AP-42 Section Number: 9.10.1.2

Reference Number: 5

Title: Results of a Source Emission Compliance Test At Southern Minnesota Beet Sugar Cooperative, Renville, Minnesota

MMT Environmental, Inc.

MMT Environmental, Inc.

January 1988

#20 AP-42 Section 9.10.1.2
Reference 5
Report Sect.
Reference

MMT Environmental, Inc.
4643 North Chatsworth Street
St. Paul, MN 55112

RESULTS OF A SOURCE EMISSION COMPLIANCE TEST AT SOUTHERN MINNESOTA BEET SUGAR COOPERATIVE RENVILLE, MINNESOTA 56284

January 21, 1988

Submitted to:

Southern Minnesota Beet Sugar
Cooperative
P.O. Box 500
Renville, Minnesota 56248

Attention: Mr. W.D. DeBelly

Prepared by:

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Senior Vice President

Report Number 8675
Project Number 8014

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RESULTS OF A SOURCE EMISSION COMPLIANCE TEST AT SOUTHERN MINNESOTA BEET SUGAR COOPERATIVE RENVILLE, MINNESOTA 56284

Report Number 8675
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1 INTRODUCTION

On January 21, 1988, MMT Environmental, Inc. performed a source emission compliance test on one of the four cyclones used to remove the particulates from the exhaust gas of drum dryer "A". The cyclone tested is designated "A2", it is the only cyclone of the four that has straightening vanes in the discharge. Testing of the other cyclones, without flow straightening vanes, would be invalid due to turbulence and cyclonic flow patterns. The tests were performed at the request of Mr. W.D. DeBelly.

The MMT sampling team consisted of Clifford E. Mohs and Robert A. Laska.

MPCA officials were notified of the compliance test but elected not to observe the on-site testing.

2 TEST RESULTS

The significant results generated by the test program are presented in this section.

2.1 Particulate Emissions

Table 2.1 presents the results of the particulate emission tests. Particulate emissions of the three runs averaged 0.105 gr/SCF.

2.2 Visible Emissions

Attempts were made to make visible emissions observation during all three of the test runs but because of the high moisture content of the gas and the close proximity of the other stacks, it was impossible to make V.E. reading.

2.3 Cyclone A2 Particulate Removal

Table 2.3.1 presents the result of the pulp material collected at the bottom of the cyclone A2. Collected material averaged 263.2 lb/hr.

Table 2.3.2 presents the cyclone removal efficiency. The average efficiency was determined as 94.8%.

2.4. Comments

Flow measurements were made in two cyclones B1 and B2 of drum dryer "B", to determine if the flow patterns would be acceptable under EPA regulations to perform a US-EPA method 5 to determine the emissions. Both stacks showed significant cyclonic flow patterns and testing would not be acceptable unless straightening vanes or other mechanical method was used to provide a better flow pattern.

TABLE 2.1 SUMMARY OF PARTICULATE EMISSION TEST RESULTS

PROJECT NUMBER: 8214 COMPANY: SOUTHERN MN. BEET SUGAR
TEST NUMBER: 1 SOURCE: CYCLONE "A-2"

TEST PARAMETER	RUN 1	RUN 2	RUN 3	
TEST DATE	1/21/88	1/21/88	1/21/88	
TIME OF TEST, HR:				
START	1103	1243	1432	
FINISH	1231	1352	1532	
EFFLUENT TEMPERATURE, DEGREES F	288	292	292	
EFFLUENT MOISTURE CONTENT, % V/V	37.8	36.4	41.7	
EFFLUENT COMPOSITION, % V/V DRY:				
CARBON DIOXIDE	5.5	4.6	6.2	
OXYGEN	14.2	15.6	13.1	
CARBON MONOXIDE	0.0	0.0	0.0	
EFFLUENT VOLUMETRIC FLOW RATE:				Rated @ 23,000 ACFM
ACTUAL CONDITIONS, ACFM	22532	22593	24183	23,078 100.3% of capacity
STANDARD CONDITIONS, SCFM	15567	15535	16566	
DRY STANDARD CONDITIONS, DSCFM	9678	9874	9662	~~9738~~
ISOKINETIC VARIATION, %	110.0	102.3	113.0	105.17
EFFLUENT PARTICULATE CONCENTRATION:				
ACTUAL CONDITIONS, GR/ACF	0.0744	0.0765	0.0665	
STANDARD CONDITIONS, GR/SCF	0.1077	0.1112	0.0968	
DRY STANDARD CONDITIONS, GR/DSCF	0.1733	0.1758	0.1660	0.1714
SOURCE PARTICULATE EMISSION RATE:				
CLASSICAL METHOD, LB/HR	14.36	14.82	13.76	14.32
RATIO OF AREAS METHOD, LB/HR	15.85	15.18	15.42	15.47

PARTICULATE CONCENTRATION AND EMISSION RATES BASED ON ANALYSIS OF THE SAMPLING TRAIN FRONT AND BACK CATCHES.

STANDARD CONDITIONS: 68 DEGREES FAHRENHEIT, 29.92 INCHES OF MERCURY.

CYCLONE BOTTOM COLLECTION

Table 2.3.1

Start: 11:45 End 3:45 4 Hours

Wheelbarrow Tare Weight	44 lbs	46 lbs
Wheelbarrow & Pulp Weight	73	78
	74	78
	74	79
	76	80
	78	80
	81	82
	82	90
	89	90
	97	97
	78	84
	96	88
	98	90
	94	88
	73	
	1163	1104
	- (14 x 44)	- (13 x 46)
	546 lbs	506 lbs

Total 546 lbs + 506 lbs = 1053/4hours = 263.2 lbs/hr

CYCLONE "A2" REMOVAL EFFICIENCY

Table 2.3.2

	lb/hr	lb/hr	Efficiency
Run #1	14.38	277.4	94.8
Run #2	14.82	277.8	94.7
Run #3	13.76	276.8	95.0
Average	14.32	277.3	94.8

$$E = 100 - \left(\frac{\text{Emissions (lb/hr)}}{\text{Bottom Collection (lb/hr)} + \text{Emission (lb/hr)}} \times 100 \right)$$

3 EMISSION TEST PROCEDURES

3.1 General

In order to determine the pollutant emission rate from stationary sources, the Environmental Protection Agency (EPA) has established a series of reference methods which specify the manner in which tests must be performed. These reference methods are found in the Code of Federal Regulations under Title 40 - Protection of Environment; Chapter 1 - Environmental Protection Agency; Subchapter C - Air Programs; Part 60 - Standards of Performance for New Stationary Sources; Appendix A - Reference Methods. Unless otherwise noted, the tests presented in this report were performed according to the EPA Reference Methods as revised on July 1, 1983. A brief description of the test procedures used follows.

3.2 Sampling Points

The sampling required for EPA Methods 2 and 5 was performed at numerous points across the duct cross-section. The number of sampling points and their locations within the duct were determined according to EPA Method 1 (Figures 3.1 and 3.2). The number of points required is based on the distance of undisturbed flow both up and downstream of the sampling location.

3.3 Effluent Flow Rate

The effluent volumetric flow rate was determined per EPA Method 2. The effluent velocity pressure and temperature were measured at numerous points across the duct cross-section using an S-type pitot tube and a chromel-alumel thermocouple. The flow rate measurements were made simultaneously with each particulate concentration test run.

Figure 3.1 Description of Sampling Location

Duct cross-sectional dimensions at the sampling location: 47.5

Equivalent diameter (rectangular duct only): _____

Distance from sampling ports to the nearest flow disturbance;

Before sampling ports: 5.6 = _____ duct diameters

After sampling ports: 2.0 = _____ duct diameters

Number of sampling points;

