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.

AP-42 Section Number: 9.10.1.2

Reference Number: 10

Title: Particulate Emission Testing Performed For Monitor Bay Sugar Company, Bay City, Michigan, on the Pulp Dryer 1 Exhaust

Network Environmental, Inc.

Network Environmental, Inc.

October 1992

AP-42 Section 9.10.1.2
Reference 10
Report Sect. ____
Reference ____

Report of...

Particulate Emission Testing

performed for...

Monitor Sugar Company
Bay City, Michigan

on the

Pulp Dryer 1 Exhaust

October 14, 1992

022.06

Network Environmental, Inc.
Grand Rapids, MI

SOURCE EMISSION TESTING

at

MONITOR SUGAR COMPANY

BAY CITY, MICHIGAN

PULP DRYER #1

DATE: 10/14/92

Network Environmental, Inc.
P.O. Box 2021
Grand Rapids, MI 49501

INTRODUCTION

Network Environmental, Inc. was retained by the Monitor Sugar Company of Bay City, Michigan to perform a particulate emissions compliance test on the number one beet pulp dryer exhaust. The purpose of the testing was to document the particulate emissions from the dryer exhaust.

The testing was performed by R. Scott Cargill, and Bertram J. Smith of Network Environmental, Inc. on October 14, 1992 by employing Michigan Department of Natural Resources (MDNR) Method 5B. Assisting in the study was Mr. Allan Sauer of the Monitor Sugar Company.

Network Environmental, Inc.

EMISSION SOURCE SUMMARY

STANDARD ANALYSIS

COMPANY NAME: MONITOR SUGAR COMPANY TEST DATE: 10/14/92

COMPANY LOCATION: BAY CITY, MICHIGAN

SOURCE NAME: PULP DRYER #1

SAMPLING STAFF: CARGILL/SMITH

STACK RADIUS, inches		33.0
AREA OF STACK, sq. ft.		23.76
STATIC PRESSURE IN STACK, in. H2O		1.05-
STACK GAS TEMPERATURE, deg. F		178
PERCENT MOISTURE AT TEST LOCATION		37.16
DRY GAS COMPOSITION:	% OXYGEN	15.78
	% CARBON DIOXIDE	3.18
	% CARBON MONOXIDE	0.00
	% NITROGEN	81.04
DENSITY, WET, @ STP, lbs./cu.ft.		0.0646
MOLECULAR WEIGHT, DRY, @ STP, lbs./mole		29.15
AVERAGE GAS VELOCITY, feet/min.		2965
STACK GAS FLOW RATE:	ACFM	70440
	SCFM	56311
	SCFM, DRY	35381

EMISSIONS:

LBS. PARTICULATE/1000 LBS. GAS, ACTUAL(1)	0.0619
LBS. PARTICULATE/1000 LBS. GAS, DRY(2)	0.0619
GRAINS/DSCF(4)	0.0445
LBS./HOUR	13.51

1. 'ACTUAL' MEANS AT THE CONDITIONS FOUND AT THE SAMPLING LOCATION.
2. 'DRY' INCLUDES ONLY THE NATURAL MOISTURE THAT WOULD BE EMITTED FROM THE PROCESS. MOISTURE ADDED OR SUBTRACTED BY THE COLLECTOR IS NOT INCLUDED.
3. 'WET' INCLUDES THE MOISTURE AS MEASURED AT THE SAMPLING LOCATION.
4. 'DSCF' IS UNDER TOTALLY DRY CONDITIONS, ALL MOISTURE REMOVED.

Network Environmental, Inc.

SUMMARY OF PARTICULATE EMISSIONS

COMPANY NAME: MONITOR SUGAR COMPANY TEST DATE: 10/14/92

COMPANY LOCATION: BAY CITY, MICHIGAN

SOURCE NAME: PULP DRYER #1

SAMPLING STAFF: CARGILL/SMITH

SAMPLE NUMBER	1	2	3
STANDARD ANALYSIS			
E1. TOTAL WEIGHT COLLECTED, grams	0.135	0.129	0.124
E2. LBS. PARTICULATE/1000 LBS. GAS, ACTUAL(1)	0.064	0.063	0.058
E3. LBS. PARTICULATE/1000 LBS. GAS, DRY(2)	0.064	0.063	0.058
E6. GRAINS/DSCF(4)	0.046	0.044	0.043
E7. LBS./HOUR	13.98	13.97	12.59

1. 'ACTUAL' MEANS AT THE CONDITIONS FOUND AT THE SAMPLING LOCATION.
2. 'DRY' INCLUDES ONLY THE NATURAL MOISTURE THAT WOULD BE EMITTED FROM THE PROCESS. MOISTURE ADDED OR SUBTRACTED BY THE COLLECTOR IS NOT INCLUDED.
3. 'WET' INCLUDES THE MOISTURE AS MEASURED AT THE SAMPLING LOCATION.
4. 'DSCF' IS UNDER TOTALLY DRY CONDITIONS, ALL MOISTURE REMOVED.

Network Environmental, Inc.

SUMMARY OF EXHAUST GAS PARAMETERS

COMPANY NAME: MONITOR SUGAR COMPANY TEST DATE: 10/14/92

COMPANY LOCATION: BAY CITY, MICHIGAN

SOURCE NAME: PULP DRYER #1

SAMPLING STAFF: CARGILL/SMITH

	SAMPLE NUMBER	1	2	3
G1.	STACK RADIUS, inches	33.0	33.0	33.0
G2.	AREA OF STACK, sq. ft.	23.76	23.76	23.76
G3.	BAROMETRIC PRESSURE, in. HG.	28.86	28.86	28.86
G4.	STATIC PRESSURE IN STACK, in. H2O	1.05-	1.05-	1.05-
G5.	STACK GAS TEMPERATURE, deg. F	178	177	178
G6.	AVG. SQRT VELOCITY PRESSURE OF POINTS SAMPLED	0.711	0.718	0.715
G7.	PERCENT MOISTURE AT TEST LOCATION	37.08	34.48	39.92
G8.	PERCENT MOISTURE BEFORE COLLECTOR	37.08	34.48	39.92
G9.	DRY GAS COMPOSITION: % OXYGEN	15.33	16.07	15.93
	% CARBON DIOXIDE	3.60	2.93	3.00
	% CARBON MONOXIDE	0.00	0.00	0.00
	% NITROGEN	81.07	81.00	81.07
G10.	PERCENT EXCESS AIR AT TEST LOCATION			
	DENSITY AND MOLECULAR WEIGHT OF STACK GAS:			
G11.	DRY, @ STP, lbs./cu.ft.	0.0755	0.0753	0.0753
G12.	WET, @ STP, lbs./cu.ft.	0.0647	0.0653	0.0638
G13.	WET, @ STACK CONDITIONS, lbs./cu.ft.	0.0517	0.0523	0.0510
G14.	MOLECULAR WEIGHT, DRY, @ STP, lbs./mole	29.20	29.12	29.13
G15.	AVERAGE GAS VELOCITY, feet/min.	2947	2962	2985
	STACK GAS FLOW RATE:			
G16.	STACK CONDITIONS, ACFM	70,027	70,367	70,925
G17.	STANDARD CONDITIONS, SCFM	55,969	56,285	56,680
G18.	STANDARD CONDITIONS, DRY SCFM	35,214	36,876	34,051

STANDARD TEMPERATURE AND PRESSURE (STP) = 29.92 inches HG, 70 deg. F

Network Environmental, Inc.

