AIR POLLUTION TESTING, INC.

AP-42 Section 9.12.1
Reference 15
Report Sect. 4
Reference 23

Volatile Organic Compound Emissions
Source Test Report for
Coors Brewing Company

Bottle Crusher Unit

Report prepared for:
Coors Brewing Company
Bottle Crusher Unit
Golden, Colorado 80401

Report reviewed by:
Paul Ottenstein
Project Manager

Test Dates:
April 21, 1993
August 31, 1993

Project Code:
CB30141

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Introduction

Air Pollution Testing, Inc. was contracted by Coors Brewing Company to conduct a series of source emissions tests on the temporary enclosure surrounding the bottle crusher unit at their Golden, Colorado brewery facility. The purpose of the testing was to determine the reduction in volatile organic compound emissions for the bottle crusher unit following equipment modifications. The baseline testing took place on April 21, 1993. The testing after modifications took place on August 31, 1993. Mr. Robert Jorgenson of the Colorado Department of Health, Air Pollution Control Division was present to observe the testing on both occasions.

Summary of Procedures

Testing for volatile organic compounds (VOCs) at the bottle crusher temporary enclosure was conducted in accordance with *EPA Method 25A - Measurement of Total Gaseous Organic Emissions Using a Flame Ionization Analyzer* as detailed in *Code of Federal Regulations, Title 40, Part 60, Appendix A*.

Waste glass beer bottles, both full and empty, are dumped into the unit for crushing prior to recycling. Dumping occurs in batches on a variable schedule, with a maximum of approximately four batches per hour. A temporary enclosure of wooden two-by-four framing and plastic sheet walls was erected around the unit for testing purposes. Air flow out of the enclosure is provided by a fan pulling an average of approximately 1700 acfm of air from the room through a twelve inch square metal duct. This air is vented to the surrounding brewery facility. Air flow into the room is provided by (1) the surrounding brewery complex through imperfect seals around the enclosure, (2) outside though an eighteen inch square air duct, and (3) from a large beer holding tank containing waste beer from the crushing operation. Additionally, when full bottle hoppers are brought into the room and empty hoppers are removed from the room, a large door on the enclosure is opened. This is unavoidable, but open door time was kept to a minimum during testing.

VOC testing was conducted at a sampling port on the exhaust duct outside of the room, at a point upstream of the fan. Each sampling period consisted of extracting a gas sample from the duct and pumping it directly into the inlet port of a JUM Model 3-100 flame ionization analyzer. The total organic concentration in the duct gas was displayed on the analyzer front panel (expressed as parts per million propane on a wet volume / volume basis), and recorded on a strip chart. Before and after each sampling period, the analyzer was challenged with calibration gases. To ensure accurate data collection, all calibration gases were prepared and certified in accordance with EPA Protocol 1, and were introduced to the analyzer at the sampling probe tip at ambient temperature and pressure.

Concurrent with each method 25A sampling period, differential pressure and temperature measurements were taken in the duct with a standard pitot tube and a K-type thermocouple in accordance with methods 1 and 2 to determine the volumetric air flow rate in the duct. Negligible moisture content, and ambient concentrations of carbon dioxide (0.0%) and oxygen (20.9%) were assumed. The VOC concentration data was combined with the volumetric air flow data to calculate pounds per hour of VOCs as propane for each sampling period. Because the organic emissions are believed to be primarily ethanol, the data is also expressed as pounds per hour of ethanol using an empirical conversion factor determined experimentally for the specific flame ionization analyzer used in the testing. Additionally, production data (number of batches crushed during sampling and average daily crushes) were collected, and the emissions

data were expressed as pounds of ethanol emissions per batch crushed. Ethanol emissions tons per year values were calculated using the pounds per crush data and total crushes per year. The ethanol emission rates (expressed as pounds per hour and as pounds per crush) measured before and after the system modifications were used to calculate the percent change in VOC emissions.

Additional Notes

Sampling Duration

Sample duration varied from one to two hours. Longer sampling times were used when the batch crush rate slowed, to allow at least three crush batches per sampling period.

Capture Efficiency

Complete capture of VOC emissions from the crushing unit was demonstrated by measurements of the air flow into the room through the inlet duct. The average air speed into the enclosure for the baseline testing was 306 standard feet per minute (the average of thirty measurements taken over the duration of the testing program). The average air speed into the enclosure for the post-modification testing was 237 standard feet per minute (the average of sixty measurements taken over the duration of the testing program).

Ethanol-/ Propane Conversion

Although flame ionization analyzers (FIAs) are designed to detect carbon atoms in organic molecules without respect to the remainder of the molecule, experiments have demonstrated that FIA response is somewhat dependent on molecular structure. Because the VOC emissions from the bottle crusher are believed to be primarily ethanol, the data presented in the Results section have been corrected from propane calibrated FIA data to theoretical ethanol values. Earlier experiments with the same analyzer used in this testing program have demonstrated an empirical constant of 2.506 to convert analyzer propane masses to ethanol masses.

Results

The results of the testing are presented in the following table. Any testing parameters not found in the table may be found in *Appendix 1 - Testing Parameters / Sample Calculations.*

Coors Brewing Company
Bottle Crusher
4-21-93
VOC Mass Emission Rates

Field Data

	Run #1	Run #2	Run #3	Averages
start time	07:15	09:23	11:45	
stop time	09:15	10:39	13:45	
VOC conc. (ppm wet)	41.7	57.7	47.2	48.9
% H2O*	0.0	0.0	0.0	0.0
volumetric flow rate (dscfm)**	1579	1610	1667	1619

Process Data

# of crushes	4	6	5	5
# of crushes (daily average)***	33.8	33.8	33.8	33.8

Calculations

VOC emissions (lb/hr as propane)	0.45	0.64	0.54	0.54
VOC emissions (lb/hr as ethanol)****	1.13	1.60	1.35	1.36
VOC emissions (lb/crush as ethanol)	0.57	0.34	0.54	0.48
VOC emissions (tons/year as ethanol)*****	3.50	2.08	3.34	2.97

* - negligible moisture content assumed
** - from concurrent methods 1 and 2 flow measurements
*** - average crushes per day for first 33 weeks of 1993
**** - empirical conversion factor of 2.506 demonstrated in earlier testing program
***** - tons/year based on lb per crush and average crushes per year

Table 1 - Bottle Crusher Baseline VOC Results
April 21, 1993

Results (continued)

Coors Brewing Company
Bottle Crusher
8-31-93
VOC Mass Emission Rates

Field Data

	Run #1	Run #2	Run #3	Averages
start time	09:43	10:52	11:57	
stop time	10:43	11:52	13:13	
VOC conc. (ppm wet)	19.1	22.4	22.0	21.2
% H2O*	0.0	0.0	0.0	0.0
volumetric flow rate (dscfm)**	1198	1281	1343	1274

Process Data

# of crushes	3	4	5	4
# of crushes (daily average)***	33.8	33.8	33.8	33.8

Calculations

VOC emissions (lb/hr as propane)	0.16	0.20	0.20	0.19
VOC emissions (lb/hr as ethanol)****	0.39	0.49	0.51	0.47
VOC emissions (lb/crush as ethanol)	0.13	0.12	0.13	0.13
VOC emissions (tons/year as ethanol)*****	0.81	0.76	0.80	0.79

* - negligible moisture content assumed
** - from concurrent methods 1 and 2 flow measurements
*** - average crushes per day for first 33 weeks of 1993
**** - empirical conversion factor of 2.506 demonstrated in earlier testing program
***** - tons/year based on lb per crush and average crushes per year

Table 2 - Bottle Crusher Post-modification VOC Results
August 31, 1993

Results (continued)

Coors Brewing Company
Bottle Crusher
4-21-93 to 8-31-93
VOC Reduction

Field Data

Test #1 (4-21-93)

	Run #1	Run #2	Run #3	Averages
start time	07:15	09:23	11:45	
stop time	09:15	10:39	13:45	
VOC emissions (lb/hr as ethanol)	1.1	1.6	1.4	1.4
VOC emissions (lb/crush as ethanol)	0.57	0.34	0.54	0.48

Test #2 (8-31-93)

	Run #1	Run #2	Run #3	
start time	09:43	10:52	11:57	
stop time	10:43	11:52	13:13	
VOC emissions (lb/hr as ethanol)	0.39	0.49	0.51	0.46
VOC emissions (lb/crush as ethanol)	0.13	0.12	0.13	0.13

Calculations

% reduction (mass/time)	65	69	64	66
% reduction (mass/crush)	77	65	76	73

Table 3 - Bottle Crusher VOC Reduction Results
April 21 through August 31, 1993

Conclusions

The results of the testing indicate that the VOC emissions on both testing days are characterized by a double-peak spike in concentration with each batch crushed. The first peak associated with each crush occurs almost immediately after a hopper is dumped into the unit. After a batch is crushed, the broken glass is held for approximately 10 minutes by a gate. This holding time allows excess beer to drain into a holding tank before the crushed glass is allowed to fall into the transport hopper. The second peak associated with each crush coincides with the opening of the gate after draining.

Following collection of the baseline VOC data, Coors Brewing Company personnel constructed a larger dump bin and a water spray unit for the bottle crusher. The water spray unit runs at the beginning of each crush cycle. The reported reduction values indicate a significant decrease in VOC emissions from the bottle crusher unit following installation of the modifications.

Appendix 1
Testing Parameters
Sample Calculations

Coors Brewing Company

Bottle Crusher

4-21-93 to 8-31-93

VOC Reduction

Field Data

Test #1 (4-21-93)

	Run #1	Run #2	Run #3	Averages
start time	07:15	09:23	11:45	
stop time	09:15	10:39	13:45	
VOC emissions (lb/hr as ethanol)	1.1	1.6	1.4	1.4
VOC emissions (lb/crush as ethanol)	0.57	0.34	0.54	0.48

Test #2 (8-31-93)

	Run #1	Run #2	Run #3	
start time	09:43	10:52	11:57	
stop time	10:43	11:52	13:13	
VOC emissions (lb/hr as ethanol)	0.39	0.49	0.51	0.46
VOC emissions (lb/crush as ethanol)	0.13	0.12	0.13	0.13

Calculations

% reduction (mass/time)	65	69	64	66
% reduction (mass/crush)	77	65	76	73

Coors Brewing Company

Bottle Crusher

4-21-93

EPA Methods 1-2 : Determination of Volumetric Flow Rate and Molecular Weight

Field Data	Run #1	Run #2	Run #3	Averages
stack temp. (oF)	70	70	70	70
barometric pressure (mbar)	845	845	845	845
barometric pressure (" Hg)	24.958	24.958	24.958	24.958
static press. (in. water)	-0.80	-0.78	-0.81	-0.80
oxygen (%)	20.9	20.9	20.9	20.9
carbon dioxide (%)	0.0	0.0	0.0	0.0
(delta p)^1/2	0.4365	0.4450	0.4608	0.4474
pitot tube constant	0.99	0.99	0.99	0.99
stack diameter (inches)	13.5	13.5	13.5	13.5

Calculations	Run #1	Run #2	Run #3	Averages
molecular weight (dry)	28.836	28.836	28.836	28.836
gas velocity (ft/sec)	31.7	32.4	33.5	32.5
gas flow (acfm)	1904	1941	2010	1952
gas flow (dscfm)	1579	1610	1667	1619

* - equivalent diameter of a round stack

Coors Brewing Company

Bottle Crusher

4-21-93

VOC Mass Emission Rates

Field Data

	Run #1	Run #2	Run #3	Averages
start time	07:15	09:23	11:45	
stop time	09:15	10:39	13:45	
VOC conc. (ppm wet)	41.7	57.7	47.2	48.9
% H2O*	0.0	0.0	0.0	0.0
volumetric flow rate (dscfm)**	1579	1610	1667	1619

Process Data

# of crushes	4	6	5	5
# of crushes (daily average)***	33.8	33.8	33.8	33.8

Calculations

VOC emissions (lb/hr as propane)	0.45	0.64	0.54	0.54
VOC emissions (lb/hr as ethanol)****	1.13	1.60	1.35	1.36
VOC emissions (lb/crush as ethanol)	0.57	0.34	0.54	0.48
VOC emissions (tons/year as ethanol)*****	3.50	2.08	3.34	2.97

* - negligible moisture content assumed

** - from concurrent methods 1 and 2 flow measurements

*** - average crushes per day for first 33 weeks of 1993

**** - empirical conversion factor of 2.506 demonstrated in earlier testing program

***** - tons/year based on lb per crush and average crushes per year

Coors Brewing Company

Bottle Crusher

4-21-93

Method 25A : Measurement of Total Organic Concentration Using a Flame Ionization Analyzer

Strip Chart Data

Run #1		Zero (%FS)	Span (%FS)	Actual Span (ppm)
Start	07:15	0.0	91.0	91.3
Stop	09:15	0.0	91.0	

point #	%FS VOC	ppm VOC	point #	%FS VOC	ppm VOC
1	27.0	27.1	31	29.5	29.6
2	27.0	27.1	32	29.0	29.1
3	28.0	28.1	33	28.0	28.1
4	26.0	26.1	34	28.0	28.1
5	26.5	26.6	35	28.0	28.1
6	26.5	26.6	36	34.0	34.1
7	27.0	27.1	37	37.0	37.1
8	28.5	28.6	38	33.0	33.1
9	30.5	30.6	39	32.0	32.1
10	32.0	32.1	40	29.0	29.1
11	40.0	40.1	41	44.0	44.1
12	42.0	42.1	42	67.0	67.2
13	43.0	43.1	43	65.0	65.2
14	42.5	42.6	44	63.0	63.2
15	42.0	42.1	45	59.0	59.2
16	40.0	40.1	46	57.0	57.2
17	39.0	39.1	47	64.0	64.2
18	38.0	38.1	48	65.5	65.7
19	37.0	37.1	49	65.0	65.2
20	34.0	34.1	50	58.0	58.2
21	33.0	33.1	51	58.0	58.2
22	32.0	32.1	52	57.5	57.7
23	32.0	32.1	53	59.5	59.7
24	32.0	32.1	54	59.0	59.2
25	31.5	31.6	55	55.0	55.2
26	31.0	31.1	56	53.0	53.2
27	30.5	30.6	57	60.0	60.2
28	30.0	30.1	58	63.0	63.2
29	30.0	30.1	59	62.5	62.7
30	29.5	29.6	60	61.0	61.2
averages:	32.9	33.0		50.1	50.3

Drift Cal. Avg. VOC (ppm as propane) 41.7

EPA Method 25A : Measurement of Total Organic Concentration Using a Flame Ionization Aanlyzer

Sample Calculations

drift cal. ppm as propane

= [(%FS analyzer stack value) - (%FS analyzer average 0 value)](span gas value ppm)
[(%FS analyzer average span value) - (%FS analyzer average 0 value)]

= (41.5 %FS) - [(0.0 %FS - 0.0 %FS) / 2](91.3 ppm)
[(91.0 %FS + 91.0 %FS) / 2]-[(0.0 %FS - 0.0 %FS)/2]

= 41.7 ppm VOC as propane

VOC emissions (lb/hr as propane)

= [avg. VOC conc. (ppm)][stack flow (dscfm)](60 min/hr)(28.317 liter/ft^3)(44.09 g/mole)(2.205 lb/kg)
(24.055 liters/mole @ STP)(1000 g/kg)($1x10^6$)(1 - %H_2O/100)

= (41.7 ppm)(1579 dscfm)(60)(28.317)((44.09)(2.205)
(24.055)(1000)($1x10^6$)(1 - 0.0)

= 0.45 lb/hr VOC as propane

VOC emissions (lb/hr as ethanol)

= [VOC (lb/hr as ethanol)][2.506 (empirical constant)

= (0.45)(2.506)

= 1.1 lb/hr VOC as ethanol

VOC emissions (lb/gal as ethanol)

= [VOC (lb/hr as ethanol)
[production (gal/hr)]

= (1.1)/(219/2)

= 0.010 lb/gal VOC as ethanol

VOC emissions (lb/crush as ethanol)

= [VOC (lb/hr as ethanol)
[production (crush/hr)]

= (1.1)/(4/2)

= 0.57 lb/crush VOC as ethanol

VOC emissions (tons/year as ethanol)

= [VOC (lb/crush as ethanol)][33.8 (crushes/day)][365 (days/year)]/[2000 (lbs/ton)]

= (0.57)(33.8)(365)
(2000)

= 3.50 tons/year VOC as ethanol

Coors Brewing Company

Bottle Crusher

4-21-93

Method 25A : Measurement of Total Organic Concentration Using a Flame Ionization Analyzer