Required by EPA Method 1: 26

Actually used: Only used 20 because straightening vanes were installed

Number of ports: 2

Points per port: 10

Sketch of sampling location: Not to Scale

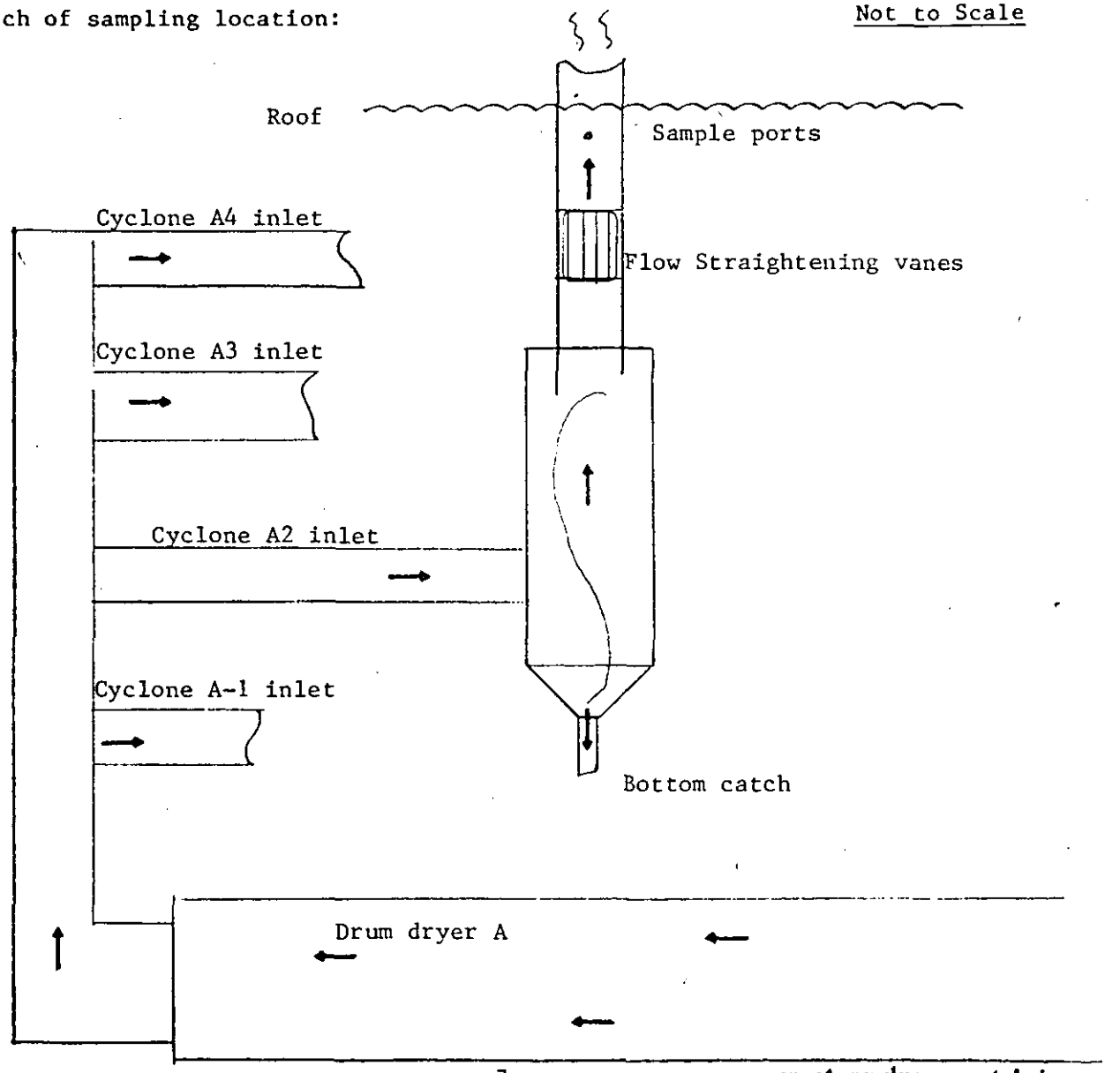
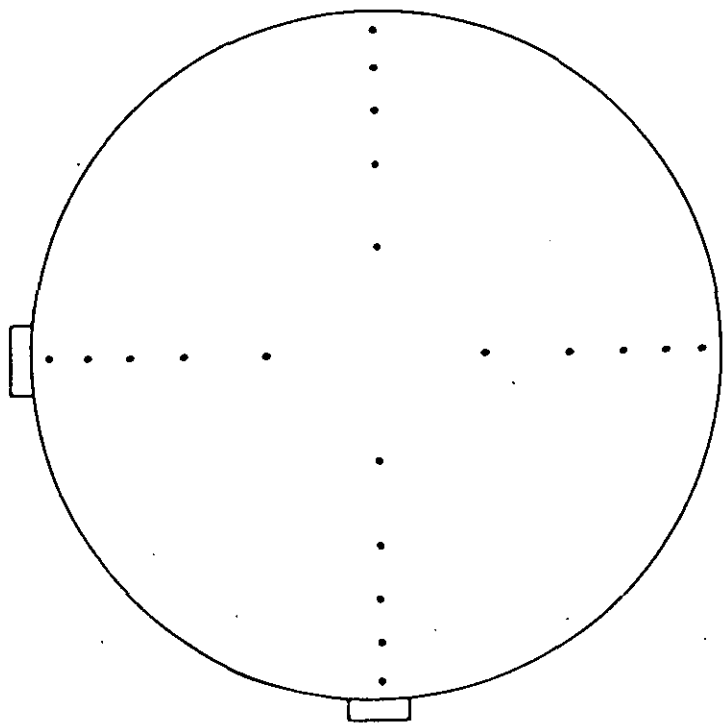


Figure 3.2 Sampling Point Locations Within the Duct

Sketch: Not to Scale



Location of sampling points within each port:

Point Number	Distance From Duct Inside Wall (by Port) to the Sampling Point: % of Duct Diameter	Inches	Point Number	Distance From Duct Inside Wall (by Port) to the Sampling Point: % of Duct Diameter	Inches
1	2.53	1.2	13		
2	8.21	3.9	14		
3	14.5	6.9	15		
4	22.5	10.7	16		
5	34.1	16.2	17		
6	65.9	31.3	18		
7	77.5	36.8	19		
8	85.5	40.6	20		
9	91.8	43.6	21		
10	97.5	46.3	22		
11			23		
12			24		

3.4 Effluent Composition (CO_2, O_2)

The carbon dioxide and oxygen content of the effluent was determined per EPA Method 3. One (1) multi-point integrated sample was collected simultaneously with each particulate test run. Analysis of the sample was performed with a standard Orsat analyzer using commercially prepared solutions.

3.5 Effluent Moisture Content

The effluent moisture content during each test run was determined simultaneously with the particulate concentration determination as per EPA Method 5. The moisture content was calculated from the volume and/or mass of condensed water collected in the cold box impingers and the volume of gas sampled.

3.6 Effluent Particulate Concentration

The effluent particulate concentration was determined per EPA Method 5. In this procedure, particulate matter is isokinetically withdrawn from the source and collected on a glass-fiber filter. Organic vapors and other condensibles which pass through the filter are collected in an ice-cooled impinger trap. The particulate mass, which includes any material which condenses at the filtration temperature, is determined gravimetrically after removal of any uncombined water.

The sampling train (Figure 3.3) consists of a heated sampling probe with attached thermocouple and S-type pitot tube. The probe attaches to the front sample case (hot box) which has an all-glass in-line filter holder in a temperature controlled environment. The back sample case (cold box) houses a series of impingers and a desiccant column in an ice bath. The sample case is connected via an umbilical cord to the control unit which contains the vacuum pump, pressure indicator and all operating controls. The thermocouple is connected to a separately housed temperature readout.

Figure 3.3 Particulate Sampling Train

Sampling train;

Manufacturer: RAC (Research Appliance Company)

Model: Stak Samplr

Hot box set-up;

Cyclone: NA

Filter media: Type A/E glass fiber
100 mm effective diameter

Filtration temperature, °F: +250°F

Cold box set-up;

Impinger Number	Type*	Contents
1	M	Deionized - Distilled H_2O
2	S	Deionized - Distilled H_2O
3	M	Empty
4	M	Silica Gel
5		

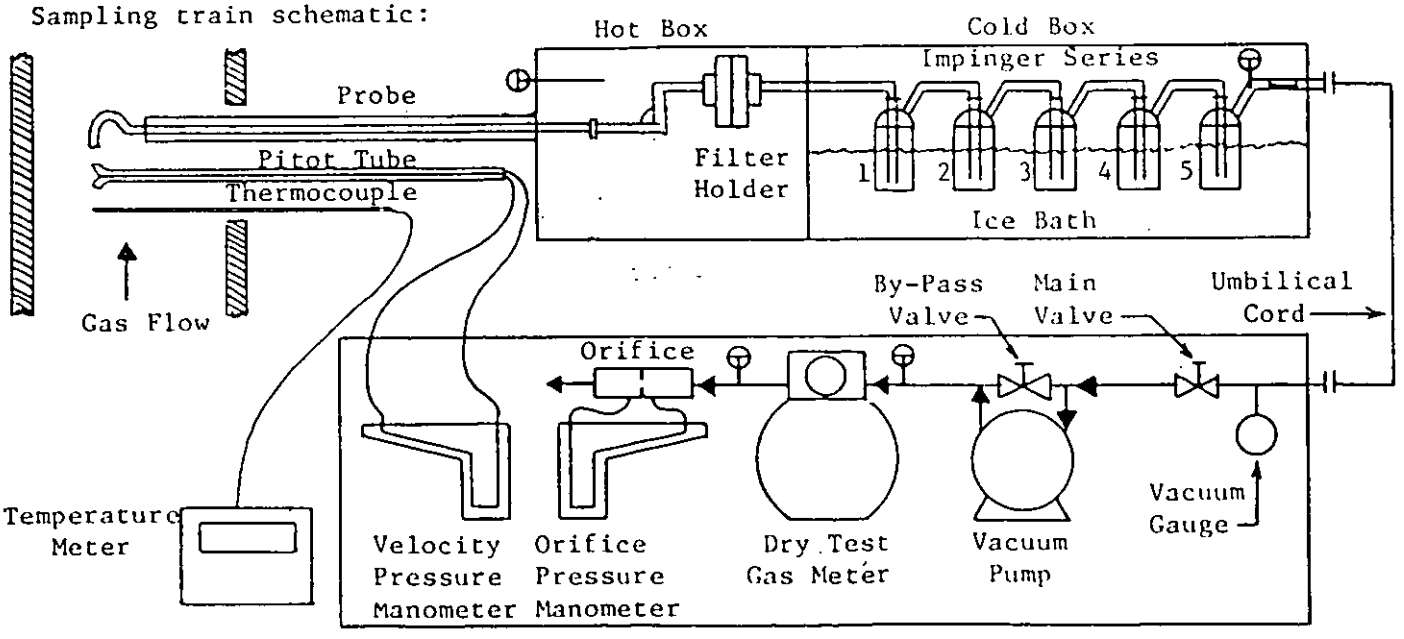
* S: Standard Greenburg-Smith design
M: Modified Greenburg-Smith design (straight tip)

Probe: 5 foot with stainless steel liner.

Nozzle: stainless steel, .375 inch nominal diameter

Sampling time: 60 minutes per point; 5 minutes per test run.

Sampling train schematic:



A representative particulate sample was acquired by sampling for equal periods of time at the center of a number of equal area regions in the duct. At each sampling point the gas velocity head and temperature were measured and the sampling rate rapidly adjusted to isokinetic conditions with the aid of a nomograph. Sample gas drawn into the nozzle flowed through the probe to the glass fiber filter where the particulates were collected. The gases then passed through the ice-cooled condenser (impingers and desiccant column) which quantitatively sorbed all moisture from the gas stream. The gas then passed through the vacuum pump, the drytest meter and the calibrated orifice.

Leak checks to detect any dilution air being pulled into the sampling line were performed at the beginning and end of each test run and also when and if any sample line connections were broken.

After completion of each test run, the sampling train was removed to the clean-up area for sample recovery. The filter was removed from the filter holder and placed in Container #1. Particulate matter collected in the nozzle, probe, cyclone and all connecting glassware in front of the filter was quantitatively transferred to Container #2 by means of a distilled water wash followed by an acetone wash. A stiff brush was used in the probe cleaning step to help dislodge deposits. The water collected in each of the impingers (desiccant column excluded) was measured and transferred to Container #3. All sample exposed surfaces between the filter and the desiccant column were then rinsed with distilled water and the rinsings added to Container #3. These same surfaces were then rinsed with acetone and the rinsings placed in Container #4. The disiccant column was then weighed and its contents transferred to a waste desiccant container.

Sample analysis was performed at MMT's laboratory. The filter was dried in a 105^{o}C oven for 3 hours and then desiccated to constant weight. The contents of Containers #2 and #4 were each transferred to a tared beaker, evaporated to near dryness, and

desiccated to a constant weight. Organic particulate matter was extracted (separatory funnel) from the impinger solution in Container #3 with three (3) 25 ml portions of chloroform followedby three (3) 25 ml portions of ethyl ether. The ether and chloroform extracts were combined in a tared dish, evaporated to near dryness, and then desiccated to constant weight. The total mass of particulate matter collected during each test run is the sum of the front catch, filler catch and back catch.