SUMMARY OF PARTICULATE TRAIN PARAMETERS

COMPANY NAME: MONITOR SUGAR COMPANY TEST DATE: 10/14/92

COMPANY LOCATION: BAY CITY, MICHIGAN

SOURCE NAME: PULP DRYER #1

SAMPLING STAFF: CARGILL/SMITH

	SAMPLE NUMBER	1	2	3
P1.	NUMBER OF POINTS SAMPLED	12	12	12
P2.	DURATION OF SAMPLE, minutes	60.00	60.00	60.00
P3.	NOZZLE DIAMETER, inches	0.313	0.313	0.313
P4.	NOZZLE AREA, sq. ft.	0.00053	0.00053	0.00053
P5.	PITOT CALIBRATION FACTOR	0.860	0.860	0.860
P6.	METER CALIBRATION FACTOR	0.998	0.998	0.998
P7.	AVERAGE FILTER TEMPERATURE, deg. F	0	0	0
P8.	AVERAGE METER TEMPERATURE, deg. F	84.7	81.9	90.2
P9.	AVERAGE METER PRESSURE, inches of water	2.083	2.097	2.079
P10.	METER VOLUME, ACTUAL READING, cu.ft.	47.59	47.50	47.53
P11.	METER VOLUME, @ STP, cu.ft.	44.79	44.94	44.29
P12.	LIQUID VOLUME OF WATER CONDENSED, mls.	557.0	499.0	621.0
P13.	VAPOR VOLUME OF WATER CONDENSED, @ STP, cu.ft.	26.40	23.65	29.44
P14.	TOTAL GAS SAMPLED, @ STP, cu.ft.	71.20	68.59	73.73
P15.	WEIGHT OF GAS SAMPLED, DRY, lbs.	3.38	3.38	3.33
P16.	WEIGHT OF GAS SAMPLED, WET, lbs.	4.61	4.48	4.70
P17.	PERCENT ISOKINETICS	94.6	90.6	96.7

CONCENTRATION CONVERSION FACTORS:

P18.	50 % EXCESS AIR, AFTER COLLECTOR			
P19.	50 % EXCESS AIR, BEFORE COLLECTOR			
P20.	MOISTURE CONDITIONS BEFORE COLLECTOR	1.00	1.00	1.00

STANDARD TEMPERATURE AND PRESSURE (STP) = 29.92 inches HG, 70 deg. F

DISCUSSION OF RESULTS

The particulate emission concentrations for the three samples were 0.064 Lbs/1000 Lbs for sample one, 0.063 Lbs/1000 Lbs for sample two, and 0.058 Lbs/1000 Lbs for sample three. The average exhaust particulate concentration was 0.0619 Lbs/1000 Lbs.

The particulate mass emission rates were 13.98 Lbs/Hr for sample one, 13.97 Lbs/Hr for sample two, and 12.59 Lbs/Hr for sample three. The average mass emission rate was 13.51 Lbs/Hr.

SOURCE DESCRIPTION

The source tested was the number one beet pulp dryer. The rotary dryer is fired by natural gas and dries the pulp with direct contact. The pulp is fed into the dryer at the beginning of the rotary section. The pulp is passed through the rotary dryer where most of the moisture is removed. The particulate laden exhaust is then passed through a multiclone collector and then a scrubber for particulate removal before it is exhausted to the atmosphere.

Process operating information for the day of the sampling can be found in Appendix A.

SAMPLING AND ANALYTICAL PROTOCOL

The sampling location was on the 66 inch I.D. exhaust stack at a distance that meets the eight duct diameter downstream two duct diameter upstream requirement of U.S. EPA Reference Method 1.

Particulate

The particulate sampling and analysis were performed in accordance with MDNR Reference Method 5B, and the methods referenced therein. Three (3) samples, each sixty (60) minutes in duration, were collected from the exhaust stack. All the quality control and quality assurance requirements specified in the methods were incorporated in the sampling and analysis. No alterations were incorporated in the testing or analysis. Figure 1 shows a schematic of the particulate sampling train.

Exhaust Gas Parameters

The exhaust gas parameters (air flow rate, temperature, moisture, and density) were determined by employing U.S. EPA Reference Methods 1 through 4. All the quality control and quality assurance procedures specified in the methods were incorporated in the sampling and analysis. No alterations were incorporated in the sampling and analysis.

This report was prepared by:

David D. Engelhardt
Vice President

This report was reviewed by:

Stephan K. Byrd
President

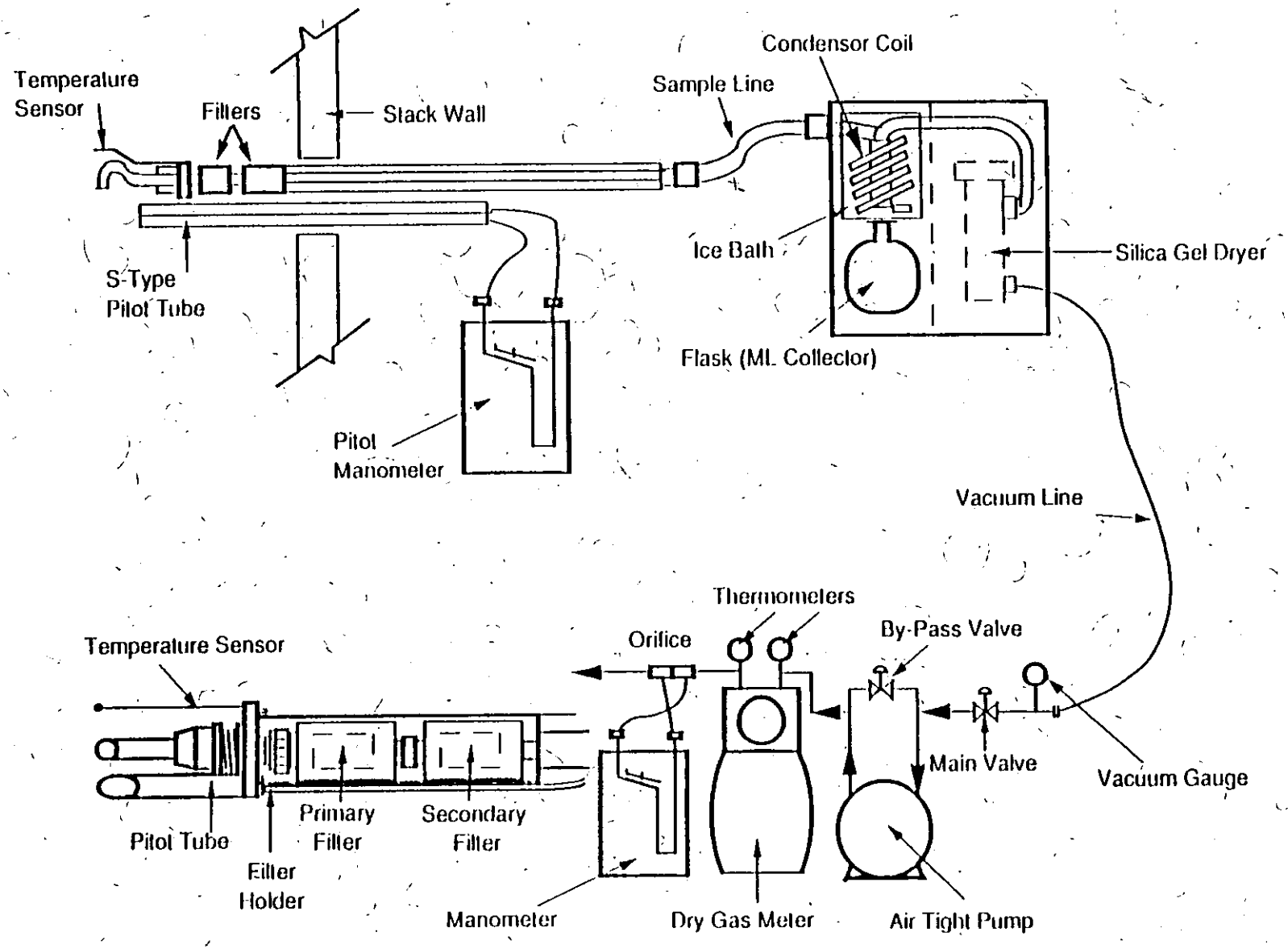


Figure 1

Particulate Sampling Train

APPENDIX A

FIELD DATA

Network Environmental, Inc.

PITOT TRAVERSE DATA

COMPANY NAME: MONITOR SUGAR COMPANY TEST DATE: 10/14/92

COMPANY LOCATION: BAY CITY, MICHIGAN

SOURCE NAME: PULP DRYER #1

SAMPLING STAFF: CARGILL/SMITH

RUN NUMBER: 1 % CARBON DIOXIDE:

STACK RADIUS, in.: 33 % OXYGEN:

GAS TEMPERATURE, Deg F: 170 % CARBON MONOXIDE:

STATIC PRESSURE, in. H2O: -1.05 PITOT FACTOR: .86

BAROMETRIC PRESSURE: 28.86

PT. #	POINT LOCATION, INCHES	VELOCITY PRESSURE, INCHES OF WATER PORT 1	PORT 2
1	2.90	0.52	0.48
2	9.70	0.72	0.69
3	19.47	0.73	0.68
4	46.53	0.53	0.26
5	56.30	0.71	0.51
6	63.10	0.67	0.62

Network Environmental, Inc.