Strip Chart Data

Run #2

		Zero (%FS)	Span (%FS)	Actual Span (ppm)
Start	09:23	0.0	91.0	91.3
Stop	10:39	0.0	91.0	

point #	%FS VOC	ppm VOC	point #	%FS VOC	ppm VOC
1	44.0	44.1	20	54.0	54.2
2	42.5	42.6	21	52.5	52.7
3	41.5	41.6	22	56.0	56.2
4	42.0	42.1	23	51.0	51.2
5	52.0	52.2	24	46.5	46.7
6	61.0	61.2	25	54.0	54.2
7	60.0	60.2	26	60.5	60.7
8	53.0	53.2	27	73.0	73.2
9	56.0	56.2	28	76.0	76.3
10	43.0	43.1	29	69.0	69.2
11	46.0	46.2	30	63.0	63.2
12	48.0	48.2	31	72.0	72.2
13	47.0	47.2	32	79.0	79.3
14	48.0	48.2	33	76.0	76.3
15	61.0	61.2	34	71.0	71.2
16	64.0	64.2	35	66.0	66.2
17	65.0	65.2	36	63.0	63.2
18	63.0	63.2	37	57.0	57.2
19	54.0	54.2	38	54.0	54.2
averages:	52.2	52.3		62.8	63.0

Drift Cal. Avg. VOC (ppm as propane) 57.7

Coors Brewing Company

Bottle Crusher

4-21-93

Method 25A : Measurement of Total Organic Concentration Using a Flame Ionization Analyzer

Strip Chart Data

Run #3		Zero (%FS)	Span (%FS)	Actual Span (ppm)
Start	11:45	0.0	90.0	91.3
Stop	13:45	0.0	91.0	

point #	%FS VOC	ppm VOC	point #	%FS VOC	ppm VOC
1	58.5	59.0	31	37.5	37.8
2	55.0	55.5	32	37.0	37.3
3	54.0	54.5	33	37.0	37.3
4	66.0	66.6	34	37.5	37.8
5	71.0	71.6	35	32.0	32.3
6	64.0	64.6	36	28.5	28.8
7	53.0	53.5	37	24.5	24.7
8	49.0	49.4	38	22.0	22.2
9	47.0	47.4	39	22.0	22.2
10	46.0	46.4	40	25.5	25.7
11	50.0	50.4	41	29.0	29.3
12	53.0	53.5	42	31.0	31.3
13	62.0	62.5	43	31.5	31.8
14	65.0	65.6	44	32.0	32.3
15	65.0	65.6	45	32.5	32.8
16	59.0	59.5	46	32.5	32.8
17	51.0	51.5	47	33.0	33.3
18	51.0	51.5	48	47.0	47.4
19	53.0	53.5	49	45.5	45.9
20	64.0	64.6	50	47.5	47.9
21	60.0	60.5	51	45.0	45.4
22	53.0	53.5	52	40.5	40.9
23	52.0	52.5	53	47.0	47.4
24	49.0	49.4	54	50.0	50.4
25	47.0	47.4	55	53.5	54.0
26	44.5	44.9	56	63.0	63.6
27	42.0	42.4	57	63.5	64.1
28	40.5	40.9	58	56.0	56.5
29	39.5	39.8	59	52.0	52.5
30	38.5	38.8	60	68.0	68.6
averages:	53.4	53.9		40.1	40.5

Drift Cal. Avg. VOC (ppm as propane) 47.2

Coors Brewing Company

Bottle Crusher

8-31-93

EPA Methods 1-2 : Determination of Volumetric Flow Rate and Molecular Weight

Field Data	Run #1	Run #2	Run #3	Averages
stack temp. (oF)	73	73	73	73
barometric pressure (mbar)	843	843	841	842
barometric pressure (" Hg)	24.899	24.899	24.840	24.879
static press. (in. water)	-0.73	-0.72	-0.74	-0.73
oxygen (%)	20.9	20.9	20.9	20.9
carbon dioxide (%)	0.0	0.0	0.0	0.0
(delta p)^1/2	0.3325	0.3555	0.3731	0.3537
pitot tube constant	0.99	0.99	0.99	0.99
stack diameter (inches)*	13.5	13.5	13.5	13.5

Calculations	Run #1	Run #2	Run #3	Averages
molecular weight (dry)	28.836	28.836	28.836	28.836
gas velocity (ft/sec)	24.3	25.9	27.3	25.8
gas flow (acfm)	1457	1557	1636	1550
gas flow (dscfm)	1198	1281	1343	1274

* - equivalent diameter of a round stack

Coors Brewing Company

Bottle Crusher

8-31-93

VOC Mass Emission Rates

Field Data

	Run #1	Run #2	Run #3	Averages
start time	09:43	10:52	11:57	
stop time	10:43	11:52	13:13	
VOC conc. (ppm wet)	19.1	22.4	22.0	21.2
% H2O*	0.0	0.0	0.0	0.0
volumetric flow rate (dscfm)**	1198	1281	1343	1274

Process Data

# of crushes	3	4	5	4
# of crushes (daily average)***	33.8	33.8	33.8	33.8

Calculations

VOC emissions (lb/hr as propane)	0.16	0.20	0.20	0.19
VOC emissions (lb/hr as ethanol)****	0.39	0.49	0.51	0.47
VOC emissions (lb/crush as ethanol)	0.13	0.12	0.13	0.13
VOC emissions (tons/year as ethanol)*****	0.81	0.76	0.80	0.79

* - negligible moisture content assumed

** - from concurrent methods 1 and 2 flow measurements

*** - average crushes per day for first 33 weeks of 1993

**** - empirical conversion factor of 2.506 demonstrated in earlier testing program

***** - tons/year based on lb per crush and average crushes per year

Coors Brewing Company

Bottle Crusher

8-31-93

25A : Measurement of Total Gaseous Organic Concentration Using a Flame Ionzation Analyzer

Strip Chart Data

Run #1		Zero (%FS)	Span (%FS)	Actual Span (ppm)
Start	09:43	0.0	8.5	44.2
Stop	10:43	0.0	9.0	

point #	%FS VOC	ppm VOC	point #	%FS VOC	ppm VOC
1	4.5	22.7	31	5.0	25.3
2	4.5	22.7	32	5.0	25.3
3	4.5	22.7	33	5.0	25.3
4	4.0	20.2	34	4.5	22.7
5	4.0	20.2	35	4.5	22.7
6	4.0	20.2	36	4.0	20.2
7	4.0	20.2	37	3.5	17.7
8	4.0	20.2	38	3.5	17.7
9	4.0	20.2	39	3.5	17.7
10	4.0	20.2	40	3.0	15.2
11	4.0	20.2	41	4.0	20.2
12	4.0	20.2	42	4.5	22.7
13	4.0	20.2	43	4.0	20.2
14	4.5	22.7	44	4.0	20.2
15	5.0	25.3	45	3.5	17.7
16	5.0	25.3	46	3.5	17.7
17	4.5	22.7	47	3.0	15.2
18	4.0	20.2	48	3.0	15.2
19	3.5	17.7	49	2.5	12.6
20	3.0	15.2	50	2.5	12.6
21	3.0	15.2	51	2.5	12.6
22	3.0	15.2	52	3.0	15.2
23	2.5	12.6	53	3.5	17.7
24	2.5	12.6	54	3.5	17.7
25	3.0	15.2	55	3.5	17.7
26	3.5	17.7	56	4.0	20.2
27	3.5	17.7	57	4.0	20.2
28	3.5	17.7	58	4.0	20.2
29	3.5	17.7	59	4.0	20.2
30	4.0	20.2	60	4.0	20.2
averages:	3.8	19.4		3.7	18.9

Drift Cal. Avg. VOC (ppm as propane) 19.1

Coors Brewing Company

Bottle Crusher

8-31-93

Method 25A : Measurement of Total Gaseous Organic Concentration Using a Flame Ionization Analyzer

Strip Chart Data

Run #2		Zero (%FS)	Span (%FS)	Actual Span (ppm)
Start	10:52	0.0	44.0	44.2
Stop	11:52	0.0	43.5	

point #	%FS VOC	ppm VOC	point #	%FS VOC	ppm VOC
1	18.0	18.2	31	19.5	19.7
2	17.5	17.7	32	26.0	26.3
3	17.0	17.2	33	30.0	30.3
4	17.0	17.2	34	23.5	23.7
5	22.0	22.2	35	23.0	23.2
6	31.5	31.8	36	21.5	21.7
7	25.5	25.8	37	19.0	19.2
8	23.5	23.7	38	17.5	17.7
9	21.5	21.7	39	16.0	16.2
10	20.5	20.7	40	14.5	14.6
11	19.0	19.2	41	14.0	14.1
12	17.0	17.2	42	17.0	17.2
13	16.0	16.2	43	21.0	21.2
14	15.0	15.2	44	22.0	22.2
15	17.0	17.2	45	24.0	24.2
16	21.0	21.2	46	21.0	21.2
17	25.5	25.8	47	28.0	28.3
18	27.0	27.3	48	41.0	41.4
19	30.5	30.8	49	34.5	34.9
20	25.0	25.3	50	34.0	34.3
21	23.0	23.2	51	32.0	32.3
22	21.0	21.2	52	29.0	29.3
23	19.5	19.7	53	27.0	27.3
24	17.0	17.2	54	24.0	24.2
25	16.0	16.2	55	22.0	22.2
26	15.0	15.2	56	20.5	20.7
27	14.0	14.1	57	20.5	20.7
28	13.5	13.6	58	24.5	24.8
29	15.5	15.7	59	31.0	31.3
30	19.0	19.2	60	34.0	34.3
averages:	20.0	20.2		24.4	24.6

Drift Cal. Avg. VOC (ppm as propane) 22.4

Coors Brewing Company

Bottle Crusher

8-31-93

Method 25A : Measurement of Total Gaseous Organic Concentration Using a Flame Ionization Analyzer

Strip Chart Data

Run #3		Zero (%FS	Span (%FS)	Actual Span (ppm)
Start	11:57	0.0	43.5	44.2
Stop	13:13	0.0	43.0	

point #	%FS	VOC ppm	VOC	point #	%FS	VOC ppm	VOC	point #	%FS	VOC ppm	VOC
1	30.0	30.7		31	13.0	13.3		61	16.0	16.4	
2	27.5	28.1		32	13.0	13.3		62	15.0	15.3	
3	27.0	27.6		33	14.5	14.8		63	14.5	14.8	
4	34.0	34.7		34	15.5	15.8		64	15.0	15.3	
5	28.0	28.6		35	20.0	20.4		65	17.5	17.9	
6	25.0	25.5		36	20.5	21.0		66	21.0	21.5	
7	24.0	24.5		37	26.0	26.6		67	22.5	23.0	
8	22.0	22.5		38	27.5	28.1		68	24.5	25.0	
9	20.5	21.0		39	24.5	25.0		69	24.0	24.5	
10	19.0	19.4		40	23.0	23.5		70	26.0	26.6	
11	17.0	17.4		41	22.5	23.0		71	27.5	28.1	
12	16.5	16.9		42	21.0	21.5		72	23.5	24.0	
13	17.5	17.9		43	19.5	19.9		73	22.0	22.5	
14	21.0	21.5		44	18.0	18.4		74	20.5	21.0	
15	24.0	24.5		45	17.0	17.4		75	19.0	19.4	
16	25.5	26.1		46	16.0	16.4		76	17.0	17.4	
17	26.5	27.1		47	16.5	16.9					
18	27.0	27.6		48	18.5	18.9					
19	26.0	26.6		49	21.0	21.5					
20	25.5	26.1		50	24.0	24.5					
21	26.0	26.6		51	26.5	27.1					
22	27.0	27.6		52	28.0	28.6					
23	26.0	26.6		53	26.0	26.6					
24	23.0	23.5		54	25.0	25.5					
25	20.5	21.0		55	26.0	26.6					
26	19.0	19.4		56	21.5	22.0					
27	17.5	17.9		57	21.0	21.5					
28	16.0	16.4		58	20.0	20.4					
29	14.5	14.8		59	18.0	18.4					
30	13.5	13.8		60	17.0	17.4					
averages:		22.9	23.4			20.7	21.1			20.3	20.8

Drift Cal. Avg. VOC (ppm as propane) 22.0

EPA Method 2 : Determination of Stack Gas Velocity and Volumetric Flow Rate (Standard Pitot Tube)

Sample Calculations

molecular weight dry (grams/mole)

$= 0.440(\%CO_2) + 0.320(\%O_2) + 0.280(\%N_2 + \%CO)$

$= 0.440(0.0\ \%CO_2) + (0.320)(20.9\ \%O_2) + (0.280)(79.1\ \%N_2)$

$= 28.836$ grams/mole

molecular weight actual (grams/mole)

$= M_d(1 - B_{ws}) + 18.0(B_{ws})$

$= (28.836\ \text{grams/mole})(1 - 0.0) + (18.0)(0.0)$

$= 28.836$ grams/mole

gas velocity (ft/sec)

$= \{85.49\ \text{ft/sec}\ [(\text{lb/lb-mole})(\text{in. Hg})/(^\circ\text{R})(\text{in. } H_2O)]^{1/2}\}C_p(\Delta p^{1/2})_{avg}(T_{s(avg)}/P_sM_s)^{1/2}$

$= (85.49)(0.99)(0.4365)\{(70+460)/[(24.958-0.80/13.6)(28.836)]\}^{1/2}$

$= 31.7$ ft/sec

gas flow (acfm)

$= A_{vs}(60\ \text{seconds/minute})$

$= (\Pi)(13.54/12\ \text{ft})^2(31.7\ \text{ft/sec})(60)/4$

$= 1904$ acfm

gas flow (dscfm)

$= (60\ \text{seconds/minute})(1 - B_{ws})v_sAT_{std}P_s/(T_{s(avg)}P_{std})$

$= (60)(1-0.0)(31.7)(\Pi)(13.54/12\ \text{ft})^2(528)(24.958-0.80/13.6)/[(70+460)(29.92)(4)]$