3.7 Source Plume Opacity

The opacity of emissions from the stationary source was determined visually by a certified observer per EPA Method 9.

The observer positioned himself at a distance sufficient to provide a clear view of the emissions with the sun oriented in the 140^{O} sector to his back. Consistent with the requirement, the observer's line of site was, as much as possible, perpendicular to the plume's direction.

Opacity observations were made at the point of greatest opacity in that portion of the plume where condensed water vapor was not present. Observations were made at 15-second intervals and recorded to the nearest 5 percent opacity. (Refer section 2.2, page 2)

4 CYCLONE DISCHARGE PROCEDURE

Two preweighed wheelbarrows were alternately placed under the cyclone A2 bottom discharge pipe. Approximately every 10 minutes the wheelbarrow under the discharge pipe would be replaced with the other wheelbarrow and then weighed. This was done continuously during the test period, including the change over time between each of the runs.

APPENDIX A

CALCULATIONS

DEFINITION OF VARIABLES

An .... CROSS-SECTIONAL AREA OF NOZZLE, SF
As .... CROSS-SECTIONAL AREA OF STACK, SF
Bwp ... EFFLUENT MOISTURE CONTENT, PERCENT BY VOLUME
Bws ... EFFLUENT MOISTURE CONTENT, PROPORTION BY VOLUME
Ca* ... EFFLUENT PARTICULATE CONCENTRATION AT ACTUAL CONDITIONS, GR/ACF; *=f,b,t; Caf: FRONT CATCH ONLY; Cab: BACK CATCH ONLY; Cat: TOTAL CATCH
CD .... EFFLUENT CARBON DIOXIDE CONCENTRATION, % V/V DRY
CM .... EFFLUENT CARBON MONOXIDE CONCENTRATION, % V/V DRY
Cp .... PITOT TUBE COEFFICIENT, DIMENSIONLESS
Cs* ... EFFLUENT PARTICULATE CONCENTRATION AT DRY STANDARD CONDITIONS, GR/DSCF; *=f,b,t; Csf: FRONT CATCH ONLY; Csb: BACK CATCH ONLY; Cst: TOTAL CATCH
Cw* ... EFFLUENT PARTICULATE CONCENTRATION AT STANDARD CONDITIONS, GR/SCF; *=f,b,t; Cwf: FRONT CATCH ONLY; Cwb: BACK CATCH ONLY; Cwt: TOTAL CATCH
Dn .... NOZZLE DIAMETER, IN
I ..... ISOKINETIC VARIATION, %
Md .... EFFLUENT MOLECULAR WEIGHT, LB/LB-MOLE, DRY BASIS
Ms .... EFFLUENT MOLECULAR WEIGHT, LB/LB-MOLE, WET BASIS
NI .... EFFLUENT NITROGEN CONCENTRATION, % V/V DRY
OX .... EFFLUENT OXYGEN CONCENTRATION, % V/V DRY
Pb .... BAROMETRIC PRESSURE, IN HG
Pg .... STACK STATIC PRESSURE, IN WC
Po .... AVERAGE PRESSURE DROP ACROSS THE METERING ORIFICE, IN WC
Ps .... STACK ABSOLUTE PRESSURE, IN HG
Pv .... AVERAGE SQUARE-ROOT VELOCITY PRESSURE, IN WC
Qa .... EFFLUENT FLOW RATE AT ACTUAL CONDITIONS, ACFM
Qs .... EFFLUENT FLOW RATE AT STANDARD CONDITIONS, SCFM
Qsd ... EFFLUENT FLOW RATE AT STANDARD CONDITIONS, DRY BASIS, DSCFM
Rc* ... SOURCE PARTICULATE EMISSION RATE, CLASSICAL METHOD, LB/HR; *=f,b,t; Rcf: FRONT CATCH ONLY; Rcb: BACK CATCH ONLY; Rct: TOTAL CATCH
Rr* ... SOURCE PARTICULATE EMISSION RATE, RATIO OF AREAS METHOD, LB/HR; *=f,b,t; Rrf: FRONT CATCH ONLY; Rrb: BACK CATCH ONLY; Rrt: TOTAL CATCH
Sl .... STACK DIAMETER OR LENGTH, IN
Sw .... STACK WIDTH, IN
Ti .... TOTAL SAMPLING TIME, MIN
Tm .... AVERAGE DRY GAS METER TEMPERATURE, DEG F
Ts .... AVERAGE EFFLUENT TEMPERATURE, DEG F
Vl .... VOLUME OF LIQUID COLLECTED, ML
Vm .... VOLUME OF GAS SAMPLED AT METER CONDITIONS, DCF
Vms ... VOLUME OF GAS SAMPLED AT STANDARD CONDITIONS, DSCF
Vs .... AVERAGE EFFLUENT VELOCITY, FPS
Vw .... VOLUME OF WATER VAPOR COLLECTED AT STANDARD CONDITIONS, SCF
Wb .... MASS OF PARTICULATE MATTER COLLECTED IN THE BACK (WET) CATCH, G
Wf .... MASS OF PARTICULATE MATTER COLLECTED IN THE FRONT (DRY) CATCH, G
Wt .... TOTAL MASS OF PARTICULATE MATTER COLLECTED, G
Y ..... DRY GAS METER COEFFICIENT, DIMENSIONLESS

EQUATIONS USED TO CALCULATE PARTICULATE EMISSIONS

An = 0.005454154 * Dn * Dn

As = 0.005454154 * Sl * Sl (FOR ROUND STACKS)

As = Sl * Sw / 144.0 (FOR RECTANGULAR STACKS)

Ps = Pb + Pg/13.6

NI = 100.0 - CD - OX - CM

Wt = Wf + Wb

Vms = (528/29.92) * Vm * Y * (Pb + Po/13.6) / (Tm + 460.0)

Vw = 0.04707 * Vl

Bws = Vw / (Vw + Vms)

Bwp = 100.0 * Bws

Md = 0.440 * CD + 0.320 * OX + 0.280 * (NI + CM)

Ms = Md * (1.0 - Bws) + 18.0 * Bws

Vs = 85.49 * Cp * Pv * SQRT((Ts+460.0)/(Ms*Ps))

Qa = 60.0 * Vs * As

Qs = Qa * (528/29.92) * Ps / (Ts + 460.0)

Qsd = Qs * (1.0 - Bws)

I = 0.09450 * (Ts+460.0) * Vms / (Ps * Vs * An * Ti * (1.0-Bws))

Csf = 15.42 * Wf / Vws
Csb = 15.42 * Wb / Vws
Cst = 15.42 * Wt / Vws

Cwf = Csf / (1.0 - Bws)
Cwb = Csb / (1.0 - Bws)
Cwt = Cst / (1.0 - Bws)

Caf = Cwf * (29.92/528.0) * (Ts+460.0) / Ps
Cab = Cwb * (29.92/528.0) * (Ts+460.0) / Ps
Cat = Cwt * (29.92/528.0) * (Ts+460.0) / Ps

Rcf = 0.008578 * Csf * Qsd
Rcb = 0.008578 * Csb * Qsd
Rct = 0.008578 * Cst * Qsd

Rrf = 0.008578 * Csf * (Vms/Ti) * (As/An)
Rrb = 0.008578 * Csb * (Vms/Ti) * (As/An)
Rrt = 0.008578 * Cst * (Vms/Ti) * (As/An)

DEFINITION OF UNIT ABBREVIATIONS

ACFM ..... ACTUAL CUBIC FEET PER MINUTE

DEG F ..... DEGREES FAHRENHEIT

DCF ..... DRY CUBIC FEET

DSCF ..... DRY STANDARD CUBIC FEET

DSCFM ..... DRY STANDARD CUBIC FEET PER MINUTE

FPS ..... FEET PER SECOND

G ..... GRAMS

GR/ACF ..... GRAINS PER ACTUAL CUBIC FOOT

GR/DSCF ..... GRAINS PER DRY STANDARD CUBIC FOOT

GR/SCF ..... GRAINS PER STANDARD CUBIC FOOT

IN ..... INCHES

IN HG ..... INCHES OF MERCURY

IN WC ..... INCHES OF WATER

LB/HR ..... POUNDS PER HOUR

LB/LB-MOLE .. POUND PER POUND-MOLE

MIN ..... MINUTES

ML ..... MILLILITERS

SCF ..... STANDARD CUBIC FEET

SCFM ..... STANDARD CUBIC FEET PER MINUTE

SF ..... SQUARE FEET

% V/V DRY ... PERCENT BY VOLUME, DRY BASIS

DEFINITION OF STANDARD CONDITIONS

STANDARD TEMPERATURE ..... 68 DEGREES FAHRENHEIT

STANDARD PRESSURE ..... 29.92 INCHES OF MERCURY

PARTICULATE EMISSION TEST CALCULATIONS

PROJECT NUMBER: 8014 COMPANY: SOUTHERN MN. BEET SUGAR
TEST NUMBER: 1 SOURCE: CYCLONE "A-2"
RUN NUMBER: 1 TIME: 1/21/88 1128-1231

TEST DATA

GAS METER COEFFICIENT	1.0035	Y	VOLUME OF LIQUID COLLECTED, ML	515.5	Vl
PITOT TUBE COEFFICIENT	0.840	Cp			
			GAS COMPOSITION, % V/V DRY;		
NOZZLE DIMENSIONS;			CARBON DIOXIDE	5.50	CD
DIAMETER, IN	0.375	Dn	OXYGEN	14.20	OX
AREA, SF	0.000767	An	CARBON MONOXIDE	0.00	CM
			NITROGEN (BY DIFFERENCE)	80.30	NI
STACK DIMENSIONS;					
DIAMETER/LENGTH, IN	47.50	Sl	AVE. TRAVERSE POINT DATA;		
WIDTH, IN	0.00	Sw	STACK TEMP., DEG F	288	Ts
AREA, SF	12.306	As	METER TEMP., DEG F	68	Tm
			ORIFICE PRESSURE, IN WC	1.450	Po
BAROMETRIC PRESSURE, IN HG	29.30	Pb	SQRT VELOCITY P., IN WC	0.421	Pv
STACK PRESSURES;			MASS OF PARTICULATE MATTER		
STATIC, IN WC	0.00	Pg	COLLECTED, G;		
ABSOLUTE, IN HG	29.30	Ps	FRONT CATCH (94.6%)	0.4246	Mf
			BACK CATCH (5.2%)	0.0234	Mb
SAMPLING TIME, MIN	60.00	Ti	TOTAL CATCH	0.4480	Mt
VOLUME OF GAS SAMPLED AT METER, DCF	40.427	Vm			

