AP-42 Section Number: 9.10.1.2

Reference Number: 18

Title: Results of a Source Emission Compliance Test on the Sugar Cooler Stack at American Crystal Sugar Company, Crookston, Minnesota, March 11, 1993

Twin City Testing Corporation

Twin City Testing Corporation

April 1993

Report Number: 4232-93-2259-5

Report Issued: April 16, 1993

AIR EMISSION TEST REPORT

RESULTS OF A
SOURCE EMISSION COMPLIANCE TEST ON
THE SUGAR COOLER STACK AT
AMERICAN CRYSTAL SUGAR COMPANY
CROOKSTON, MINNESOTA
MARCH 11, 1993

Submitted to:

AMERICAN CRYSTAL SUGAR COMPANY
Highway 75, P.O. Box 600
Crookston, MN 56716

Submitted by:

TWIN CITY TESTING CORPORATION
Air Quality Services Department
737 Pelham Blvd.
St. Paul, Minnesota 55114

Prepared by:

Alan L. Trowbridge
Manager, Source and Ambient Testing
Air Quality Services

Approved by:

Ahto Niemioja, P.E.
Director
Air Quality Services

twin city testing
corporation

662 CROMWELL AVENUE
ST. PAUL, MN 55114
PHONE 612/645-3601

April 16, 1993

Mr. Jim Dudley
American Crystal Sugar Company
Highway 75
P.O. Box 600
Crookston, MN 56716

Re: Source Emission Test Report - Sugar Cooler

Dear Mr. Dudley:

Enclosed are two copies of Twin City Testing Corporation's report #4232-93-2259-5 concerning the particulate emission compliance test performed on the sugar cooler stack at your facility.

Thank you for allowing TCT the opportunity of working with you on this project. If you have any questions regarding this report please call me at (612) 659-7566.

Sincerely,

Ahto Niemioja, P.E.
Director, Air Quality Services

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INTRODUCTION

Twin City Testing Corporation (TCT) was contracted by American Crystal Sugar Company (ACS) to perform a source emission compliance test on the sugar cooler stack at the ACS facility in Crookston, Minnesota. Particulate emissions generated by the sugar cooling process are controlled with a venturi scrubber which is shown schematically in Figure 1. The scrubber exhaust was tested for particulate emissions on March 11, 1993. This report presents the results of the test program along with all substantiating documentation.

American Crystal Sugar Company was represented throughout the test period by Messrs. Dann Hoffman and Larry Carlson. The TCT sampling team consisted of Messrs. Alan Trowbridge, Jim Tryba and Brad Lavold. The Minnesota Pollution Control Agency was invited to witness the test proceedings but declined to do so.

TEST RESULTS

The results of the particulate emission test are summarized in Table 1. The data indicates an average particulate emission rate of 2.98 pounds per hour and an average particulate concentration of 0.014 grains per dry standard cubic foot.

Minnesota Rule 7005.0480, Subpart 1, Paragraph A states that the industrial process equipment shall not discharge into the atmosphere any gases which contain particulate matter in excess of 31.30 pounds per hour (based on an average process weight rate of 40.55 tons per hour), provided that the owner/operator shall not be required to reduce particulate matter emissions below a concentration of 0.067 grains per dry standard cubic foot (based on a volumetric flow rate of 24,693 dry standard cubic feet per minute), provided that regardless of the mass emission rate, the source shall not be permitted to emit particulate matter in a concentration in excess of 0.30 grains per dry standard cubic foot. Process data is presented in Appendix E and a copy of the Minnesota Rule is presented in Appendix G.

Meteorological conditions did not permit the performance of a visible emission test. Minnesota Rule 7005.0480, Subpart 1, Paragraph B states that the industrial process equipment shall not discharge into the atmosphere any gases which exhibit greater than 20 percent opacity.

FIGURE 1. PROCESS SCHEMATIC WITH SAMPLING PORT LOCATION

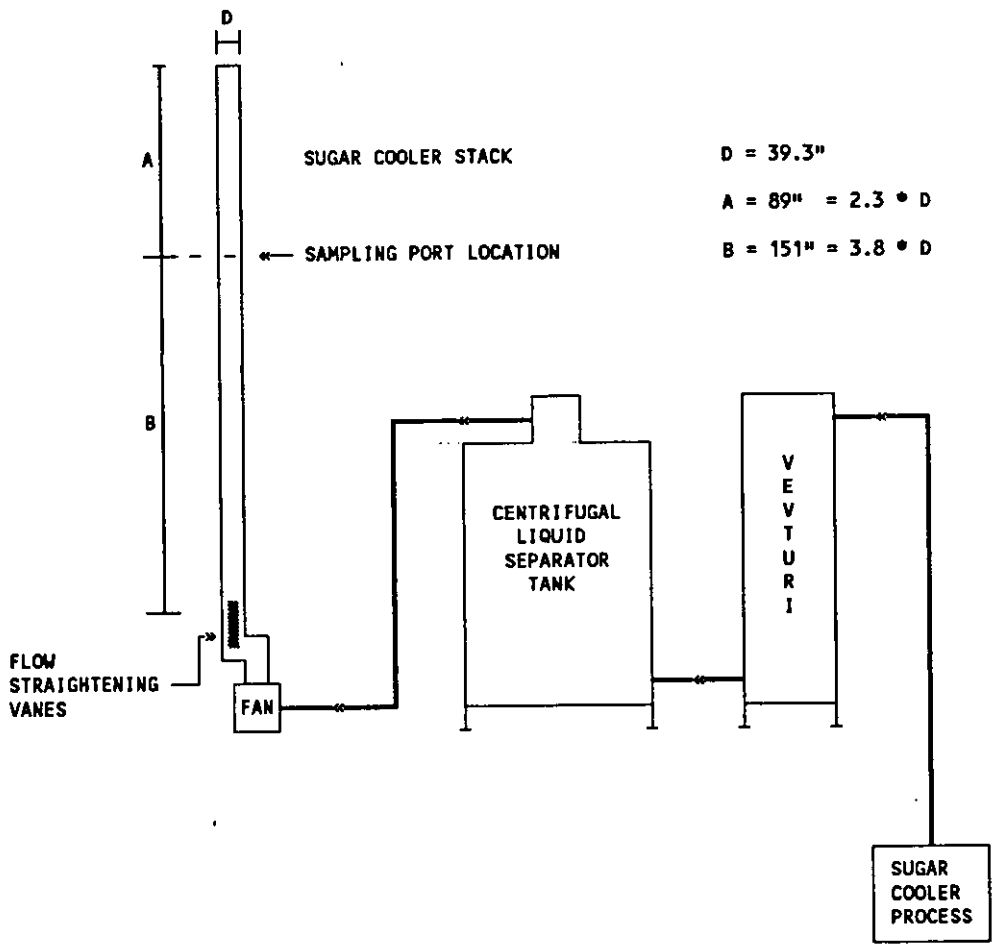

Table 1
Summary of particulate emission test results
American Crystal Sugar Company, Crookston, Minnesota
Sugar Cooler Scrubber Stack
March 11, 1993

Parameter	Run #1	Run #2	Run #3	Average
Time of Test;				
Start	0945	1137	1313	---
Finish	1050	1242	1420	---
Effluent Temperature, °F	117	113	111	114
Effluent Moisture Content, % v/v	9.0	8.3	7.5	8.3
Effluent Composition, % v/v dry;				
Carbon Dioxide	0.0	0.0	0.0	0.0
Oxygen	20.6	20.5	20.5	20.5
Effluent Volumetric Flow Rate;				
Actual Conditions, acfm	28,154	28,854	30,359	29,122
Standard Conditions, scfm	25,773	26,728	28,224	26,908
Dry Standard Conditions, dscfm	23,453	24,523	26,102	24,693
Isokinetic Variation, %	99.2	98.6	95.3	97.7
Effluent Particulate Concentration;				
Actual Conditions, gr/acf	0.0161	0.0105	0.0098	0.0121
Standard Conditions, gr/scf	0.0176	0.0113	0.0106	0.0132
Dry Standard Conditions, gr/dscf	0.0193	0.0123	0.0114	0.0143
Source Particulate Emission Rate;				
Classical Method, lb/hr	3.89	2.59	2.56	3.01
Ratio of Areas Method, lb/hr	3.85	2.56	2.44	2.95
Process Weight Rate, ton/hr	43.30	41.05	37.30	40.55

Standard Conditions: 68°F, 29.92 in. Hg. Particulate concentration and emission rates are based on analysis of the sampling train front and back catches.

TEST PROCEDURES

The EPA Methods referenced below are described in Appendix A of the Code of Federal Regulations, Title 40, Part 60 (40 CFR 60).

The number of sampling points and their location with in the source stack/duct was determined per EPA Method 1 which is entitled "Sample and velocity traverses for stationary sources". In this method the number of sampling points is based on the length of straight, undisturbed flow both before and after the sampling port location. The following data is specific to the source tested:

Stack cross-sectional dimensions, inches:	39.3 diameter
Length of straight undisturbed flow;	
Before sampling ports:	151 inches = 3.84 diameters
After sampling ports:	89 inches = 2.26 diameters
Required number of sampling points:	24
Number of sampling points used:	24
Sampling point distribution;	
Number of sampling ports:	2
Number of sampling points per port:	12
Particulate test sampling time;	
Time at each sampling point, minutes:	2.5
Test run total sampling time, minutes:	60.0

Effluent flow measurments were made per EPA Method 2 which is entitled "Determination of stack gas velocity and volumetric flow rate (Type S pitot tube)". Gas velocity pressure (head) and temperature data were obtained during each EPA Method 5 particulate test run by traversing each of the sampling points defined by EPA Method 1. This data along with gas density (EPA Method 3) and moisture content (EPA Method 4) data was used to calculcate the gas velocity at each sampling point. The source volumetric flow rate was calculated by multiplying the average gas velocity by the stack/duct cross-sectional area at the point of measurement. Velocity pressure (head) measurements were made using a Type S pitot tube constructed to the design specifications detailed in EPA Method 2. Such pitot tubes have a base line coefficient of 0.84.

The density of the effluent was determined per EPA Method 3 which is entitled "Gas analysis for the determination of dry molecular weight". A multi-point, integrated gas sample was collected simultaneously with each EPA Method 5 particulate test run. The gas sample was analyzed for carbon dioxide and oxygen concentrations with a standard Orsat analyzer using commercially prepared solutions. For calculations of gas density the balance of the gas was assumed to be nitrogen and carbon monoxide.

The effluent moisture content was determined per EPA Method 4 which is entitled "Determination of moisture content in stack gases". Data for making a gas moisture content determination was collected simultaneously with each EPA Method 5 particulate test run. The gas moisture content was calculated from the mass and/or volume of liquid collected in the Method 5 sampling train cold box impingers and the volume of gas sampled.

The effluent particulate concentration was determined per EPA Method 5 which is entitled "Determination of particulate emissions from stationary sources". For each test run, particulate matter was with drawn from the gas stream at each of the EPA Method 1 defined sampling points and collected on a glass fiber filter which was maintained at 248±25°F. Water vapor, organic vapors and other matter in vapor form which passed through the filter was collected in an ice-cooled impinger trap who's exit temperature was maintained at less than 68°F.

Sampling was performed using a Grasby-Nutech Model 2010 Method 5 stack sampling system which employed a five foot inconel lined probe with a 7/32" nominal diameter stainless steel nozzle. Particulate emissions included analyses of both the front and back (condensible organics) catches as specified in section 7005.0490, Minnesota Rules.