SAMPLING TRAIN DATA

COMPANY NAME: MONITOR SUGAR COMPANY TEST DATE: 10/14/92

COMPANY LOCATION: BAY CITY, MICHIGAN

SOURCE NAME: PULP DRYER #1

SAMPLING STAFF: CARGILL/SMITH

SAMPLE NUMBER:	1	IMPINGER BOX #:	1	GAS METER START:	451.93
TYPE OF TRAIN:	5B	FILTER SET #:	25	METER CAL. FACTOR:	.9976
NOZZLE DIA, in:	.3125	PRIM. FILTER #:	DH-368	CLOCK TIME START:	8:45
VENTURI NUMBER:		SEC. FILTER #:	BH-368	METER TIME START:	0
CONTROL BOX #:	3072	BAROMETRIC PRESS:	28.86	METER TIME STOP:	1
		PITOT CAL. FACTOR:	.86		

PORT	POINT	VELOCITY PRESSURE IN. H2O	RATE MTR PRESSURE IN. H2O	GAS METER READING CU. FT.	PUMP VAC. IN. HG	GAS METER TEMP., F IN	OUT	STACK TEMP. F
2	1	0.43	1.72	455.500	2.00	83	84	181
	2	0.68	2.72	460.060	3.00	79	83	181
	3	0.65	2.60	464.740	3.00	83	83	181
	4	0.18	0.72	467.210	2.00	85	84	180
	5	0.52	2.08	470.950	3.00	87	83	177
	6	0.61	2.44	475.260	3.00	91	83	178
1	1	0.54	2.16	479.330	3.00	89	83	176
	2	0.70	2.80	483.960	3.50	88	84	177
	3	0.65	2.60	488.530	3.50	88	83	176
	4	0.31	1.24	491.740	2.00	88	82	176
	5	0.62	2.48	496.080	3.00	88	82	177
	6	0.36	1.44	499.520	2.00	88	82	175

Network Environmental, Inc.

SAMPLING TRAIN DATA

COMPANY NAME: MONITOR SUGAR COMPANY TEST DATE: 10/14/92

COMPANY LOCATION: BAY CITY, MICHIGAN

SOURCE NAME: PULP DRYER #1

SAMPLING STAFF: CARGILL/SMITH

SAMPLE NUMBER:	2	IMPINGER BOX #:	1	GAS METER START:	499.68
TYPE OF TRAIN:	5B	FILTER SET #:	3	METER CAL. FACTOR:	.9976
NOZZLE DIA, in:	.3125	PRIM. FILTER #:	DH-372	CLOCK TIME START:	9:57
VENTURI NUMBER:		SEC. FILTER #:	BH-372	METER TIME START:	0
CONTROL BOX #:	3072	BAROMETRIC PRESS:	28.86	METER TIME STOP:	1
		PITOT CAL. FACTOR:	.86		

PORT	POINT	VELOCITY PRESSURE IN. H2O	RATE MTR PRESSURE IN. H2O	GAS METER READING CU. FT.	PUMP VAC. IN. HG	GAS METER TEMP., F IN	GAS METER TEMP., F OUT	STACK TEMP. F
1	1	0.54	2.16	503.630	2.50	76	77	178
	2	0.62	2.48	507.990	3.50	79	78	179
	3	0.58	2.32	512.240	3.50	82	78	178
	4	0.48	1.92	516.050	3.00	84	78	178
	5	0.44	1.76	519.760	3.00	86	79	177
	6	0.58	2.32	523.920	3.50	87	79	175
2	1	0.51	2.04	527.870	3.00	83	79	177
	2	0.68	2.72	532.480	4.00	86	79	177
	3	0.62	2.48	536.760	5.00	88	80	178
	4	0.21	0.84	539.170	2.50	88	80	179
	5	0.49	1.96	542.970	5.00	88	80	177
	6	0.54	2.16	547.180	5.00	91	81	176

Network Environmental, Inc.

SAMPLING TRAIN DATA

COMPANY NAME: MONITOR SUGAR COMPANY TEST DATE: 10/14/92

COMPANY LOCATION: BAY CITY, MICHIGAN

SOURCE NAME: PULP DRYER #1

SAMPLING STAFF: CARGILL/SMITH

SAMPLE NUMBER:	3	IMPINGER BOX #:	1	GAS METER START:	547.33
TYPE OF TRAIN:	5B	FILTER SET #:	13	METER CAL. FACTOR:	.9976
NOZZLE DIA, in:	.3125	PRIM. FILTER #:	DH-381	CLOCK TIME START:	11:13
VENTURI NUMBER:		SEC. FILTER #:	BH-381	METER TIME START:	0
CONTROL BOX #:	3072	BAROMETRIC PRESS:	28.86	METER TIME STOP:	1
		PITOT CAL. FACTOR:	.86		

PORT	POINT	VELOCITY PRESSURE IN. H2O	RATE MTR PRESSURE IN. H2O	GAS METER READING CU. FT.	PUMP VAC. IN. HG	GAS METER TEMP., F IN	GAS METER TEMP., F OUT	STACK TEMP. F
2	1	0.51	2.04	551.100	3.00	84	84	178
	2	0.67	2.68	555.660	4.00	85	83	179
	3	0.62	2.48	560.040	4.00	90	84	180
	4	0.22	0.88	562.760	2.50	93	85	180
	5	0.48	1.92	566.490	4.00	95	85	179
	6	0.54	2.16	570.545	4.00	97	85	178
1	1	0.47	1.88	574.240	4.00	96	85	179
	2	0.70	2.80	578.810	5.00	96	88	177
	3	0.52	2.08	582.890	4.00	97	88	177
	4	0.51	2.04	586.830	4.00	97	89	177
	5	0.51	2.04	590.810	4.00	99	90	176
	6	0.48	1.95	594.865	4.00	100	90	176

Network Environmental, Inc.

ORSAT ANALYSIS DATA

COMPANY NAME: MONITOR SUGAR COMPANY TEST DATE: 10/14/92

COMPANY LOCATION: BAY CITY, MICHIGAN

SOURCE NAME: PULP DRYER #1

SAMPLING STAFF: CARGILL/SMITH

DATE OF ANALYSIS: 10/15/92 METHOD: MULTIPOINT INTEGRATED SAMPLE

PART SMPL #	CONT #	RUN #	CARBON DIOXIDE			OXYGEN			CARBON MONOXIDE		
			FINAL	INIT.	%	FINAL	INIT.	%	FINAL	INIT.	%
1	1	1	3.6	0.0	3.6	19.0	3.6	15.4	19.0	19.0	0.0
		2	3.6	0.0	3.6	18.8	3.6	15.2	18.8	18.8	0.0
		3	3.6	0.0	3.6	19.0	3.6	15.4	19.0	19.0	0.0
2	2	1	2.8	0.0	2.8	19.0	2.8	16.2	19.0	19.0	0.0
		2	3.0	0.0	3.0	19.0	3.0	16.0	19.0	19.0	0.0
		3	3.0	0.0	3.0	19.0	3.0	16.0	19.0	19.0	0.0
3	3	1	3.0	0.0	3.0	19.0	3.0	16.0	19.0	19.0	0.0
		2	3.0	0.0	3.0	18.8	3.0	15.8	18.8	18.8	0.0
		3	3.0	0.0	3.0	19.0	3.0	16.0	19.0	19.0	0.0

Network Environmental, Inc.