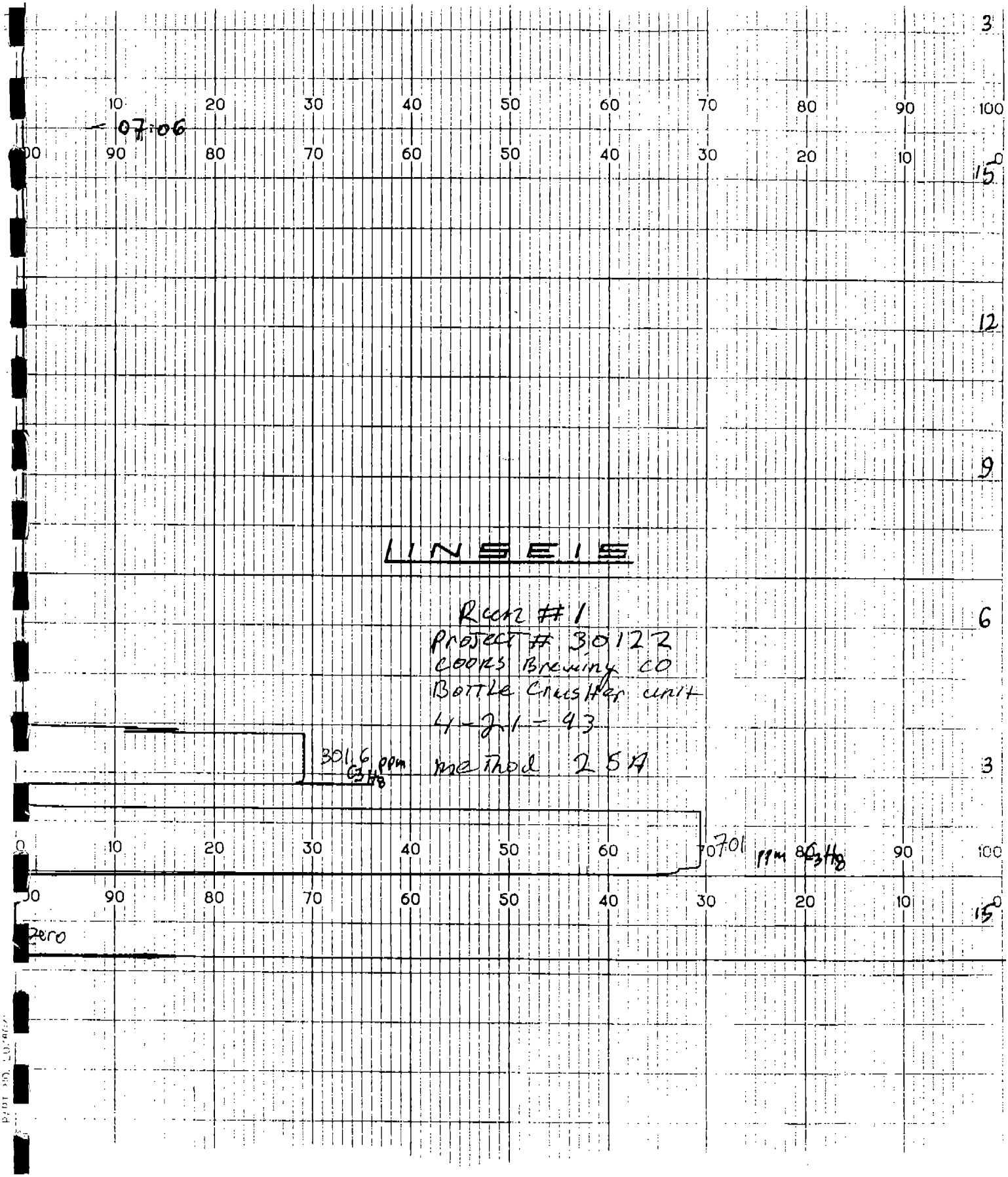
$= 1579$ dscfm

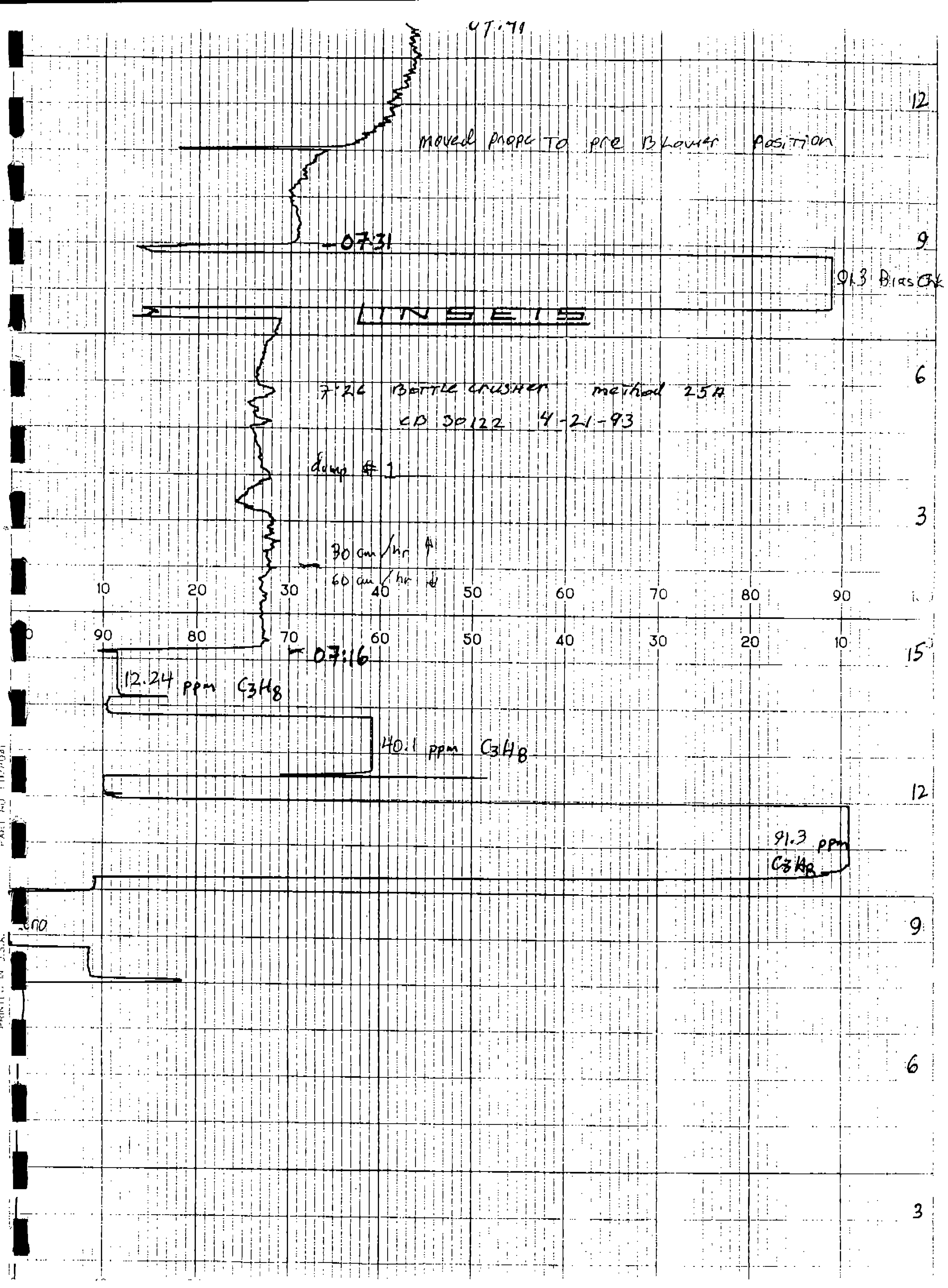
EPA Method 2 : Determination of Stack Gas Velocity and Volumetric Flow Rate (Standard Pitot Tube)

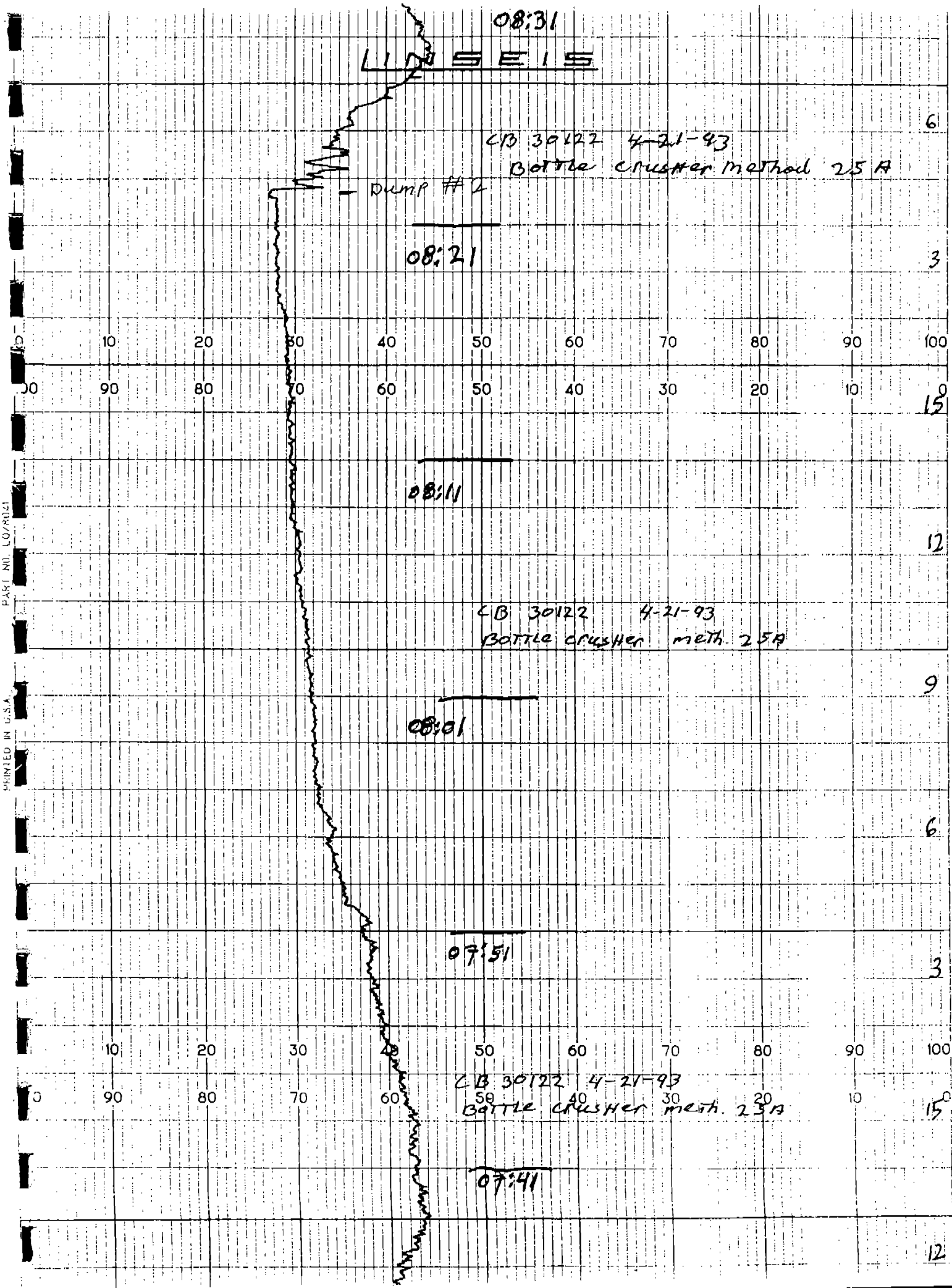
Variables

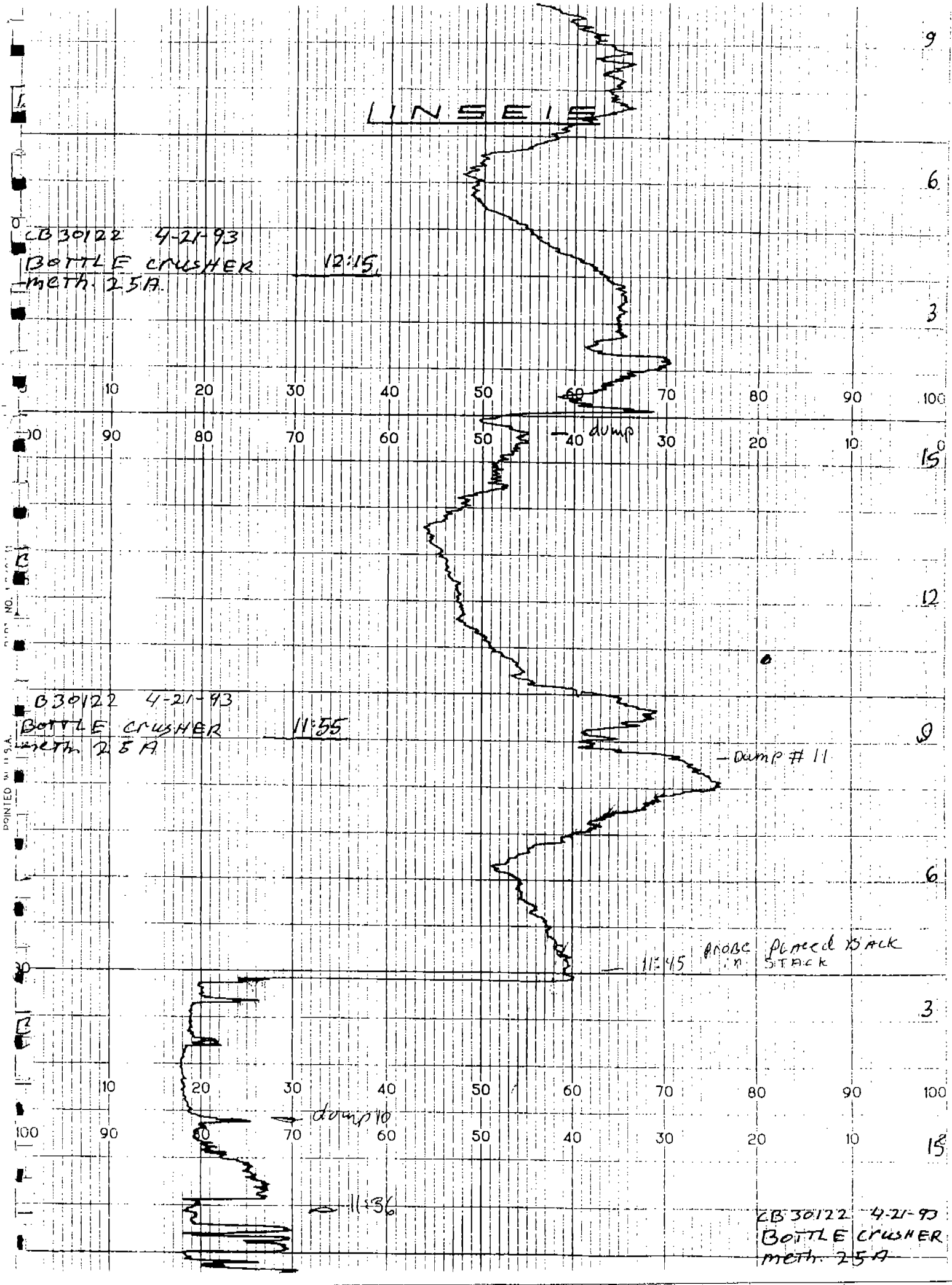
A = Stack cross-sectional area (ft^2)
B_{ws} = Water vapor in the gas stream, proportion by volume
C_p = Pitot coefficient (0.99 dimensionless)
Δp = Velocity head of stack gas (in. H_2O)
M_d = Molecular weight of dry stack gas (lb/lb mole)
M_s = Molecular weight of wet stack gas (lb/lb mole)
P_{bar} = Barometric pressure (in. Hg)
P_g = Stack pressure relative to ambient (in. H_2O)
P_s = Absolute stack pressure (in. Hg)
P_{std} = Standard atmospheric pressure (29.92 in. Hg)
Q_a = Actual volumetric air flow out of stack (acfm)
Q_{std} = Volumetric air flow out of stack corrected to standard conditions (dscfm)
$T_{s(avg)}$ = Average stack temperature (°F + 460 = °R)
T_{std} = Standard temperature (528 °R)
v_s = Stack gas velocity (ft/sec)