APPENDIX A

CALCULATIONS

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

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 / Vms
Csb = 15.42 * Wb / Vms
Cst = 15.42 * Wt / Vms

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

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

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)

SUMMARY OF PARTICULATE EMISSION TEST LABORATORY DATA

PROJECT NUMBER: 4232-93-2259
TEST NUMBER: 5

COMPANY: American Crystal Sugar
SOURCE: Sugar Cooler

	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	0.0429	0.0000	0.0054	0.0483	0.0031	0.0029	0.0060	0.0543
2	0.0291	0.0000	0.0040	0.0331	0.0015	0.0014	0.0029	0.0360
3	0.0263	0.0000	0.0020	0.0283	0.0025	0.0035	0.0060	0.0343

* NOT APPLICABLE

** CHLOROFORM/ETHYL ETHER EXTRACTION

twin city testing corporation

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TRAVERSE POINT DATA SUMMARY AND VELOCITY PROFILE

PROJECT NUMBER: 93-2259 COMPANY: American Crystal Sugar
TEST NUMBER: 5 SOURCE: Sugar Cooler
RUN NUMBER: 1 TIME: 3/11/93 0945-1050

		TRAVERSE POINT DATA					VELOCITY PROFILE	
SAMPLING LOCATION PORT	POINT	VELOCITY PRESSURE IN WC	ORIFICE PRESSURE IN WC	TEMPERATURE, DEG.F STACK GAS	METER INLET	METER OUTLET	SQRT VELOCITY PRESSURE	GAS VELOCITY FT/SEC
A	1	0.570	1.300	105	92	90	0.755	44.64
A	2	0.690	1.600	110	91	90	0.831	49.34
A	3	0.780	1.800	115	92	90	0.883	52.68
A	4	0.700	1.600	118	92	90	0.837	50.04
A	5	0.700	1.600	120	93	90	0.837	50.13
A	6	0.840	2.000	121	94	91	0.917	54.96
A	7	1.200	2.800	121	95	92	1.095	65.69
A	8	1.300	3.100	120	95	91	1.140	68.31
A	9	1.250	3.000	121	95	91	1.118	67.04
A	10	0.980	2.300	121	96	91	0.990	59.36
A	11	0.910	2.200	120	96	91	0.954	57.15
A	12	0.990	2.400	119	95	91	0.995	59.56
B	1	0.430	1.000	111	93	91	0.656	38.98
B	2	0.500	1.200	113	92	91	0.707	42.11
B	3	0.630	1.500	118	93	91	0.794	47.47
B	4	0.790	1.900	118	93	91	0.889	53.16
B	5	0.880	2.100	118	94	91	0.938	56.11
B	6	0.850	2.000	119	94	92	0.922	55.19
B	7	0.900	2.100	119	94	92	0.949	56.79
B	8	0.910	2.200	116	95	91	0.954	56.96
B	9	1.000	2.400	114	94	91	1.000	59.60
B	10	1.100	2.600	116	95	92	1.049	62.62
B	11	1.150	2.700	115	95	91	1.072	63.97
B	12	1.200	2.800	115	95	91	1.095	65.35
AVERAGE		0.885	2.092	117	94	91	0.932	55.70

PARTICULATE EMISSION TEST CALCULATIONS

PROJECT NUMBER: 93-2259 COMPANY: American Crystal Sugar
TEST NUMBER: 5 SOURCE: Sugar Cooler
RUN NUMBER: 1 TIME: 3/11/93 0945-1050

TEST DATA

GAS METER COEFFICIENT	0.9908	Y	VOLUME OF LIQUID COLLECTED, ML	91.0	Vl
PITOT TUBE COEFFICIENT	0.840	Cp	GAS COMPOSITION, % V/V DRY;		
NOZZLE DIMENSIONS;			CARBON DIOXIDE	0.00	CD
DIAMETER, IN	0.219	Dn	OXYGEN	20.60	OX
AREA, SF	0.000262	An	CARBON MONOXIDE	0.00	CM
			NITROGEN (BY DIFFERENCE)	79.40	NI
STACK DIMENSIONS;			AVE. TRAVERSE POINT DATA;		
DIAMETER/LENGTH, IN	39.30	Sl	STACK TEMP., DEG F	117	Ts
WIDTH, IN	0.00	Sw	METER TEMP., DEG F	92	Tm
AREA, SF	8.424	As	ORIFICE PRESSURE, IN WC	2.092	Po
BAROMETRIC PRESSURE, IN HG	29.92	Pb	SQRT VELOCITY P., IN WC	0.932	Pv
STACK PRESSURES;			MASS OF PARTICULATE MATTER COLLECTED, G;		
STATIC, IN WC	0.00	Pg	FRONT CATCH (89.0%)	0.0483	Wf
ABSOLUTE, IN HG	29.92	Ps	BACK CATCH (11.0%)	0.0060	Wb
SAMPLING TIME, MIN	60.00	Ti	TOTAL CATCH	0.0543	Wt
VOLUME OF GAS SAMPLED AT METER, DCF	45.495	Vm			

CALCULATED RESULTS

VOLUME OF GAS SAMPLED AT METER, DSCF	43.306	Vms	GAS MOLECULAR WEIGHT;		
			DRY BASIS, LB/LB-MOLE	28.82	Md
EQUIVALENT VOLUME OF WATER VAPOR COLLECTED, SCF	4.283	Vw	WET BASIS, LB/LB-MOLE	27.85	Ms
			AVERAGE GAS VELOCITY, FPS	55.70	Vs
GAS MOISTURE CONTENT;			GAS VOLUMETRIC FLOW RATE;		
VOLUME FRACTION	0.0900	Bws	ACTUAL, ACFM	28154	Qa
PERCENT BY VOLUME	9.00	Bwp	STANDARD, SCFM	25773	Qs
			DRY STANDARD, DSCFM	23453	Qsd
			ISOKINETIC VARIATION, %	99.16	I

PARTICULATE EMISSION PARAMETER	FRONT CATCH	BACK CATCH	TOTAL CATCH
PARTICULATE CONCENTRATION			
ACTUAL, GR/ACF	0.0143 Caf	0.0018 Cab	0.0161 Cat
STANDARD, GR/SCF	0.0157 Cwf	0.0019 Cwb	0.0176 Cwt
DRY STANDARD, GR/DSCF	0.0172 Csf	0.0021 Csb	0.0193 Cst
PARTICULATE EMISSION RATE, LB/HR			
CLASSICAL METHOD	3.46 Rcf	0.43 Rcb	3.89 Rct
RATIO OF AREAS METHOD	3.43 Rrf	0.43 Rrb	3.85 Rrt

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

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TRAVERSE POINT DATA SUMMARY AND VELOCITY PROFILE

PROJECT NUMBER: 93-2259 COMPANY: American Crystal Sugar
TEST NUMBER: 5 SOURCE: Sugar Cooler
RUN NUMBER: 2 TIME: 3/11/93 1137-1242

		TRAVERSE POINT DATA					VELOCITY PROFILE	
SAMPLING LOCATION PORT	POINT	VELOCITY PRESSURE IN WC	ORIFICE PRESSURE IN WC	TEMPERATURE, DEG.F STACK GAS	METER INLET	METER OUTLET	SQRT VELOCITY PRESSURE	GAS VELOCITY FT/SEC
A	1	0.450	1.100	106	93	92	0.671	39.54
A	2	0.490	1.200	108	93	92	0.700	41.33
A	3	0.710	1.700	114	94	92	0.843	50.02
A	4	0.790	1.900	115	94	92	0.889	52.81
A	5	0.810	1.900	118	95	92	0.900	53.61
A	6	0.950	2.300	119	95	92	0.975	58.11
A	7	1.150	2.700	117	95	93	1.072	63.82
A	8	0.990	2.400	114	96	93	0.995	59.06
A	9	1.150	2.700	113	96	92	1.072	63.60
A	10	1.300	3.100	112	96	93	1.140	67.56
A	11	1.400	3.300	112	97	93	1.183	70.11
A	12	1.400	3.300	114	97	93	1.183	70.24
B	1	0.650	1.500	96	94	92	0.806	47.10
B	2	0.860	2.000	106	94	92	0.927	54.66
B	3	0.780	1.900	110	94	92	0.883	52.24
B	4	0.810	1.900	115	95	92	0.900	53.47
B	5	0.830	2.000	116	95	92	0.911	54.17
B	6	0.740	1.800	117	95	92	0.860	51.20
B	7	1.300	3.100	114	95	92	1.140	67.68
B	8	1.300	3.100	113	96	92	1.140	67.62
B	9	0.990	2.400	114	96	92	0.995	59.06
B	10	1.100	2.600	115	96	92	1.049	62.31
B	11	0.910	2.200	117	96	92	0.954	56.77
B	12	0.830	2.000	118	95	92	0.911	54.27
AVERAGE		0.945	2.254	113	95	92	0.963	57.09

PARTICULATE EMISSION TEST CALCULATIONS

PROJECT NUMBER: 93-2259 COMPANY: American Crystal Sugar
TEST NUMBER: 5 SOURCE: Sugar Cooler
RUN NUMBER: 2 TIME: 3/11/93 1137-1242

TEST DATA

GAS METER COEFFICIENT	0.9908	Y	VOLUME OF LIQUID COLLECTED, ML	86.0	Vl
PITOT TUBE COEFFICIENT	0.840	Cp			
NOZZLE DIMENSIONS;			GAS COMPOSITION, % V/V DRY;		
DIAMETER, IN	0.219	Dn	CARBON DIOXIDE	0.00	CD
AREA, SF	0.000262	An	OXYGEN	20.50	OX
			CARBON MONOXIDE	0.00	CM
			NITROGEN (BY DIFFERENCE)	79.50	NI
STACK DIMENSIONS;			AVE. TRAVERSE POINT DATA;		
DIAMETER/LENGTH, IN	39.30	Sl	STACK TEMP., DEG F	113	Ts
WIDTH, IN	0.00	Sw	METER TEMP., DEG F	94	Tm
AREA, SF	8.424	As	ORIFICE PRESSURE, IN WC	2.254	Po
BAROMETRIC PRESSURE, IN HG	30.08	Pb	SQRT VELOCITY P., IN WC	0.963	Pv
STACK PRESSURES;			MASS OF PARTICULATE MATTER		
STATIC, IN WC	0.00	Pg	COLLECTED, G;		
ABSOLUTE, IN HG	30.08	Ps	FRONT CATCH (91.9%)	0.0331	Wf
			BACK CATCH (8.1%)	0.0029	Wb
SAMPLING TIME, MIN	60.00	Ti	TOTAL CATCH	0.0360	Wt
VOLUME OF GAS SAMPLED AT METER, DCF	47.114	Vm			

CALCULATED RESULTS

VOLUME OF GAS SAMPLED AT METER, DSCF	45.003	Vms	GAS MOLECULAR WEIGHT;		
			DRY BASIS, LB/LB-MOLE	28.82	Md
			WET BASIS, LB/LB-MOLE	27.93	Ms
EQUIVALENT VOLUME OF WATER VAPOR COLLECTED, SCF	4.048	Vw	AVERAGE GAS VELOCITY, FPS	57.09	Vs
GAS MOISTURE CONTENT;			GAS VOLUMETRIC FLOW RATE;		
VOLUME FRACTION	0.0825	Bws	ACTUAL, ACFM	28854	Qa
PERCENT BY VOLUME	8.25	Bwp	STANDARD, SCFM	26728	Qs
			DRY STANDARD, DSCFM	24523	Qsd
			ISOKINETIC VARIATION, %	98.55	I

PARTICULATE EMISSION PARAMETER	FRONT CATCH	BACK CATCH	TOTAL CATCH
PARTICULATE CONCENTRATION			
ACTUAL, GR/ACF	0.0096 Caf	0.0008 Cab	0.0105 Cat
STANDARD, GR/SCF	0.0104 Cwf	0.0009 Cwb	0.0113 Cwt
DRY STANDARD, GR/DSCF	0.0113 Csf	0.0010 Csb	0.0123 Cst
PARTICULATE EMISSION RATE, LB/HR			
CLASSICAL METHOD	2.39 Rcf	0.21 Rcb	2.59 Rct
RATIO OF AREAS METHOD	2.35 Rrf	0.21 Rrb	2.56 Rrt

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

TRAVERSE POINT DATA SUMMARY AND VELOCITY PROFILE

PROJECT NUMBER: 93-2259 COMPANY: American Crystal Sugar
TEST NUMBER: 5 SOURCE: Sugar Cooler
RUN NUMBER: 3 TIME: 3/11/93 1313-1420