LABORATORY ANALYSIS REPORT

COMPANY NAME: MONITOR SUGAR COMPANY TEST DATE: 10/14/92

COMPANY LOCATION: BAY CITY, MICHIGAN

SOURCE NAME: PULP DRYER #1

SAMPLING STAFF: CARGILL/SMITH

DATE SUBMITTED TO LAB: 10/15/92 RECEIVED BY: BJS

DATE REPORTED FROM LAB: 10/16/92 CHEMIST(S): BJS

PARTICULATE TRAIN SAMPLE NUMBER 1

LAB IDENT. NO.	SAMPLE IDENT. MARK	-----PARTICULATE WEIGHT GAIN, MGS.----- STD. ANAL.	ALT 1	ALT 2	CAPTURED WATER S. GEL GRAMS	CONDSR MLS.
1	DH-368	101.90			17.0	540.0
	BH-368	14.70				
	NW-1	18.00				
TOTALS		134.60	0.00	0.00	17.0	540.0

PARTICULATE TRAIN SAMPLE NUMBER 2

LAB IDENT. NO.	SAMPLE IDENT. MARK	-----PARTICULATE WEIGHT GAIN, MGS.----- STD. ANAL.	ALT 1	ALT 2	CAPTURED WATER S. GEL GRAMS	CONDSR MLS.
2	DH-372	100.70			9.0	490.0
	BH-372	15.80				
	NW-2	12.30				
TOTALS		128.80	0.00	0.00	9.0	490.0

PARTICULATE TRAIN SAMPLE NUMBER 3

LAB IDENT. NO.	SAMPLE IDENT. MARK	-----PARTICULATE WEIGHT GAIN, MGS.----- STD. ANAL.	ALT 1	ALT 2	CAPTURED WATER S. GEL GRAMS	CONDSR MLS.
3	DH-381	98.00			11.0	610.0
	BH-381	16.50				
	NW-3	9.40				
TOTALS		123.90	0.00	0.00	11.0	610.0

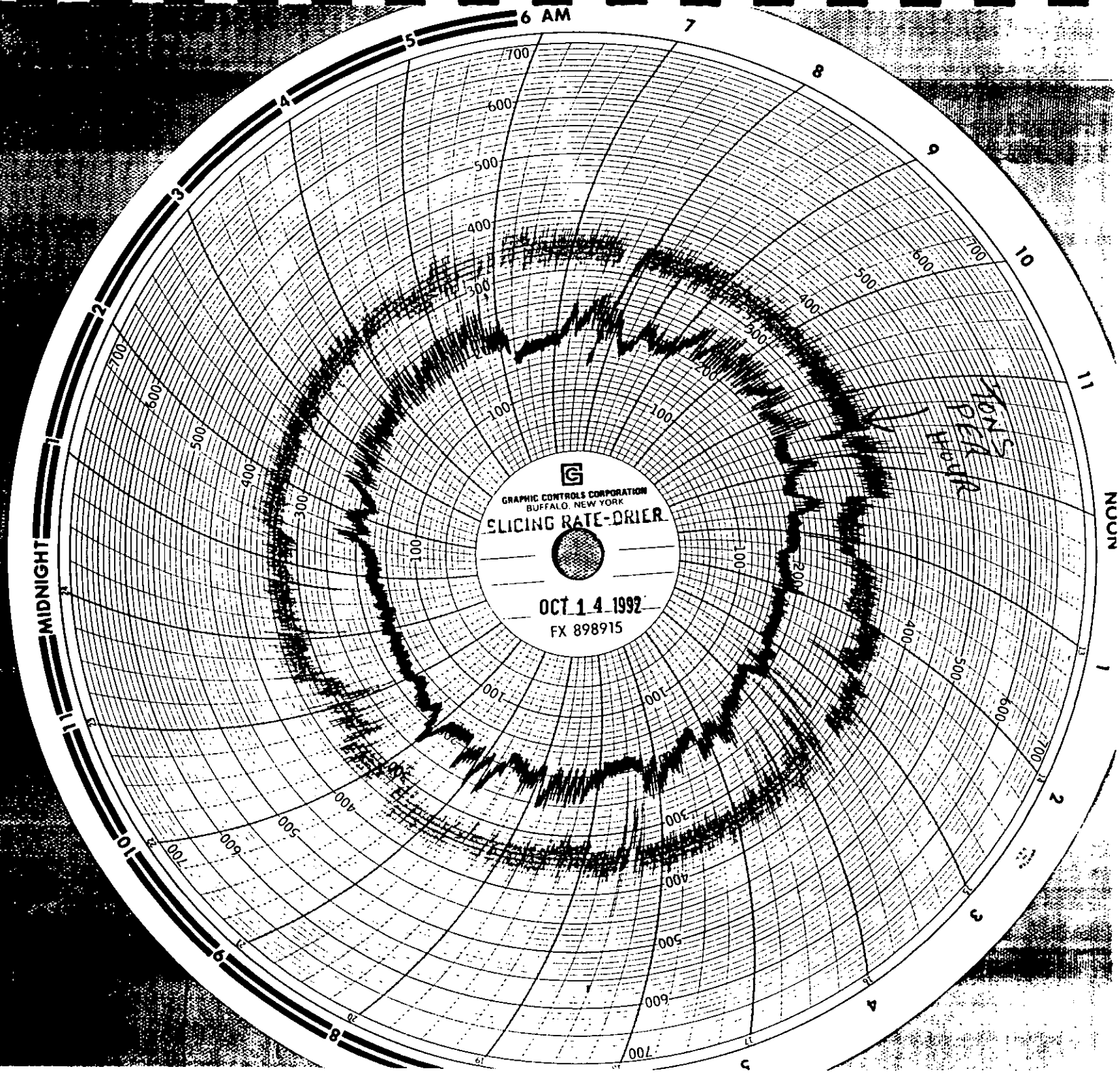
MONITOR SUGAR COMPANY

Operating Log
Pulp Driers Station

Day Ending: 10-14-92
Campaing Day: 21

Time	Inlet Temp. #1	Inlet Temp. #2	Inlet Temp. #3	Outlet Temp. #1	Outlet Temp. #2	Outlet Temp. #3	Moist. Plain #1	Moist. Plain #2	Moist. Plain #3	Moist. Pellets	Collectors Press. Drop #1	Collectors Press. Drop #2	Collectors Press. Drop #3	Collectors Press. Drop #4	Belt Scale Wet Pulp Ton/Hr.	Feed Conv. R.P.M. #1	Feed Conv. R.P.M. #2	Feed Conv. R.P.M. #3	Loading Scrolls % #1	Loading Scrolls % #2	Loading Scrolls % #3
7	850	900	830	170	145	125	13.2	10.1	10.6	10.6	4	4	4	4	69	240	180	100	61	41	52
8	870	1040	850	170	145	125	10.3	9.5	9.7	10.4	4	4	4	4	87	240	210	100	60	41	52
9	870	1000	830	170	145	125	14.0	11.6	10.1	10.4	4	4	4	4	74	240	210	100	60	41	50
10	860	1060	860	170	145	125	12.8	12.4	13.1	10.1	4	4	4	4	95	240	205	100	60	41	55
11	870	1040	880	170	145	125	12.4	11.0	12.6	9.9	4	4	4	4	90	240	195	100	60	41	45
12	860	1020	880	170	145	125	13.1	11.8	13.5	10.1	4	4	4	4	90	240	195	100	60	41	50
1	680	1000	860	170	145	125	10.1	10.1	11.8	10.3	4	4	4	4	85	240	195	100	58	41	50
2	830	1020	900	170	145	125	15.5	11.0	11.8	10.1	4	4	4	4	62	240	195	60	60	41	55
3	600	900	880	170	145	125	7.2	10.0	11.4	10.5	4	4	3	4	57	240	200	100	60	40	50
4	720	920	880	170	145	125	11.6	12.1	13.1	9.5	4	4	3	4	71	240	200	100	60	40	50
5	740	980	880	170	145	125	13.7	11.0	11.0	8.9	4	4	3	4	64	240	220	100	62	44	52
6	780	940	880	175	145	125	9.3	9.3	11.0	9.7	4	4	3	4	79	240	220	100	60	44	50
7	820	1000	840	175	145	125	10.0	10.2	9.5	9.5	4	4	3	4	75	240	220	100	60	44	50
8	760	940	820	175	145	125	8.5	11.4	11.0	9.2	4	4	3	4	78	240	220	100	60	44	50
9	740	980	800	175	145	125	8.7	9.3	10.8	9.2	4	4	3	4	82	240	220	100	60	44	50
10	760	940	840	175	145	125	8.7	9.5	11.0	9.9	4	4	3	4	71	240	220	100	60	44	50
11	600	940	820	165	145	125	8.7	9.1	11.0	10.1	4	4	4	4	75	240	220	100	60	44	50
12	560	820	900	165	145	125	10.2	11.1	12.1	10.3	4	4	4	4	62	240	220	100	60	44	52
1	700	820	840	165	145	125	10.0	10.3	11.0	9.9	4	4	4	4	52	240	220	100	60	44	52
2	800	940	820	165	145	125	8.9	10.8	10.3	9.8	4	4	4	4	77	240	200	100	60	42	50
3	780	920	800	165	145	125	9.2	10.8	9.8	10.0	4	4	4	4	76	240	200	100	60	42	52
4	780	920	840	165	145	125	10.1	11.0	9.6	10.1	4	4	4	4	88	240	200	100	60	42	52
5	740	900	820	165	145	125	9.9	11.3	10.2	9.6	4	4	4	4	85	240	200	100	60	42	52
6	760	920	840	165	145	125	10.8	8.2	10.2	9.9	4	4	4	4	75	240	200	100	60	[illegible]	52