CALCULATED RESULTS

VOLUME OF GAS SAMPLED AT METER, DSCF	39.872	Vms	GAS MOLECULAR WEIGHT;		
			DRY BASIS, LB/LB-MOLE	29.45	Md
			WET BASIS, LB/LB-MOLE	25.12	Ms
EQUIVALENT VOLUME OF WATER VAPOR COLLECTED, SCF	24.265	Vw	AVERAGE GAS VELOCITY, FPS	30.52	Vs
GAS MOISTURE CONTENT;			GAS VOLUMETRIC FLOW RATE;		
VOLUME FRACTION	0.3783	Bws	ACTUAL, ACFM	22532	Qa
PERCENT BY VOLUME	37.83	Bwp	STANDARD, SCFM	15567	Qs
			DRY STANDARD, DSCFM	9678	Qsd
			ISOKINETIC VARIATION, %	110.24	I

PARTICULATE EMISSION PARAMETER	FRONT CATCH	BACK CATCH	TOTAL CATCH
PARTICULATE CONCENTRATION			
ACTUAL, GR/ACF	0.0705 Caf	0.0039 Cab	0.0744 Cat
STANDARD, GR/SCF	0.1021 Csf	0.0056 Csb	0.1077 Cst
DRY STANDARD, GR/DSCF	0.1642 Cdf	0.0090 Cdb	0.1733 Cdt
PARTICULATE EMISSION RATE, LB/HR			
CLASSICAL METHOD	13.63 Rcf	0.75 Rcb	14.38 Rct
RATIO OF AREAS METHOD	15.02 Rrf	0.83 Rrb	15.85 Rrt

STANDARD CONDITIONS: 68 DEG F, 29.92 IN HG * NON-APPLICABLE DATA

PARTICULATE EMISSION TEST CALCULATIONS

PROJECT NUMBER: 8014 COMPANY: SOUTHERN MN. BEET SUGAR
TEST NUMBER: 1 SOURCE: CYCLONE "A-2"
RUN NUMBER: 2 TIME: 1/21/88 1248-1352

TEST DATA

GAS METER COEFFICIENT	1.0035	Y	VOLUME OF LIQUID COLLECTED, ML	460.0	Vl
PITOT TUBE COEFFICIENT	0.840	Cp			
NOZZLE DIMENSIONS;			GAS COMPOSITION, % V/V DRY;		
DIAMETER, IN	0.375	Dn	CARBON DIOXIDE	4.60	CD
AREA, SF	0.000767	An	OXYGEN	15.60	OX
			CARBON MONOXIDE	0.00	CM
			NITROGEN (BY DIFFERENCE)	79.80	NI
STACK DIMENSIONS;					
DIAMETER/LENGTH, IN	47.50	Sl	AVE. TRAVERSE POINT DATA;		
WIDTH, IN	0.00	Sw	STACK TEMP., DEG F	292	Ts
AREA, SF	12.306	As	METER TEMP., DEG F	68	Tm
			ORIFICE PRESSURE, IN WC	1.385	Po
BAROMETRIC PRESSURE, IN HG	29.30	Pb	SQRT VELOCITY P., IN WC	0.422	Pv
STACK PRESSURES;			MASS OF PARTICULATE MATTER		
STATIC, IN WC	2.00	Pg	COLLECTED, G;		
ABSOLUTE, IN HG	29.30	Ps	FRONT CATCH (96.0%)	0.4116	Wf
			BACK CATCH (4.0%)	0.0170	Wb
SAMPLING TIME, MIN	60.00	T:	TOTAL CATCH	0.4286	Wt
VOLUME OF GAS SAMPLED AT METER, DCF	38.299	Vm			

CALCULATED RESULTS

VOLUME OF GAS SAMPLED AT METER, DSCF	37.767	Vms	GAS MOLECULAR WEIGHT;		
			DRY BASIS, LB/LB-MOLE	29.36	Md
			WET BASIS, LB/LB-MOLE	25.22	Ms
EQUIVALENT VOLUME OF WATER VAPOR COLLECTED, SCF	21.652	Vw	AVERAGE GAS VELOCITY, FPS	30.60	Vs
GAS MOISTURE CONTENT;			GAS VOLUMETRIC FLOW RATE;		
VOLUME FRACTION	0.3644	Bws	ACTUAL, ACFM	22593	Qa
PERCENT BY VOLUME	36.44	Bwp	STANDARD, SCFM	15535	Qs
			DRY STANDARD, DSCFM	9874	Qsd
			ISOKINETIC VARIATION, %	102.34	I

PARTICULATE EMISSION PARAMETER	FRONT CATCH	BACK CATCH	TOTAL CATCH
PARTICULATE CONCENTRATION:			
ACTUAL, GR/ACF	0.0734 Caf	0.0030 Cab	0.0765 Cat
STANDARD, GR/SCF	0.1068 Csf	0.0044 Csb	0.1112 Cst
DRY STANDARD, GR/DSCF	0.1681 Csf	0.0069 Csb	0.1750 Cst
PARTICULATE EMISSION RATE, LB/HR			
CLASSICAL METHOD	14.23 Rcf	0.59 Rcb	14.82 Rct
RATIO OF AREAS METHOD	14.56 Rrf	0.60 Rrb	15.16 Rrt

STANDARD CONDITIONS: 68 DEG F, 29.92 IN HG * NON-APPLICABLE DATA

PARTICULATE EMISSION TEST CALCULATIONS

PROJECT NUMBER: 8014 COMPANY: SOUTHERN MN. BEET SUGAR
TEST NUMBER: 1 SOURCE: CYCLONE "A-2"
RUN NUMBER: 3 TIME: 1/21/88 1430-1533

TEST DATA

GAS METER COEFFICIENT	1.0035 Y	VOLUME OF LIQUID COLLECTED, ML	614.1 Vl
PITOT TUBE COEFFICIENT	0.840 Cp		
NOZZLE DIMENSIONS;		GAS COMPOSITION, % V/V DRY;	
DIAMETER, IN	0.375 Dn	CARBON DIOXIDE	6.00 CD
AREA, SF	0.000767 An	OXYGEN	13.10 OX
		CARBON MONOXIDE	0.00 CM
		NITROGEN (BY DIFFERENCE)	80.90 NI
STACK DIMENSIONS;		AVE. TRAVERSE POINT DATA;	
DIAMETER/LENGTH, IN	47.50 Sl	STACK TEMP., DEG F	292 Ts
WIDTH, IN	0.00 Sw	METER TEMP., DEG F	68 Tm
AREA, SF	12.306 As	ORIFICE PRESSURE, IN WC	1.555 Po
BAROMETRIC PRESSURE, IN HG	29.30 Pb	SQRT VELOCITY P., IN WC	0.446 Pv
STACK PRESSURES;		MASS OF PARTICULATE MATTER COLLECTED, G;	
STATIC, IN WC	0.00 Pg	FRONT CATCH (95.8%)	0.4170 Wf
ABSOLUTE, IN HG	29.30 Ps	BACK CATCH (4.2%)	0.0184 Wb
SAMPLING TIME, MIN	60.00 Ti	TOTAL CATCH	0.4354 Wt
VOLUME OF GAS SAMPLED AT METER, DCF	41.000 Vm		

CALCULATED RESULTS

VOLUME OF GAS SAMPLED AT METER, DSCF	40.448 Vms	GAS MOLECULAR WEIGHT;	
		DRY BASIS, LB/LB-MOLE	29.46 Md
		WET BASIS, LB/LB-MOLE	24.70 Ms
EQUIVALENT VOLUME OF WATER VAPOR COLLECTED, SCF	28.906 Vw	AVERAGE GAS VELOCITY, FPS	32.65 Vs
GAS MOISTURE CONTENT;		GAS VOLUMETRIC FLOW RATE;	
VOLUME FRACTION	0.4168 Bws	ACTUAL, ACFM	24108 Qa
PERCENT BY VOLUME	41.68 Bwp	STANDARD, SCFM	16566 Qs
		DRY STANDARD, DSCFM	9662 Qsd
		ISOKINETIC VARIATION, %	112.02 I

PARTICULATE EMISSION PARAMETER	FRONT CATCH	BACK CATCH	TOTAL CATCH
PARTICULATE CONCENTRATION			
ACTUAL, GR/ACF	0.0637 Caf	0.0028 Cab	0.0665 Cat
STANDARD, GR/SCF	0.0927 Cwf	0.0041 Cwb	0.0968 Cwt
DRY STANDARD, GR/DSCF	0.1590 Csf	0.0070 Csb	0.1660 Cst
PARTICULATE EMISSION RATE, LB/HR			
CLASSICAL METHOD	13.18 Rcf	0.58 Rcb	13.76 Rct
RATIO OF AREAS METHOD	14.75 Rrf	0.65 Rrb	15.42 Rrt

STANDARD CONDITIONS: 68 DEG F, 29.92 IN HG * NON-APPLICABLE DATA

TRAVERSE POINT DATA SUMMARY AND VELOCITY PROFILE

PROJECT NUMBER: 8014 COMPANY: SOUTHERN MN. BEET SUGAR
TEST NUMBER: 1 SOURCE: CYCLONE "A-2"
RUN NUMBER: 1 TIME: 1/21/88 1128-1231

SAMPLING LOCATION PORT	POINT	TRAVERSE POINT DATA: VELOCITY PRESSURE IN WC	ORIFICE PRESSURE IN WC	TEMPERATURE, DEG.F STACK GAS	METER INLET	METER OUTLET	VELOCITY PROFILE: SQRT VELOCITY PRESSURE	GAS VELOCITY FT/SEC
A	1	0.160	1.300	290	68	68	0.400	29.00
A	2	0.160	1.300	288	68	68	0.400	28.96
A	3	0.170	1.300	285	68	68	0.412	29.79
A	4	0.190	1.400	284	68	68	0.436	31.47
A	5	0.220	1.600	291	68	68	0.469	34.03
A	6	0.210	1.900	293	68	68	0.458	33.29
A	7	0.220	1.700	294	68	68	0.469	34.09
A	8	0.210	1.800	295	68	68	0.458	33.33
A	9	0.210	1.700	296	68	68	0.458	33.35
A	10	0.160	1.700	291	68	68	0.400	29.02
B	1	0.160	1.300	287	68	68	0.400	28.94
B	2	0.160	1.300	285	68	68	0.400	28.90
B	3	0.160	1.300	289	68	68	0.400	28.98
B	4	0.190	1.600	291	68	68	0.436	31.62
B	5	0.200	1.600	290	68	68	0.447	32.42
B	6	0.190	1.600	290	68	68	0.436	31.60
B	7	0.170	1.400	286	68	68	0.412	29.81
B	9	0.140	1.100	282	68	68	0.374	26.98
B	9	0.140	1.100	282	68	68	0.374	26.98
B	10	0.150	1.100	279	68	68	0.387	27.87
AVERAGE		0.179	1.450	288	68	68	0.421	30.52