		TRAVERSE POINT DATA					VELOCITY PROFILE	
SAMPLING LOCATION PORT	POINT	VELOCITY PRESSURE IN WC	ORIFICE PRESSURE IN WC	TEMPERATURE, DEG.F STACK GAS	METER INLET	METER OUTLET	SQRT VELOCITY PRESSURE	GAS VELOCITY FT/SEC
A	1	0.630	1.500	102	90	90	0.794	46.55
A	2	0.840	2.000	108	90	90	0.917	54.03
A	3	0.950	2.300	115	91	90	0.975	57.82
A	4	0.980	2.400	115	92	90	0.990	58.72
A	5	0.940	2.300	114	93	90	0.970	57.46
A	6	1.100	2.600	114	93	90	1.049	62.16
A	7	1.500	3.600	109	94	91	1.225	72.27
A	8	1.500	3.600	109	95	91	1.225	72.27
A	9	1.300	3.100	110	95	91	1.140	67.34
A	10	1.300	3.100	110	95	91	1.140	67.34
A	11	1.200	2.900	112	95	91	1.095	64.81
A	12	0.850	2.100	115	95	91	0.922	54.69
B	1	0.580	1.400	109	92	91	0.762	44.94
B	2	0.610	1.400	111	92	91	0.781	46.17
B	3	0.680	1.600	114	92	91	0.825	48.87
B	4	0.750	1.800	115	93	91	0.866	51.37
B	5	0.730	1.800	115	93	91	0.854	50.68
B	6	0.960	2.300	116	94	91	0.980	58.17
B	7	1.200	2.900	112	94	91	1.095	64.81
B	8	1.100	2.700	108	95	91	1.049	61.83
B	9	1.300	3.100	108	95	91	1.140	67.22
B	10	1.400	3.400	108	95	91	1.183	69.76
B	11	1.500	3.600	109	96	91	1.225	72.27
B	12	1.400	3.400	110	96	91	1.183	69.88
AVERAGE		1.054	2.538	111	94	91	1.016	60.06

PARTICULATE EMISSION TEST CALCULATIONS

PROJECT NUMBER: 93-2259 COMPANY: American Crystal Sugar
TEST NUMBER: 5 SOURCE: Sugar Cooler
RUN NUMBER: 3 TIME: 3/11/93 1313-1420

TEST DATA

GAS METER COEFFICIENT	0.9908	Y	VOLUME OF LIQUID COLLECTED, ML	80.0	Vl
PITOT TUBE COEFFICIENT	0.840	Cp			
NOZZLE DIMENSIONS;			GAS COMPOSITION, % V/V DRY;		
DIAMETER, IN	0.219	Dn	CARBON DIOXIDE	0.00	CD
AREA, SF	0.000262	An	OXYGEN	20.50	OX
			CARBON MONOXIDE	0.00	CM
			NITROGEN (BY DIFFERENCE)	79.50	NI
STACK DIMENSIONS;					
DIAMETER/LENGTH, IN	39.30	Sl	AVE. TRAVERSE POINT DATA;		
WIDTH, IN	0.00	Sw	STACK TEMP., DEG F	111	Ts
AREA, SF	8.424	As	METER TEMP., DEG F	92	Tm
			ORIFICE PRESSURE, IN WC	2.538	Po
BAROMETRIC PRESSURE, IN HG	30.09	Pb	SQRT VELOCITY P., IN WC	1.016	Pv
STACK PRESSURES;			MASS OF PARTICULATE MATTER		
STATIC, IN WC	0.00	Pg	COLLECTED, G;		
ABSOLUTE, IN HG	30.09	Ps	FRONT CATCH (82.5%)	0.0283	Wf
			BACK CATCH (17.5%)	0.0060	Wb
SAMPLING TIME, MIN	60.00	Ti	TOTAL CATCH	0.0343	Wt
VOLUME OF GAS SAMPLED AT METER, DCF	48.313	Vm			

CALCULATED RESULTS

VOLUME OF GAS SAMPLED AT METER, DSCF	46.321	Vms	GAS MOLECULAR WEIGHT;		
			DRY BASIS, LB/LB-MOLE	28.82	Md
			WET BASIS, LB/LB-MOLE	28.01	Ms
EQUIVALENT VOLUME OF WATER VAPOR COLLECTED, SCF	3.766	Vw	AVERAGE GAS VELOCITY, FPS	60.06	Vs
GAS MOISTURE CONTENT;			GAS VOLUMETRIC FLOW RATE;		
VOLUME FRACTION	0.0752	Bws	ACTUAL, ACFM	30359	Qa
PERCENT BY VOLUME	7.52	Bwp	STANDARD, SCFM	28224	Qs
			DRY STANDARD, DSCFM	26102	Qsd
			ISOKINETIC VARIATION, %	95.30	I

PARTICULATE EMISSION PARAMETER	FRONT CATCH	BACK CATCH	TOTAL CATCH
PARTICULATE CONCENTRATION			
ACTUAL, GR/ACF	0.0081 Caf	0.0017 Cab	0.0098 Cat
STANDARD, GR/SCF	0.0087 Cwf	0.0018 Cwb	0.0106 Cwt
DRY STANDARD, GR/DSCF	0.0094 Csf	0.0020 Csb	0.0114 Cst
PARTICULATE EMISSION RATE, LB/HR			
CLASSICAL METHOD	2.11 Rcf	0.45 Rcb	2.56 Rct
RATIO OF AREAS METHOD	2.01 Rrf	0.43 Rrb	2.44 Rrt

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

APPENDIX B

FIELD DATA FORMS

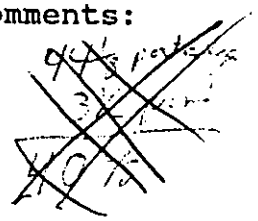
Date: 3-11-93 Project: 4232-93-2259

Technician: AT/JT/BL Client: ACS

Source/Process: Sugar Cooler

Point	90 diameter	wall from wall		DP		
1	2.1	1.0		0.72		
2	6.7	2.6		0.76		
3	11.8	4.6		0.80		
4	17.7	7.0		0.78		
5	25.0	9.8		0.85		
6	35.6	14.0		0.85		
7	64.4	25.3		1.3		
8	75.0	29.5		1.3		
9	82.3	32.3		1.2		
10	88.2	34.7		1.0		
11	93.3	36.7		0.95		
12	97.9	38.5		0.82		

Comments:



151" before = 3.54

89" after = 2.26

41 7/8

41 3/4"

39.3 ϕ

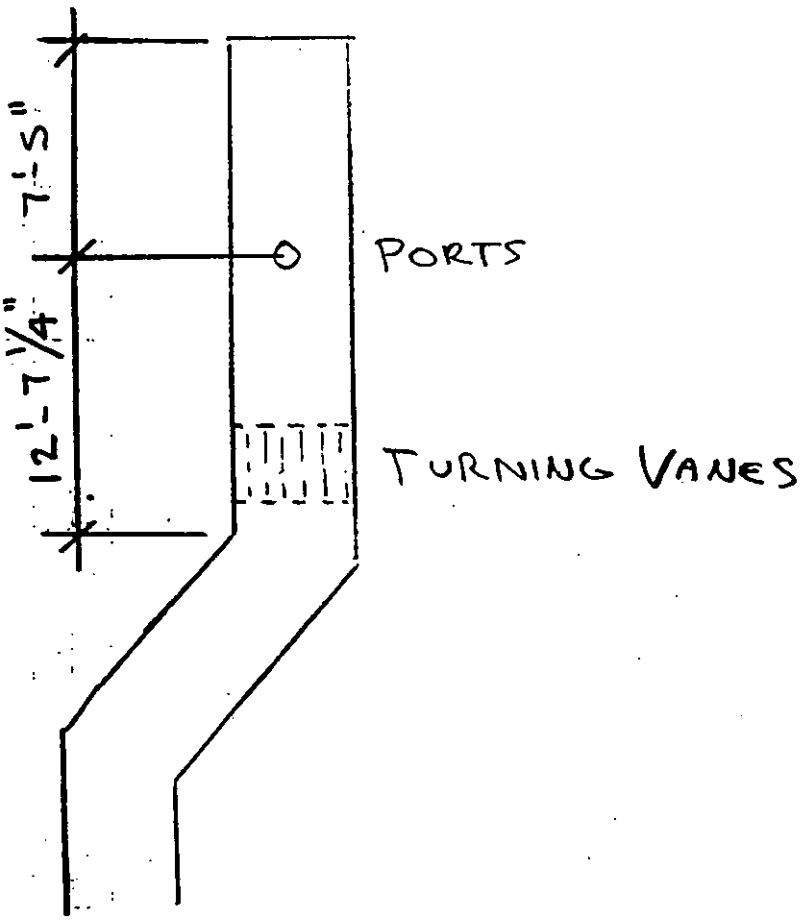
Form SST00001, General Data, Revised 10/21/92

twin city testing corporation

B-1

ACSC - CROOKSTON	3-4-93	DWG.# SK930304-F

SUGAR COOLER STACK



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SOURCE EMISSION TEST FIELD DATA SHEET TEST: 5 RUN: 1 PAGE: 1 of 1

TEST IDENTIFICATION		EQUIPMENT IDENTIFICATION		NOMOGRAPH SETTINGS	
TCT Project Number:	4232-93-2259	Control Unit Number:	#1	ΔHa	2.098
Date:	3-11-93	Gas Meter Coefficient:	1.0045	Tm	90
Company:	ACS	Sample Box Number:	#3	MC	8
Source:	Super Cooler	Probe No: 51	Length: 5ft	Ps/Pm	1.0
Source Dimensions:	39.3"ø	Pitot No: 51	Coefficient: 0.84	C	—
Test Team:	AT / JT / BL	Nozzle No: #7	Diameter: (7/32) 0.219	Ts	120
Test Procedures:	EPA 1-5	Filter No:	56	R	—
Ambient Temp., °F:	—	Barometric Pressure, in.Hg:	29.92	Static Pressure, in.WC:	—

EPA METHOD 5 TRAVERSE DATA

CLOCK TIME hours	TRAVERSE POINT NUMBER	SAMPLE TIME minute	SAMPLE VOLUME cu.ft.	VELOCITY HEAD in.WC	ORIFICE ΔH, in.WC REQ.	ORIFICE ΔH, in.WC ACT.	PUMP VAC. inHG	TEMPERATURE, °F STACK GAS	PROBE LINER	FILTER OVEN	IMPINGER EXIT	AUXILIARY	GAS METER IN	GAS METER OUT
0945	A-1	0	78.544	0.57	1.3	1.3	2.5	105	203	249	37	—	92	90
—	2	2.5	80.1	0.69	1.6	1.6	3.0	110	193	258	43	—	91	90
—	3	5	81.7	0.78	1.8	1.8	3.0	115	190	258	45	—	92	90
—	4	7.5	83.5	0.70	1.6	1.6	3.0	118	189	258	45	—	92	90
—	5	10	85.2	0.70	1.6	1.6	3.0	120	187	257	46	—	93	90
—	6	12.5	86.9	0.84	2.0	2.0	3.5	121	193	256	46	—	94	91
—	7	15	88.7	1.20	2.8	2.8	4.5	121	199	255	48	—	95	92
—	8	17.5	91.0	1.30	3.1	3.1	5.0	120	199	256	48	—	95	91
—	9	20	93.3	1.25	3.0	3.0	5.0	121	202	256	49	—	95	91
—	10	22.5	95.6	0.98	2.3	2.3	4.0	121	201	254	49	—	96	91
—	11	25	97.7	0.91	2.2	2.2	3.5	120	202	255	49	—	96	91
—	12	27.5	99.7	0.99	2.4	2.4	4.0	119	202	253	49	—	95	91
1015	end A	30	101.644	X	X	X	X	X	X	X	X	X	X	X
1020	B-1	0	101.644	0.43	1.0	1.0	2.0	111	202	255	39	—	93	91
—	2	2.5	102.9	0.50	1.2	1.2	2.5	113	204	256	44	—	92	91
—	3	5	104.4	0.63	1.5	1.5	3.0	118	205	254	45	—	93	91
—	4	7.5	106.0	0.79	1.9	1.9	3.5	118	206	255	47	—	93	91
—	5	10	107.9	0.88	2.1	2.1	3.5	118	205	255	48	—	94	91
—	6	12.5	109.8	0.85	2.0	2.0	3.5	119	213	255	49	—	94	92
—	7	15	111.6	0.90	2.1	2.1	4.0	119	218	255	49	—	94	92
—	8	17.5	113.6	0.91	2.2	2.2	4.0	116	219	256	50	—	95	91
—	9	20	115.5	1.00	2.4	2.4	4.0	114	218	255	52	—	94	91
—	10	22.5	117.6	1.10	2.6	2.6	4.0	116	219	255	51	—	95	92
—	11	25	119.7	1.15	2.7	2.7	4.0	115	220	255	53	—	95	91
—	12	27.5	121.9	1.20	2.8	2.8	4.5	115	222	255	53	—	95	91
—	end B	30	124.039	X	X	X	X	X	X	X	X	X	X	X