FAC-042
(11-8[illegible]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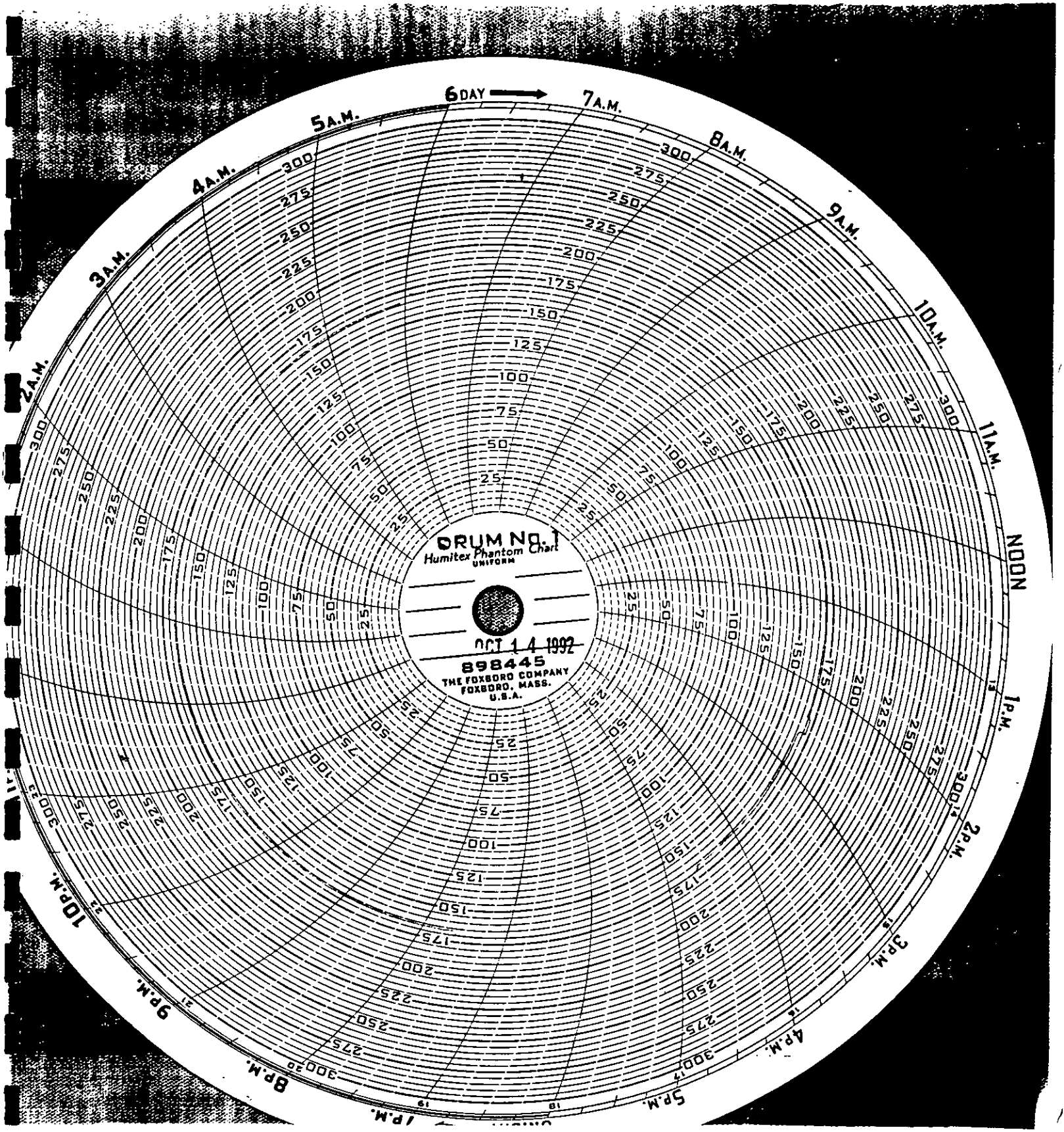
MIDNIGHT
NOON
GRAPHIC CONTROLS CORPORATION
BUFFALO, NEW YORK
SLICING RATE-DRIER
OCT 14 1992
FX 898915
TONS PER HOUR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Humitex Phantom Chart
UNIFORM
OCT 14 1992
898445
THE FOXBORO COMPANY
FOXBORO, MASS.
U.S.A.
6 DAY
7 A.M.
8 A.M.
9 A.M.
10 A.M.
11 A.M.
NOON
1 P.M.
2 P.M.
3 P.M.
4 P.M.
5 P.M.
6 P.M.
7 P.M.
8 P.M.
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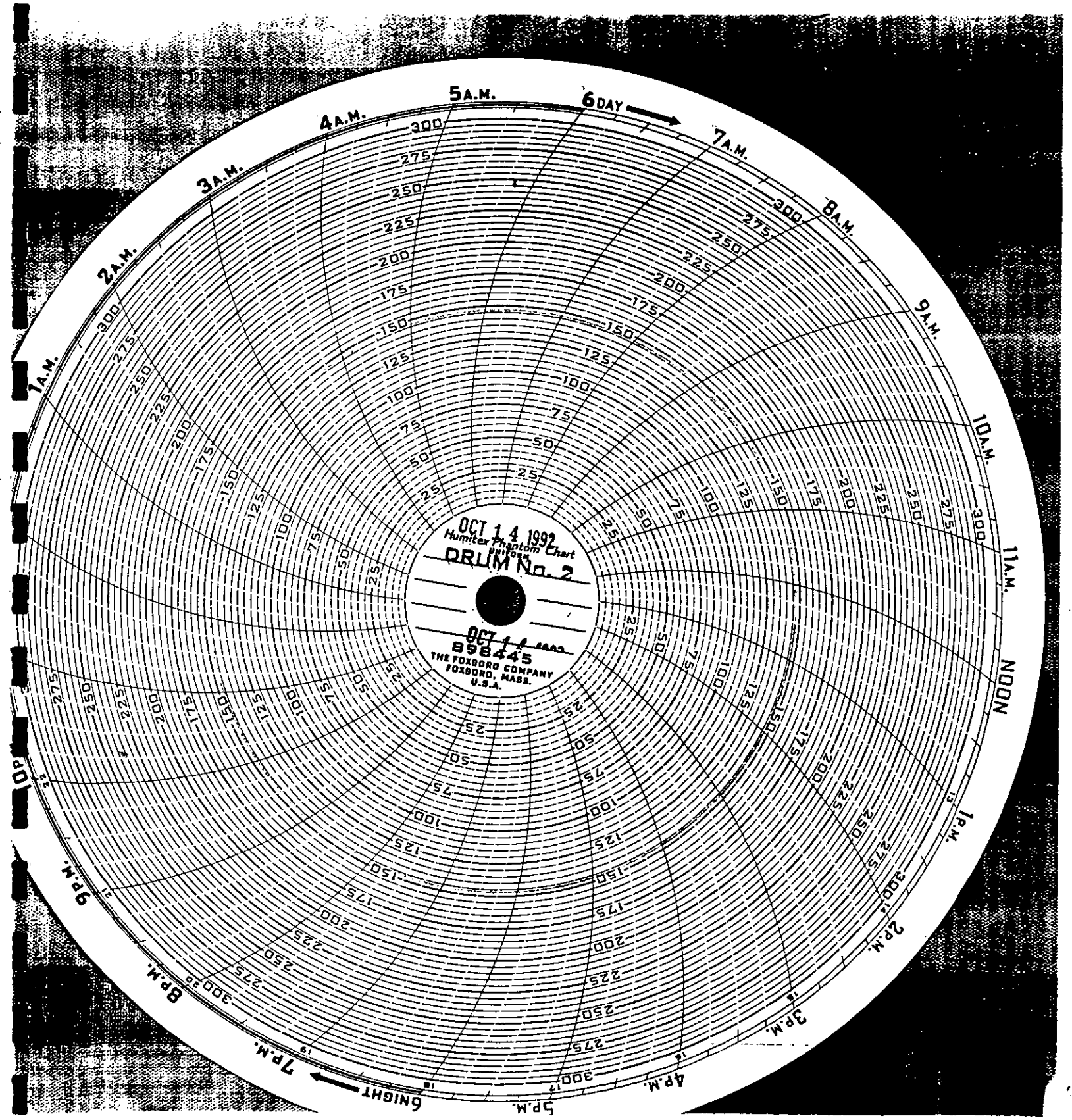
2 A.M.
3 A.M.
4 A.M.
5 A.M.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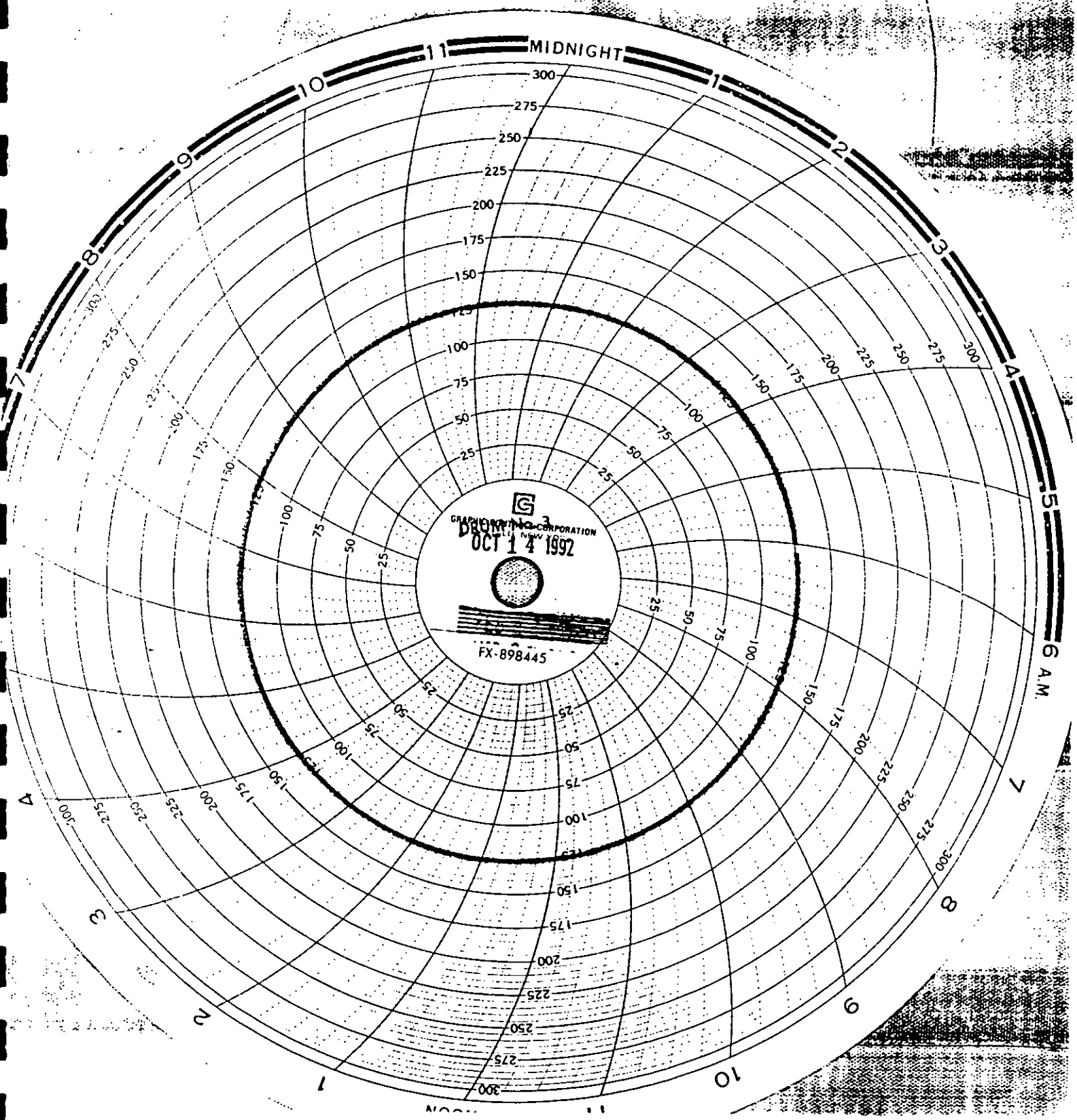
3P.M.
2P.M.
1P.M.
NOON
11A.M.
10A.M.
9A.M.
8A.M.
7A.M.
6DAY
5A.M.
4A.M.
3A.M.
2A.M.
1A.M.
12MIDNIGHT
7P.M.
8P.M.
9P.M.
10P.M.
OCT 14 1992
Humiter Phantom Chart
DRUM No. 2
898445
THE FOXBORO COMPANY
FOXBORO, MASS.
U.S.A.



