INC. Form # 15

TRAVERSE DATA & FLOW COMPUTATION

Customer COORS ELECTRONIC

Test No. AFTER #3

Test Team RW, JW

Location CHATTANOOGA, TENN

Date 8/26/93

Unit FURNACE

Barometer 29.74 in. Hg.

Dry Bulb ______ F.

Wet Bulb ______ F.

Time 12 . 28 AM [✓ PM]

SP 0 in WG in Hg

Pitot Type SPECIAL

Fs for Pitot 0.84

SMPL POINT	Vp inches	$\sqrt{V_p}$	Temp. ts F.	ΔP 0°REF.	α#
A1	0.025		110		91
2	0.03		110		
3	0.03		110		89
4	0.03		110		
5	0.03		110		92
6	0.025		110		
B1	0.03		112		90
2	0.03		112		
3	0.03		113		91
4	0.03		114		
5	0.03		115		87
6	0.03		116		90
AVERAGE					

Sketch (if applicable)

1. ts (Avg.) = ______ + 460= ______ T_s (Rankin

2. Duct Area = A = ______ = ______ Sq.Ft.

3. P_s = Barometer ± SP = ______ in. Hg.

4. G.D. = $\rho_s \left(\frac{530}{T_s}\right)\left(\frac{P_s}{29.92}\right)$ = ______ lbs/cu.

5. K=Constant= $\frac{1096.5}{\sqrt{G.D.}}$ = ______

6. V=Velocity=K $F_s \sqrt{V_p}$ Avg. ______ ft/mi

7. VOLUME average =AxV = ______ ACF

8. SCFM = Volume $\left(\frac{530}{T_s}\right)\left(\frac{P_s}{29.92}\right)$ ______ SCFM

ρ_s = Spec. Wt. of Air = .075 lbs/ft^3

#α= angle in degree of to yield 0ΔP

ANALYTICAL TESTING CONSULTANTS, INC.

GAS ANALYSIS DATA FOR EPA 3A

DATE: 8/26/93 ANALYST: JW

CLIENT: COORS ELECTRONIC SOURCE: FURNACE

CALIBRATION DATA

INSTRUMENTS FYRITE

CAL GAS	OXYGEN %	INST. READING
HI PURITY N_2	0%	—
AIR	20.95%	20.9%
11.0% O_2	11.0%	—

CARBON DIOXIDE BY FYRITE

SAMPLE DATA

RUN 1, 2, 3 SAMPLE TYPE: ✓ GRAB ____ INTEGRATED ____ CONTINUOUS

POINT	CO_2 %	O_2 %	N_2 %	OTHER____ % PPM	REMARK
1	0	21.0			
2	0	21.0			
3	0	21.0			
4	0	21.0			
5	0	21.0			
6	0	21.0			
7	0	21.0			
8	0	21.0			
9	0	21.0			
10	0	21.0			
11	0	21.0			
12	0	21.0			
AVERAGE					

SYSTEM CALIBRATION ERROR DATA

CLIENT Coors Elect. Pack.
DATE 8/26/93
LOCATION Chattanooga TN.
CAL GAS Propane in N_2
SPAN VALUE
START TIME
METHOD 25A
ANALYZER Ratfisch RS55CA

INITIAL CALIBRATION

RANGE	CONCENTRATION	PREDICTED CHART	ACTUAL CHART	% ERROR
ZERO	0	0	0	
LOW	16.5	15.2	14.9	1.97
MID	30.6	28.3	27.9	1.41
HIGH	64.1	59.2	58.4	1.37
SPAN	86.6	80.0	80.0	

K_2 ≐ ACTUAL CHART OF SPAN/SPAN CONCENTRATION= PPM OR %/UNIT

%ERROR = (PREDICTED-ACTUAL)/PREDICTED X 100*
*PREDICTED MINUS ACTUAL SHOULD BE TAKEN AS ABSOLUTE VALUE!