EPA METHOD 4: MOISTURE DETERMINATION

IMPINGER	1	2	3	4	5
Final	167	111	5	703	X
Initial	100	100	0	695	X
Net	67	11	5	8	X

Total Moisture Collected: 91

Impinger Catch Description: —

EPA METHOD 5 LEAK CHECK

Time	Rate, dcfm	Vac, in.Hg
0942	0.001	16.5
[illegible]	—	—
1052	0.000	8.5
—	—	—

Total Volume of Gas Sampled, DCF: 45.495

Total Sampling Time, Min: 60.0

Filter Catch Description: —

EPA METHOD 3: GAS COMPOSITION BY ORSAT ANALYSIS

Sample Identification	Replicate 1 Buret Reading	Replicate 1 Percent Volume	Replicate 2 Buret Reading	Replicate 2 Percent Volume	Replicate 3 Buret Reading	Replicate 3 Percent Volume	Replicate 4 Buret Reading	Replicate 4 Percent Volume	Compound Average Percent Volume
Initial Reading	0.0	[illegible]	0.0	[illegible]		[illegible]		[illegible]	[illegible]
Carbon Dioxide	0.0	0.0	0.0	0.0	X	X	X	X	0.00
Oxygen	20.6	20.6	20.6	20.6	X	X	X	X	20.60
Carbon Monoxide	—	—	—	—	X	X	X	X	—

Form SST5, Revised 12/28/92

Signature of Sampling Team Leader: Alan L Trowbridge

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SOURCE EMISSION TEST FIELD DATA SHEET TEST: 5 RUN: 2 PAGE: 1 of 1

TEST IDENTIFICATION		EQUIPMENT IDENTIFICATION			NOMOGRAPH SETTINGS	
TCT Project Number:	4232-93-2259	Control Unit Number:	#1		ΔH@	2.098
Date:	3-11-93	Gas Meter Coefficient:	1.0045		Tm	90
Company:	ACS	Sample Box Number:	4		MC	8
Source:	Sugar Cooler	Probe No:	51	Length: 5 ft	Ps/Pm	1.0
Source Dimensions:	39.3" ϕ	Pitot No:	51	Coefficient: 0.84	C	—
Test Team:	AT/JT/BL	Nozzle No:	#7	Diameter: (7/32) 0.219	Ts	118
Test Procedures:	EPA 1-5	Filter No:	58		R	—
Ambient Temp., °F:	—	Barometric Pressure, in.Hg:	30.08	Static Pressure, in.WC:	—	

EPA METHOD 5 TRAVERSE DATA

CLOCK TIME hours	TRAVERSE POINT NUMBER	SAMPLE TIME minute	SAMPLE VOLUME cu.ft.	VELOCITY HEAD in.WC	ORIFICE ΔH, in.WC REQ.	ORIFICE ΔH, in.WC ACT.	PUMP VAC. inHG	TEMPERATURE, °F STACK GAS	PROBE LINER	FILTER OVEN	IMPINGER EXIT	AUXILIARY	GAS METER IN	GAS METER OUT
1137	B-1	0	125.361	0.45	1.1	1.1	2.0	106	182	236	41	X	93	92
—	2	2.5	126.7	0.49	1.2	1.2	2.0	108	183	246	46	—	93	92
—	3	5	128.2	0.71	1.7	1.7	3.0	114	179	253	49	—	94	92
—	4	7.5	129.9	0.79	1.9	1.9	3.0	115	179	256	50	—	94	92
—	5	10	131.7	0.81	1.9	1.9	3.0	118	179	257	51	—	95	92
—	6	12.5	133.5	0.95	2.3	2.3	3.0	119	187	257	52	—	95	92
—	7	15	135.5	1.15	2.7	2.7	3.5	117	196	256	53	—	95	93
—	8	17.5	137.7	0.99	2.4	2.4	3.5	114	201	256	53	—	96	93
—	9	20	139.8	1.15	2.7	2.7	3.5	113	198	256	53	—	96	92
—	10	22.5	141.9	1.30	3.1	3.1	4.0	112	201	256	54	—	96	93
—	11	25	144.2	1.40	3.3	3.3	4.0	112	202	256	57	—	97	93
—	12	27.5	146.6	1.40	3.3	3.3	4.5	114	202	256	58	—	97	93
1207	end B	30	148.957	X	X	X	X	X	X	X	X	X	X	X
1212	A-1	0	148.957	0.65	1.5	1.5	2.5	96	196	257	45	—	94	92
—	2	2.5	150.6	0.86	2.0	2.0	3.0	106	191	254	50	—	94	92
—	3	5	152.4	0.78	1.9	1.9	3.0	110	189	252	52	—	94	92
—	4	7.5	154.3	0.81	1.9	1.9	3.0	115	183	254	53	—	95	92
—	5	10	156.1	0.83	2.0	2.0	3.0	116	186	254	53	—	95	92
—	6	12.5	158.0	0.74	1.9	1.8	3.0	117	189	254	53	—	95	92
—	7	15	159.9	1.30	3.1	3.1	4.0	114	192	254	55	—	95	92
—	8	17.5	162.1	1.30	3.1	3.1	4.0	113	190	255	55	—	96	92
—	9	20	164.4	0.99	2.4	2.4	3.5	114	193	255	55	—	96	92
—	10	22.5	166.5	1.10	2.6	2.6	3.5	115	192	255	57	—	96	92
—	11	25	168.6	0.91	2.2	2.2	3.5	117	195	255	56	—	96	92
—	12	27.5	170.6	0.83	2.0	2.0	3.0	118	195	255	53	—	95	92
1242	end A	30	172.475	X	X	X	X	X	X	X	X	X	X	X

EPA METHOD 4: MOISTURE DETERMINATION

IMPINGER	1	2	3	4	5
Final	163	108	4	699	X
Initial	100	100	0	688	X
Net	63	8	4	11	X

Total Moisture Collected: 86

Impinger Catch Description:

EPA METHOD 5 LEAK CHECK

Time	Rate, dcfm	Vac, in.Hg
1130	0.003	12
1244	0.001	6
X	X	X
X	X	X

Total Volume of Gas Sampled, DCF: 47.114

Total Sampling Time, Min: 60.0

Filter Catch Description: —

EPA METHOD 3: GAS COMPOSITION BY ORSAT ANALYSIS

Sample Identification	Replicate 1 Buret Reading	Replicate 1 Percent Volume	Replicate 2 Buret Reading	Replicate 2 Percent Volume	Replicate 3 Buret Reading	Replicate 3 Percent Volume	Replicate 4 Buret Reading	Replicate 4 Percent Volume	Compound Average Percent Volume
Initial Reading	0.0		0.0						
Carbon Dioxide	0.0	0.0	0.0	0.0					0.00
Oxygen	20.5	20.5	20.5	20.5					20.50
Carbon Monoxide	—	—	—	—					—

Form SST5, Revised 12/28/92

Signature of Sampling Team Leader: Alan L Trowbridge

SOURCE EMISSION TEST FIELD DATA SHEET TEST: 5 RUN: 3 PAGE: 1 of 1

TEST IDENTIFICATION		EQUIPMENT IDENTIFICATION			NOMOGRAPH SETTINGS	
TCT Project Number:	4232-93-2259	Control Unit Number:	#1		oha	2.098
Date:	3-11-93	Gas Meter Coefficient:	1.0045		Tm	95
Company:	ACS	Sample Box Number:	#1		MC	8
Source:	Sugar Cooler	Probe No:	51	Length: 5 ft	Ps/Pm	1.0
Source Dimensions:	39.3" ϕ	Pitot No:	51	Coefficient: 0.84	C	—
Test Team:	AT / JT / BL	Nozzle No:	#7	Diameter: (7/32) 0.219	Ts	115
Test Procedures:	EPA 1-5	Filter No:	61		R	—
Ambient Temp., °F:	—	Barometric Pressure, in.Hg:	30.09	Static Pressure, in.WC:	—	

EPA METHOD 5 TRAVERSE DATA

CLOCK TIME hours	TRAVERSE POINT NUMBER	SAMPLE TIME minute	SAMPLE VOLUME cu.ft.	VELOCITY HEAD in.WC	ORIFICE ΔH, in.WC REQ.	ORIFICE ΔH, in.WC ACT.	PUMP VAC. inHG	TEMPERATURE, °F STACK GAS	PROBE LINER	FILTER OVEN	IMPINGER EXIT	AUXILIARY	GAS METER IN	GAS METER OUT
1313	A-1	0	172.907	0.63	1.5	1.5	4.5	102	183	231	29	—	90	90
	2	2.5	174.5	0.84	2.0	2.0	6.0	108	179	243	40	—	90	90
	3	5	176.2	0.95	2.3	2.3	7.0	115	175	248	42	—	91	90
	4	7.5	178.2	0.98	2.4	2.4	7.0	115	175	254	46	—	92	90
	5	10	180.2	0.94	2.3	2.3	7.0	114	175	256	48	—	93	90
	6	12.5	182.2	1.1	2.6	2.6	7.5	114	182	256	48	—	93	90
	7	15	184.3	1.5	3.6	3.6	10.0	109	185	257	49	—	94	91
	8	17.5	186.6	1.5	3.6	3.6	11.0	109	185	256	51	—	95	91
	9	20	189.0	1.3	3.1	3.1	10.0	110	184	257	49	—	95	91
	10	22.5	191.3	1.3	3.1	3.1	10.0	110	185	256	49	—	95	91
	11	25	193.6	1.2	2.9	2.9	9.0	112	187	256	51	—	95	91
	12	27.5	195.8	0.85	2.1	2.1	6.5	115	190	257	51	—	95	91
1343	end A	30	197.849	X	X	X	X	X	X	X	X	X	X	X
1351	B-1	0	197.849	0.58	1.4	1.4	5.0	109	183	255	39	—	92	91
	2	2.5	199.4	0.61	1.4	1.4	5.0	111	182	253	46	—	92	91
	3	5	200.9	0.68	1.6	1.6	5.5	114	179	254	49	—	92	91
	4	7.5	202.5	0.75	1.8	1.8	5.5	113	179	255	50	—	93	91
	5	10	204.1	0.73	1.8	1.8	5.5	115	184	255	51	—	93	91
	6	12.5	205.8	0.96	2.3	2.3	7.0	116	194	256	52	—	94	91
	7	15	207.6	1.2	2.9	2.9	9.5	112	201	255	53	—	94	91
	8	17.5	209.7	1.1	2.7	2.7	9.0	108	201	255	54	—	95	91
	9	20	211.9	1.3	3.1	3.1	9.0	108	202	256	55	—	95	91
	10	22.5	214.1	1.4	3.4	3.4	10.0	108	201	254	58	—	95	91
	11	25	216.4	1.5	3.6	3.6	10.5	109	200	255	58	—	96	91
	12	27.5	218.9	1.4	3.4	3.4	10.5	110	199	254	60	—	96	91
1480	end B	30	221.220	X	X	X	X	X	X	X	X	X	X	X

EPA METHOD 4: MOISTURE DETERMINATION

IMPINGER	1	2	3	4	5
Final	157	109	2	692	X
Initial	100	100	0	680	X
Net	57	9	2	12	X

Total Moisture Collected: 80

Impinger Catch Description: clear

EPA METHOD 5 LEAK CHECK

Time	Rate, dcfm	Vac, in.Hg
1301	0.000	11
1423	0.001	14
X	X	X

Total Volume of Gas Sampled, DCF: 48.313

Total Sampling Time, Min: 60.0

Filter Catch Description: —

EPA METHOD 3: GAS COMPOSITION BY ORSAT ANALYSIS

Sample Identification	Replicate 1 Buret Reading	Replicate 1 Percent Volume	Replicate 2 Buret Reading	Replicate 2 Percent Volume	Replicate 3 Buret Reading	Replicate 3 Percent Volume	Replicate 4 Buret Reading	Replicate 4 Percent Volume	Compound Average Percent Volume
Initial Reading	0.0		0.0						
Carbon Dioxide	0.0	0.0	0.0	0.0	X	X	X	X	0.00
Oxygen	20.5	20.5	20.5	20.5					20.50
Carbon Monoxide	—	—	—	—					—

Form SST5, Revised 12/28/92

Signature of Sampling Team Leader: Alan L Trowbridge

B-5

twin city testing corporation

APPENDIX C

LABORATORY REPORTS

LABORATORY REPORT: EPA METHOD 5 PARTICULATE ANALYSIS

Project Number: 4232-93-2259	TEST	RUN
Client: American Crystal	5	1

FILTER CATCH

Sample Number: 312355 — Filter Number: 56

	Date	Time	By	grams
Weight #4				
Weight #3				
Weight #2	3-22-93	10:35	MKC	0.35394
Weight #1	3-19-93	16:24	CD	0.35396
Filter Tare Weight				0.34856
Net Sample Weight				0.0054

WEIGHING PROCEDURE

Weighings shall be to the nearest 0.1 mg. Weighings shall be to "constant weight" which means a difference of no more than 0.5 mg between two consecutive weighings, with no less than six hours of desiccation time between weighings.