TRAVERSE POINT DATA SUMMARY AND VELOCITY PROFILE

PROJECT NUMBER: 8014 COMPANY: SOUTHERN MN. BEET SUGAR
TEST NUMBER: 1 SOURCE: CYCLONE "A-2"
RUN NUMBER: 2 TIME: 1/21/88 1248-1352

SAMPLING LOCATION PORT	POINT	TRAVERSE POINT DATA: VELOCITY PRESSURE IN WC	ORIFICE PRESSURE IN WC	TEMPERATURE, DEG.F. STACK GAS	METER INLET	METER OUTLET	VELOCITY PROFILE: SQRT VELOCITY PRESSURE	GAS VELOCITY FT/SEC
A	1	0.180	1.400	293	68	68	0.424	30.76
A	2	0.190	1.500	294	68	68	0.436	31.62
A	3	0.190	1.500	295	68	68	0.436	31.64
A	4	0.190	1.500	295	68	68	0.436	31.64
A	5	0.200	1.500	298	68	68	0.447	32.53
A	6	0.200	1.500	300	68	68	0.447	32.57
A	7	0.180	1.400	295	68	68	0.424	30.80
A	8	0.160	1.200	287	68	68	0.400	28.88
A	9	0.130	1.000	288	68	68	0.361	26.05
A	10	0.130	1.000	286	68	68	0.361	26.02
B	1	0.170	1.300	287	68	68	0.412	29.77
B	2	0.190	1.500	292	68	68	0.436	31.58
B	3	0.130	1.000	291	68	68	0.361	26.10
B	4	0.210	1.600	292	68	68	0.458	33.20
B	5	0.230	1.800	294	68	68	0.480	34.79
B	6	0.210	1.600	294	68	68	0.458	33.24
B	7	0.190	1.500	293	68	68	0.436	31.60
B	8	0.190	1.500	292	68	68	0.436	31.58
B	9	0.170	1.300	286	68	68	0.412	29.75
B	10	0.150	1.100	288	68	68	0.387	27.98
AVERAGE		0.180	1.385	292	68	68	0.422	30.60

TRAVERSE POINT DATA SUMMARY AND VELOCITY PROFILE

PROJECT NUMBER: 8014 COMPANY: SOUTHERN MN. BEET SUGAR
TEST NUMBER: 1 SOURCE: CYCLONE "A-2"
RUN NUMBER: 3 TIME: 1/21/88 1430-1533

SAMPLING LOCATION PORT	POINT	TRAVERSE POINT DATA: VELOCITY PRESSURE IN WC	ORIFICE PRESSURE IN WC	TEMPERATURE, DEG.F: STACK GAS	METER INLET	METER OUTLET	VELOCITY PROFILE: SQRT VELOCITY PRESSURE	GAS VELOCITY FT/SEC
A	1	0.190	1.500	292	68	68	0.436	31.91
A	2	0.230	1.800	294	68	68	0.480	35.15
A	3	0.220	1.750	296	68	68	0.469	34.43
A	4	0.220	1.750	294	68	68	0.469	34.38
A	5	0.220	1.500	295	68	68	0.469	34.40
A	6	0.190	1.400	293	68	68	0.436	31.93
A	7	0.180	1.300	292	68	68	0.424	31.06
A	8	0.170	1.300	290	68	68	0.412	30.14
A	9	0.160	1.300	289	68	68	0.400	29.22
A	10	0.160	1.300	287	68	68	0.400	29.18
B	1	0.180	1.400	298	68	68	0.424	31.18
B	2	0.190	1.500	292	68	68	0.436	31.91
B	3	0.190	1.500	293	68	68	0.436	31.93
B	4	0.200	1.600	293	68	68	0.447	32.76
B	5	0.210	1.700	294	68	68	0.458	33.59
B	6	0.220	1.750	293	68	68	0.469	34.36
B	7	0.240	1.900	294	68	68	0.490	35.91
B	8	0.230	1.800	292	68	68	0.480	35.11
B	9	0.210	1.650	290	68	68	0.458	33.50
B	10	0.180	1.400	288	68	68	0.424	30.98
AVERAGE		0.200	1.555	292	68	68	0.446	32.65

APPENDIX B

FIELD DATA FORMS

SOURCE EMISSION TEST
FIELD DATA SHEET

TEST: 1 RUN: 1
Page 1 of 1

TEST IDENTIFICATION	EQUIPMENT IDENTIFICATION	NOMOGRAPH PARAMETERS
MMT Job Number: 8015	Control Unit No.: 1 1.0035	ΔH@ 1.95
Date: 1/21/88	Gas Meter Coefficient: 1 ~~0.9985~~	TM 110
Company: Southern Mn Sugar	Sample Box No.: #1	MC 35
Source: Cyclone A-2	Probe No.: 5ft Length: 5ft	PS/PM 1.00
Source Dimensions: 47.5	Pitot No.: S-1 Coefficient: .84	C
Test Team: CM/RL	Nozzle No.: 5 Diameter: 0.375	TS ~~300~~ 290
Test Procedure: M-5	Filter No.: 8093	R
Ambient Temp., °F:	Barometric Pressure, in.Hg: 29.30	Static Pressure, in.WC: -0.00

CLOCK TIME hours	TRAVERSE POINT NUMBER	SAMPLE TIME min.	SAMPLE VOLUME cu.ft.	VELOCITY HEAD in.WC	ORIFICE ΔH, in.WC REQ.	ORIFICE ΔH, in.WC ACT.	PUMP VAC. inHG	TEMPERATURE, DEG F STACK GAS	GAS METER IN	GAS METER OUT	OVEN	PROBE	LAST IMP.
1128	A-1	0	380.598	0.16	1.3	1.3	2	290	74	74	255	Hot	30
31	A-2	3	82.3	0.16	1.3	1.3	2	288	72	72			
34	A-3	6	84.4	0.16	1.3	1.3	2	285	68	68	260		34
37	A-4	9	86.4	0.17	1.4	1.4	2	284	68	68			
40	A-5	12	88.3	0.19	1.6	1.6	3	291	68	68			
43	A-6	15	90.5	0.22	1.8	1.8	4	293	68	68	260		36
46	A-7	18	92.7	0.21	1.7	1.7	4	294	68	68			
49	A-8	21	94.8	0.22	1.8	1.8	4	295	68	68	265		39
52	A-9	24	97.1	0.21	1.7	1.7	5	296	68	68			
55	A-10	27	99.5	0.21	1.7	1.7	5	291	68	68			
1158	END A	30	401.9										
1201	B-1	0	~~4.9~~	0.16	1.3	1.3	2	287	68	68	265	Hot	40
4	B-2	3	~~3.8~~	0.16	1.3	1.3	2	285	68	68			
7	B-3	6	5.7	0.16	1.3	1.3	3	289	68	68			
10	B-4	9	7.3	0.19	1.6	1.6	4	291	68	68			
13	B-5	12	9.12	0.20	1.6	1.6	4	290	68	68	265		44
16	B-6	15	12.0	0.19	1.6	1.6	4	290	68	68			
19	B-7	18	14.2	0.17	1.4	1.4	3	286	68	68			
22	B-8	21	16.2	0.14	1.1	1.1	2	282	68	68	260		49
25	B-9	24	18.1	0.14	1.1	1.1	2	282	68	68			
28	B-10	27	19.6	0.15	1.1	1.1	2	279	68	68			
1231	END B	30	421.025										

MOISTURE DETERMINATION

IMPINGER	1	2	3	4	5
Final	391.9	258.6	42.4	718.2	
Initial	100.0	100.0	0	695.6	
Difference	291.9	158.6	42.4	22.6	

Total Moisture Collected: 515.5

SYSTEM LEAK CHECKS

Time	Rate (cfm)	Vac. (in.Hg)
1116	27" Hg	0.002 cfm
1233	0.002	15" Hg

Impinger Catch Description: light yellow in color

DETERMINATION OF GAS COMPOSITION BY ORSAT ANALYSIS

Sample Id: #2	Replicate 1 Buret Reading	Replicate 1 Percent Volume	Replicate 2 Buret Reading	Replicate 2 Percent Volume	Replicate 3 Buret Reading	Replicate 3 Percent Volume	Average Compound	Average Percent Volume
Initial Reading								
Carbon Dioxide	94.4	5.6	94.5	5.5	94.5	5.5	CO_2	5.5
Oxygen	80.2	14.2	80.2	14.3	80.3	14.2	O_2	14.2
Carbon Monoxide							CO	

Total Sampling Time, min.: 60
Volume of Gas Sampled: DCF: 40.4270

FORM: S-FD-5

SOURCE EMISSION TEST
FIELD DATA SHEET

TEST: 2 RUN: —
Page of

TEST IDENTIFICATION		EQUIPMENT IDENTIFICATION		NOMOGRAPH PARAMETERS
MMT Job Number:	8014	Control Unit No.:	1 1.0035	ΔH@ 1.95
Date:	1-21-88	Gas Meter Coefficient:	0.~~9985~~	TM 68
Company:	S. MN Sugar Coop	Sample Box No.:	#2	MC 35
Source:	A-2 Cyclone	Probe No.: 5-1	Length: 5'	PS/PM 1.00
Source Dimensions:	47.5	Pitot No.: 5-1	Coefficient: 0.84	C
Test Team:	CM RL	Nozzle No.: 5	Diameter: 0.375	TS 290
Test Procedure:	EPA 5	Filter No.:	8094	R
Ambient Temp., °F:		Barometric Pressure, in.Hg: 29.30		Static Pressure, in.WC: 000