HOURLY SPAN AND ZERO CHECKS

		ZERO			MID	
TIME	PREDICTED	ACTUAL	% ERROR	PREDICTED	ACTUAL	% ERROR
1:00	0	0.5	0.5	28.3	28.0	0.3
2:00	0	0.5	0.5	28.3	28.0	0.3
3:00	0	0.9	0.9	28.3	28.8	0.5
	~~0~~			~~28.~~		
FINAL						

ALLOWABLE INITIAL CALIBRATION ERROR = ±5%
ALLOWABLE HOURLY CALIBRATION ERROR AND DRIFT = ±3%

ANALYTICAL TESTING CONSULTANTS

SOURCE SURVEY AND DESCRIPTION

SYSTEM TYPE: _____ BOILER ✓ PROCESS _____ OTHER

NARRATIVE DESCRIPTION: ASTRO MODEL# CPF-2048-MS SERIAL# F8608065
Ceramic currying Furnace - Batch loading, ceramic plates for computer chips; furnace is purged w/ H_2, N_2 gas @ 50 CFH.
Exhaust is flaired by ignighter

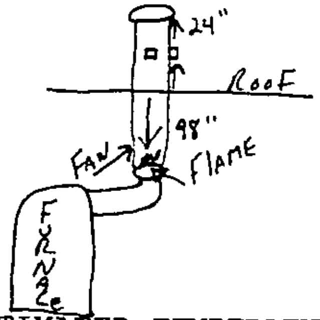
PURPOSE OF TESTING: ✓ COMPLIANCE _____ EVALUATION

PROCESS RATE OR CAPACITY: 36#s PER BATCH (ABNORMAL) DETERMINED BY: PLANT PERSONEL

CONTROL EQUIPMENT: _____ SCRUBBER _____ ESP _____ BAGHOUSE
✓ OTHER HYDROGEN FLARE

CONTROL EQUIPMENT OPERATING PARAMETERS: PRESSURE DROP N/A
OTHER _____

SAMPLING LOCATION DATA:
DISTANCE DOWNSTREAM FROM FLOW DISTRUBANCE: _____
NATURE OF DISTURBANCE: BEND, [✓ FAN], EXPANSION, BYPASS, DUCT,
OTHER 98" 8 DIAMETERS
DISTANCE UPSTREAM FROM FLOW DISTURBANCE: _____
NATURE OF DISTURBANCE: [✓ STACK EXHAUST], FAN, EXPANSION, DUCT,
OTHER 24" 2 DIAMETERS
INDIVIDUAL STACK ✓ COMMON STACK _____
STACK DIAMETER OR DIMENSIONS: 12"
NUMBER OF PORTS: 2 POINTS PER PORT: 6
SKETCH:



ESTIMATED TEMPERATURE: AMBIENT ESTIMATED MOISTURE: 1-2%
GAS COMPOSITION BY: [✓ FYRITE], OXYGEN METER, INSTRUMENTAL,
OTHER _____

LABORATORY:

SAMPLE RECOVERY: ATC LABORATORY ✓ CLEAN FIELD AREA _____
ATC VAN _____ OTHER _____

SAMPLE SHIPMENT: ✓ ATC VAN _____ OTHER _____

SAMPLE ANALYSIS: ✓ ATC _____ OTHER _____

FILTER MATERIAL: _____ GELMAN A/E _____ WHATMAN 934AH _____ OTHER _____

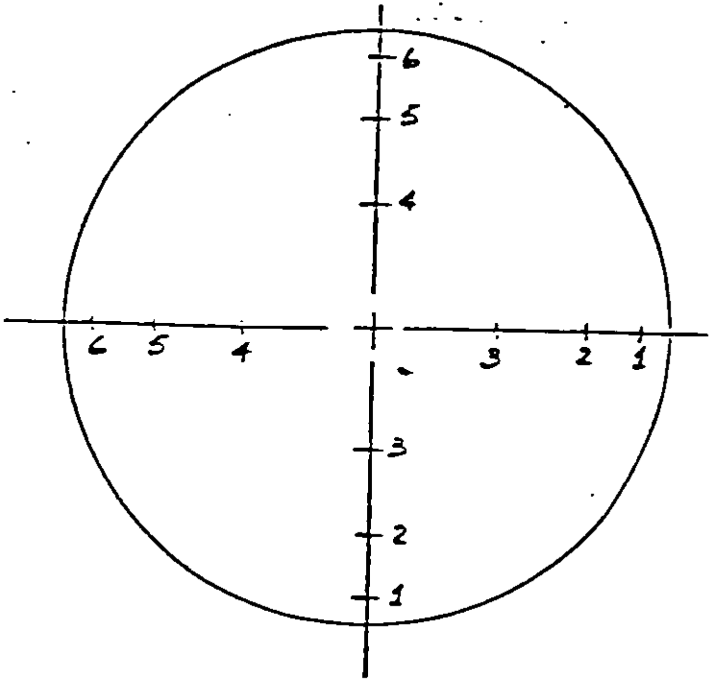
ANALYTICAL TESTING CONSULTANTS, INC.