IMPINGER CATCH VOLUME

Measured Sample Volume, ml:	383
Estimated Volume Lost, ml:	—

FRONT WASH

Sample Number: 312397 — Measured Sample Volume, ml: 100 — Estimated Volume Lost, ml: —

	Date	Time	By	grams
Weight #4				
Weight #3				
Weight #2	4-5-93	3:54	JW	2.70222
Weight #1	4-5-93	8:40	MKC	2.70213
Dish Tare	3-31-93	10:50	MKC	2.65486
Weight of collected matter				0.0473
Water Blank based on 50 ml				0.0022
Acetone Blank based on 50 ml				0.0022
Net Sample Weight				0.0429

IMPINGER CATCH ORGANIC EXTRACTION

Sample Number: 312396

	Date	Time	By	grams
Weight #4				
Weight #3				
Weight #2	4-9-93	4:45	MKC	3.74064
Weight #1	4/7/93	14:25	MKC	3.74052
Dish Tare	3-23-93	3:50	MKC	3.73607
Weight of collected matter				0.0040
Less Solvent Blanks				
Ethyl Ether based on 75 ml				0.0007
Chloroform based on 75 ml				0.0002
based on ml				—
Net Sample Weight				0.0031

IMPINGER ACETONE RINSE

Sample Number: 312395 — Measured Sample Volume, ml: 104 — Estimated Volume Lost, ml: —

	Date	Time	By	grams
Weight #3				
Weight #2	4.5.93	4:05	JW	2.61566
Weight #1	4-5-93	8:25	MKC	2.61572
Dish Tare	3-31-93	10:50	MKC	2.60826
Weight of collected matter				0.0074
Acetone Blank based on 104 ml				0.0045
Net Sample Weight				0.0029

IMPINGER CATCH MASS RESIDUE

Sample Number:

	Date	Time	By	grams
Weight #5				
Weight #4				
Weight #3				
Weight #2				
Weight #1				
Dish Tare				
Weight of collected matter				
Water Blank based on ml				
Net Sample Weight				

Form: SST-LAB52C

P Cowley 4/12/93

LABORATORY REPORT: EPA METHOD 5 PARTICULATE ANALYSIS

Project Number: 4232- 93-2259	TEST	RUN
Client: American Crystal	5	2

FILTER CATCH

Sample Number: 312356	Filter Number: 58			
	Date	Time	By	grams
Weight #4				
Weight #3				
Weight #2	3-22-93	10:30	MKC	0.35143
Weight #1	3-19-93	16:17	CMD	0.35160
Filter Tare Weight				0.34748
Net Sample Weight				0.0040

WEIGHING PROCEDURE

Weighings shall be to the nearest 0.1 mg. Weighings shall be to "constant weight" which means a difference of no more than 0.5 mg between two consecutive weighings, with no less than six hours of desiccation time between weighings.

IMPINGER CATCH VOLUME

Measured Sample Volume, ml:	351
Estimated Volume Lost, ml:	—

FRONT WASH

Sample Number: 312400	Measured Sample Volume, ml 121	Estimated Volume Lost, ml —		
	Date	Time	By	grams
Weight #4				
Weight #3				
Weight #2	4-5-93	4:00	JN	2.65722
Weight #1	4-5-93	8:40	MKC	2.65730
Dish Tare	3-31-93	10:55	MKC	2.62294
Weight of collected matter				0.0343
Water Blank based on 60 ml				0.0026
Acetone Blank based on 60 ml				0.0026
Net Sample Weight				0.0291

IMPINGER CATCH ORGANIC EXTRACTION

Sample Number: 312399				
	Date	Time	By	grams
Weight #4				
Weight #3				
Weight #2	4-9-93	4:45	MKC	3.73361
Weight #1	4/7/93	14:30	pfc	3.73373
Dish Tare	3-23-93	3:55	MKC	3.73124
Weight of collected matter				0.0024
Less Solvent Blanks				
Ethyl Ether based on 75 ml				0.0007
Chloroform based on 75 ml				0.0002
based on ml				—
Net Sample Weight				0.0015

IMPINGER ACETONE RINSE

Sample Number: 312398	Measured Sample Volume, ml 122	Estimated Volume Lost, ml —		
	Date	Time	By	grams
Weight #3				
Weight #2	4-5-93	3:30	JN	2.60342
Weight #1	4-5-93	8:40	MKC	2.60550
Dish Tare	3-31-93	10:55	MKC	2.59877
Weight of collected matter				0.0067
Acetone Blank based on 122 ml				0.0053
Net Sample Weight				0.0014

IMPINGER CATCH MASS RESIDUE

Sample Number:				
	Date	Time	By	grams
Weight #5				
Weight #4				
Weight #3				
Weight #2				
Weight #1				
Dish Tare				
Weight of collected matter				
Water Blank based on ml				
Net Sample Weight				

Form: SST-LAB52C

P Crowley 4/12/93

twin city testing corporation

LABORATORY REPORT: EPA METHOD 5 PARTICULATE ANALYSIS

Project Number: 4232-93-2259	TEST	RUN
Client: American Crystal	5	3

FILTER CATCH

Sample Number: 312357 — Filter Number: 61

	Date	Time	By	grams
Weight #4				
Weight #3				
Weight #2	3-22-93	10:25	MKC	0.35736
Weight #1	3-19-93	1615	CMD	0.35729
Filter Tare Weight				0.35533
Net Sample Weight				0.0020

WEIGHING PROCEDURE

Weighings shall be to the nearest 0.1 mg. Weighings shall be to "constant weight" which means a difference of no more than 0.5 mg between two consecutive weighings, with no less than six hours of desiccation time between weighings.

IMPINGER CATCH VOLUME

Measured Sample Volume, ml:	322
Estimated Volume Lost, ml:	—

FRONT WASH

Sample Number: 312403 — Measured Sample Volume, ml: 119 — Estimated Volume Lost, ml: —

	Date	Time	By	grams
Weight #4				
Weight #3				
Weight #2	4.5.93	3:57	JW	2.62973
Weight #1	4-5-93	8:40	MKC	2.62995
Dish Tare	3-31-93	11:00	MKC	2.59841
Weight of collected matter				0.0313
Water Blank based on 59 ml				0.0025
Acetone Blank based on 59 ml				0.0025
Net Sample Weight				0.0263

IMPINGER CATCH ORGANIC EXTRACTION

Sample Number: 312402

	Date	Time	By	grams
Weight #4				
Weight #3				
Weight #2	4-9-93	9:50	MKC	3.75012
Weight #1	4/7/93	14:30	MKC	3.75032
Dish Tare	3-23-93	7:55	MKC	3.74477
Weight of collected matter				0.0034
Less Solvent Blanks				
Ethyl Ether based on 75 ml				0.0007
Chloroform based on 75 ml				0.0002
based on ml				—
Net Sample Weight				0.0025

IMPINGER ACETONE RINSE

Sample Number: 312401 — Measured Sample Volume, ml: 90 — Estimated Volume Lost, ml: —

	Date	Time	By	grams
Weight #3				
Weight #2	4.5.93	3:53	JW	2.60523
Weight #1	4-5-93	9:10	MKC	2.60532
Dish Tare	3-31-93	11:00	MKC	2.59788
Weight of collected matter				0.0074
Acetone Blank based on 90 ml				0.0039
Net Sample Weight				0.0035

IMPINGER CATCH MASS RESIDUE

Sample Number:

	Date	Time	By	grams
Weight #5				
Weight #4				
Weight #3				
Weight #2				
Weight #1				
Dish Tare				
Weight of collected matter				
Water Blank based on ml				
Net Sample Weight				

Form: SST-LAB52C

P Crowley 4/10/93

LABORATORY REPORT: EPA METHOD 5 PARTICULATE TEST SOLVENT BLANKS

Project Number: 4232-93-2259	TEST
Client: American Crystal	1 & 5

DISTILLED, DEIONIZED WATER

Sample Number: 312404		Measured Sample Volume, ml: 102		Estimated Volume Lost, ml: —
	Date	Time	By	grams
Weight #4				
Weight #3				
Weight #2	3-30-93	8:00	MKC	3.75333
Weight #1	3-29-93	10:55	MKC	3.75333
Dish Tare	3-23-93	4:00	MKC	3.74898
Weight of residual matter				0.00435
Mass Concentration: 0.0234 mg/ml				

ACETONE

Sample Number: 312407		Measured Sample Volume, ml: 105		Estimated Volume Lost, ml: —
	Date	Time	By	grams
Weight #4				
Weight #3				
Weight #2	3-30-93	7:50	MKC	3.75838
Weight #1	3-29-93	10:40	MKC	3.75828
Dish Tare	3-23-93	4:00	MKC	3.75375
Weight of residual matter				0.00453
Mass Concentration: 0.0431 mg/ml				

CHLOROFORM

Sample Number: 312406		Measured Sample Volume, ml: 75		Estimated Volume Lost, ml: —
	Date	Time	By	grams
Weight #4				
Weight #3				
Weight #2	3-30-93	7:55	MKC	3.77149
Weight #1	3-29-93	10:35	MKC	3.77113
Dish Tare	3-23-93	4:00	MKC	3.77091
Weight of residual matter				0.00022
Mass Concentration: 0.00293 mg/ml				

ETHYL ETHER

Sample Number: 312405		Measured Sample Volume, ml: 75		Estimated Volume Lost, ml: —
	Date	Time	By	grams
Weight #4				
Weight #3				
Weight #2	3-30-93	7:50	MKC	3.76270
Weight #1	3-29-93	10:35	MKC	3.76266
Dish Tare	3-23-93	4:00	MKC	3.76196
Weight of residual matter				0.00070
Mass Concentration: 0.0093 mg/ml				

Sample Number:		Measured Sample Volume, ml		Estimated Volume Lost, ml
	Date	Time	By	grams
Weight #4				
Weight #3				
Weight #2				
Weight #1				
Dish Tare				
Weight of residual matter				
Mass Concentration: mg/ml				

Sample Number:		Measured Sample Volume, ml		Estimated Volume Lost, ml
	Date	Time	By	grams
Weight #4				
Weight #3				
Weight #2				
Weight #1				
Dish Tare				
Weight of residual matter				
Mass Concentration: mg/ml				

Form: SST-LAB53C

P Crowley 4/1/93

APPENDIX D

CALIBRATION DATA

GAS METER AND ORIFICE CALIBRATION

Pretest calibration of TCT control unit #1 generated a gas meter coefficient of 1.0045. Post test calibration yielded a coeffiecient of 0.9908. Both sets of calibration data are included on the following pages.

All calculations presented in this report were performed using the lower (0.9908) calibration factor which produces worst case emission data.

PITOT TUBE CALIBRATION DATA

Pitot tube #51 (Nutech) is a Type S pitot tube which meets the design specifications described in EPA Method 2 and the base line coefficient of 0.84 was assumed.