CLOCK TIME hours	TRAVERSE POINT NUMBER	SAMPLE TIME min.	SAMPLE VOLUME cu.ft.	VELOCITY HEAD in.WC	ORIFICE ΔH, in.WC REQ.	ORIFICE ΔH, in.WC ACT.	PUMP VAC. inHG	TEMPERATURE, DEG F STACK GAS	GAS METER IN	GAS METER OUT	OVEN	PROBE	LAST IMP.
1248	B-1	0	422.280	0.18	1.4	1.4	4	293	68	68	265	Max	38
51	2	3	24.2	0.19	1.5	1.5	5	294	68	68			
54	3	6	26.2	0.19	1.5	1.5	5	295	68	68			
57	4	9	28.2	0.19	1.5	1.5	5	295	68	68	260		40
1300	5	12	30.1	0.20	1.5	1.5	5	298	68	68			
3	6	15	32.1	0.20	1.5	1.5	5	300	68	68			
6	7	18	34.1	0.18	1.4	1.4	5	295	68	68			
9	8	21	36.0	0.16	1.2	1.2	4	287	68	68	265		39
12	9	24	37.8	0.13	1.0	1.0	2	288	68	68			
15	10	27	39.6	0.13	1.0	1.0	2	286	68	68			
1218	end B	30	41.2										
1322	A-1	0	41.2	0.17	1.3	1.3	4	287	68	68	265	Max	43
25	2	3	43.1	0.19	1.5	1.5	6	292	68	68			
28	3	6	45.0	0.13	1.0	1.0	3	291	68	68			
31	4	9	46.6	0.21	1.6	1.6	7	292	68	68	265		46
34	5	12	48.7	0.23	1.8	1.8	9	294	68	68			
37	6	15	50.8	0.21	1.6	1.6	7	294	68	68			
40	7	18	52.9	0.19	1.5	1.5	6	293	68	68			
43	8	21	55.0	0.19	1.5	1.5	6	292	68	68	265		48
46	9	24	58.9	0.17	1.3	1.3	5	286	68	68			
49	10	27	58.8	0.15	1.1	1.1	3	288	68	68			
1352	end A	30	460.599										

MOISTURE DETERMINATION

IMPINGER	1	2	3	4	5
Final	261.4	279.6	74.3	775.0	
Initial	100	100	0	730.0	
Difference	161.4	179.6	74.3	45.0	

Total Moisture Collected: 460.0

SYSTEM LEAK CHECKS

Time	Rate (cfm)	Vac. (in.Hg)
1240	0.001	16
1353	0.002	19

Impinger Catch Description: Light Yellow Color

DETERMINATION OF GAS COMPOSITION BY ORSAT ANALYSIS

Sample Id: #4	Replicate 1 Buret Reading	Replicate 1 Percent Volume	Replicate 2 Buret Reading	Replicate 2 Percent Volume	Replicate 3 Buret Reading	Replicate 3 Percent Volume	Average Compound	Average Percent Volume
Initial Reading								
Carbon Dioxide	95.4	4.6	95.5	4.5	95.4	4.6	CO2	4.6
Oxygen	79.8	15.6	79.8	15.7	80.0	15.4	O2	15.6
Carbon Monoxide							CO	

Total Sampling Time, min.: 60
Volume of Gas Sampled, DCF: 38.299

FORM: S-FD-5

SOURCE EMISSION TEST
FIELD DATA SHEET

TEST: 7 RUN: 3
Page of

TEST IDENTIFICATION		EQUIPMENT IDENTIFICATION		NOMOGRAPH PARAMETERS
MMT Job Number:	8014	Control Unit No.: 1	1.0035	ΔH@ 1.93
Date:	1-21-88	Gas Meter Coefficient:	~~0.9935~~	TM 68
Company:	S. MN Sugar Coop	Sample Box No.:	1	MC 34
Source:	#2 Cyclone	Probe No.: 5-1	Length: 5'	PS/PM 1.00
Source Dimensions:	47.5"	Pitot No.: 5-1	Coefficient: 0.84	C
Test Team:	RL CM	Nozzle No.: 5	Diameter: 3/8 (0.375)	TS 290
Test Procedure:	EPA 5	Filter No.:	8095	R

Ambient Temp., °F: | Barometric Pressure, in.Hg: 29.32 | Static Pressure, in.WC: 0.00

CLOCK TIME hours	TRAVERSE POINT NUMBER	SAMPLE TIME min.	SAMPLE VOLUME cu.ft.	VELOCITY HEAD in.WC	ORIFICE ΔH, in.WC REQ.	ORIFICE ΔH, in.WC ACT.	PUMP VAC. inHG	TEMPERATURE, DEG F STACK GAS	GAS METER IN	GAS METER OUT	OVEN	PROBE	LAST IMP.
1430	A-1	0	463390	0.19	1.5	1.5	2	292	68	68	260	Max	38
33	2	3	65.4	0.23	1.8	1.8	2	294	68	68			
36	3	6	67.6	0.22	1.75	1.75	2	296	68	68			
39	4	9	69.8	0.22	1.75	1.75	3	294	68	68			
42	5	12	71.9	0.22	1.75	1.75	3	295	68	68	260		42
45	6	15	74.1	0.19	1.5	1.5	3	293	68	68			
48	7	18	76.1	0.18	1.4	1.4	2	292	68	68			
51	8	21	78.1	0.17	1.3	1.3	2	290	68	68			
54	9	24	79.9	0.16	1.3	1.3	2	289	68	68	260		44
57	10	27	81.8	0.16	1.3	1.3	2	287	68	68			
1500	end A	30	83.6	~~~	~~~	~~~	~~~	~~~	~~~	~~~	~~~	~~~	~~~
1503	B-1	0	83.6	0.18	1.4	1.4	3	298	68	68		Max	
6	2	3	85.5	0.19	1.5	1.5	3	292	68	68	260		42
9	3	6	87.5	0.19	1.5	1.5	3	293	68	68			
12	4	9	89.5	0.20	1.6	1.6	4	293	68	68			
15	5	12	91.6	0.21	1.7	1.7	4	294	68	68	260		45
18	6	15	93.7	0.22	1.75	1.75	4	293	68	68			
21	7	18	95.9	0.24	1.9	1.9	5	294	68	68			
24	8	21	98.1	0.23	1.8	1.8	5	292	68	68	265		49
27	9	24	500.2	0.21	1.65	1.65	4	290	68	68			
30	10	27	502.4	0.16	1.4	1.4	4	288	68	68			
1533	end B	30	504.390	~~~	~~~	~~~	~~~	~~~	~~~	~~~	~~~	~~~	~~~

MOISTURE DETERMINATION

IMPINGER	1	2	3	4	5
Final	382.7	331.6	83.7	716.1	
Initial	100	100	0	743.0	
Difference	282.7	231.6	83.7	16.1	

Total Moisture Collected: 614.1

SYSTEM LEAK CHECKS

Time	Rate (cfm)	Vac. (in.Hg)
1426	0.003	18" Hg
1534	0.002	15"

Impinger Catch Description: Light Yellow Color

DETERMINATION OF GAS COMPOSITION BY ORSAT ANALYSIS

Sample Id: #6	Replicate 1 Buret Reading	Replicate 1 Percent Volume	Replicate 2 Buret Reading	Replicate 2 Percent Volume	Replicate 3 Buret Reading	Replicate 3 Percent Volume	Average Compound	Average Percent Volume
Initial Reading								
Carbon Dioxide	94	6	94	6	94.1	5.9	CO_2	6.0
Oxygen	80.9	13.1	80.5	12.7	80.7	13.4	O_2	13.1
Carbon Monoxide							CO	

Total Sampling Time, min.: 60
Volume of Gas Sampled, DCF: 41.000

FORM: S-FD-5

VISIBLE EMISSIONS OBSERVATION FORM

Job No.: 8014 Date: 1/21/88 Observer (print): Clifford E. Mohs

Company: Southern Mn Beet Sugar Coop

Address:

Source: Cyclone A-2 discharge

Source Dimensions; Height: Diameter:

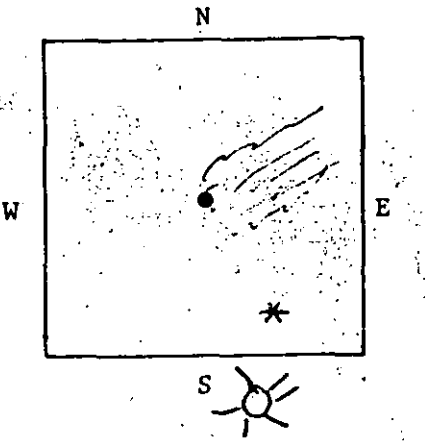
Observer's position ffom source:

Plume Description: large moisture plume

Background Description: Clear sky

Wind Direction: 5-10 Speed: SW

Ambient Temperature, °F: 5°



OBSERVERS (X) POSITION RELATIVE TO SOURCE (●), PLUME (≈) AND SUN (✲)

Comments (use back of form if necessary):

Because the stack was to close to the other stacks and from all the other emission sources it is impossible to take any VE Readings. The Plumes are all combining together and the is one large moisture plume heading across the field

VISUAL OBSERVATIONS OF PLUME OPACITY

Observations are to be made at fifteen second intervals and recorded to the nearest five percent opacity

No Reading To much moisture and interferences from other sources

Time: Start 11:45 Finish

SEC / MIN	0	15	30	45
0				
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				

SEC / MIN	0	15	30	45
20				
21				
22				
23				
24				
25				
26				
27				
28				
29				
30				
31				
32				
33				
34				
35				
36				
37				
38				
39				

SEC / MIN	0	15	30	45
40				
41				
42				
43				
44				
45				
46				
47				
48				
49				
50				
51				
52				
53				
54				
55				
56				
57				
58				
59				

SEC / MIN	0	15	30	45
60				
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79				

Last Re-Certification Date: 10/21/87 Observers Signature: Clifford E. Mohs

FORM: S-VE-1

mmt environmental, inc.