Customer COORS ELECTRONIC Date 8/26/93

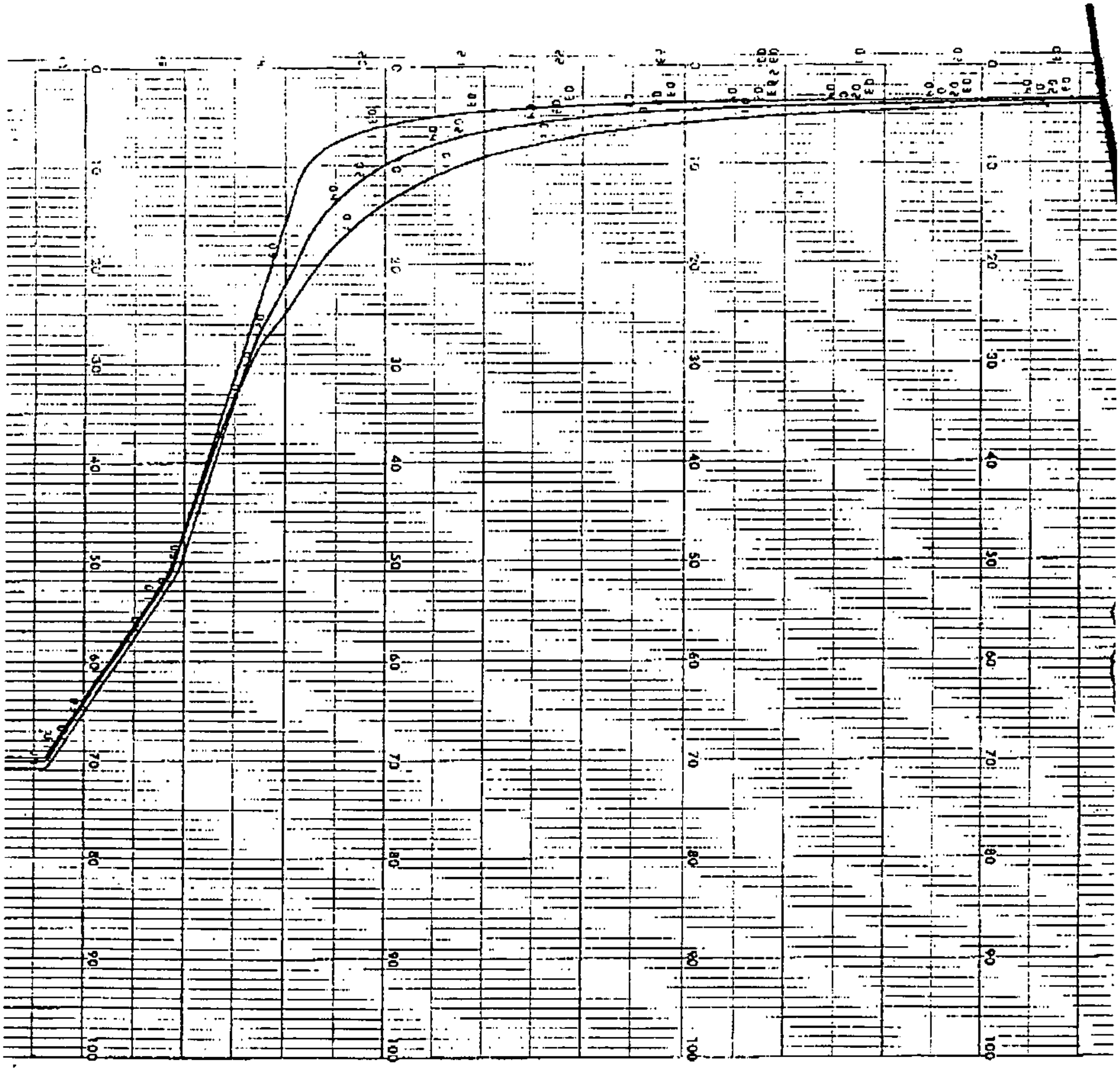
Location CHATTANOOGA, TN Data by JW

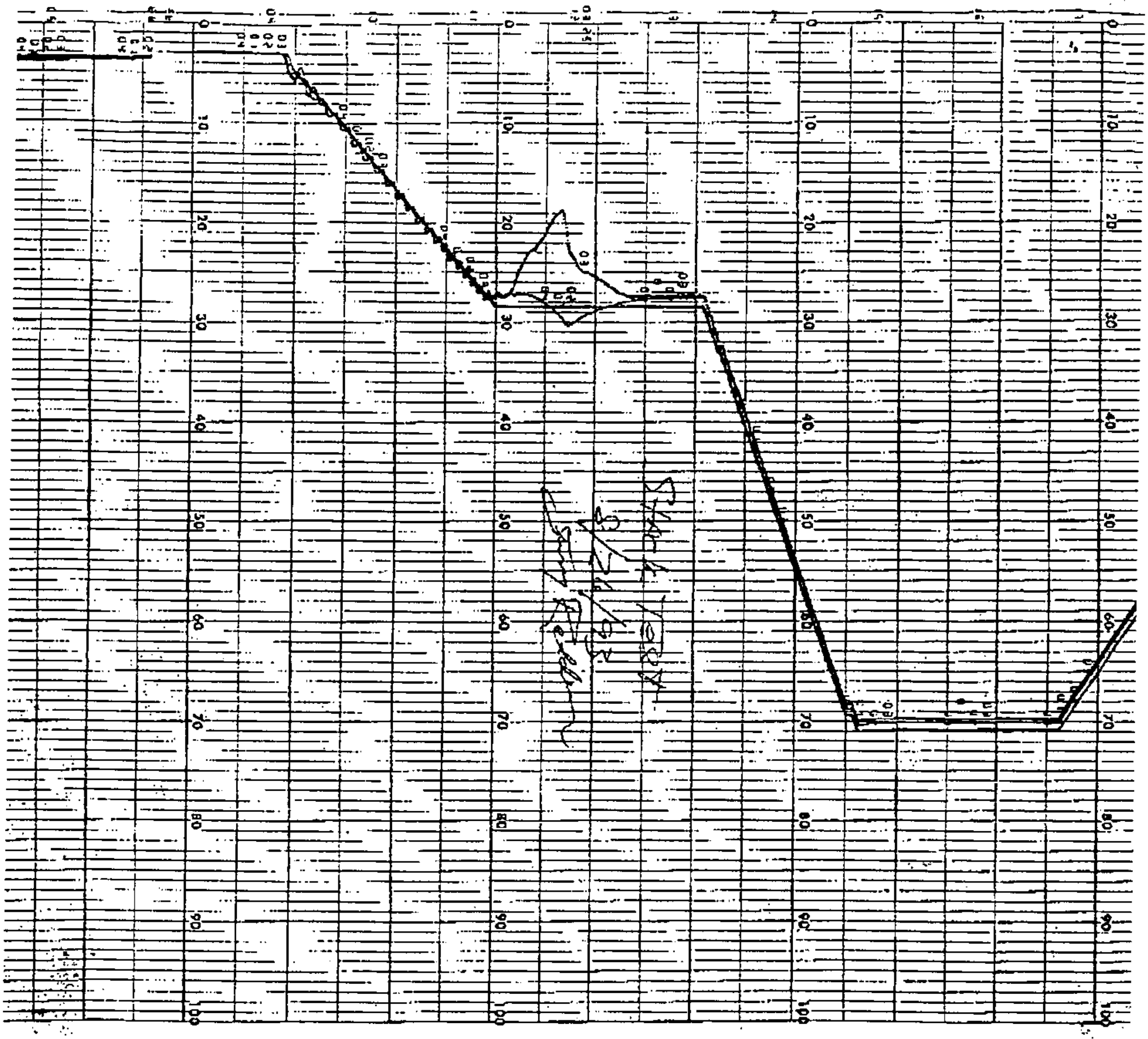
Checked by JW

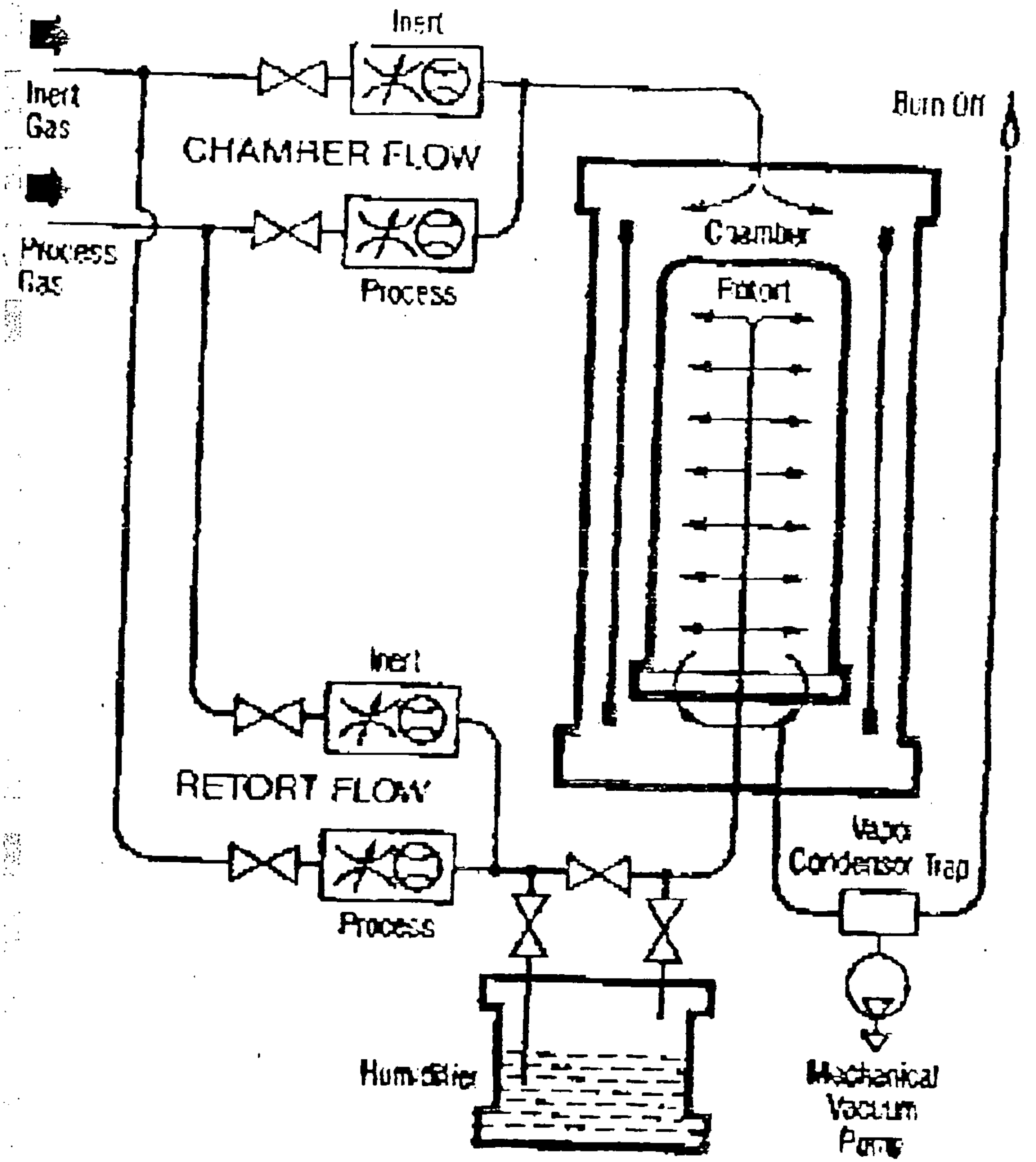
Description EQUAL AREA CALCULATIONS
ROUND DUCT - SIX POINT TRAVERSE/DIAMETER



Stack I.D.= 12 In.		
Point No.	% of Diameter	Distance (Inches)
1	4.4	0.53
2	14.7	1.76
3	29.5	3.54
4	70.6	8.47
5	85.3	10.24
6	95.6	11.47


0
10
20
30
40
50
60
70
80