ORIFICE and DRY GAS METER CALIBRATION FORM

Date: Feb 8, 1993 Meter # 1 ~ Barometric Pressure,Pb: 29.86

Orifice manometer setting dH,in.H2O	Gas Volume Wet test meter Vw, ft3	Dry gas meter Vd, ft3	Temperature Wet test meter tw, dF	Dry gas meter Inlet tdi, dF	Outlet tdo, dF	Average td, dF	Time e,min.
0.5	5.000	5.020	66	70	67	68.5	13.40
1.0	5.000	5.015	66	74	68	71.0	9.48
2.0	10.000	10.125	66	79	70	74.5	13.98
4.0	10.000	10.059	66	85	72	78.5	9.77
6.0	10.000	10.040	66	88	74	81.0	8.10
8.0	10.000	10.057	66	91	76	83.5	7.00

Y	dH@
$\frac{Vw\ Pb\ (td + 460)}{Vd\ [Pb + (dH/13.6)]\ (tw + 460)}$	$\frac{0.0317\ dH}{Pb\ (to + 460)} \left[\frac{(tw + 460)\ e}{Vw}\right]^2$
Yi 1 = 0.9995	dH@i 1 = 2.0016
Yi 2 = 1.0040	dH@i 2 = 1.9998
Yi 3 = 0.9987	dH@i 3 = 2.1663
Yi 4 = 1.0078	dH@i 4 = 2.1080
Yi 5 = 1.0095	dH@i 5 = 2.1653
Yi 6 = 1.0076	dh@i 6 = 2.1481
Y = 1.0045	dH@ = 2.098

Definitions:

Vw = Gas volume passing through the wet test meter, ft3.
Vd = Gas volume passing through the dry gas meter, ft3.
tw = Temperature of the gas in the wet test meter, dF.
tdi = Temperature of the inlet gas of the dry gas meter, dF.
tdo = Temperature of the outlet gas of the dry gas meter, dF.
td = Average temperature of the gas in the dry gas meter, dF.
dH = Pressure differential across orifice, in. H2O.
Yi = Ratio of accuracy of wet test meter to dry gas meter for each run.
Y = Average of Yi. Tolerance = +/- 0.02
Pb = Barometric pressure, in Hg.
e = Time of calibration run, min.
dH@i = Orifice pressure differential for each run.
dH@ = Average oriface pressure differential. Tolerance = +/- 0.20

Calibrator - James Tryba

Feb 8, 1993
Date

ORIFICE and DRY GAS METER POST TEST FORM

Client: AMERICAN CRYSTAL SUGAR, Crookston, MN
Date: Mar 24, 1993 Meter # 1 Barometric Pressure,Pb: 29.76
Max. Vacuum Achieved (in.Hg.): 10.0 Intermediate Orifice Setting: 1.00

Orifice manometer setting dH,in.H2O	Gas Volume Wet test meter Vw, ft3	Dry gas meter Vd, ft3	Temperature Wet test meter tw, dF	Dry gas meter Inlet tdi, dF	Outlet tdo, dF	Average td, dF	Time e,min.
1.00	5.000	5.107	66	70	66	68.0	9.72
1.00	5.000	5.008	66	71	66	68.5	9.68
1.00	5.000	5.060	66	71	67	69.0	9.75

Y	dH@
$\frac{Vw\ Pb\ (td + 460)}{Vd\ [Pb + (dH/13.6)]\ (tw + 460)}$	$\frac{0.0317\ dH}{Pb\ (to + 460)} \left[\frac{(tw + 460)\ e}{Vw}\right]^2$
Yi 1 = 0.9803	dH@i 1 = 2.1174
Yi 2 = 1.0007	dH@i 2 = 2.1000
Yi 3 = 0.9913	dH@i 3 = 2.1265
Y = 0.9908	dH@ = 2.1146

Definitions:

Vw = Gas volume passing through the wet test meter, ft3.
Vd = Gas volume passing through the dry gas meter, ft3.
tw = Temperature of the gas in the wet test meter, dF.
tdi = Temperature of the inlet gas of the dry gas meter, dF.
tdo = Temperature of the outlet gas of the dry gas meter, dF.
td = Average temperature of the gas in the dry gas meter, dF.
dH = Pressure differential across orifice, in. H2O.
Yi = Ratio of accuracy of wet test meter to dry gas meter for each run.
Y = Average of Yi. Tolerance = +/- 0.02
Pb = Barometric pressure, in Hg.
e = Time of calibration run, min.
dH@i = Orifice pressure differential for each run.
dH@ = Average oriface pressure differential. Tolerance = +/- 0.20

Calibrator

Mar 24, 1993
Date

APPENDIX E

PROCESS DATA

CROOKSTON FACTORY SUGAR COOLER

DATE: 3/11/93

TIME	SPRAY FLOW (GPM)	DIFF. PRESSURE ("H_2O)	9:00 A.M. 857
:00	247	-3.25	
:15	248	-3.25	
:30	248	~~-2.85~~ 4.17	10:00 A.M. 866
:45	251	4.51	
:00	250	3.79	
:15	252	3.95	
:30	248	4.66	11:00 A.M. 730
:45	250	4.70	
:00	251	4.60	
NOON 12 :15	247	4.86	NOON 821
12 :30	250	4.15	
12 :45	251	4.22	
1 :00	255	4.70	1:00 P.M. 697
1 :15	255	4.38	
1 :30	251	4.91	
1 :45	248	4.34	
2 :00	250	4.56	2:00 P.M. 746
2 :15	261	5.20	
:30			
:45			

From ACS 4/6/93

E-1

SUGAR COOLER MOISTURES

3-11-93	
10:00 AM	.012
11:00 AM	.017
12:00 PM	.011
1:00 PM	.016
2:00 PM	.012

From ACS 4/6/93

E-2

Sugar Cooler Maintenance:

Service transmitters, louvers, air louver valves, went through whole system in December 1992.

Transformer controls, piston ram August 1992.

From ACS
4/6/93

E-3

Lime Kiln Level Controls	019634002	03/16/90	15.0
		09/18/90	8.0
		09/03/91	20.0
		04/13/92	44.0
		09/06/92	92.0
		12/08/92	2.0
		03/10/93	56.0
Sugar Cooler	013240001	03/16/90	5.0
		08/08/90	16.0
		07/31/91	39.5
		04/13/92	4.0
		09/06/92	40.0
Sugar Cooler Scrubber	013230004	03/16/90	6.0
		07/31/91	5.0
		04/13/92	16.0
		09/06/92	3.0
Granulator Scrubber	019632010	08/31/92	49.2
		03/06/93	6.0
Sugar Cooler Valves	019632004	03/16/90	3.0
		05/24/90	32.0
		09/03/91	68.0
		04/13/92	8.0
Sugar Cooler Xmitters	019632005	03/16/90	11.0
		09/03/91	10.0
		04/13/92	19.0
		03/08/93	27.0
Sugar Cooler Controller	019632006	03/16/90	12.0
		05/31/90	24.0
		09/03/91	10.0
		04/13/92	4.0
		12/11/92	9.0
Pulp Dryer Emission Monitoring	039610006	04/13/92	126.5
		03/28/93	36.0
Pulp Dryer Control Room Equipment	039610003	03/16/90	88.0
		03/16/90	33.0
		09/18/90	16.0
		04/13/92	163.0
		09/06/92	6.0
		03/07/93	127.0
Pulp Dryer Transmitters	039610002	01/01/90	4.0
		03/15/90	6.0
		03/16/90	52.5
		09/03/91	13.0
		04/13/92	108.0
		09/06/92	10.0

From ACS 4/6/93

Maintenance Man-hours

Pulp Dryer Transmitters (continued)		09/09/92	2.0
		03/25/92	123.0
Pellet Cooler	033030001	03/15/90	9.0
		09/18/90	48.0
		04/13/92	114.5
		02/19/93	13.0
		02/28/93	7.0
		03/18/93	81.5
		03/25/93	14.0
Dust Collector	033040001	- 0 -	- 0 -
Dust Collector Fan	033040002	03/15/90	2.0
		11/21/92	16.0
Pellet Cooler Baghouse	033040004	04/13/92	4.0
Pellet Elevator	033050001	03/15/90	3.0
		09/18/90	15.0
		09/03/91	18.0
		11/25/92	37.0
		01/30/93	4.0
		02/01/93	19.0
		03/12/93	12.0
		03/29/93	80.0
Sacking Equipment	034060001	03/16/90	16.0
		04/13/92	19.0
		11/27/92	10.0
		01/29/93	16.0
		02/28/93	8.0

Maintenance Man-hours

From ACS 4/6/93

E-5

FACSIMILE COVER LETTER

DATE: 4/14/93

TO: Al Trowbridge

FROM: Dennis Hoffman

FIRM NAME: AMERICAN CRYSTAL SUGAR COMPANY - CROOKSTON, MN.

OUR FAX NUMBER IS (218)281-4413 OUR TELEPHONE # IS (218)281-1993

NUMBER OF PAGES (including cover letter) 3

COMMENTS:

MESSAGE: Regarding test on Sugar Cooler.
Please review attached drawing for accuracy.
Need through-put rate (lb/hr thru cooler)
during the following periods on 3/11/93

Test #1: 0945 - 1050 866 cwt/hr
Test #2: 1135 - 1240 821 cwt/hr
Test #3: 1310 - 1420 746 cwt/hr

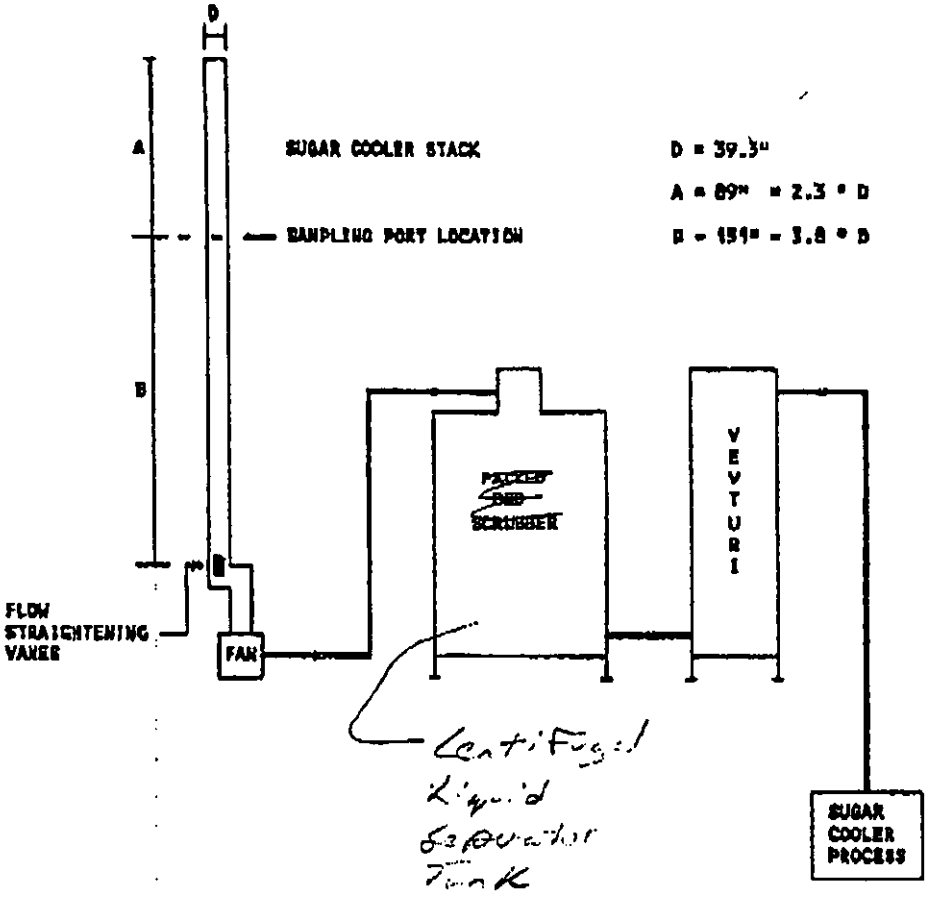
NOTE

This message includes this cover sheet and 1 additional page(s). Please contact us if you do not rece all of the pages indicated.

A member of the HIH group of companies

E-6

FIGURE 1. PROCESS SCHEMATIC WITH SAMPLING PORT LOCATION



E-7

APPENDIX F

MPCA EXHIBIT C

REQUIRED DATA
for
PROCESS EMISSIONS

Company Name American Crystal Sugar

C. Equipment & Operating Data

1. Process Equipment No./Ident. Sugar Cooler

2. Process Equipment Description FMC Roto-Louver Rotary Dryer

3. Process equipment operating under normal operating conditions?

No _____. Yes X. Process rate during the test _____.
(raw materials or finished product)

D. Instrument Data on Process Equipment

1. Include copy of production records or instrumentation which indicates rate of production or operation of the equipment, i.e. units per hour, lbs. per hour, pressure, air flow, etc.