APPENDIX C

LABORATORY REPORT

SUMMARY OF PARTICULATE EMISSION TEST LABORATORY DATA

PROJECT NUMBER: B014 COMPANY: SOUTHERN MN. BEET SUGAR
TEST NUMBER: 1 SOURCE: CYCLONE "A-2"

	MASS OF PARTICULATE MATTER COLLECTED, GRAMS							
	FRONT CATCH				BACK CATCH			TOTAL PARTICULATE MASS COLLECTED
RUN NUMBER	FRONT WASH	CYCLONE CATCH	FILTER CATCH	FRONT TOTAL	IMPINGER CATCH **	IMPINGER WASH	BACK TOTAL	
1	0.1630	0.0000	0.2616	0.4246	0.0112	0.0122	0.0234	0.4480
2	0.1760	0.0000	0.2356	0.4116	0.0087	0.0083	0.0170	0.4286
3	0.1611	0.0000	0.2559	0.4170	0.0122	0.0062	0.0184	0.4354

* NOT APPLICABLE

** CHLOROFORM/ETHYL ETHER EXTRACTION

From Lab Note Book

14

Page 1

Date of Weightings, filter weights

ID #	Tare Wt Date	1st wt	2nd wt	3rd wt	Usage
1 ms					
8083	12-17-87	1/18/88			
8084	" " "	1/18/88			
8085	" " "	1/18/88			
8086	" " "	1/18/88			
8087	" " "	1/19/88			
8088	12/28/87	1/18/88			
8089					
~~80~~ 1 ms	12-17-87				
8090	12-18-87				
8091	12-18-87				
8092	1/20-88	1/25/88	1/26/88		
8093	1/20-88	1/25/88	1/26/88		
8094	1/20-88	1/25/88	1/26/88		
8095	1/20-88	1/25/88	1/26/88		
8096	1/20-88				
8097					
8098					
8099					
1 ms					
8100					
8101					
8102					
8103					
8104					
8105					
8106					
8107					
8108					
8109					

Filter Wts

ID	TARE WT	1ST WT	2ND WT	3RD WT	WT Gain	Test Run
Img						
8083	.7734	.9202			.1468	S 3-2
8084	.7771	.9587			.1816	N 3-3
8085	.7606	.8753			.1147	S 3-3
8086	.7581	.9707			.2126	S 4-1
8087	.7692	.9194			.1502	N 4-1
8088	.7712	.9708			.1996	N 4-3
8089	.7666	.7665			.0001	Blank
Img	1.0003				.0003	
8090	.7615					
8091	.7543					
8092	.7675	.7676	.7677	.0001	.2616	Blank
8093	.7694	1.0313	1.314		~~.2356~~	SmaBS T-1 R-1
8094	.7570	.9924	.9927		.2356	SmaBS T-1 R2
8095	.7630	1.0189	1.0187		.2559	SmaBS T-1 R3
8096	.7761					Spare
8097						
8098						
8099						
Img						
9100						
8101						
8102						
8103						
8104						
8105						
8106						
8107						
8108						
8109						

Probe Rinse, evap. extract, acetone Imp. Rinse

Wts

Date of Wts TARE	Final	Sample ID wt	TARE wt	1st wt	2nd wt	wt gain	
1/22/88		8149	2.4756				SD-1-123 mf
"		8150	2.5009				SO-2-123 mf
"		8151	2.4660				SO-3-123 mf
"		8152	2.4843				SO-4-123 mf
1/22/88		8153	2.4593				Blank
1/25/88	Y27	8154	2.4683	2.4809	2.4800	.0122	Sm SD Xtract R1-R1
"	"	8155	2.4928	2.5019	2.5005	.0083	Sm SB T1 Xtract R2
"	"	8156	2.4838	2.5004	2.4998	.0062	Sm SB T1 Xtract R3
"	"	8157	2.4815	2.6440	2.6430	.1630	Sm SB T1 Acetone RP R1
"	"	8158	2.4982	2.6743	2.6740	.1760	Sm SB T1 R2 Probe Rinse
"	"	8159	2.4742	2.6353	2.6358	.1611	Sm SB T1 R3 Probe Rinse
"	"	OC	1.0001				~~Sm SB R1 Imp Rinse~~
"	"	8160	2.4716	2.4833	2.4823	.0112	Sm SB T1 R1 Acet. Imp Rinse
"	"	8161	2.4747	2.4834	2.4833	.0087	Sm SB T1 R2 Ace. Imp Rinse
"	"	8162	2.4629	2.4748	2.4854	.0122	Sm SB T1 R3 "
"	"	8163	2.4821	2.4825	2.4824	.0003	Acetone Blank
1/25/88	Y27	8164	2.4671	2.4672	2.4673	.0001	$CHCl_3$ + Ether Blank
		8165					
		8166					
		8167					
		8168					
		8169					
		~~8170~~ OC					
		8170					
		8171					
		8172					
		8173					
		8174					
		8175					
		8176					

APPENDIX D

CALIBRATION DATA

CALIBRATION
DRY TEST METER/ORIFICE METER

Date: 1/11/88 Barometric Pressure, in. Hg. (Pb): 29.12

EQUIPMENT IDENTIFICATION			
Control Unit	Dry Test Meter	Wet Test Meter	Calibration Type
Mfg: RAC	Mfg: Rockwell	Mfg: GCA	General: X
Model: STAK Sampler	Model: R-200 TC	Model: 63123	Post-test:
SN: 2452	SN: 3041326	SN: 11-AH12	

EQUIPMENT CALIBRATION

Orifice Pressure Drop in. WC H	Pump Vac. in.Hg	Wet Test Meter Volume, CF Initial V_{wi}	Wet Test Meter Volume, CF Final V_{wf}	Wet Test Meter Temp. °F T_w	Dry Test Meter Volume, CF Initial V_{di}	Dry Test Meter Volume, CF Final V_{df}	Dry Test Meter Temperature, °F Inlet Initial T_{ii}	Dry Test Meter Temperature, °F Inlet Final T_{if}	Dry Test Meter Temperature, °F Outlet Initial T_{oi}	Dry Test Meter Temperature, °F Outlet Final T_{of}	Elapsed Time, min. Q
.5	0	0.00	4.730	56	10.662	15.482	68	68	68	68	12
1.1		4.730	10.500	56.5	15.482	21.358	68	68	68	68	10
2.0		10.500	18.180	56.5	21.358	27.137	68	68	68	68	10
4.0		18.180	26.440	56.5	29.137	37.682	68	68	68	68	8

COMPUTER PRINTOUT

H	Vw	Tw	Vd	Td	Q	C	Hθ
0.5	4.730	56	4.620	68.0	12.0	1.0029	1.7666
1.1	5.770	57	5.876	68.0	10.2	1.0010	1.8173
2.0	7.680	57	7.775	68.0	10.0	1.0056	1.8624
4.0	8.460	57	8.545	68.0	8.0	1.0020	1.9673

AVERAGE CORRECTION FACTOR: C = 1.0029
AVERAGE ORIFICE CONSTANT: Hθ = 1.8534

EQUATIONS:

$V_w = V_{wf} - V_{wi}$

$V_d = V_{df} - V_{di}$

$T_d = (T_{ii} + T_{if} + T_{oi} + T_{of}) / 4$

$C = V_w * P_b * (T_d+460) / (V_d * (P_b+H/13.6) * (T_w+460))$

$H\theta = 0.0317 * H * ((T_w+460)*Q/V_w)^2 / (P_b * (T_d+460))$

Calibration Performed by:

(Print) Clifford E. Mohs

(Signature) Clifford E Mohs

CALIBRATION
DRY TEST METER/ORIFICE METER

Date: 1/27/88 Barometric Pressure, in. Hg. (Pb): 29.57

EQUIPMENT IDENTIFICATION			
Control Unit	Dry Test Meter	Wet Test Meter	Calibration Type
Mfg: RAC	Mfg: Rockwell	Mfg: GCA	General:
Model: GTAK Sampler	Model: R-200-TC	Model: 63123	Post-test: X
SN: 2452	SN: 5041326	SN: 11-AH12	

EQUIPMENT CALIBRATION											
Orifice Pressure Drop in. WC H	Pump Vac. in.Hg	Wet Test Meter Volume, CF Initial V_{wi}	Wet Test Meter Volume, CF Final V_{wf}	Wet Test Meter Temp. °F T_w	Dry Test Meter Volume, CF Initial V_{di}	Dry Test Meter Volume, CF Final V_{df}	Dry Test Meter Temperature, °F Inlet Initial T_{ii}	Dry Test Meter Temperature, °F Inlet Final T_{if}	Dry Test Meter Temperature, °F Outlet Initial T_{oi}	Dry Test Meter Temperature, °F Outlet Final T_{of}	Elapsed Time, min. Q
.5	0	0.00	7.057	64.5	510.763	517.853	68	68	68	68	18.0
1.0	0	7.057	14.136	65.0	517.853	524.892	68	68	68	68	13.0
2.0	0	14.136	22.441	65.0	524.892	533.169	68	68	68	68	11.0
3.0	0	22.441	31.518	65.0	533.169	542.214	68	68	68	68	10.0

COMPUTER PRINTOUT

H	Vw	Tw	Vd	Td	Q	C	Ha
0.5	7.057	65	7.090	68.0	18.3	1.0007	1.8169
1.0	7.079	65	7.039	68.0	13.0	1.0009	1.8873
2.0	8.305	65	8.277	68.0	11.0	1.0041	1.9635
3.0	9.077	65	9.045	68.0	10.0	1.0018	2.0376

AVERAGE CORRECTION FACTOR: C = 1.0039
AVERAGE ORIFICE CONSTANT: Ha = 1.9267

EQUATIONS:

$V_w = V_{wf} - V_{wi}$

$V_d = V_{df} - V_{di}$

$T_d = (T_{ii} + T_{if} + T_{oi} + T_{of}) / 4$

$C = V_w * P_b * (T_d+460) / (V_d * (P_b+H/13.6) * (T_w+460))$

$Ha = 0.0317 * H * ((T_w+460)*Q/V_w)^2 / (P_b * (T_d+460))$

Calibration Performed by:

(Print) Clifford E. Mohs

(Signature) Clifford E. Mohs

CALIBRATION

NOZZLE DIAMETER

Nozzle Number	Nominal Diameter, in.	Measured Diameter, in. D1	D2	D3	Nozzle* Diameter, in.
#5	3/8	.0375	.374	.375	.375

* Nozzle diameter = (D1 + D2 + D3)/3

Calibration Performed by:

(Print) Clifford E. Mohs

(Signature) Clifford E Mohs

Date: 1/20/88

CALIBRATION

S-TYPE PITOT TUBE

Date: 1/20/88

Ambient Temperature, °F: 78

Barometric Pressure, in. Hg.: 29.6

S-Type Pitot Tube ID No.: 5

Standard Pitot Tube ID No.: STD-5

Standard Pitot Tube Coefficient: .995

PITOT TUBE EXAMINATION

Alignment Check	Pitot Tube Dimensions	Pitot Assembly Intercomponent Spacings
✓ $\alpha 1 < 10°$ ✓ $\alpha 2 < 10°$ ✓ $\beta 1 < 5°$ ✓ $\beta 2 < 5°$ ✓ $Q < 1/8$ in. ✓ $R < 1/32$ in.	External tubing diameter (D_t): 3/8" Base to Side A opening plane (P_A): .6" Base to Side B opening plane (P_B): .6"	Pitot to 1/2 in nozzle (X): .5 in Pitot to probe sheath (Y): 3.2 in Pitot to thermocouple, along probe (W): 2.3 in Pitot to thermocouple, perpendicular to probe (Z): .28 in