90
100


0
10
20
30
40
50
60
70
80
90
100
Stack 4
8/26/93



Typical gas flow diagram for the CPF system.

ANALYTICAL TESTING CONSULTANTS, INC

BAROMETER #1 CALIBRATION

DATE/TIME	STATION PRES.	BAR. READING	ADJUSTMENT	INIT
7/10/92	29.41	29.41	0	DF
8/25/92	29.80	29.83	0.03	JW
9/10/92	29.98	29.98	0	RNW
10/21/92	30.11	30.11	0	CDM
11/19/92	29.17	29.16	0.01	SM
12/4/92	29.43	29.43	0	WKP
1/12/93	29.39	29.46	0.07	SM
2/9/93	29.47	29.47	0	JW
3/5/93	29.77	29.79	0.02	SM
4/5/93	29.38	29.43	0.05	JW
5/14/93	29.75	29.75	0	KP
6/22/93	29.98	29.98	0	SM
7/10/93	29.46	29.51	0.05	SM

PRIMARY MODULE CALIBRATION CALCULATION

DATE	6/25/93
P BAR	29.98
MODULE ID	ATC 1
BY	MEADOWS

ORIFICE	Vw	Vd	Tw	Td	TIME	D H@	Y
0.5	4.17	4.18	80	75	10	1.65714	0.98716
1	5.88	5.87	80	76	10	1.663779	0.991851
1.5	7.23	7.25	80	77	10	1.647614	0.988066
2	8.32	8.31	80	78	10	1.655832	0.992626
3	10.14	10.18	80	79	10	1.669059	0.986964
						1.658685	0.989333