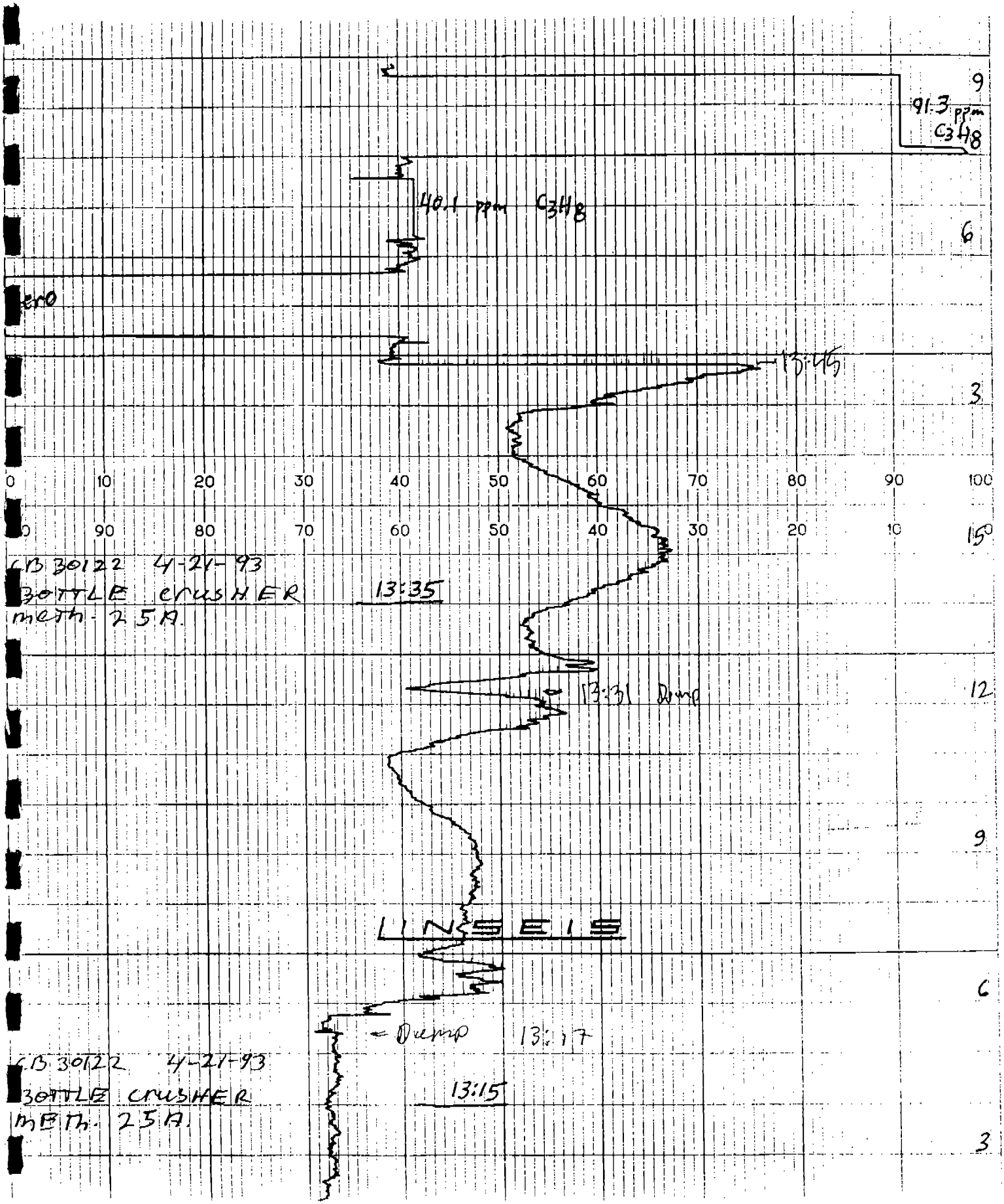
Appendix 2
Field Data

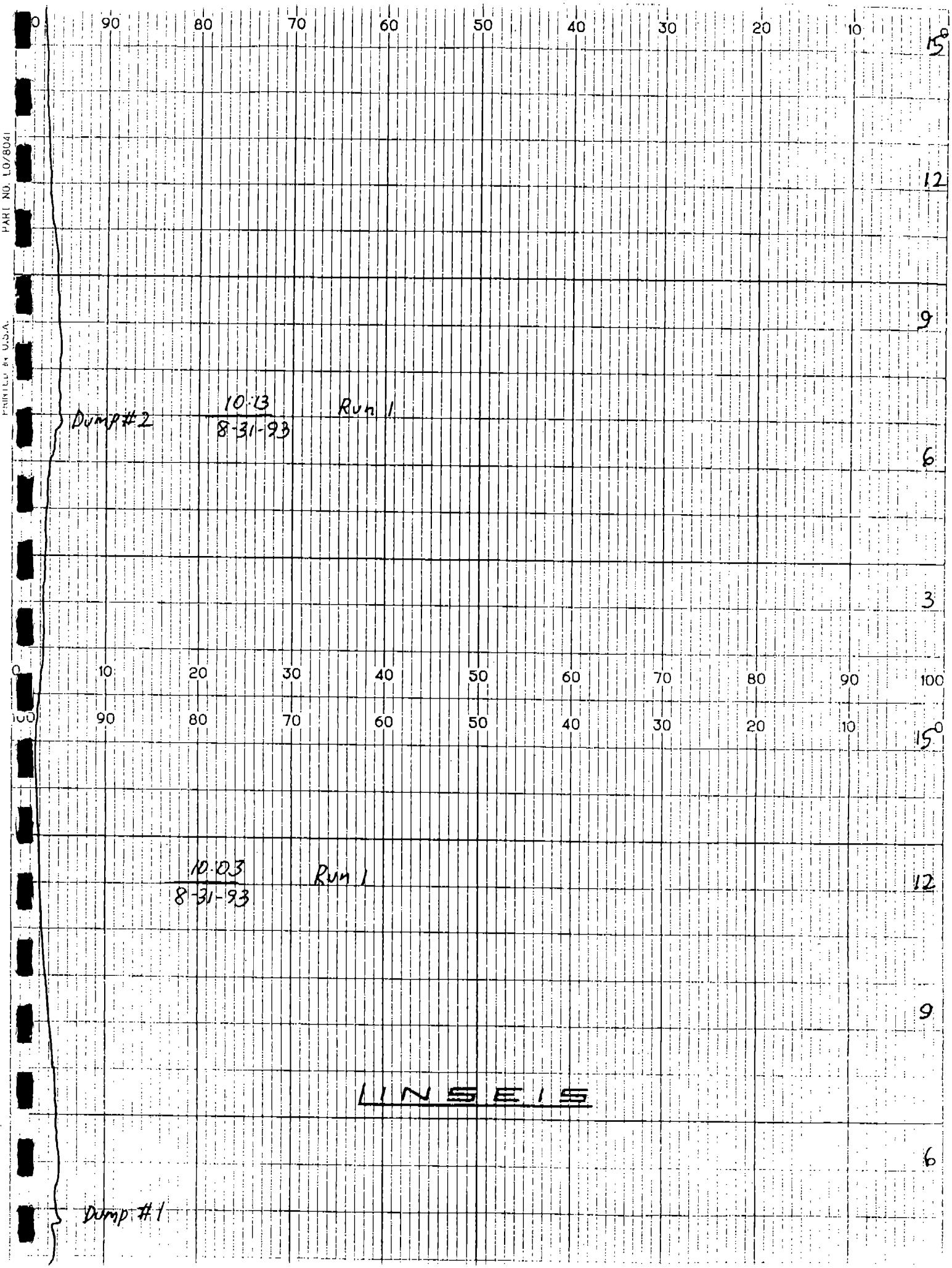

07:06
LINSEIS
Run #1
Project # 3012R
Coors Brewing CO
Bottle Crusher unit
4-21-93
301.6 ppm C3H8
method 257
707.01 ppm C3H8
zero

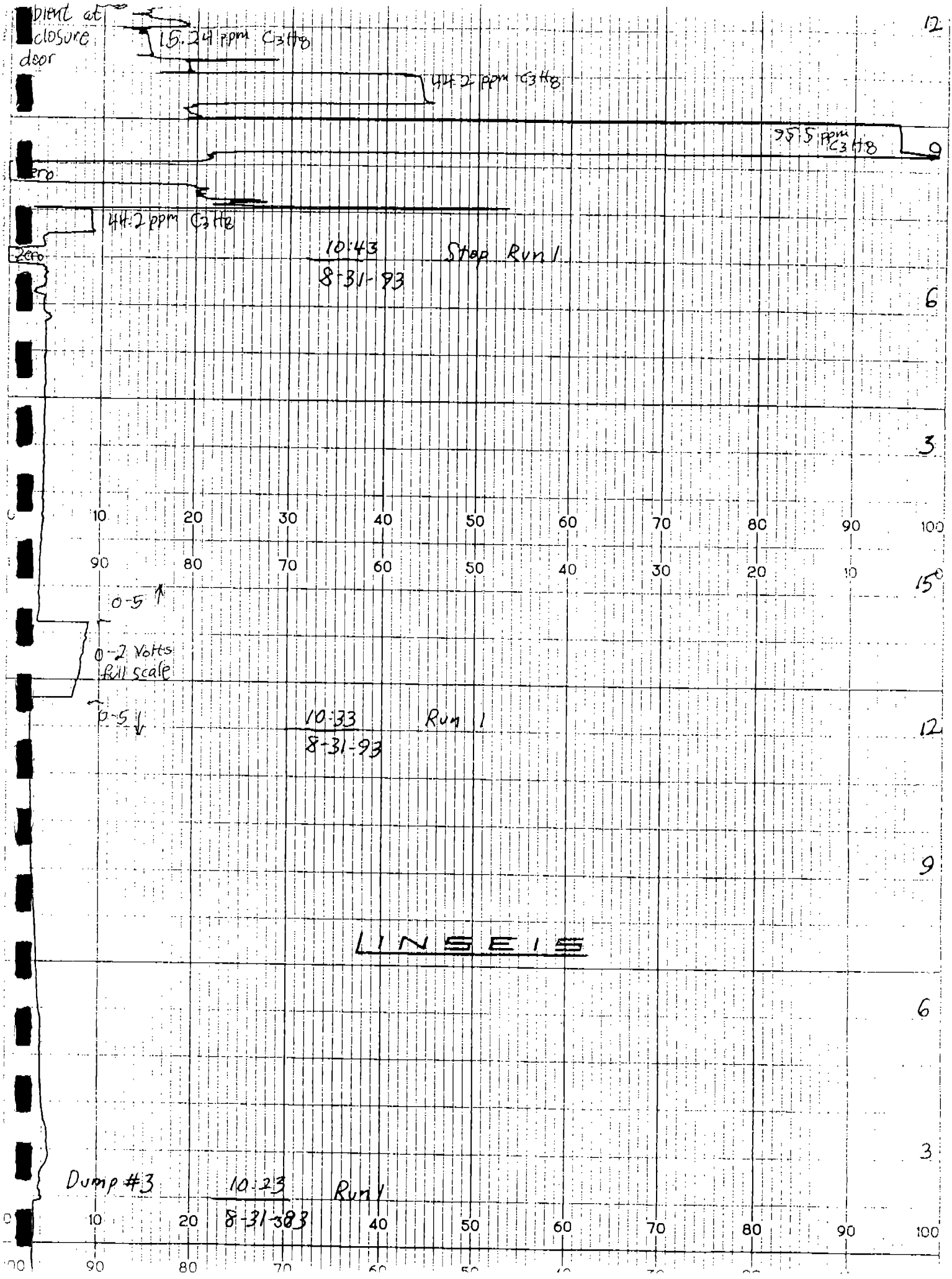

07:41
moved probe to pre Blower position
0731
91.3 Bias Chk
LINSEIS
7:26 Bottle crusher method 25A
CD 30122 4-21-93
dump #1
30 cm/hr ↑
60 cm/hr ↓
10 20 30 40 50 60 70 80 90
90 80 70 60 50 40 30 20 10
07:16
12.24 ppm C_3H_8
40.1 ppm C_3H_8
91.3 ppm C_3H_8
zero
12
9
6
3
15
12
9
6
3
PRINTED IN U.S.A.

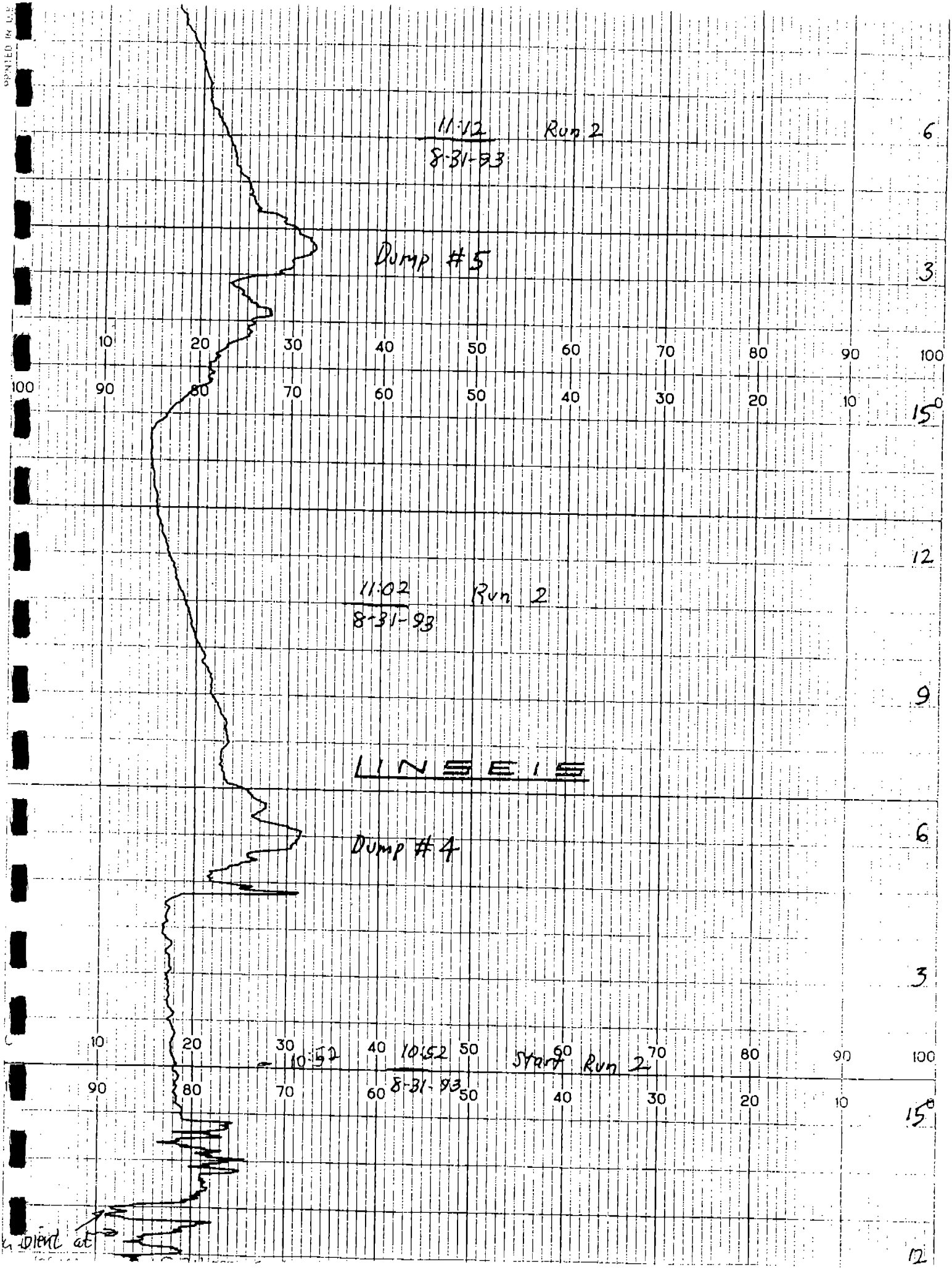

08:31
LINES
6
CB 30122 4-21-93
Bottle crusher method 25 A
Dump #4
08:21
3
10 20 30 40 50 60 70 80 90 100
00 90 80 70 60 50 40 30 20 10 0
15
08:11
12
CB 30122 4-21-93
Bottle crusher meth. 25A
9
08:01
6
07:51
3
10 20 30 40 50 60 70 80 90 100
0 90 80 70 60 50 40 30 20 10 0
CB 30122 4-21-93
Bottle crusher meth. 25A
15
07:41
12
PART NO. LO/R121
PRINTED IN U.S.A.

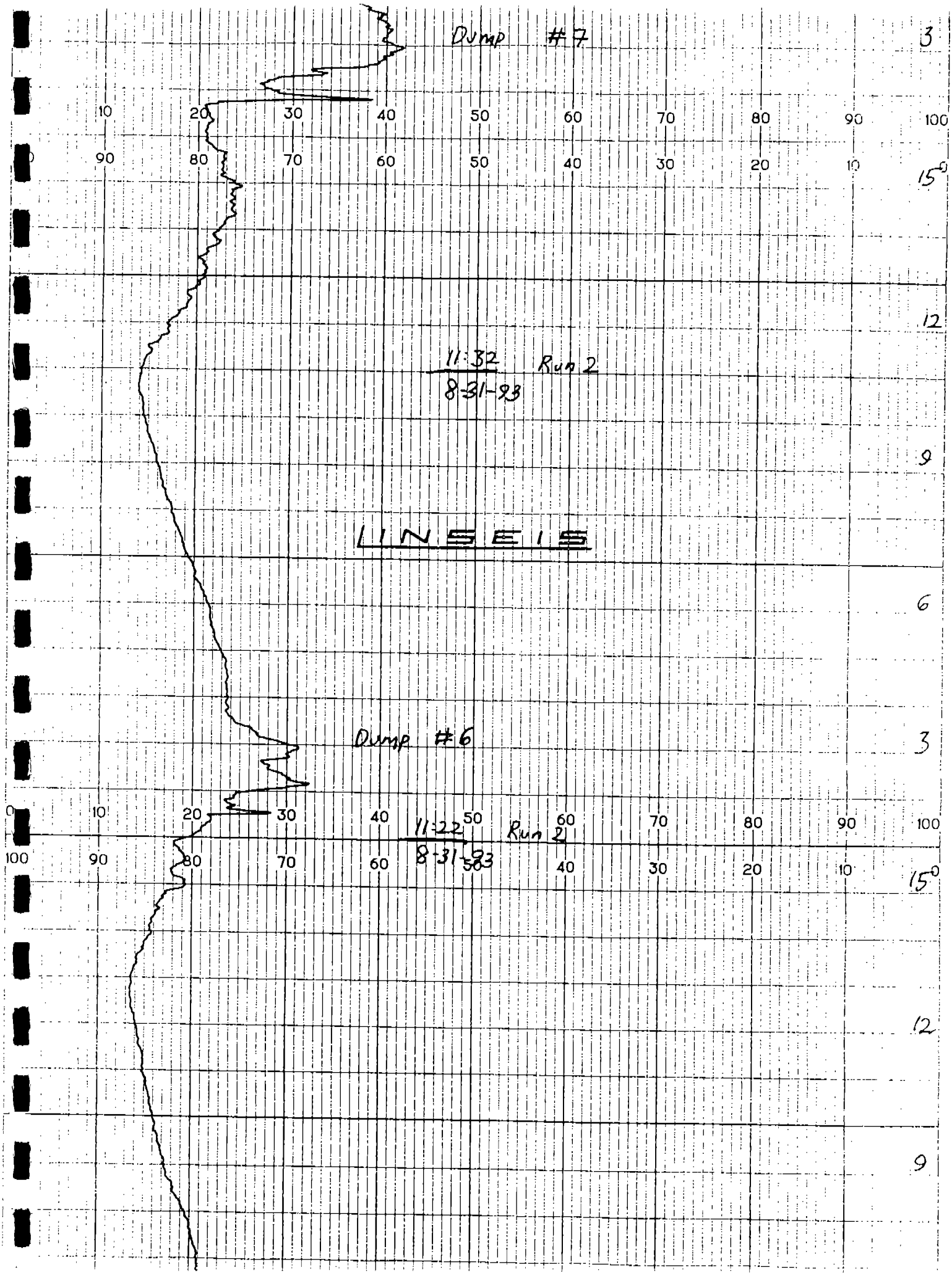

LINSEIS
CB30122 4-21-93
BOTTLE CRUSHER
meth. 25A.
12:15
dump
CB30122 4-21-93
BOTTLE CRUSHER
meth. 25A
11:55
Dump # 11
11:45 probe placed back in stack
dump 10
11:36
CB30122 4-21-93
BOTTLE CRUSHER
meth. 25A