E. Air Pollution Control Equipment

1. Type/model of control equipment Hetl Wet Venturi Scrubber.

2. Air pressure drop across the control equipment 7" WC.

3. Air flow through the control equipment 37,000 ACFM Max

4. Was the control equipment operating normally? Yes.

5. Data of last major maintenance/cleaning of control equipment _____
Summer Shut Down Completed 8/93.

F. Plant Manager's Certification

I certify that the information submitted herein is accurate and correct and that no information requested was withheld from the Division Manager.

By _____. Position _____.

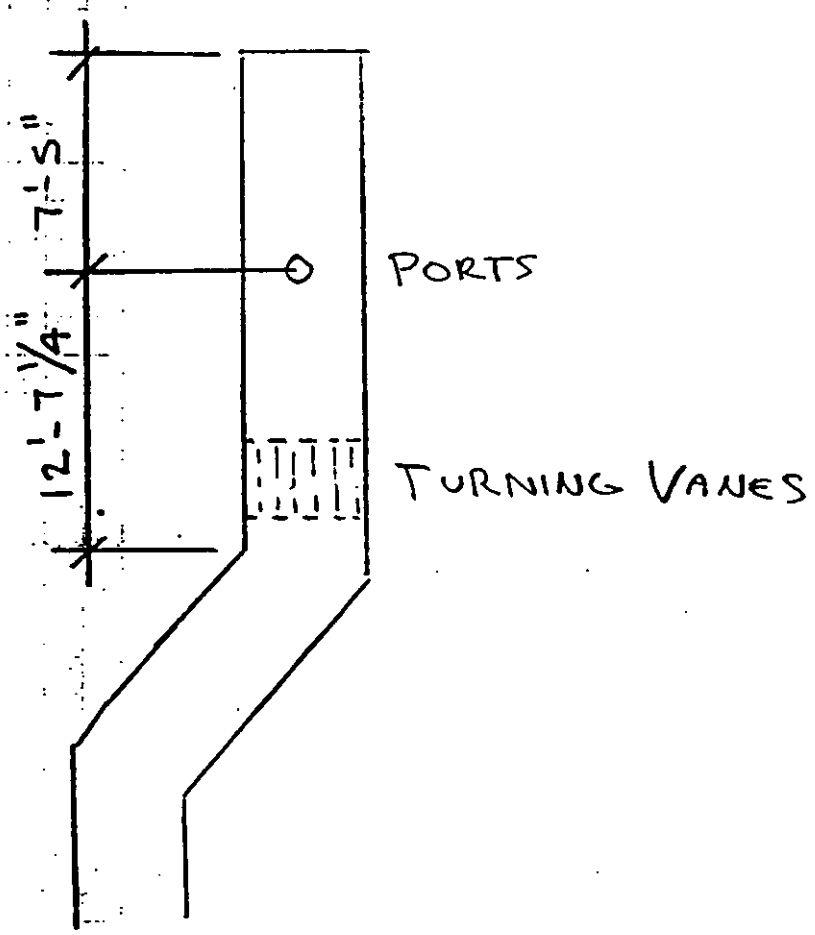
lmb1770

From ACS 4/6/93

F-1

ACSC - CROOKSTON	3-4-93	DWG.# SK930304-F

SUGAR COOLER STACK



From ACS
4/6/93

F-2

APPENDIX G

TEST PLAN & PROTOCOL

draft copy

1) GENERAL INFORMATION

A: Permittee: . . . . . American Crystal Sugar Company

B: MPCA DAQ File No: 29C

C: Permittee contact person: . . . . . Jim Dudley

Telephone number: . . . . . (218) 281-1993

Mailing address: . . . . . American Crystal Sugar Company
. . . . . Highway 75
. . . . . P.O. Box 600
. . . . . Crookston, MN 56716

D: MPCA permitting engineer: . . . . . Greg Siems
. . . . . Phone (612) 296-6743

E: Pre-test Meeting: . . . . . March 3, 1993

F: Test plan prepared by: . . . . . Alan Trowbridge
. . . . . Twin City Testing Corporation
. . . . . 737 Pelham Blvd.
. . . . . St. Paul, MN 55114
. . . . . Phone (612) 659-7541

2) SOURCES

This test plan is applicable to the following sources located at the above facility:

A: Sugar cooler

3) PROCESS UNIT INFORMATION

The information in this section applies to each of the sources listed in section 2.

A: Pollutants to be Quantified: . . . . . Particulate Matter, Opacity

B: Applicable Regulations: . . . . . Minnesota Rule 7005.0480

C: Special averaging times: . . . . . ???

D: Steady-state or batch operation: . . . . . steady-state

E: Type of pollution control equipment: . . . . . venturi scrubber

F: Reason for testing: . . . . . compliance demonstration

G: Is this test for initial compliance demonstration: . . ???

H: Testing Schedule: . . . . . Week of March 9, 1993
Testing Firm: . . . . . Twin City Testing Corp.

I: Permitting engineer to witness the test: . . . . . ???

4) EMISSION POINT INFORMATION

The venturi scrubber on the source has a single stack. ≈ 40" ϕ

The inlet to the pollution control equipment will not be tested.

Drawings showing location of sampling ports are to be furnished.

5) TEST PLAN

A: Fuel Sampling and Analysis . . . . . **NOT APPLICABLE**
Required as part of the compliance demonstration. The MPCA will not accept test reports without analysis of fuel samples collected at the time of the test.

1) Sampling - One sample is collected during each particulate test run:
In order to be representative of the fuel burned at the time of the test the fuel must be sampled as close as possible to the burner. The samples should be collected per ASTM methodology which is described in MPCA Exhibit D.
2) Analysis - The individual fuel samples are to be combined together into a single composite sample which is to be analyzed for:
   a) Gross heating value, BTU/gal or BTU/lb
   b) Sulfur, % by weight
   c) Ash, % by weight
   d) Specific gravity (if applicable)
   e) Moisture content, % by weight

B: Moisture Content in the Raw Material or Product
Required as part of the compliance demonstration. The MPCA will not accept test reports without analysis of product moisture content at the time of the test.

1) *Sampling - One composite sample is collected for each particulate test run:*
Take two samples of raw material or product during each test run. Inorder to be representative of the material processed during the test period, the samples must be collected as close to the process as possible. For each particulate test run, mix the two individual samples into a single composite.
2) Analysis - Each composite sample is to be analyzed for moisture content per ASTM or other recognized methodologies.

C: Process Operating Conditions Under Which Test is to be Conducted

1) Process rates:

2) Raw material input rates: . . . . . 40 tons per hour sugar

3) Product output rates:

4) Physical parameters:

5) Chemical parameters:

6) Fuels used : . . . . . not applicable

7) Fuel usage rates: . . . . . not applicable

8) Special conditions (batch operations):

throughput from slicer rate

D: Pollution Control Equipment Operating Conditions

The venturi scrubber must be operated under normal conditions.

The venturi scrubber operating parameters listed in Table 1 must be documented.

E: Operating data to be recorded during the test period

1) Operating conditions of the source(s) tested and the associated pollution control equipment must be documented in the test report. The data will be collected by plant personnel and must be signed/certified by a responsible party. The MPCA will not accept test reports without complete documentation of the process conditions during the test. Documentation of process operating conditions includes:
   a) Record keeping of operational parameters as measured during the test in its entirety. For continuous recorders, provide properly labelled copies of strip charts. For discrete data, provide data taken at intervals of no greater than 15 minutes.
   b) Calculations.
   c) Certification of the data by a responsible representative of the plant.
   d) Brief explanation of how the parameters are measured. Indicate if it is a routine measurement, or a special procedure followed for purposes of the test only.

2) Specific parameters which must be documented:
   a) Process rates.
   b) Raw material input rates.
   c) Product output rates.
   d) Fuels used.
   e) Fuel usage rates.
   f) Physical parameters.
   g) Chemical parameters.
   h) Strip charts from any/all continuous emission monitors.
   i) Pollution control equipment operating parameters:
      The venturi scrubber operating parameters listed in Table 1.
   j) Include a description of the most recent maintainance and/or cleaning to the boiler and pollution control system and how frequently such cleaning is required. A frequency of cleaning schedule may be included as a permit condition.

3) A completed and signed copy of MPCA Exhibit C must be included in the test report.

Table 1: Pollution Control Equipment Parameters

CYCLONES
pressure drop
cleaning cycles

BAGHOUSE FABRIC FILTERS
pressure drop
cleaning cycles
air to cloth ratios

ELECTROSTATIC PRECIPITATORS
primary and secondary volts
primary and secondary amperes
spark rates
rapping cycles
number of fields on line
flue gas conditioning

ENERGIZED GRAVEL BED FILTERS
energizing levels
gravel circulation rate
pressure drop
cleaning cycles

SCRUBBERS
pressure drop
liquid flow rate
liquid chemical parameters
liquid pressure
recirculation rates
gas temperature at inlet

VENTURI SCRUBBERS
pressure drop across the throat
liquid flow rate
liquid chemical parameters
liquid pressure
recirculation rates
gas temperature at inlet

AFTERBURNERS
combustion temperature
retention time
auxiliary fuel usage
combustion air

CATALYTIC INCINERATORS
oxidation temperature
catalyst used
age of catalyst
amount of catalyst
cleaning cycles

6) STACK TESTING PROTOCOL

The following test methodology applies to each source listed in section 2.

A: EPA Method 1 for the location of sampling ports and sampling points. Location of the sampling ports must be approved by the MPCA before the test.

A check for cyclonic flow must be done whenever there is a cyclonic type of device directly upstream of the sampling location. The check must be performed even if flow straightening vanes have been installed.

If the sampling location does not meet the minimum requirements of EPA Method 1, then the testing firm must conduct flow pattern evaluation and testing according to the alternative procedures in part 2.5 of EPA Method 1 (ie. three-dimensional directional probe).

B: EPA Method 2 for velocity and volumetric flow rate determination. Three (3) test runs are required; one concurrent with each EPA Method 5 particulate emission test run.

C: EPA Method 3 for gas analysis (CO_2 & O_2). Three (3) determinations are required; one integrated sample concurrent with each EPA Method 5 particulate emission test run.

D: EPA Method 4 for determination of moisture in the flue gases. Three (3) test runs are required; one concurrent with each EPA Method 5 particulate emission test run.

E: EPA Method 5 as amended in MPCA Exhibit C and Minnesota Rule 7005.0500 for the determination of particulate matter emissions. Three (3) one-hour test runs are required. Each run must represent a minimum sample volume of 30 dry standard cubic feet.

F: EPA Method 9 as amended in Minnesota Rule 7005.1860 for the determination of visible emissions. Normally one (1) sixty-minute test is required. However, three (3) sixty-minute tests are required if the purpose is to demonstrate initial compliance. Except as noted below, the test(s) must be performed concurrent with one (or all three) of the EPA Method 5 particulate emission test runs.

Note: Weather conditions may make it impossible to perform the visible emission test concurrent with a particulate test. If such circumstances exist, the visible emission test will be rescheduled for a later time/date and will be performed at similar load conditions.