DRUM No. 3
OCT 14 1992

APPENDIX B

CALCULATIONS

Network Environmental, Inc.

CALCULATION FORMULAS

MOISTURE TRAIN CALCULATIONS:

M1. BAROMETRIC PRESSURE, inches of Mercury

M2. DURATION OF SAMPLE, minutes

M3. METER CALIBRATION FACTOR

M4. AVERAGE METER TEMPERATURE, degrees F

M5. AVERAGE METER PRESSURE, inches of water

M6. METER VOLUME, ACTUAL, cubic feet

M7. METER VOLUME, STP, cubic feet

$$M7 = M3 * M6 * \frac{530}{M4 + 460} * \frac{M1 + .07355 * M5}{29.92}$$

M8. LIQUID VOLUME OF WATER CONDENSED, milliliters

M9. VAPOR VOLUME OF WATER CONDENSED, @ STP, cubic feet

$$M9 = M8 * 0.0474$$

M10. TOTAL GAS SAMPLED, @ STP, cubic feet

$$M10 = M7 + M9$$

M11. PERCENT MOISTURE

$$M11 = \frac{M9}{M10} * 100$$

EXHAUST GAS CALCULATIONS:

G1. STACK DIMENSIONS, inches

G2. AREA OF STACK, square feet

$$G2\ (ROUND) = \frac{3.14159 * (DIA/2)^2}{144}$$

$$G2\ (RECT.) = \frac{WIDTH * LENGTH}{144}$$

G3. BAROMETRIC PRESSURE, inches of Mercury

G4. STATIC PRESSURE IN STACK, inches of water

G5. STACK GAS TEMPERATURE, degrees F

G6. AVG. SQRT VELOCITY PRESSURE OF POINTS SAMPLED

G7. PERCENT MOISTURE AT TEST LOCATION

$$G7 = \frac{P13}{P14} * 100$$

Network Environmental, Inc.