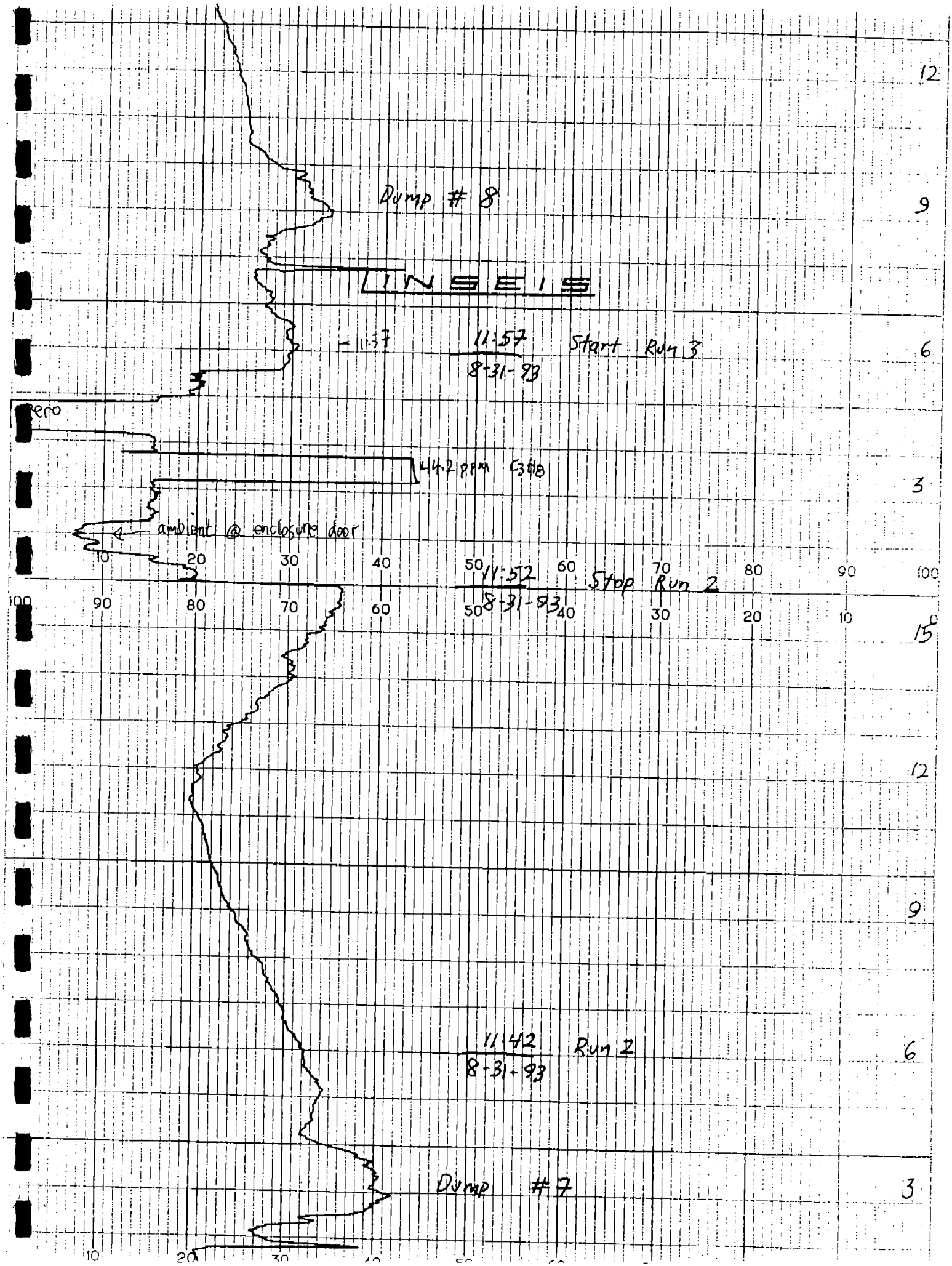


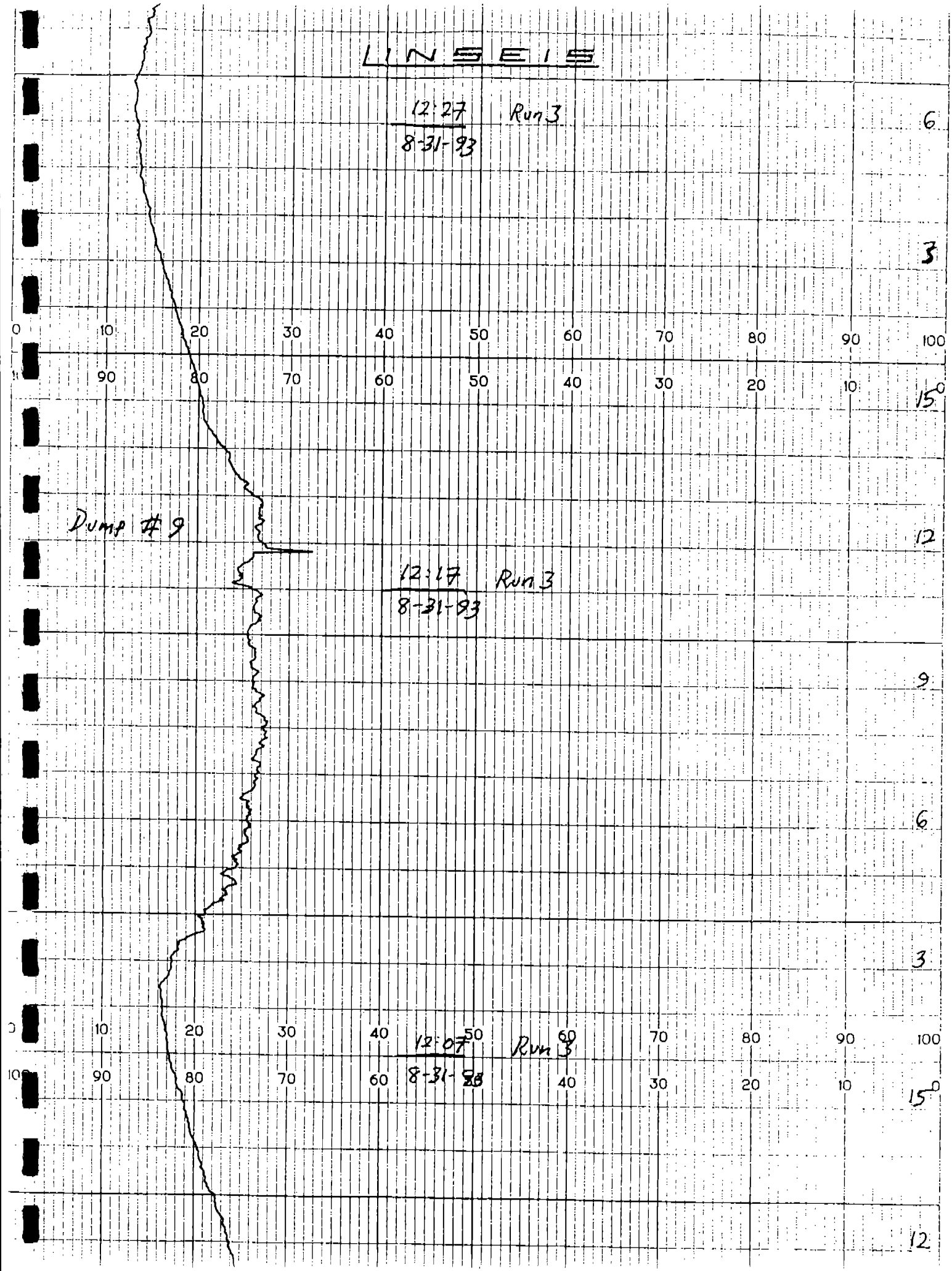

0 90 80 70 60 50 40 30 20 10 15°
12
9
Dump #2
10:13
8-31-93
Run 1
6
3
0 10 20 30 40 50 60 70 80 90 100
100 90 80 70 60 50 40 30 20 10 15°
10:03
8-31-93
Run 1
12
9
LINSEIS
6
Dump #1

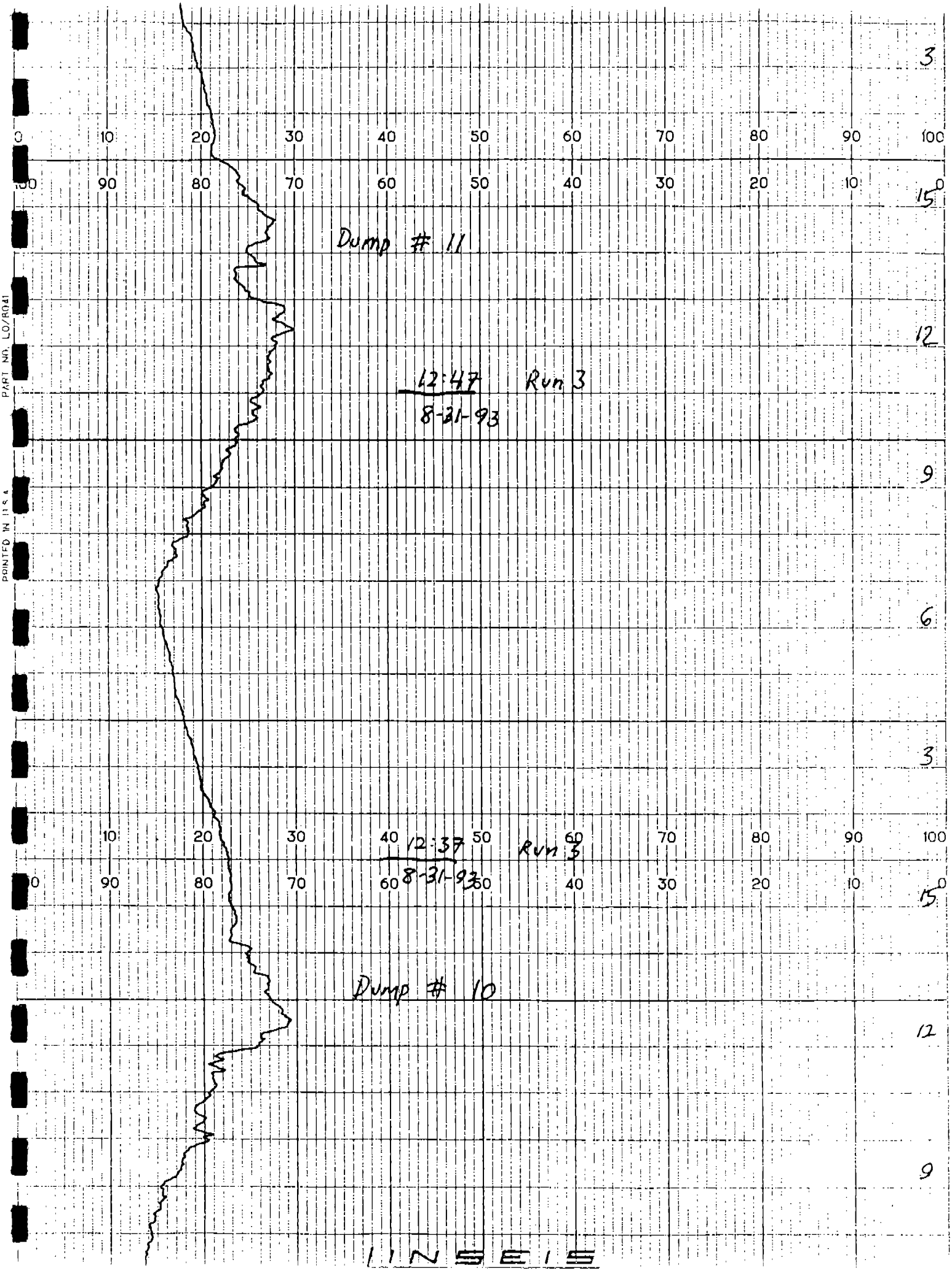

Ambient at closure door
15.24 ppm C3H8
444.2 ppm C3H8
955 ppm C3H8
Zero
444.2 ppm C3H8
Zero
10:43
8-31-93
Step Run 1
12
9
6
3
0
10 20 30 40 50 60 70 80 90 100
90 80 70 60 50 40 30 20 10 0
15
0-5 V
0-2 Volts
Full scale
0-5 V
10:33
8-31-93
Run 1
12
9
LINSEIS
6
3
Dump #3
10:23
8-31-93
Run 1
0
10 20 40 50 60 70 80 90 100
90 80 70 60 50 40 30 20 10 0

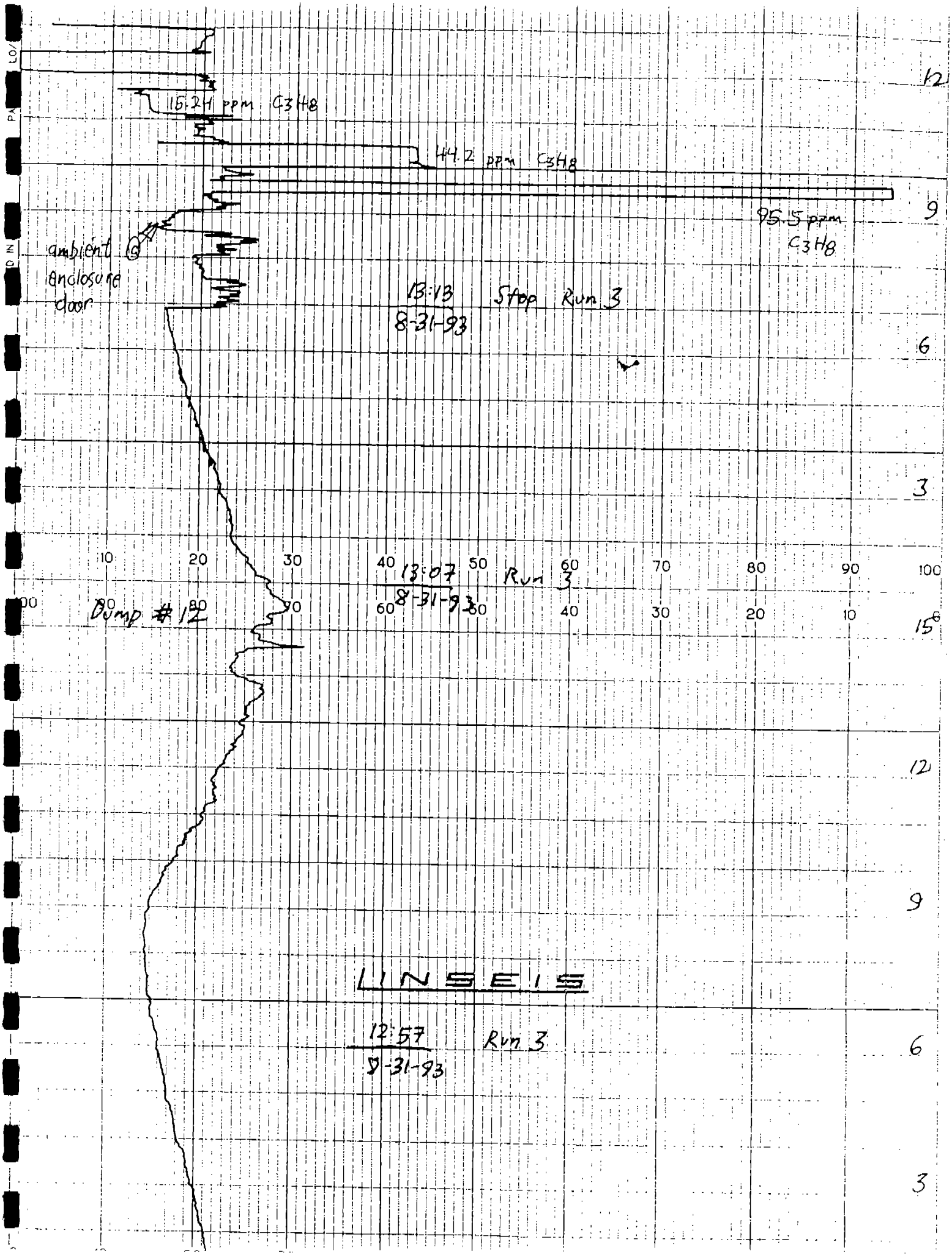

11:12
8-31-93
Run 2
Dump #5
11:02
8-31-93
Run 2
LINSEIS
Dump #4
10:52
10:52
8-31-93
Start Run 2