PROCESS SOURCE DESCRIPTION	
Company:	AMERICAN CRYSTAL SUGAR
Location:	CROOKSTON
Process Number:	#10
Process Description:	SUGAR COOLER
Maximum Process Feed Rate, lb/hr:	40 TON HR
Finished Product Rate, lb/hr:	40 TON HR

PROCESS INPUT FEED RATES

Ingredient/Component	Usage Rate (lbs/hr, gal/hr)	Moisture Content as Used, %
1: SUGAR	40 TON HR	18%
2:		
3:		
4:		

AIR POLLUTION CONTROL EQUIPMENT

Type:	VENTURI SCRUBBER
Manufacturer/Model:	Heil
Air Pressure Drop Across Control Equipment:	5-7" WATER ACROSS THROAT
Air Flow Through the Control Equipment:	37,000 ACFM 100°F (25,000 DSCFM)

AVAILABLE PROCESS DATA
(List all metered and/or recorded parameters)

SCRUBBING LIQUID FLOW RATE	MONITORING EQUIPMENT
280 GPM AT 20 PSIG	PSI GAUGE, LIQUID FLOW METER
	MFR. RECOMMENDED PSI OROP
	5-7 IN WATER

STACK SAMPLING LOCATION DESCRIPTION
(attach drawing/sketch if available)

Stack Cross-Sectional Dimension at Sampling Location:	I.D. 3.33 feet
Length of Straight, Undisturbed Flow Before Sampling Ports:	
Length of Straight, Undisturbed Flow After Sampling Ports:	

COMMENTS

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Minnesota Poliution Control Agency

Air Quality Division
520 Lafayette Road
Saint Paul, MN 55155-3898

FACSIMILE TRANSMITTAL SHEET

To: Ahto Niemoja

Company or Agency: Twin City Testing

Facsimile Number: (612) 659- ~~7544~~ - 7515

Subject: American Crystal Sugar
Follow-up pretest meeting letter

From: Yolanda Hernandez

Company or Agency: MPCA/AIR QUALITY DIVISION

Telephone Number: (612) 296-8374

Facsimile Number: 297-7709

Date: March 5, 1993

Pages to Follow: 2
(Please Number ALL Pages)

If you have questions regarding this transmittal, please call: (612)_____.

faxed to Larry Carlson
Dann Hoffman

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Minnesota Pollution Control Agency

March 5, 1993

Mr. Dann Hoffman
Factory Facilitator
P.O. Box 600
Crookston, Minnesota 56716

RE: Pre-test Meeting of March 3, 1993, Attended by Yolanda Hernandez (MPCA), Greg Siems (MPCA), Ahto Niemioja (TCT), Alan Trowbridge (TCT), Larry Carlson (ACS), and Dann Hoffman (ACS).

Dear Mr. Hoffman:

This letter is written as a follow-up to the pre-test meeting of March 3, 1993. Purposes of testing are for permit fee purposes, baseline testing for PSD purposes, and to demonstrate compliance with existing rules for draft permit purposes. The testing is for your Crookston facility and the test dates discussed are listed below:

MARCH 8-12, 1993

All Sources to be tested for PM and VE

Pulp pellet cooler (baghouse stack #1)	Tuesday
Pulp pellet cooler (baghouse stack #2)	Tuesday
Pulp bagger	Wednesday
Lime kiln	Wednesday
Sugar cooler	Thursday

MARCH 15-19, 1993

All Sources to be test for PM, SO_x, No_x, and VE

Boiler 1	Tuesday
Boiler 2	Wednesday
Boiler 3	Thursday

The intercampaign boiler schedule was left for discussion at a later date.

1) At the pre-test meeting, draft testplans which included protocol were submitted. Given the data provided by the Company on emission unit installation dates, non-NSPS applicability was determined for all sources.

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2) The Company was asked to submit port locations and applicable dimensions before beginning actual tests. These schematics were received, and port locations appear acceptable. Verification of absence of cyclonic flow will be performed as listed in the protocol.

3) Fuel to be used during testing will be the "dirtiest" fuel the Company wishes to demonstrate compliance and be permitted at. The Company indicated it would be testing on sub-bituminous coal for the boilers.

4) The Company must perform compliance tests at the maximum load they wish to be permitted at.

5) The Company is responsible for documenting all operating parameters that will be used to determine whether maximum operating conditions were achieved during testing.

6) During the pre-test meeting the question of whether opacity runs should be done with ash pulling or soot blowing arose. The opacity runs for boilers 1, 2, and 3 shall be done during soot blowing.

7) The pulp pellet cooler has two stacks. The possibility of a cumulative limit for particulate was discussed.

8) The Company was given a copy of Exhibit C and a draft copy of Exhibit D. Submittal schedules for the report and microfiche were discussed.

9) No major changes were made to the testplan.

It is the responsibility of the Permittee to submit two copies of the test report on or before the due date. Please discuss the enclosures with your consultant. If you have questions or corrections regarding the contents of this letter, please contact me at (612)296-8374.

Sincerely,

Yolanda Hernandez

Yolanda Hernandez
Pollution Control Specialist
Compliance and Enforcement Section
Air Quality Division

YOH:mlp3595

Enclosures

cc: Greg Siems, AQD
Dave Crowell, AQD
Cary Hernandez, Detroit Lakes Region
AQD File No. 29C

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STANDARDS OF PERFORMANCE FOR INDUSTRIAL PROCESS EQUIPMENT

7005.0450 DEFINITIONS.

Subpart 1. **Scope.** As used in parts 7005.0450 to 7005.0520, the following words shall have the meanings defined herein.

Subp. 2. **Collection efficiency.** "Collection efficiency" means the percent of the total amount of particulate matter entering the control equipment which is removed from the exhaust stream by the control equipment and is calculated by the following equation:

$$\text{collection efficiency} = \frac{100(A - B)}{A}$$

where:

A = the amount (grams or pounds) or the concentration (gr/SCF) of particulate matter entering the collection equipment; and

B = the amount (grams or pounds) or the concentration (gr/SCF) of particulate matter leaving the control equipment.

Subp. 3. **Industrial process equipment.** "Industrial process equipment" means any equipment, apparatus, or device embracing chemical, industrial, or manufacturing facilities such as ovens, mixing kettles, heating and reheating furnaces, kilns, stills, dryers, roasters, and equipment used in connection therewith, and all other methods or forms of manufacturing or processing that may emit any air contaminant such as smoke, odor, particulate matter, or gaseous matter. Industrial process equipment is an affected facility. An emission facility may consist of more than one unit of industrial process equipment.

Subp. 4. **Process weight.** "Process weight" means the total weight in a given time period of all materials introduced into any industrial process equipment that may cause any emission of particulate matter. Solid fuels charged are considered as part of the process weight, but liquid and gaseous fuels and combustion air are not. For a cyclical or batch operation, the process weight per hour is derived by dividing the total process weight by the number of hours in one complete operation from the beginning of any given process to the completion thereof, excluding any time during which the equipment is idle. For a continuous operation, the process weight per hour is derived by dividing the process weight for a typical period of time.

Statutory Authority: *MS s 116.07 subd 4*

7005.0460 SCOPE.

Parts 7005.0450 to 7005.0520 shall apply to industrial process equipment for which a standard of performance has not been promulgated in a specific rule.

Statutory Authority: *MS s 116.07 subd 4*

7005.0470 STANDARDS OF PERFORMANCE FOR PRE-1969 INDUSTRIAL PROCESS EQUIPMENT.

Subpart 1. **Prohibited discharge of gases.** No owner or operator of any industrial process equipment which was in operation before July 9, 1969, shall cause to be discharged into the atmosphere from the industrial process equipment any gases which:

A. in any one hour contain particulate matter in excess of the amount permitted in part 7005.0510 for the allocated process weight; provided that the owner or operator shall not be required to reduce the particulate matter emission below the concentration permitted in part 7005.0520 for the appropriate source gas volume; provided further that regardless of the mass emission permitted by part 7005.0510, the owner or operator shall not be permitted to emit particulate

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matter in a concentration in excess of 0.30 grains per standard cubic foot of exhaust gas; or

B. exhibit greater than 20 percent opacity, except that a maximum of 60 percent opacity shall be permissible for four minutes in any 60-minute period and a maximum of 40 percent opacity shall be permissible for four additional minutes in any 60-minute period.

Subp. 2. **Compliance.** The owner or operator of any industrial process equipment which was in operation before July 9, 1969, which has control equipment with a collection efficiency of not less than 99 percent by weight shall be considered in compliance with the requirements of subpart 1, item A.

Subp. 3. **Equipment located outside of Saint Paul, Minneapolis, and Duluth.** The owner or operator of any industrial process equipment which was in operation before July 9, 1969, which is located outside the Minneapolis-Saint Paul Air Quality Control Region and the city of Duluth, which is located not less than one-fourth mile from any residence or public roadway, and which has control equipment with a collection efficiency of not less than 85 percent by weight, and the operation of the entire emission facility does not cause a violation of the ambient air quality standards, shall be considered in compliance with the requirements of subpart 1, item A.

Statutory Authority: *MS s 116.07 subd 4*

7005.0480 STANDARDS OF PERFORMANCE FOR POST-1969 INDUSTRIAL PROCESS EQUIPMENT.

Subpart 1. **Prohibited discharge of gases.** No owner or operator of any industrial process equipment which was not in operation before July 9, 1969, shall cause to be discharged into the atmosphere from the industrial process equipment any gases which:

A. in any one hour contain particulate matter in excess of the amount permitted in part 7005.0510 for the allocated process weight; provided that the owner or operator shall not be required to reduce the particulate matter emission below the concentration permitted in part 7005.0520 for the appropriate source gas volume; provided that regardless of the mass emission permitted by part 7005.0510, the owner or operator shall not be permitted to emit particulate matter in a concentration in excess of 0.30 grains per standard cubic foot of exhaust gas; or

B. exhibit greater than 20 percent opacity.

Subp. 2. **Compliance.** The owner or operator of any industrial process equipment which was not in operation before July 9, 1969, which has control equipment with a collection efficiency of not less than 99.7 percent by weight shall be considered in compliance with the requirements of subpart 1, item A.

Subp. 3. **Equipment located outside of Saint Paul, Minneapolis, and Duluth.** The owner or operator of any industrial equipment which was in operation after July 9, 1969, which is located outside the Minneapolis-Saint Paul Air Quality Control Region and the city of Duluth, which is located not less than one-fourth mile from any residence or public roadway, and which has control equipment with a collection efficiency of not less than 85 percent by weight, and the operation of the entire emission facility does not cause a violation of the ambient air quality standards, shall be considered in compliance with the requirements of subpart 1, item A.

Statutory Authority: *MS s 116.07 subd 4*

7005.0490 PERFORMANCE TEST METHODS.

Unless another method is approved by the agency, any owner or operator required to submit performance tests for any industrial process equipment shall utilize the following test methods:

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A. Method 1 for sample and velocity traverses;

B. Method 2 for velocity and volumetric flow rate;

C. Method 3 for gas analysis;

D. Method 5 for the concentration of particulate matter and associated moisture content; and

E. Method 9 for visual determination of the opacity of emissions from stationary sources.

Statutory Authority: *MS s 116.07 subd 4*

7005.0500 PERFORMANCE TEST PROCEDURES.

In the event that emissions from any industrial process equipment contain organic vapors which condense at standard conditions of temperature and pressure, the following changes in method 5 for determining particulate emissions shall be made:

A. Paragraph 4.2, Sample Recovery in method 5 is amended to read as follows:

4.2 Sample Recovery. Exercise care in moving the collection train from the test site to the sample recovery area so as to minimize the loss of collected sample or the gain of extraneous particulate matter. Set aside a portion of the acetone and water used in the sample recovery as a blank for analysis. Place the samples in containers as follows:

Container #1. Remove the filter from its holder, place in this container, and seal.

Container #2. Place loose particulate matter and water and acetone washings from all sample-exposed surfaces preceding the filter paper in this container and seal. The probe and nozzle should be scrubbed with a stiff brush and distilled water, followed by an acetone rinse. If these solvents do not do a good cleaning job, an adequate solvent must be found and used. Use a razor blade or rubber policeman to loosen adhering particles if necessary.

Container #3. Measure the volume of water from the first three impingers and place the water in this container. Place water rinsings of all sample-exposed surfaces between the filter and fourth impinger in this container prior to sealing.

Container #4. Transfer the silica gel from the fourth impinger to the original container and seal. Use a rubber policeman as an aid in removing silica gel from the impinger.

Container #5. Thoroughly rinse all sample-exposed surfaces between the filter paper and fourth impinger with acetone, place the washings in this container, and seal.

B. Paragraph 4.3, Analysis in Method 5 is amended to read as follows:

4.3 Analysis. Record the data required on the example sheet shown in figure 5-3. Handle each sample container as follows:

Container #1. Transfer the filter and any loose particulate matter from the sample container to a tared glass weighing dish, desiccate, and dry to a constant weight. Report results to the nearest 0.5 milligram.

Container #2. Transfer the washings to a tared beaker and evaporate to dryness at ambient temperature and pressure. Desiccate and dry to a constant weight. Weigh to the nearest 0.5 milligram.

Container #3. Extract organic particulate matter from the impinger solution with three 25 ml portions of chloroform. Complete the extraction with three 25 ml portions of ethyl ether. Combine the ether and chloroform extracts, transfer to a tared beaker and evaporate at 70 degrees Fahrenheit until no solvent remains. Desiccate, dry to a constant weight, and report the results to the nearest 0.5 milligram.

Container #4. Weigh the spent silica gel and report to the nearest gram.

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