POSTTEST MODULE CALIBRATION CALCULATION

DATE	8/30/93
P BAR	29.87
MODULE ID	ATC 1
BY	WELCH

ORIFICE	Vw	Vd	Tw	Td	TIME	D H@	Y
1.5	7.29	7.26	84	84	10	1.629518	1.000438
1.5	7.29	7.3	84	86	10	1.623549	0.998614
1.5	7.29	7.31	84	87	10	1.620581	0.999075
						1.624549	0.999376

TYPE "S" PITOT TUBE INSPECTION DATA FORM

PITOT TUBE I.D. 23 DATE 6/7/93

PITOT TUBE ASSEMBLY LEVEL? XX YES NO

PITOT TUBE OPENINGS DAMAGED? __________YES(EXPLAIN BELOW)__XX___NO

CRITICAL ALIGNMENT MEASUREMENTS

MEASUREMENT	ALPHA <10	BETA <5	GAMMA	THETA	A	Z MUST BE <0.125	W MUST BE <0.0313
#1	0	0	0	0	1	0	0
#2	0	0	0	0	1	0	0

Pa = 0.55 Pb= 0.55

Dt = 0.375

COMMENTS

CALIBRATION REQUIRED? YES XX NO

Alpha = left to right levelness of the pitot tube openings
Beta = front to back pitch of the pitot tube openings

STACK TEMPERATURE SENSOR CALIBRATION DATA FORM

DATE 6/9/93
AMBIENT TEMP., F 81
CALIBRATOR WELCH

THERMOCOUPLE NO. 23
BAROMETRIC PRESS., IN. Hg 29.84
REFERENCE THERMOMETER MERCURY-IN-GLASS

REFERENCE POINT NO.	SOURCE* (SPECIFY)	REFERENCE TEMP. F	THERMOCOUPLE POTENTIOMETER TEMPERATURE, F	TEMPERATURE DIFFERENCE %**
1	AMBIENT	81	81	0.000
2	REFRIGERATOR	37	37.5	0.101
3	THELCO OVEN	151	151	0.000
4	THELCO OVEN	196	197	0.153
5	THELCO OVEN	224	223	0.146
6	THELCO OVEN	258	257	0.139
7	THELCO OVEN	281	281	0.000
8	THELCO OVEN	314	312	0.259

* = TYPE OF CALIBRATION SYSTEM USED
** = [(REF TEMP, C+273) - (TEST TEMP., C+273)/REF TEMP, C+273]*100<1.5%

NATIONAL SPECIALTY GASES
630 UNITED DRIVE
DURHAM, NC 27713
(919) 544-3772

CERTIFICATE OF ANALYSIS-EPA PROTOCOL MIXTURES

REFERENCE #: 88-25899 CYLINDER #:CC77880 CYL. PRESSURE:2000PSIG

EXPIRATION DATE: 8-6-96 LAST ANALYSIS DATE:8-6-93

CUSTOMER:NATIONAL WELDERS
SALISBURY, NC

P.O.# 67393
METHOD: EPA PROTOCOL # 13.0.4.G-1

STANDARD:

SRM #:2643A

CYL #:SX20245

CONC.:99.1PPM

INSTRUMENT:

COMPONENT: BECKMAN THC

MODEL #: 400

SERIAL #: 1003052

LAST CAL.: 8-2-93

COMPONENT: PROPANE
MEAN CONC: 86.6PPM

REPLICATE CONC.
DATE: 8-6-93
86.6PPM
86.7PPM
86.5PPM
DATE:

COMPONENT:
MEAN CONC:

REPLICATE CONC.
DATE:
DATE:

COMPONENT:
MEAN CONC:

REPLICATE CONC.
DATE:
DATE:

BALANCE GAS:AIR

NATIONAL SPECIALTY GASES
630 UNITED DRIVE
DURHAM, NC 27713
(919) 544-3772

CERTIFICATE OF ANALYSIS-EPA PROTOCOL MIXTURES

REFERENCE #: 88-25898 CYLINDER #:CC114291 CYL. PRESSURE:2000PSIG

EXPIRATION DATE: 8-6-96 LAST ANALYSIS DATE:8-6-93

CUSTOMER:NATIONAL WELDERS
SALISBURY, NC

P.O.# 67393
METHOD: EPA PROTOCOL # 13.0.4.G-1

STANDARD:

SRM #:2643A

CYL #:SX20245

CONC.:99.1PPM

INSTRUMENT:

COMPONENT: BECKMAN THC

MODEL #: 400

SERIAL #: 1003052

LAST CAL.: 8-2-93

COMPONENT: PROPANE
MEAN CONC: 64.1PPM

REPLICATE CONC.
DATE: 8-6-93 DATE:
64.0PPM
64.1PPM
64.2PPM

COMPONENT:
MEAN CONC:

REPLICATE CONC.
DATE: DATE:

COMPONENT:
MEAN CONC:

REPLICATE CONC.
DATE: DATE:

BALANCE GAS:AIR

[illegible]
80 units

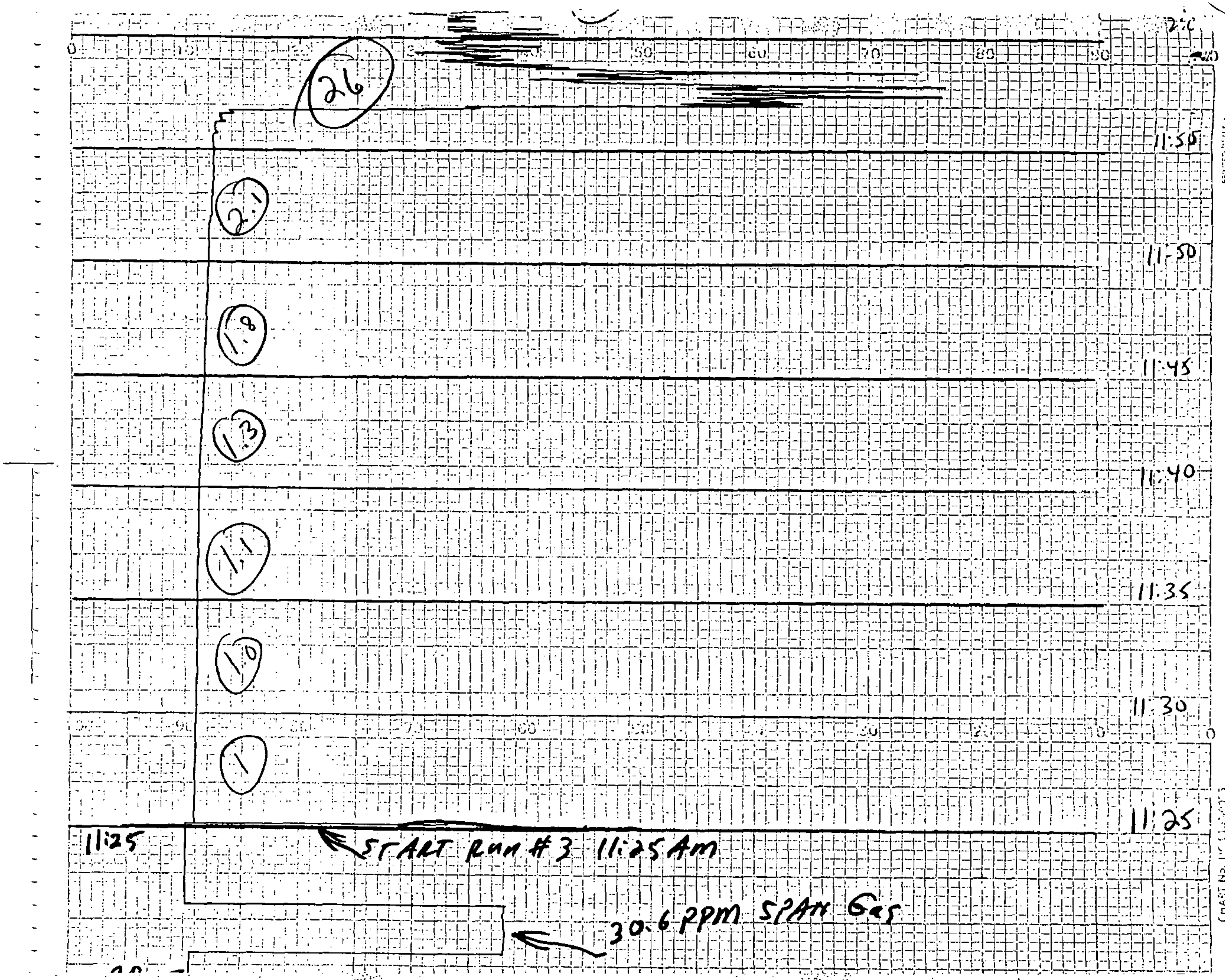
$K_2 = 1.08$

Richard Westbrook, OPERATOR

Coors Electronic Packaging
Chattanooga, Tn.
8/26/93
Chart Speed 30 cm/HR.