Dump #7
11:32
8-31-93
Run 2
LINSEIS
Dump #6
11:22
8-31-93
Run 2


Dump # 8
UNSEIS
11:57
8-31-93
Start Run 3
zero
44.2 ppm C3H8
ambient @ enclosure door
11:52
8-31-93
Stop Run 2
11:42
8-31-93
Run 2
Dump #7


LINSEIS
12:27 Run 3
8-31-93
Dump #9
12:17 Run 3
8-31-93
12:07 Run 3
8-31-93


Dump # 11
12:47
8-31-93
Run 3
12:37
8-31-93
Run 3
Dump # 10
LINERS


115.2 ppm C3H8
44.2 ppm C3H8
95.5 ppm C3H8
ambient @ enclosure door
13:13 Stop Run 3
8-31-93
13:07 Run 3
8-31-93
Dump #12
LINSEIS
12:57 Run 3
8-31-93

Plant	Coors Brewing Date 8-31-93
Location	Bottle Crusher
Operator	PO / MJ
Run Number	1
Pilot Tube Coefficient	0.99
Sample Box ID#	
Meter Box ID#	
Meter ΔH@	
C Factor	
Pre-Test Pilot Leak Check	✓
Post-Test Pilot Leak Check	✓
Pre-Test Pump Leak Check	
Post-Test Pump Leak Check	

Air Pollution Testing, Inc.
Schematic of Stack Cross Section

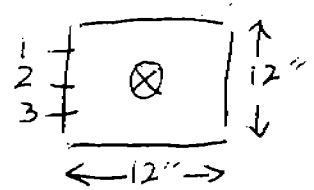
CO2 (%)	O2 (%)
Assumed Moisture (%)	Barometric Pressure (mbar) 843
Ambient Temperature (oF)	Probe Material
Probe Length (ft) 2	Filter Temperature (oF)
Probe Temperature (oF)	Moisture (grams)
Nozzle Diameter (in)	Start Time
Static Pressure (in H2O) -0.73	Stop Time
Filter ID#	Method 1-2

Traverse Point Number	Sampling Time (minutes)	Vacuum (in Hg)	Velocity Head (in H2O)	Pressure Differential (in H2O)	Gas Volume (ft3) Initial Volume	Stack Temp. (oF)	Probe Temp. (oF)	Filter Temp. (oF)	Gas Temp. Inlet (oF)	Gas Temp. Outlet (oF)	Condenser Temp. (oF)	Notes
1-1			0.02			73						
2			-0.04			73						Inlet ① 234 sfpm
3			-0.03			73						65 °F
2-1			0.24			73						
2			0.08			73						3 crushes
3			0.18			73						
3-1			0.45			73						
2			0.44			73						② 261 sfpm
3			0.48			73						67 °F
			0.3324			73						

Plant	Coors Brewing
Date	8-31-93
Location	Bottle Crusher
Operator	PO/MJ
Run Number	2
Pitot Tube Coefficient	0.99
Sample Box ID#	
Meter Box ID#	
Meter ΔH@	
C Factor	
Pre-Test Pitot Leak Check	✓
Post-Test Pitot Leak Check	✓
Pre-Test Pump Leak Check	
Post-Test Pump Leak Check	

Air Pollution Testing, Inc.

Schematic of Stack Cross Section



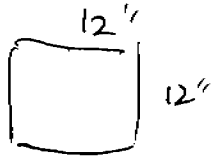
CO2 (%)	O2 (%)
Assumed Moisture (%)	Barometric Pressure (mbar) 843
Ambient Temperature (oF)	Probe Material
Probe Length (ft)	Filter Temperature (oF)
Probe Temperature (oF)	Moisture (grams)
Nozzle Diameter (in)	Start Time
Static Pressure (in H2O) -0.72	Stop Time
Filter ID#	Method 1-2

Traverse Point Number	Sampling Time (minutes)	Vacuum (in Hg)	Velocity Head (in H2O)	Pressure Differential (in H2O)	Gas Volume (ft3) Initial Volume	Stack Temp. (oF)	Probe Temp. (oF)	Filter Temp. (oF)	Gas Temp. Inlet (oF)	Gas Temp. Outlet (oF)	Condenser Temp. (oF)	Notes
1-1			0.06			73						
2			-0.02			72						Inlet(1) 217 sfpm
3			-0.01			73						69 °F
2-1			0.20			73						(2) 276 sfpm
2			0.09			73						72
3			0.16			73						4 crushes
3-1			0.45			73						
2			0.48			73						
3			0.47			73						
			0.3555			73						

Plant	Coors Brewing
Date	8-31-93
Location	Bottle Crusher
Operator	PO / MJ
Run Number	3
Pitot Tube Coefficient	0.99
Sample Box ID#	/
Meter Box ID#	/
Meter ΔH@	/
C Factor	/
Pre-Test Pitot Leak Check	✓
Post-Test Pitot Leak Check	✓
Pre-Test Pump Leak Check	/
Post-Test Pump Leak Check	/

Air Pollution Testing, Inc.

Schematic of Stack Cross Section



CO2 (%)	0.0
O2 (%)	20.9
Assumed Moisture (%)	0.0
Barometric Pressure (mbar)	841
Ambient Temperature (oF)	70
Probe Material	
Probe Length (ft)	2
Filter Temperature (oF)	/
Probe Temperature (oF)	/
Moisture (grams)	/
Nozzle Diameter (in)	/
Start Time	
Static Pressure (in H2O)	-0.74
Stop Time	
Filter ID#	/
Method	1-2

Traverse Point Number	Sampling Time (minutes)	Vacuum (in Hg)	Velocity Head (in H2O)	Pressure Differential (in H2O)	Gas Volume (ft3) Initial Volume	Stack Temp. (oF)	Probe Temp. (oF)	Filter Temp. (oF)	Gas Temp. Inlet (oF)	Gas Temp. Outlet (oF)	Condenser Temp. (oF)	Notes
1-1			0.08			74						Inlet (1) 220 sfpm
2			-0.02			74						67 °F
3			-0.01			74						(2) 216 sfpm
2-1			0.19			73						69 °F
2			0.14			73						5 crushes
3			0.23			73						
3-1			0.46			73						
2			0.45			73						
3			0.46			73						
			0.3731			73						

Appendix 3
Calibration Certificates

Scott Specialty Gases, Inc.

E. P. A. PROTOCOL CERTIFICATE OF ANALYSIS

Shipped from:
Scott Specialty Gases
Route 611
Plumsteadville, PA 18949
Purchase order :
91047

Shipped to:
AIR POLLUTION TESTING INC
ATTN: PO#91047
4535 W 68TH AVE
WESTMINSTER, CO 80030

Project No 0134629

Certified per E.P.A. Protocol # 1 Procedure #G1 Section # 3.0.4
Certified accuracy +/- 1 % NIST Traceable

Cylinder number	ALM002673	Cylinder pressure 2000 psig.	Date of assay: 1/23/92
Component		Certified concentration	Expiration date: 7/23/93
PROPANE		12.24 ppm	
NITROGEN		Balance	

Standard		Analyzer	
Type	GMIS	Make	: VARIAN
Concentration	14.99 ppm	Model	: VA3300
Cylinder #	AAL-12327	Serial number	: 7945
		Analytical principle	: FID
		Date of calibration	: 1/23/92

Raw data units:	AREA		Concentration of Customer Cylinder
Analysis	1/23/92		
Z1=0.00 R1=67168	T1=54766		12.22 ppm
R2=67173 Z2=0.00	T2=54787		12.23 ppm
Z3=0.00 T3=54905	R3=67021		12.28 ppm

Analyst _____ Approved by _____
Mark S. Sirinides/Ted Neeme

Scott Specialty Gases, Inc.

E. P. A. PROTOCOL CERTIFICATE OF ANALYSIS

Shipped from:
Scott Specialty Gases
Route 611
Plumsteadville, PA 18949
Purchase order :
91047

Shipped to:
AIR POLLUTION TESTING INC
ATTN: PO#91047
4535 W 68TH AVE
WESTMINSTER, CO 80030

Project No 0134629

Certified per E.P.A. Protocol # 1 Procedure #G1 Section # 3.0.4
Certified accuracy +/- 1 % NIST Traceable

Cylinder number	ALM016822	Cylinder pressure 2000 psig.	Date of assay: 1/23/92
Component		Certified concentration	Expiration date: 7/23/93
PROPANE		40.1 ppm	
NITROGEN		Balance	

Standard		Analyzer	
Type	GMIS	Make	: VARIAN
Concentration	98.21 ppm	Model	: VA3300
Cylinder #	CAL4282	Serial number	: 7945
		Analytical principle	: FID
		Date of calibration	: 1/23/92

Raw data units: AREA

Analysis 1/23/92

			Concentration of Customer Cylinder
Z1=0.00	R1=433693	T1=176863	40.1 ppm
R2=432885	Z2=0.00	T2=177019	40.2 ppm
Z3=0.00	T3=176482	R3=432460	40.1 ppm

Analyst Paul Smith

Approved by Ted Neeme
Mark S. Sirinides/Ted Neeme

Scott Specialty Gases, Inc.

E. P. A. PROTOCOL CERTIFICATE OF ANALYSIS

Shipped from:
Scott Specialty Gases
Route 611
Plumsteadville, PA 18949
Purchase order :
91047

Shipped to:
AIR POLLUTION TESTING INC
ATTN: PO#91047
4535 W 68TH AVE
WESTMINSTER, CO 80030

Project No 0134629

Certified per E.P.A. Protocol # 1 Procedure #G1 Section # 3.0.4
Certified accuracy +/- 1 % NIST Traceable

Cylinder number	ALM019712	Cylinder pressure 2000 psig.	Date of assay: 1/23/92
Component		Certified concentration	Expiration date: 7/23/93
PROPANE		91.3 ppm	
NITROGEN		Balance	

Standard		Analyzer	
Type	GMIS	Make	: VARIAN
Concentration	98.21 ppm	Model	: VA3300
Cylinder #	CAL4282	Serial number	: 7945
		Analytical principle	: FID
		Date of calibration	: 1/23/92

Raw data units:		AREA		Concentration of Customer Cylinder
Analysis		1/23/92		
Z1=0.00	R1=432474	T1=402119		91.3 ppm
R2=432431	Z2=0.00	T2=402018		91.3 ppm
Z3=0.00	T3=402149	R3=432116		91.4 ppm

Analyst Paul W. Smith

Approved by Ted Neeme
Mark S. Sirinides/Ted Neeme

Scott Specialty Gases

500 WEAVER PARK ROAD, LONGMONT, COLORADO 80501 (303) 442-4700 Fax (303) 772-7673

Shipped From : Scott Colorado
Date Shipped : 8-18-92
Our Project # : 808272
Your P.O. # : 92-693
Page ____ of ____
Expiration Date : 02/07/94

Customer : AIR POLLUTION TESTING INC
4535 W. 68TH AVE
WESTMINSTER CO 80030

**** CERTIFICATE OF ANALYSIS - EPA PROTOCOL GASES ****

Certified Per Traceability Section 3.0.4
Protocol # 1
File # APT301C3
Certified Accuracy 1 % NIST Traceable

Cylinder Number AAL-6506
Cylinder Pressure 2000 psig
CGA Fitting 350
QC Number 22139217

COMPONENT	CERTIFIED CONC.	REFERENCE STDS SRM # (CRM #)	CYLINDER NUMBER	CONC.	GAS ANALYZER MAKE/MODEL	LAST CALIBRATION DATE	ANALYTICAL PRINCIPLE
PROPANE	301.6 PPM	2646	AAL-18342	973.0 PPM	HEWLETT PACKARD/5890A 3115A34623	07-13-92	FLAME IONIZATION
		GMIS*	1L-14382	314.0 PPM			

BALANCE GAS : NITROGEN

CERTIFIED EPA PROTOCOL

FIRST ANALYSIS DATE : 07/31/92

ZERO GAS (mV)	TEST GAS (mV)	RESULTS PPM	REFERENCE GAS CONC.	REFERENCE GAS (mV)	REFERENCE GAS RESULTS PPM
0.00	0.3020	302.0	314.0 PPM	0.3140	314.0
0.00	0.3020	302.0		0.3140	314.0
0.00	0.3020	302.0		0.3140	314.0

CALCULATED RESULTS 302.0, 302.0, 302.0

AVERAGE : 302.0 PPM

SECOND ANALYSIS DATE : 08/07/92

ZERO GAS (mV)	TEST GAS (mV)	RESULTS PPM	REFERENCE GAS CONC.	REFERENCE GAS (mV)	REFERENCE GAS RESULTS PPM
0.00	0.3011	301.1	314.0 PPM	0.3140	314.0
0.00	0.3011	301.1		0.3140	314.0
0.00	0.3011	301.1		0.3140	314.0

CALCULATED RESULTS 301.1, 301.1, 301.1

AVERAGE : 301.1 PPM

CALIBRATION CURVE 1 st DEGREE

SRM # (CRM #)	CONC. %	SPLIT PT (%)	DVM (mV)	FITTED VALUE	PERCENT ERROR
	0.00	0	0.00	0.00	0.00
	0.00	0	0.00	0.00	0.00
	0.00	0	0.00	0.00	0.00
	0.00	0	0.00	0.00	0.00
	0.00	0	0.00	0.00	0.00
	0.00			0.00	0.00

* GMIS - GAS MANUFACTURER'S INTERNAL STANDARD

Analyst : David Chapman
DAVID CHAPMAN

Approved By : RS
RIC SCHMELTEKOPF

Scott Specialty Gases, Inc.

E. P. A. PROTOCOL CERTIFICATE OF ANALYSIS

Shipped from:
Scott Specialty Gases
Route 611
Plumsteadville, PA 18949
Purchase order :
91047

Shipped to:
AIR POLLUTION TESTING INC
ATTN: PO#91047
4535 W 68TH AVE
WESTMINSTER, CO 80030

Project No 0134629

Certified per E.P.A. Protocol # 1 Procedure #G1 Section # 3.0.4
Certified accuracy +/- 1 % NIST Traceable

Cylinder number	ALM016808	Cylinder pressure 2000 psig.	Date of assay: 1/20/92
Component		Certified concentration	Expiration date: 7/20/93
PROPANE		701 ppm	
NITROGEN		Balance	

Standard		Analyzer	
Type	GMIS	Make	: VARIAN
Concentration	750.4 ppm	Model	: VA3300
Cylinder #	A-012415	Serial number	: 7945
		Analytical principle	: FID
		Date of calibration	: 11/11/91

Raw data units:		AREA	:	: Concentration of Customer Cylinder	
Analysis		1/20/92	:	:	
Z1=0.00	R1=60210	T1=56314	:	: 702	ppm
R2=60103	Z2=0.00	T2=56091	:	: 700	ppm
Z3=0.00	T3=56017	R3=60025	:	: 700	ppm

Analyst Pamela Smith

Approved by Ted Neeme
Mark S. Sirinides/Ted Neeme

Scott Specialty Gases, Inc.