CALCULATION FORMULAS CONTINUED

G8. PERCENT MOISTURE BEFORE COLLECTOR

G9. DRY GAS COMPOSITION, %O2, %CO2, %CO, %N2

G10. PERCENT EXCESS AIR AT TEST LOCATION

$$G10 = 100 * \frac{\%O2 - 0.5 * \%CO}{.264 \bullet \%N2 - \%O2 + .5 \bullet \%CO}$$

G11. DENSITY, DRY, @STP, lbs./cu. ft.

$$G11 = \frac{.0827 \bullet \%O2 + .1137 * \%CO2 + (\%CO + \%N2) \bullet .0724}{100}$$

G12. DENSITY, WET, @STP, lbs./cu. ft.

$$G12 = G11 * \frac{100 - G7}{100} + .0465 * \frac{G7}{100}$$

G13. DENSITY, WET, @ STACK CONDITIONS, lbs./cu. ft.

$$G13 = G12 * \frac{530}{G5 + 460} * \frac{G3 + .07355 * G4}{29.92}$$

G14. MOLECULAR WEIGHT, DRY, lbs./mole

$$G14 = G11 * 386.9$$

G15. AVERAGE GAS VELOCITY, feet/minute

$$G15 = P5 * G6 * \frac{1096}{SQRT(G13)}$$

G16. STACK GAS FLOW RATE, ACFM

$$G16 = G2 * G15$$

G17. STACK GAS FLOW RATE, SCFM

$$G17 = G16 * \frac{530}{G5 + 460} * \frac{G3 + .07355 * G4}{29.92}$$

G18. STACK GAS FLOW RATE, DRY, DSCFM

$$G18 = G17 * \frac{100 - G7}{100}$$

Network Environmental, Inc.

CALCULATION FORMULAS CONTINUED

PARTICULATE TRAIN CALCULATIONS:

P1. NUMBER OF POINTS SAMPLED

P2. DURATION OF SAMPLE, minutes

P3. NOZZLE DIAMETER, inches

P4. NOZZLE AREA, square feet

$$P4 = \frac{3.14159 \bullet (P3/2)^2}{144}$$

P5. PITOT CALIBRATION FACTOR

P6. METER CALIBRATION FACTOR

P7. AVERAGE FILTER TEMPERATURE, degrees F

P8. AVERAGE METER TEMPERATURE, degrees F

P9. AVERAGE METER PRESSURE, inches of water

P10. METER VOLUME, ACTUAL, cubic feet

P11. METER VOLUME, @ STP, cubic feet

$$P11 = P10 * P6 \bullet \frac{530}{P8 + 460} * \frac{G3 + .07355 * P9}{29.92}$$

P12. LIQUID VOLUME OF WATER CONDENSED, milliliters

P13. VAPOR VOLUME OF WATER CONDENSED, @ STP, cubic feet

$$P13 = P12 * 0.0474$$

P14. TOTAL GAS SAMPLED, @ STP, cubic feet

$$P14 = P11 + P13$$

P15. WEIGHT OF GAS SAMPLED, DRY, pounds

$$P15 = P11 \bullet G11$$

P16. WEIGHT OF GAS SAMPLED, WET, pounds

$$P16 = P14 * G12$$

P17. PERCENT ISOKINETICS

$$P17 = \frac{100 \bullet 29.92 \bullet (G5 + 460) * P14}{530 \bullet (G3 + .07355 \bullet G4) * P2 \bullet P4 \bullet G15}$$

Network Environmental, Inc.

CALCULATION FORMULAS CONTINUED

CONCENTRATION CONVERSION FACTORS:

P18. 50 % EXCESS AIR, AFER COLLECTOR

$$P18 = \frac{G14 + 18 * G7/(100 - G7)}{.1826 * \%N2 - 2.0592 * \%O2 + G14 + 18 * G7/(100 - G7)}$$

P19. 50 % EXCESS AIR, BEFORE COLLECTOR

$$P19 = \frac{G14 + 18 * G7/(100 - G7)}{.1826 * \%N2 - 2.0592 * \%O2 + G14 + 18 * G8/(100 - G8)}$$

P20. MOISTURE BEFORE COLLECTOR

$$P20 = \frac{G14 + 18 * G7/(100 - G7)}{G14 + 18 * G8/(100 - G8)}$$

PARTICULATE EMISSION CALCULATIONS:

E1. TOTAL WEIGHT PARTICULATE COLLECTED, grams

E2. LBS. PARTICULATE/1000 LBS. GAS, ACTUAL

$$E2 = E1 * \frac{1000}{454 * P16}$$

E3. LBS. PARTICULATE/1000 LBS. GAS, DRY

$$E3 = E2 * P20$$

E4. LBS. PARTICULATE/1000 LBS. GAS, WET, 50% EA

$$E4 = E2 * P18$$

E5. LBS. PARTICULATE/1000 LBS. GAS, DRY, 50% EA

$$E5 = E2 * P19$$

E6. GRAINS/DRY STANDARD CUBIC FOOT

$$E6 = \frac{E1 * 7000 * 100}{454 * P14 * (100 - G7)}$$

E7. POUNDS/HOUR

$$E7 = \frac{G17 * G12 * 1000 * E1 * .06}{454 * P16}$$

E8. POUNDS/MILLION BTU

$$E8 = \frac{E7}{\text{CAPACITY, MM BTU/HR}}$$

APPENDIX C

RAW DATA

NETWORK ENVIRONMENTAL INCORPORATED

Date: 10-14-92

Clients: MONITOR SUGAR

Pitot Traverse Data Form

Proj. No.:

Plant: MONITOR SUGAR

Source: DRYER # 1

Staff: CARGILL & SMITH

Stack Size, Inches 66"

Barometric Pressure, "Hg 28.86

Gas Temperature, °F 168

Static Pressure, "H_2O −1.05

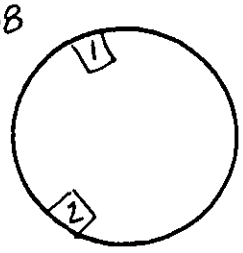
Pitot Tube # 1 ☐ Standard ☒ S-Type

%O_2 ____ %CO_2 ____

Point Location Inches	1 Port	Velocity Pressure "H_2O	2 Port	Velocity Pressure "H_2O	Port	Velocity Pressure "H_2O	Port	Velocity Pressure "H_2O
2.90	1	.52	1	.48	1		1	
9.70	2	.72	2	.69	2		2	
19.47	3	.73	3	.68	3		3	
46.53	4	.53	4	.26	4		4	
56.30	5	.71	5	.51	5		5	
63.10	6	.67	6	.62	6		6	
	7		7		7		7	
	8		8		8		8	
	9		9		9		9	
	10		10		10		10	
	11		11		11		11	
	12		12		12		12	
	13		13		13		13	
	14		14		14		14	

$\sqrt{\Delta P} = .76$ $\Delta P = .58$

Wall Thickness	
Zero Point	
Port Size/Type	



NETWORK ENVIRONMENTAL, INC.

Date: 10-14-92
Client: MONITOR SUGAR

Plant: MONITOR SUGAR
Source: DRYER #1 Staff: CARGILL & SMITH

PITOT #1 = .86

Sample # 1 Filter Set # 25 Barometric Press 28.86
Nozzle # .3125 Primary Filter # DH-368 Initial Gas Read 451.93
Rate Meter # 3072 Secondary Filter # BH 368 Clock Meter Start 8:45
Control Box # 3072 Type Train 5B Time Meter Start 0
Condenser Box # 1 Mls. H_2O Cond. 540 Time Meter Stop 1

Port	Point	Vel Press "H_2O	P Venturi "H_2O	Gas Meter Reading	Pump Vac. "Hg	Meter Temp °F In	Meter Temp °F Out	Stack Temp °F	Box Temp °F	Gas Bag #
2	1	.43	1.72	455.50	2	83	84	181		Dryer # 7
	2	.68	2.72	460.06	3	79	83	181		Notes
	3	.65	2.60	464.74	3	83	83	181		INITIAL LEAK CHECK 0.000 cu.ft. @ 17 in. Hg VACUUM
	4	.18	0.72	467.21	2	85	84	180		
	5	.52	2.08	470.95	3	87	83	177		
	6	.61	2.44	475.26	3	91	83	178		
1	1	.54	2.16	479.33	3	89	83	176		END OF TEST #1 @ 9:46
	2	.70	2.80	483.96	3.5	88	84	177		
	3	.65	2.60	488.53	3.5	88	83	176		FINAL LEAK CHECK 0.000 cu ft @ 7 in Hg VACCUM
	4	.31	1.24	491.74	2	88	82	176		
	5	.62	2.48	496.08	3	88	82	177		
	6	.36	1.44	499.52	2	88	82	175		

47.59 cu.ft.

NETWORK ENVIRONMENTAL, INC.