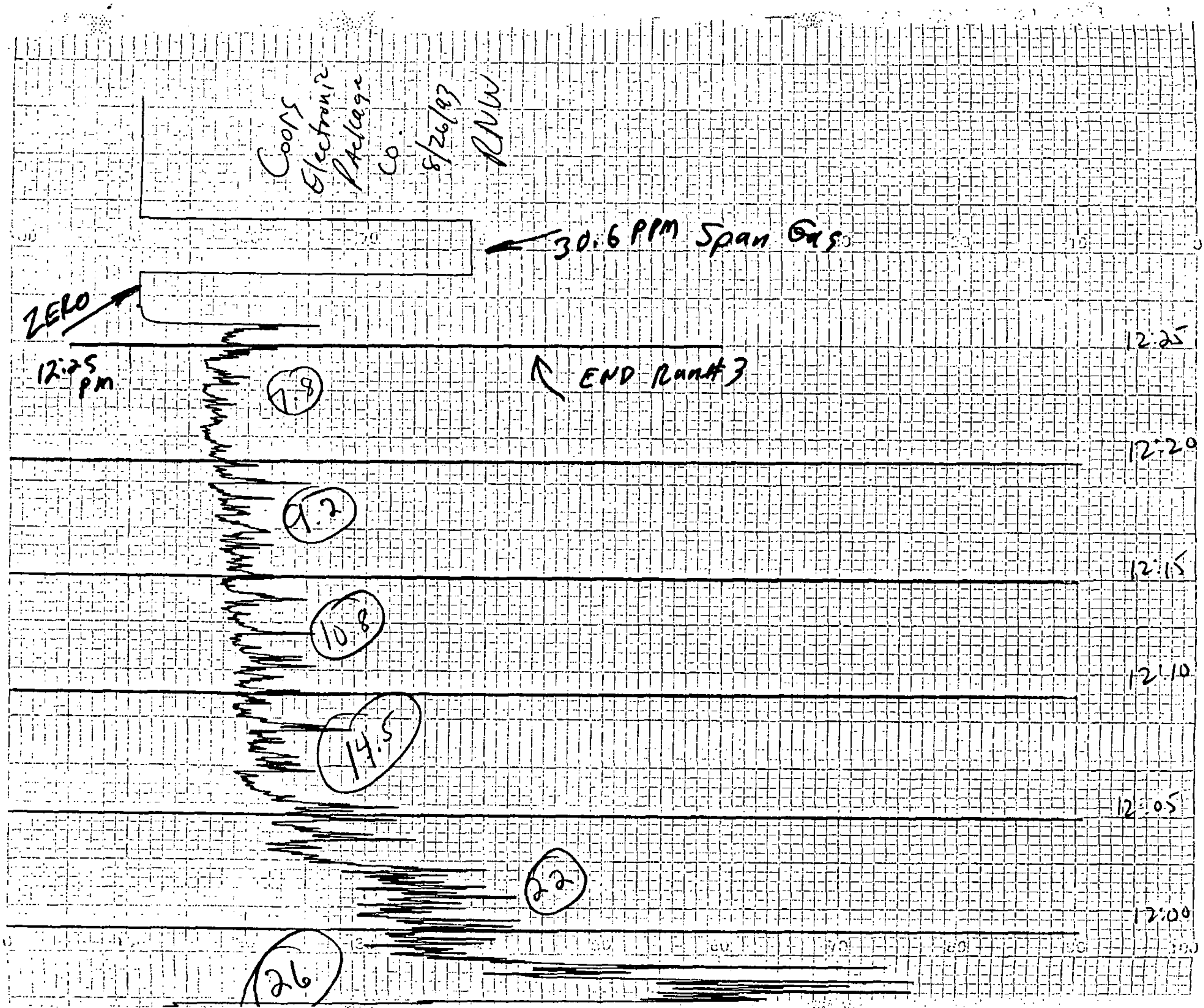
100 90 80 70 60 50 40 30 20 10 0

CHART No. LIC 0100-0025



START Run #3 11:25 AM

30.6 PPM SPAN Gas


Coors Electronic Package Co.
8/26/83
RNW
30.6 PPM Span Gas
ZERO
END Run #3
12:25 pm
12:25
12:20
12:15
12:10
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7.8
9.2
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22
26
CHART No. MC 0101-0025