6141 EASTON ROAD, P.O. BOX 310, PLUMSTEADVILLE, PA 18949-0310 (215) 766-8861 FAX: (215) 766-0320

CERTIFICATE OF ANALYSIS: EPA PROTOCOL GAS

Customer
Air Pollution Testing Inc
7711 W 6Th Ave
Suite 1
Lakewood, CO 80215

Assay Laboratory
Scott Specialty Gases, Inc.
6141 Easton Road
P.O. Box 310
Plumsteadville, PA 18949-0310

Purchase Order 931069
Scott Project # 01-47642-001

ANALYTICAL INFORMATION

Certified to exceed the minimum specifications of EPA Protocol 1 Procedure #G1, Section Number 3.0.4

Cylinder Number	ALM016727	**Certification Date**	05-26-93	**General Exp. Date**	11-26-93
Cylinder Pressure	1900 psig	**Previous Certification Dates**	None	**Acid Rain Exp. Date**	11-26-94

ANALYZED CYLINDER

Components	Certified Concentration	Analytical Uncertainty*
Propane	**15.24 ppm**	**±1% NIST Directly Traceable**
Balance Gas: Nitrogen		

*Analytical uncertainty is inclusive of usual known error sources which at least includes reference standard error & precision of the measurement processes.

REFERENCE STANDARD

Type	Expiration Date	Cylinder Number	Concentration
GMIS	07-29-93	A5794	18.15 ppm C_3H_8 in N_2

INSTRUMENTATION

Instrument/Model/Serial #	Last Date Calibrated	Analytical Principle
C3H8: Varian/VA3300/7945	04-29-93	FID

ANALYZER READINGS (Z=Zero Gas R=Reference Gas T=Test Gas r=Correlation Coefficient)

Components	First Triad Analysis	Second Triad Analysis	Calibration Curve
Propane	Date: 05-26-93 Response Units: Area Z1=000000 R1=198861 T1=167061 R2=199263 Z2=000000 T2=166253 Z3=000000 T3=167304 R3=198263 Avg. Conc. of Cust. Cyl. 15.24 ppm		Concentration=$A+Bx+Cx^2+Dx^3+Ex^4$ r=0.99999 Constants: A=0.0000E+00 B=0.0000E+00 C=0.0000E+00 D=0.0000E+00 E=0.0000E+00

Special Notes If this product is used for Acid Rain Rule compliance under 40 CFR Part 75, the Acid Rain Expiration Date applies per Appendix H. If for use with other than 40 CFR Part 75 compliance, the General Expiration Date applies.

Analyst Robert K. Kufrovich

Scott Specialty Gases, Inc.

6141 EASTON ROAD, P.O. BOX 310, PLUMSTEADVILLE, PA 18949-0310 (215) 766-8861 FAX: (215) 766-0320

CERTIFICATE OF ANALYSIS: EPA PROTOCOL GAS

Customer
Air Pollution Testing Inc
7711 W 6Th Ave
Suite 1
Lakewood, CO 80215

Assay Laboratory
Scott Specialty Gases, Inc.
6141 Easton Road
P.O. Box 310
Plumsteadville, PA 18949-0310

Purchase Order 931069
Scott Project # 01-47642-002

ANALYTICAL INFORMATION

Certified to exceed the minimum specifications of EPA Protocol 1 Procedure #G1, Section Number 3.0.4

Cylinder Number	ALM031818	**Certification Date**	05-27-93	**General Exp. Date**	11-27-93
Cylinder Pressure	1900 psig	**Previous Certification Dates**	None	**Acid Rain Exp. Date**	11-27-94

ANALYZED CYLINDER

Components	Certified Concentration	Analytical Uncertainty*
Propane	**44.2 ppm**	**±1% NIST Directly Traceable**
Balance Gas: Nitrogen		

*Analytical uncertainty is inclusive of usual known error sources which at least includes reference standard error & precision of the measurement processes.

REFERENCE STANDARD

Type	Expiration Date	Cylinder Number	Concentration
SRM1667B	03-10-97	CLM004711	47.3 ppm C_3H_8 in N_2

INSTRUMENTATION

Instrument/Model/Serial #	Last Date Calibrated	Analytical Principle
C3H8: Varian/VA3300/7945	05-27-93	FID

ANALYZER READINGS (Z=Zero Gas R=Reference Gas T=Test Gas r=Correlation Coefficient)

Components	First Triad Analysis	Second Triad Analysis	Calibration Curve
Propane	Date: 05-27-93 Response Units: Area Z1=000000 R1=521562 T1=487287 R2=521854 Z2=000000 T2=486512 Z3=000000 T3=488073 R3=521090 Avg. Conc. of Cust. Cyl. 44.2 ppm		Concentration=A+Bx+Cx^2+Dx^3+Ex^4 r=0.99999 Constants: A=0.0000E+00 B=0.0000E+00 C=0.0000E+00 D=0.0000E+00 E=0.0000E+00

Special Notes If this product is used for Acid Rain Rule compliance under 40 CFR Part 75, the Acid Rain Expiration Date applies per Appendix H. If for use with other than 40 CFR Part 75 compliance, the General Expiration Date applies.

Analyst Robert K. Kufrovich

Scott Specialty Gases, Inc.

6141 EASTON ROAD, P.O. BOX 310, PLUMSTEADVILLE, PA 18949-0310 (215) 766-8861 FAX: (215) 766-0320

CERTIFICATE OF ANALYSIS: EPA PROTOCOL GAS

Customer
Air Pollution Testing Inc
7711 W 6Th Ave
Suite 1
Lakewood, CO 80215

Assay Laboratory
Scott Specialty Gases, Inc.
6141 Easton Road
P.O. Box 310
Plumsteadville, PA 18949-0310

Purchase Order 931069
Scott Project # 01-47642-003

ANALYTICAL INFORMATION

Certified to exceed the minimum specifications of EPA Protocol 1 Procedure #G1, Section Number 3.0.4

Cylinder Number	ALM032646	**Certification Date**	05-25-93	**General Exp. Date**	11-25-93
Cylinder Pressure	1900 psig	**Previous Certification Dates**	None	**Acid Rain Exp. Date**	11-25-94

ANALYZED CYLINDER

Components	**Certified Concentration**	**Analytical Uncertainty***
Propane	**95.5 ppm**	**±1% NIST Directly Traceable**
Balance Gas: Nitrogen		

*Analytical uncertainty is inclusive of usual known error sources which at least includes reference standard error & precision of the measurement processes.

REFERENCE STANDARD

Type	**Expiration Date**	**Cylinder Number**	**Concentration**
GMIS	06-02-93	ALM029208	125.5 ppm C_3H_8 in N_2

INSTRUMENTATION

Instrument/Model/Serial #	**Last Date Calibrated**	**Analytical Principle**
C3H8: Varian/VA3300/7945	03-02-93	FID

ANALYZER READINGS (Z=Zero Gas R=Reference Gas T=Test Gas r=Correlation Coefficient)

Components	**First Triad Analysis**	**Second Triad Analysis**	**Calibration Curve**
Propane	Date: 05-25-93 Response Units: Area Z1=000000 R1=357466 T1=272375 R2=358404 Z2=000000 T2=272526 Z3=000000 T3=273405 R3=359979 Avg. Conc. of Cust. Cyl. 95.5 ppm		Concentration=$A+Bx+Cx^2+Dx^3+Ex^4$ r=0.99999 Constants: A=0.0000E+00 B=0.0000E+00 C=0.0000E+00 D=0.0000E+00 E=0.0000E+00

Special Notes If this product is used for Acid Rain Rule compliance under 40 CFR Part 75, the Acid Rain Expiration Date applies per Appendix H. If for use with other than 40 CFR Part 75 compliance, the General Expiration Date applies.

Analyst Robert K. Kufrovich

Appendix 4
Ethanol / Propane Conversion

Ethanol / Propane Conversion

An empirical constant for conversion of propane calibrated FIA data to true ethanol values was experimentally determined. Tedlar gas bags were filled with known volumes of hydorcarbon-free air using an SKC personal sampling pump and an NIST traceable bubble flow calibrator. The bags were then injected with precisely known masses of reagent grade ethanol, using a syringe that was weighed on a certified 0.1 mg scale before and after injection. The bags were allowed time to mix thoroughly and were analyzed using the FIA used for all filler room data collection presented in this report. Immediately before and after each bag was analyzed, the analyzer was challenged with hydorcarbon-free air and calibration gas prepared and certified in accordance with EPA Protocol 1.

Coors Brewing Company
Ethanol / Propane Conversion

Strip Chart Data

run #1	zero %FS	span %FS	span ppm
start	0.0	69.8	701
stop	0.2	69.0	
	bag %FS	bag ppm	
	20.0	201.4	

run #2	zero %FS	span %FS	span ppm
start	0.0	70.0	701
stop	0.2	69.5	
	bag %FS	bag ppm	
	24.0	240.5	

run #3	zero %FS	span %FS	span ppm
start	0.0	69.5	701
stop	0.2	68.0	
	bag %FS	bag ppm	
	68.0	693.3	

run #4	zero %FS	span %FS	span ppm
start	0.0	68.0	701
stop	0.0	67.5	
	bag %FS	bag ppm	
	21.3	220.4	

run #5	zero %FS	span %FS	span ppm
start	0.0	69.5	701
stop	0.0	69.5	
	bag %FS	bag ppm	
	30.0	302.6	

Table A4:1
Ethanol Propane Conversion
Strip Chart Data

Ethanol / Propane Conversion (continued)

Coors Brewing Company
Ethanol / Propane Conversion Data
1-14-93

Laboratory Data

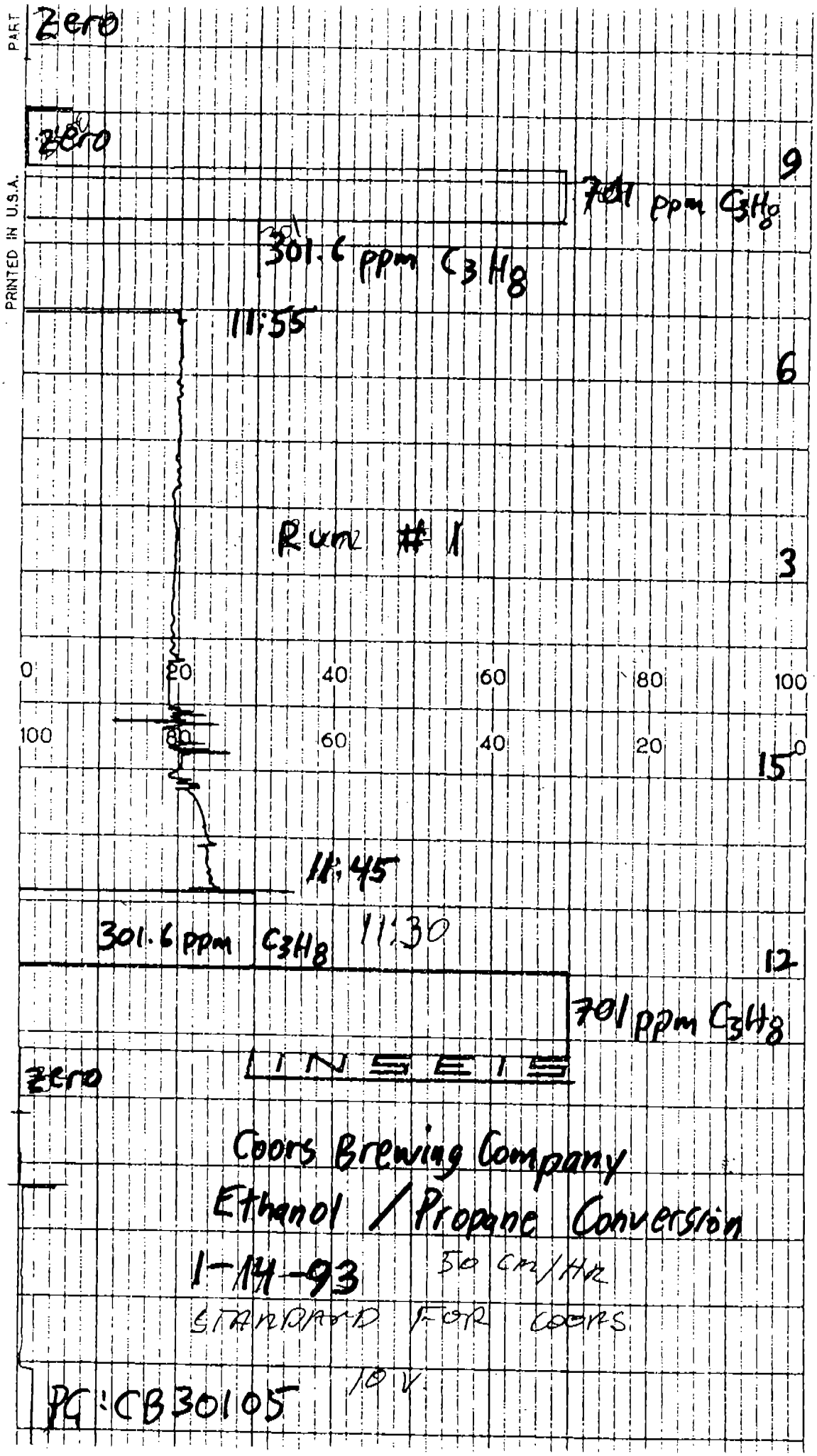
	Run #1	Run #2	Run #3	Run #4	Run #5	Averages
baro. press. (mbar)	842	842	842	842	842	842
temp. (oF)	70	70	70	70	70	70
flow (lpm)	1.85	1.89	1.90	2.37	2.32	2.07
time (min.)	15.0	16.0	15.0	18.0	17.0	16.2
ethanol (g)	0.0204	0.0281	0.0773	0.0350	0.0461	0.0414
propane (ppm)	201.4	240.5	693.3	220.4	302.6	331.6

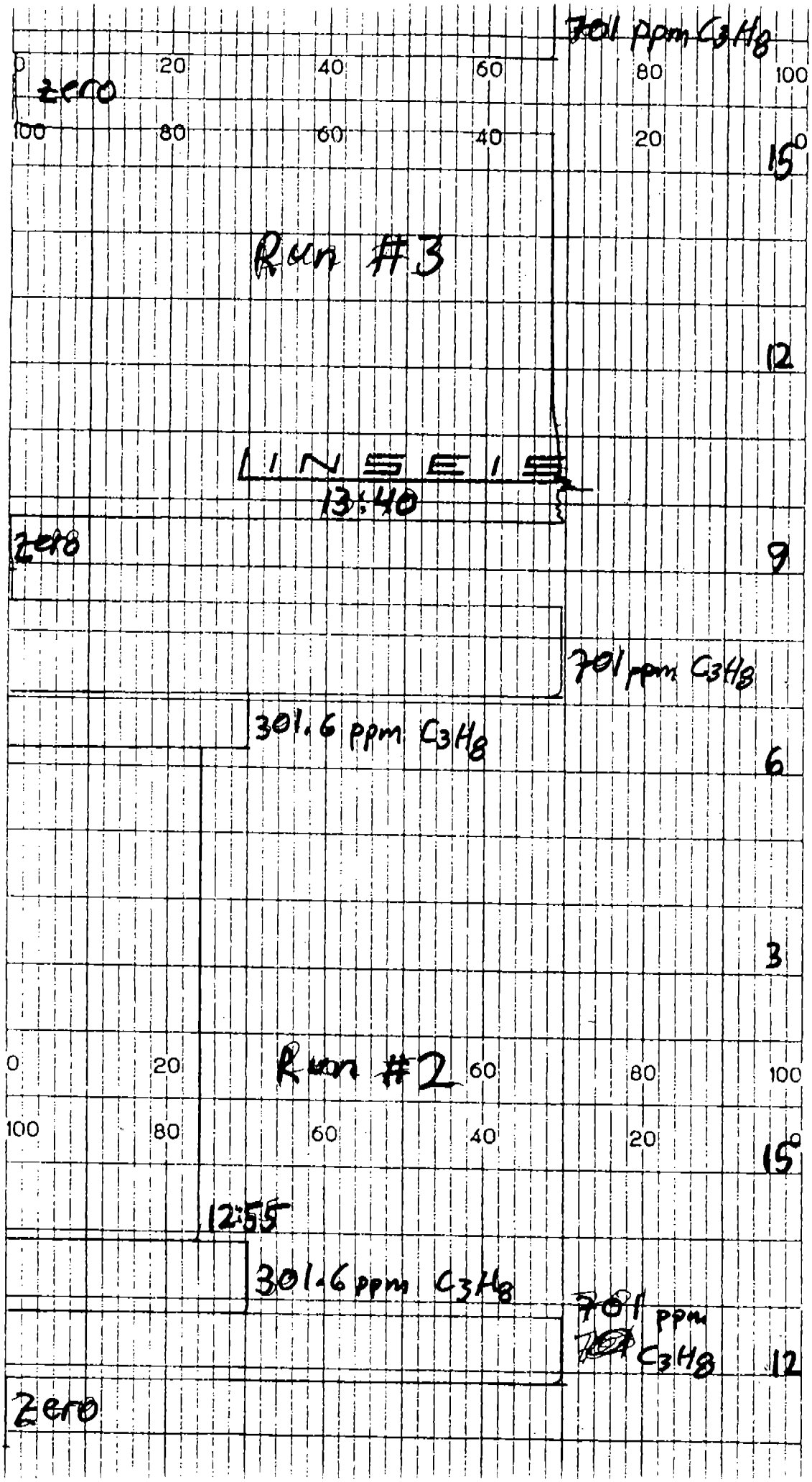
Calculations

	Run #1	Run #2	Run #3	Run #4	Run #5	Averages
ethanol (mg/scm)	890	1120	3275	991	1412	1538
propane (mg/scm)	369	441	1271	404	555	608
conversion factor	2.411	2.541	2.578	2.453	2.545	2.506