Date: 10-14-92
Client: MONITOR SUGAR

Plant MONITOR SUGAR
Source DRYER #1 Staff CARGILL & SMITH

PITOT #1 = .86

Sample # 2 Filter Set # 3 Barometric Press 28.86
Nozzle # .3125 Primary Filter # DH-372 Initial Gas Read 499.62
Rate Meter # Secondary Filter # BH-372 Clock Meter Start 9:57
Control Box # 3072 Type Train 5B Time Meter Start 0
Condenser Box # 1 Mls. H_2O Cond. 490 Time Meter Stop 1

Port	Point	Vel Press "H_2O	P Venturi "H_2O	Gas Meter Reading	Pump Vac. "Hg	Meter Temp °F In	Meter Temp °F Out	Stack Temp °F	Box Temp °F	Gas Bag #
1	1	.54	2.16	503.63	2.5	76	77	178		Dryer # 8
	2	.62	2.48	507.99	3.5	79	78	179		Notes
	3	.58	2.32	512.34	3.5	82	78	178		INITIAL LEAK CHECK = 0.000 cu.f. @ 20 IN Hg VACCUM
	4	.48	1.92	516.05	3	84	78	178		
	5	.44	1.76	519.76	3	86	79	177		
	6	.58	2.32	523.92	3.5	87	79	175		
2	1	.51	2.04	527.87	3	83	79	177		END OF TEST #2 @ 10:59
	2	.68	2.72	532.48	4	86	79	177		
	3	.62	2.48	536.76	5	88	80	178		
	4	.21	0.84	539.17	2.5	88	80	179		FINAL LEAK CHECK = 0.000 cu.ft. @ 6 IN-Hg VACCUM
	5	.49	1.96	542.97	5	88	80	177		
	6	.54	2.16	547.18	5	91	81	176		

47.5 cu. ft.

NETWORK ENVIRONMENTAL, INC.

Date: 10-14-92
Client: MONITOR SUGAR

Plant MONITOR SUGAR

Source DRYER #1 Staff CARGILL & SMITH

PITOT #1 = .86

Sample #	3	Filter Set #	13	Barometric Press	28.86
Nozzle #	.3125	Primary Filter #	NH-381	Initial Gas Read	547.33
Rate Meter #		Secondary Filter #	BH-381	Clock Meter Start	11:13
Control Box #	3072	Type Train	5B	Time Meter Start	0
Condenser Box #	1	Mls. H_2O Cond.	610	Time Meter Stop	1

Port	Point	Vel Press "H_2O	P Venturi "H_2O	Gas Meter Reading	Pump Vac. "Hg	Meter Temp °F In	Meter Temp °F Out	Stack Temp °F	Box Temp °F	Gas Bag #
2	1	.51	2.04	551.10	3	84	84	178		Dryer # 9
	2	.67	2.68	555.66	4	85	83	179		Notes
	3	.62	2.48	560.04	4	90	84	180		INITIAL LEAK CHECK 0.000 CU. ft. @ 18 IN. Hg VACCUM
	4	.22	0.88	562.76	2.5	93	85	180		
	5	.48	1.92	566.49	4	95	85	179		
	6	.54	2.16	570.545	4	97	85	178		
1	1	.47	1.88	574.24	4	96	85	179		END OF TEST #3
	2	.70	2.80	578.81	5	96	88	177		@ 12:16
	3	.52	2.08	582.89	4	97	88	177		
	4	.51	2.04	586.83	4	97	89	177		
	5	.51	2.04	590.81	4	99	90	176		FINAL LEAK CHECK 0.000 CU.FT. @ 6 IN. Hg VACCUM
	6	.48	1.95	594.865	4	100	90	176		

47.005 cu. ft.

NETWORK ENVIRONMENTAL INCORPORATED

Date: 10/9/92 Calibration Meter Identification: #1 Yds. 1.000

Meter Box Identification: 3072 Barometric Pressure (P_b): 28.70

	Orifice Reading (ΔH) in H_2O	Calibration Meter Gas Volume (V_{ds}) ft^3	Meter Box Meter Gas Volume (V_d) ft^3	Temperature: Calibration Meter Average (t_{ds}) °F	Temperature: Meter Box Meter Average (t_d) °F	Calibration Meter Pressure (Δp) in H_2O	Time (Θ) min.	Orifice Pressure Differential ($\Delta H@$)	Meter Box Meter Coefficient (Yd)	K_d
Stop	0.50	1967.210	105.095	66.5	80.0	-0.30				
Start	0.50	1961.904	99.776	66.5	76.5	-0.30	13	1.7225	1.0185	0.13471
Average	0.50	5.306	5.319	66.5	78.25	-0.30				
Stop	1.0	1972.680	110.591	66.5	80.0	-0.50				
Start	1.0	1967.646	105.538	66.5	76.5	-0.50	9	1.8391	1.0159	0.13051
Average	1.0	5.034	5.053	66.5	78.25	-0.50				
Stop	2.0	1978.724	116.721	66.5	80.0	-0.70				
Start	2.0	1973.294	111.216	66.5	76.0	-0.70	7	1.9230	1.0028	0.12795
Average	2.0	5.430	5.505	66.5	78.0	-0.70				
Stop	3.0	1989.966	128.221	66.5	81.5	-1.00				
Start	3.0	1979.545	117.555	66.5	76.0	-1.00	11	1.9411	0.9921	0.12754
Average	3.0	10.421	10.666	66.5	78.75	-1.00				
Stop	4.0	2001.802	140.450	66.5	81.5	-1.30				
Start	4.0	1990.978	129.262	66.5	75.5	-1.30	10	1.9937	0.9795	0.12615
Average	4.0	10.824	11.188	66.5	78.5	-1.30				
Stop	5.0	2013.097	152.100	66.5	81.5	-1.50				
Start	5.0	2002.331	140.963	66.5	76.0	-1.50	9	2.0498	0.9767	0.12466
Average	5.0	10.766	11.137	66.5	78.75	-1.50				
							Average	1.9116	0.9976	0.12859

$$Yd = Yds\left(\frac{Vds}{Vd}\right)\left[\frac{(td + 460)}{(tds + 460)}\right]\left[\frac{Pb}{\left(Pb + \left(\frac{\Delta H}{13.6}\right)\right)}\right] \qquad Kiso = \frac{27.40}{(Kd)^2}$$

$$K_d = Yds\left(\frac{Vds}{\Theta}\right)\sqrt{\frac{Pds}{Tds\ \Delta H}} \qquad Pds = \left[Pb + \left(\frac{\Delta P}{13.6}\right)\right] \qquad \Delta H@ = 0.0319\ \Delta H\left(\frac{td}{Pb}\right)\left[\frac{\Theta^2}{Yd^2 Vd^2}\right]$$

Kiso= 1657.149569

NETWORK ENVIRONMENTAL

Pitot tube calibration data.

PITOT TUBE IDENTIFICATION NUMBER: #1 DATE: 12/13/91

CALIBRATED BY: RSC

"A" SIDE CALIBRATION				
RUN NO.	Δp_{std} cm H_2O (in. H_2O)	$\Delta p_{(s)}$ cm H_2O (in. H_2O)	$C_{p(s)}$	DEVIATION $C_{p(s)} - \bar{C}_p(A)$
1	.235	.305	.87	.01
2	.23	.305	.86	0
3	.23	.305	.86	0
		$\bar{C}_p$ (SIDE A)	.86	.003

"B" SIDE CALIBRATION				
RUN NO.	Δp_{std} cm H_2O (in. H_2O)	$\Delta p_{(s)}$ cm H_2O (in. H_2O)	$C_{p(s)}$	DEVIATION $C_{p(s)} - \bar{C}_p(B)$
1	.23	.315	.85	0
2	.23	.31	.85	0
3	.23	.315	.85	0
		$\bar{C}_p$ (SIDE B)	.85	0

$$\text{AVERAGE DEVIATION} = \bar{\sigma}\,(A \text{ OR } B) = \frac{\sum_{1}^{3} \left| C_{p(s)} - \bar{C}_p(A \text{ OR } B) \right|}{3} \longleftarrow \text{MUST BE} \leq 0.01$$

$$\left| \bar{C}_p\,(\text{SIDE A}) - \bar{C}_p\,(\text{SIDE B}) \right| \longleftarrow \text{MUST BE} \leq 0.01$$