DESIRED CALIBRATION POINT		SIDE A CALIBRATION		SIDE B CALIBRATION	
Velocity ft/sec	P_{std} in. WC	P_{std} in. WC	P_s in. WC	P_{std} in. WC	P_s in. WC
20	0.09	.09	.121	.09	.12
40	0.37	.37	.52	.37	.51
60	0.82	.82	1.16	.82	1.16
80	1.45	1.45	1.90	1.45	2.00
100	2.30				

COMPUTER PRINTOUT

SIDE A CALIBRATION

Pstd	Ps	Cp	Cp-Cp(A)
0.090	0.121	0.858	0.007
0.370	0.520	0.839	-0.011
0.820	1.160	0.837	-0.014
1.450	1.900	0.869	0.018

Cp(A) = 0.851

SIDE B CALIBRATION

Pstd	Ps	Cp	Cp-Cp(B)
0.090	0.120	0.862	0.013
0.370	0.510	0.847	-0.001
0.820	1.160	0.837	-0.012
1.450	2.000	0.847	-0.001

Cp(B) = 0.848

Calibration Performed by:

(Print) Clifford Mohs

(Signature) Clifford E Mohs

APPENDIX E

PROCESS DATA

CHICAGO TUBE & IRON

2940 EAGANDALE BLVD. ST. PAUL, MN 55121
612/454-6800

wt of tube + funnel

	44 Lb 11:45 AM	46 Lb. ← wt of wheel barrel
1	73 Jan 21-88	78
2	74	78
3	74	79
4	76	80
5	78	80
6	81	82
7	82	90 1053
8	89	90
9	97	97
10	78	84
11	96	88
12	98	90
13	94 3:45	88
14	73 547	1104 - 598 = 506
	1163	

$\frac{547 + 506}{4\ \text{hrs}} = 263\ \text{lbs/hr}$

KOCH

KOCH REFINING COMPANY

RECEIVED JAN 2 2 1988

January 21, 1988

Mr. Dean DeBelley
Southern Minnesota Beet Sugar Coop
Post Office Box 500
Renville, Minnesota 56248

Dear Dean:

Confirming our telephone conversation, listed below is current analysis of Koch Refining Company's Industrial Fuel Oil (Clarified Oil).

API Gravity	-4.0
Viscosity, ssu 100°F	1400
Flash Point	150°
Pour Point	55°
Sulfur, wt. %	1.55
BTU Content	155,500 per gallon

If I can be of any further assistance please give me a call.

Sincerely,

KOCH REFINING COMPANY

Don Howe

Don Howe
Sales Representative

SOUTHERN MINNESOTA SUGAR CO-OP

DRYER REPORT

FORM 127 Rev. 6-83

JAN 2 6 1900

DAY ENDING 1-22-88 8 A.M.

9.1 tons/hour Tons pressed pulp/hour 85%

Test Run

	OPERATOR	BEET END 4MAN
SHIFT 1	Yesdock	R. Kennedy
SHIFT 2	Dam	L.D. Chr
SHIFT 3	C. F.	P. E.

TIME	A.M. 9	10	11	12	P.M. 1	2	3	4	5	6	7	8	9	10	11	12	A.M. 1	2	3	4	5	6	7	8
FEED RATE % (Tons)																								
NORTH	45	45	45	45	40	40	40	40	40	30	45	45	40	50	45	45	40	40	40	40	40	40	40	45
SOUTH	45	45	45	45	40	40	40	40	45	45	45	45	45	45	45	45	45	45	45	45	45	45	45	45
FURNACE TEMP.																								
NORTH	1050	1050	1050	1050	1050	1050	1100	1050	1200	1250	1400	1250	1250	1250	1300	1300	1250	1250	1250	1250	1250	1300	1200	1200
SOUTH	1200	1200	900	1150	1200	1200	1200	1200	1100	1450	1350	1450	1400	1450	1450	1400	1350	1300	1300	1300	1300	1300	1300	1300
EXIT TEMP.																								
NORTH	320	320	320	320	315	310	310	310	315	320	315	315	315	330	320	320	320	310	310	310	310	305	305	310
SOUTH	325	325	325	310	310	310	310	310	325	330	325	330	330	330	330	330	330	330	325	325	325	325	330	330
MOISTURES (% moisture)																								
PRESSED P.	76.2	76.6	75.8	76.0	73.6	75.6	73.4	76.4	78.0	77.8	77.8	N.S.	78.2	78.0	78.0	77.4	76.6	76.8	76.4	76.8	76.6	76.2	76.6	76.8
DRIED P.	9.8	9.4	9.2	9.6	8.4	10.2	9.2	10.0	N.S.	8.0	8.2	9.6	8.8	8.6	8.4	8.2	8.6	9.0	8.8	9.2	8.8	8.4	8.2	8.6
PELLETS	10.8	11.2	11.0	10.6	10.8	10.4	10.8	10.4	N.S.	10.0	10.2	10.4	10.2	10.0	10.2	10.0	10.4	11.2	11.4	11.0	10.8	11.2	11.2	11.4
STORAGE BIN (E) OR (W)																								
PYROMETER NORTH	1200	1200	1200	1200	1200	1150	1250	1200	1300	1350	1450	1350	1350	1350	1400	1400	1300	1300	1300	1300	1300	1300	1300	1300
PYROMETER SOUTH	1400	1350	1000	1350	1350	1350	1350	1350	1250	1600	1500	1600	1550	1600	1600	1600	1600	1600	1600	1600	1600	1550	1550	1600
FIRE VISIBLE EXIT END NORTH	Y	Y	Y	Y	Y	Y	Y	Y																
FIRE VISIBLE EXIT END SOUTH	Y	Y	Y	Y	Y	Y	Y	Y																
CHEMICALS TO WATER TANK		X		X		X		X																

FUEL OIL USED

NORTH METER	8 A.M. ______	4 P.M. ______	12 MID. ______	8 A.M. ______
SOUTH METER	8 A.M. 043052	4 P.M. 045427	12 MID. ______	8 A.M. ______

REASON FOR PULP TO FLOOR: FD Damper 50% Recycle 35% combuston air 90%

*COMMENTS: ______

* NOTE TIMES FOR INSTALLATION OF NEW DIES AND ROLLERS.

SOUTHERN MINNESOTA SUGAR CO-OP

FORM 138
Rev. 6-87

(4) JAN 24 1988

DIFFUSER REPORT

DAY ENDING 8 A.M. 1-23-88

SIGNATURES

OPER.

SHIFT 1 [illegible]

SHIFT 2 [illegible]

SHIFT 3 Julie Siebert

BEET END 4MAN

SHIFT 1 [illegible]

SHIFT 2 [illegible]

SHIFT 3 [illegible]

	A.M. 9	10	11	P.M. 12	1	2	3	4	5	6	7	8	9	10	11	A.M. 12	1	2	3	4	5	6	7	8
BEETS SLICED TONS	320	320	320	325	290	290	290	221	0	270	308	300	300	310	310	325	300	310	300	256	290	275	275	278
COSSETTE SCALE	8 A.M. 21945								4 P.M. 24316								12 Mid. 26431							
SLICERS IN SERVICE	4	4	3	4	4	4	4	4		4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
CONDITION OF COSSETTES	gd	gd	gd	gd	gd	gd	gd	gd		gd	gd	gd	gd	gd	gd	gd	gd	gd	gd	gd	gd	gd	gd	gd
TEMPS: SCALDING TEMP. ENT. DIFF. 94	83	79	84	90	88	89			86	84	85	82	82	83	84	84	84	82	83	80	76	76	75	
RAW JUICE LVG. DIFF. 61	56	56	61	68	70	65			65	62	61	60	61	62	63	63	66	64	65	64	62	61	57	
DIFFUSER SUPPLY 67	67	68	67	68	68	67			69	67	67	67	66	67	67	68	68	68	68	68	69	69	68	
RAW JUICE TO CARBS. 71	78	-	79	82	86	85			84	84	83	82	82	82	83	84	85	85	85	85	85	83	-	
Cossette 55	56	50	56	62	64	57			58	57	59	53	55	56	58	58	60	58	58	58	59	57	58	
WATER FLOW TO DIFF. (TON/HR)	305	305 295	295	275	215	275			275	275 285	275 285	275 285	295 300	300	300	300	270	270	270	270	270 260	260 245	245	245
DIFF. SCREENS CLEANED																				X		X		
RAW JUICE FLOW % 70	62	66	70	70	70	70			66	66	70	70	70	70	70	66	70	70	66	66	66	66	66	
DELAY TO SLICE (BELOW 250 TON/HR)																								

FORMALDEHYDE GALS. SHIFT 1 12:45pm 7 SHIFT 2 _____ SHIFT 3 8 to 5:00am

FOAM OIL GALS. SHIFT 1 7'8½" SHIFT 2 7'8½"-7'6" SHIFT 3 7'6"-7'5"

DIFFUSER TEMP.																								
69	CELL 2	71	↑	70	71	74	74	X		73	69	70	69	69	69		69	72	72	72	73	72	71	X
71	CELL 9	70			71	71	73	X		71	70	70	70	70	70	X	69	70	71	71	71	70	70	X
70	CELL 13	69		71	71	71	72	X		69	69	69	69	69	69	X	68	69	70	70	69	69	69	X
69	CELL 17	68		70	70	70	70	X		66	67	67	67	67	67	X	67	68	69	69	67	67	68	X
67	CELL 22	66		67	67	67	67	X		64	65	65	66	66	66	X	65	66	66	66	66	66	66	X
67	CELL 25	66	↓	67	67	67	67	X		66	65	66	66	66	66	X	65	66	66	66	66	66	66	X

REASON FOR DELAY: _____

SHUTTING @ 3:30 P.M. LIME KILN ↑ 5:00 P.M.

COMMENTS: Flushed Flume 10:20 A.M. Flushed flume @ 5:15 P.M.
FROZE "B" SLICER - SLICING AGAIN 11:50 -
B-SLICER MOTOR SHUT OFF 3 TIMES - QUIET IT!!