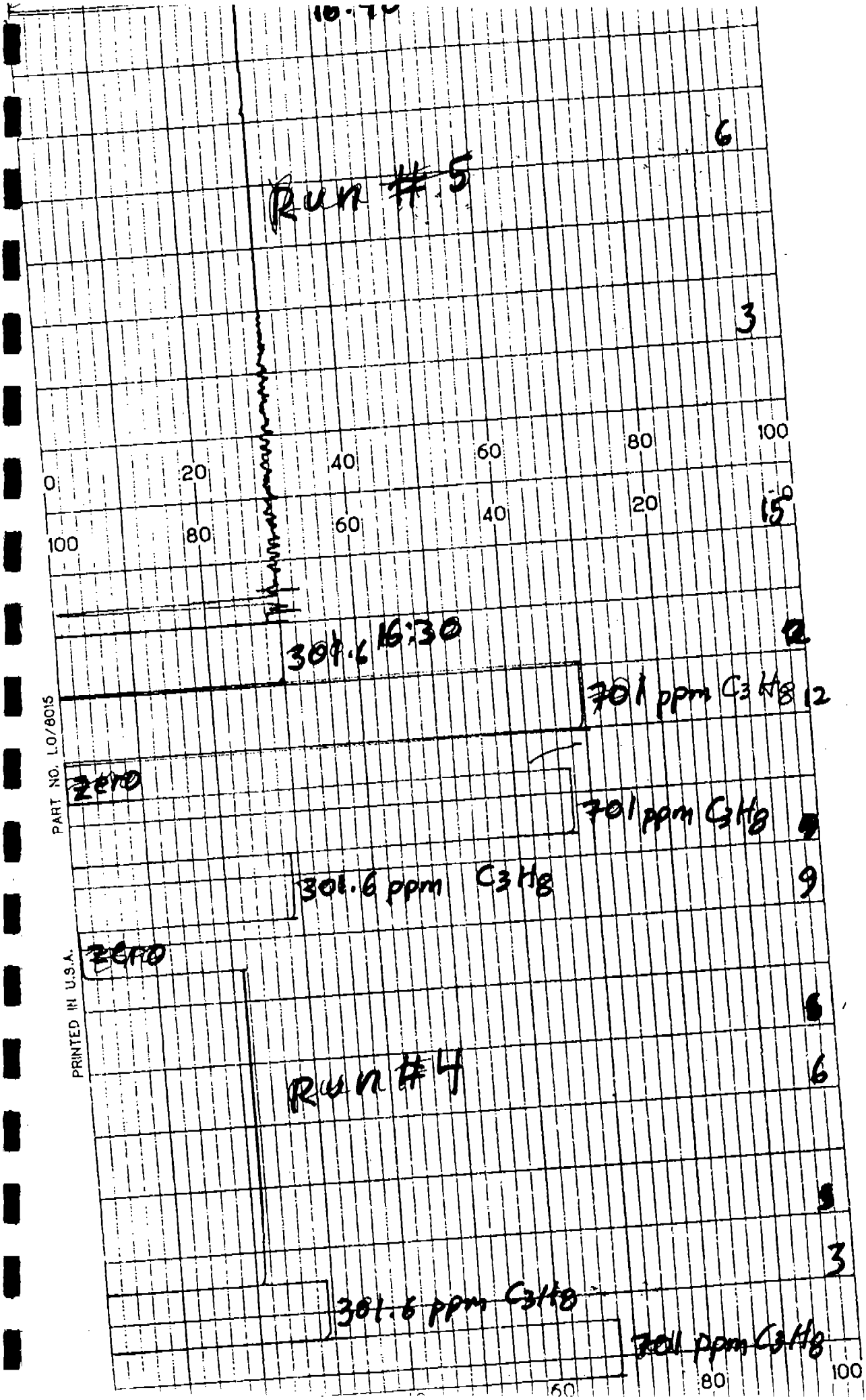
Table A4:2
Ethanol / Propane Conversion
Laboratory Data and Calculations

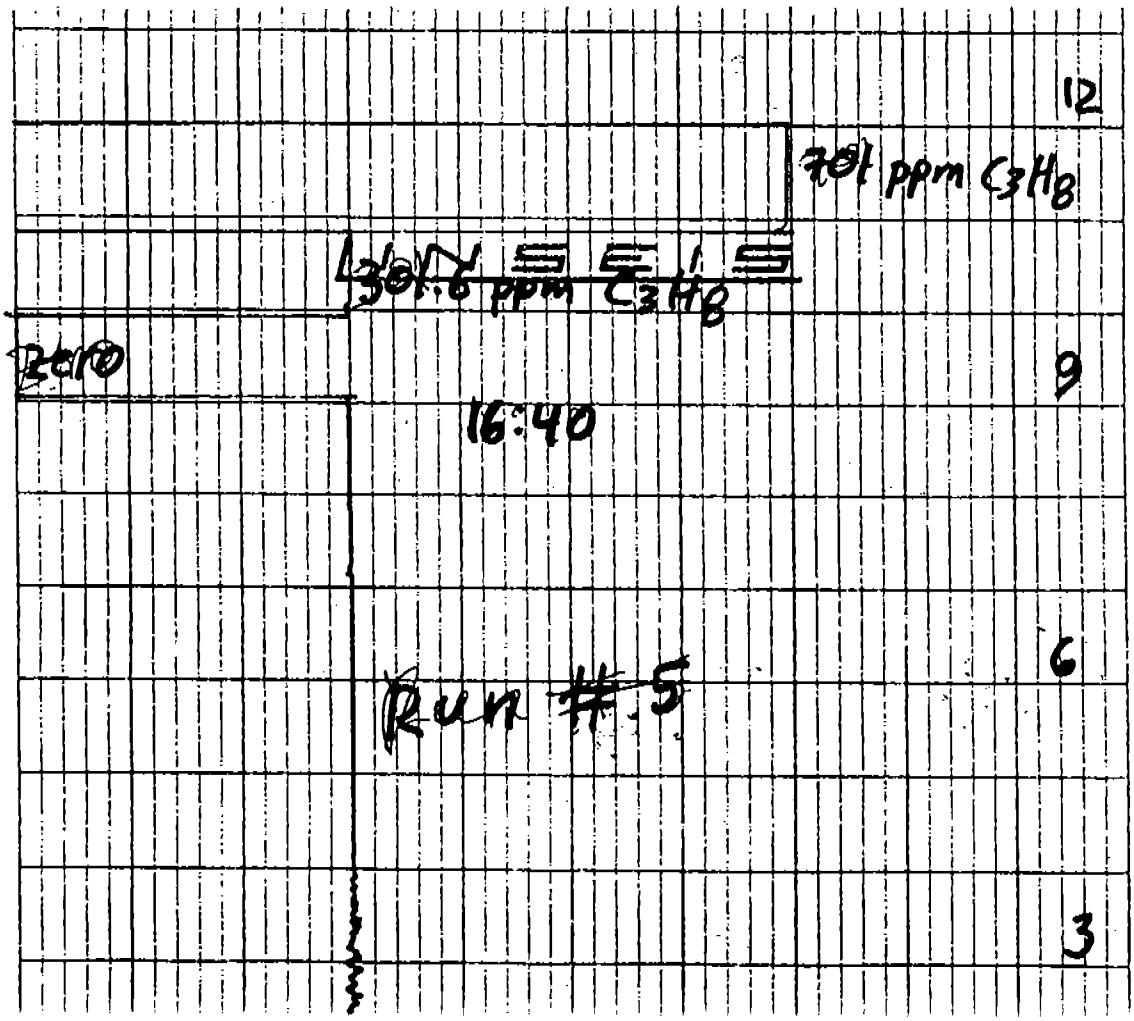
Ethanol / Propane Conversion
Laboratory Data


PART
PRINTED IN U.S.A.
Zero
Zero
9
701 ppm C3H8
301.6 ppm C3H8
11:55
6
Run # 1
3
0
20
40
60
80
100
100
80
60
40
20
0
15
11:45
301.6 ppm C3H8
11:30
12
701 ppm C3H8
Zero
LINSEIS
Coors Brewing Company
Ethanol / Propane Conversion
1-14-93
50 CM/HR
STANDARD FOR COORS
PG:CB30105
10 V



PART NO. LO/8015


Run #5
301.6 16:30
701 ppm C3H8
Zero
701 ppm C3H8
301.6 ppm C3H8
Zero
Run #4
301.6 ppm C3H8
701 ppm C3H8
PART NO. LO/8015
PRINTED IN U.S.A.


12
701 ppm C3H8
9
Zero
16:40
Run #5
6
3

AIR POLLUTION TESTING, INC.

Client	Coors Brewing Co
	Golden, Co
Date	1-14-93

Sketch Location 1	Sketch Location 2

Pump # PCXR7		Pre-test flow (liter/min)	Post -test flow (liter/min)	Mid-test flow (liter/min)	Notes: Run #5
Method # Ethanol → Propane		2.34	2.33		Syringe Mass
Ta 70	Pb 842	2.31	2.30		2.0334 tare
Start time 16:08	Stop time 16:25	2.29	2.33		1.9873 final
Average Flows (liter/min)	2.32	2.31	2.32		0.0461 diff

Pump #		Pre-test flow (liter/min)	Post -test flow (liter/min)	Mid-test flow (liter/min)	Notes:
Method #					
Ta	Pb				
Start time	Stop time				
Average Flows (liter/min)					

AIR POLLUTION TESTING, INC.

Client	Coors Brewing Co
	Golden, Co
Date	1-14-93

Sketch Location 1	Sketch Location 2

Pump # PCXR7		Pre-test flow (liter/min)	Post -test flow (liter/min)	Mid-test flow (liter/min)	Notes: Run #5
Method # Ethanol → Propane		2.34	2.33		Syringe Mass
Ta 70	Pb 842	2.31	2.30		2.0334 tare
Start time 16:08	Stop time 16:25	2.29	2.33		1.9873 final
Average Flows (liter/min)	2.32	2.31	2.32		0.0461 diff

Pump #		Pre-test flow (liter/min)	Post -test flow (liter/min)	Mid-test flow (liter/min)	Notes:
Method #					
Ta	Pb				
Start time	Stop time				
Average Flows (liter/min)					

Hydrocarbon Response Factors

6/90

Component	Resp.-Factor JUM-1	Resp.-Factor JUM-2
Methane	1.02	1.04
Propane	1.00	1.00
Acetylene	0.92	0.94
n-Butane	0.98	0.98
n-Hexane	0.85	0.86
n-Heptane	0.91	0.95
iso-Octane	0.99	0.98
cyclo-Hexane	0.93	0.94
Methanol	0.69	0.68
Ethanol	0.65	0.67
iso-Propanol	0.82	0.81
Benzene	1.05	1.05
Toluene	1.02	1.03
4-Ethyltoluene	0.88	0.89
p-Xylene	0.91	0.90
Acetone	0.72	0.73
Diethylether	0.75	0.77
Acetic Acid	0.58	0.55
Acetic Acid Ethylester	0.70	0.72
Acetic Acid Isobutylester	0.88	0.89
Dichlormethane	1.09	1.06
Chloroform	0.82	0.78
1, 1, 1,-Trichlorethane	1.06	1.02
Trichlorethane	1.03	1.01
Tetrachlorethene	1.22	1.20
Chlorbenzene	1.01	1.04
Number of Compounds	26	26
Average	0.903	0.903
Standard Tolerance	0.154	0.152

Data Compiled By :Tuv
Analyzer Type :Model VE-7
Fuel Type :100% H_2
Calibration Gas :Propane

Note: The response factors are calculated as mg (carbon) per m^3.

Appendix 5
Production Data

AIR POLLUTION TESTING, INC.

Coors Brewing Company
Bottle Crusher Unit
Volatile Organic Compound Testing
April 21, 1993

Production Data

Verbal from Mr. Tom Bueb of Coors Brewing Company:

Start Time	07:00
Stop Time	13:30
Total Crushes	16
Total Crushing Time	0.5 hours
Total Pumps	4
Gallons per Pump	177.6

Submitted,

Paul Ottenstein
Project Manager, Air Pollution Testing

7711 WEST 6TH AVE. SUITE
LAKEWOOD, CO 802
(303) 232-5213 · FAX 232-53

AIR
POLLUTION
TESTING, INC.

Coors Brewing Company
Bottle Crusher Unit
Volatile Organic Compound Testing
August 31, 1993

Production Data

Written from Mr. Tom Bueb of Coors Brewing Company

Start Time	09:40
Stop Time	13:15
Total Crushes	12
Total Crushing Time	0.3 hours
Total Pumps	3
Gallons per Pump	177.6

Submitted,

Paul Ottenstein
Project Manager, Air Pollution Testing

7711 WEST 6TH AVE. SUITE
LAKEWOOD, CO 802
(303) 232-5213 · FAX 232-53

PACKAGING BOTTLE LINE CHRUSHER THROUGH PUT VALUES FOR 1993

BTLCRU.XLS

WEEK	CRUSH COUNT	CRUSH TIME	PUMP COUNT	PUMP VOLUME	CRUSH / DAY	HOURS OF CRUSH/ DAY	TOTAL HOURS CRUSH/WEEK
1	187	5.6	6	1065.6	26.71	0.80	5.6
2	225	7.8	34	6038.4	32.14	1.11	13.4
3	309	8.6	52	9235.2	44.14	1.23	22
4	416	11.8	74	13142.4	52.00	1.48	33.8
5	115	10.5	62	11011.2	19.17	1.50	44.3
6	336	9.8	62	11011.2	48.00	1.63	54.1
7	316	9.6	58	10300.8	45.14	1.37	63.7
8	280	0.5	44	7814.4	40.00	0.07	64.2
9	263	8.4	55	9768	37.57	1.20	72.6
10	247	7.6	60	10656	35.29	1.09	80.2
11	543	16.7	122	21667.2	77.57	2.39	96.9
12	54	1.7	8	1420.8	6.75	0.24	98.6
13	287	8.1	47	8347.2	41.00	1.16	106.7
14	221	6.5	43	7636.8	44.20	1.30	113.2
15	325	10.3	64	11366.4	40.63	1.29	123.5
16	263	8.3	44	7814.4	37.57	1.19	131.8
17	196	17.5	23	4084.8	28.00	2.50	149.3
18	227	24.5	36	6393.6	25.22	2.72	173.8
19	71	6.9	33	5860.8	14.20	1.38	180.7
20	246	7.7	30	5328	35.14	1.10	188.4
21	132	7.8	27	4795.2	18.86	1.11	196.2
22	291	18.4	33	5860.8	32.33	1.82	212.6
23	206	6.3	25	4440	41.20	1.26	218.9
24	174	5.2	11	1953.6	24.86	0.74	224.1
25	251	7.9	29	5150.4	35.86	1.13	232
26	243	7.5	29	5150.4	34.71	1.07	239.5
27	185	5.8	21	3729.6	23.13	0.83	245.3
28	300	7.5	31	5505.6	42.86	1.07	252.8
29	43	9	3	532.8	7.17	1.29	261.8
30	263	7.8	22	3907.2	37.57	1.11	269.6
31	190	6	29	5150.4	27.14	0.86	275.6
32	182	6.5	30	5328	26.00	0.93	282.1
33	239	6.8	28	4972.8	34.14	0.97	288.9
TOTAL	7826	288.9		0	1116.27		
AVERAGE	237.15			0	33.83		
MAX	543			0	77.57		
				0	0.00		
				0	0.00		
				0	0.00		
				0	0.00		
				0	0.00		