PARTICULATE EMISSIONS TEST REPORT

STARCH PROCESS STACK

for

NATIONAL STARCH & CHEMICAL COMPANY

North Kansas City, Missouri

August, 1986
86-177-3

Burns & McDonnell
ENGINEERS - ARCHITECTS - CONSULTANTS

I, Richard L. Howes, hereby certify that the Particulate Emission tests conducted at National Starch & Chemical Corporation in North Kansas City, Missouri are in accordance with procedures established by the United States Environmental Protection Agency. This report accurately and faithfully represents the data obtained from this test and the results determined from analysis of this data.

Richard Howes

Richard L. Howes
Field Test Crew Chief
Air Quality Control Division

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INTRODUCTION

INTRODUCTION

This report presents the results of the source emission testing performed on Unit 1 starch process dryer unit at the National Starch and Chemical Company plant located in North Kansas City, Missouri.

The purpose of the test was to determine the particulate emission rate from the unit. The test results are located in Section II of this report.

The emissions testing was performed by Burns & McDonnell Engineering Company whose main office is located at 4800 East 63rd Street, Kansas City, Missouri 64130.

Testing was performed on August 5, 1986. The emissions tests were performed in accordance with EPA reference Methods 1, 2, 3, 4 and 5 as published in the Federal Register, "Standards of Performance for New Stationary Sources," with all the latest revisions in the July 1, 1985 Code of Federal Regulations, Title 40 - "Protection of the Environment" Parts 53 to 80.

The testing equipment, sampling procedures, and analytical procedures are described in Section IV of this report. The raw field data, plant data, equipment calibration, lab analysis reports and equations used in determining final results are presented in the Appendix.

SUMMARY OF TEST RESULTS

Summary of Test Results

The following table shows the test results of the three particulate emission tests runs made on Unit 1 starch process dryer on August 5, 1986:

DW

	Emission Rate	Process Rate[a] lb/hr	T/hr
Test Run 1	10.63 lb/hr	30,100	15.05
Test Run 2	10.33 lb/hr	29,000	14.5
Test Run 3	9.39 lb/hr	29,000	14.5
Daily Average	10.12 lb/hr		

The computer printout sheets listing complete test results are included in this section of the report on the following page.

[a] From Plant data sheet, p36

Emission Factors

Run 1 $\frac{10.63}{15.05} = 0.71$

Run 2 $\frac{10.33}{14.5} = 0.71$

Run 3 $\frac{9.39}{14.5} = 0.65$

avg $= 0.69$

NATIONAL STARCH
80-177-3
PARTICULATE TEST RESULTS
7-AUG-86

PARTICULATE ANALYTICAL DATA

RUN NUMBER		1	2	3
TEST DATE		8-5	8-5	8-5
FILTER NUMBER		254	291	203
FILTER FINAL WEIGHT	G	129.9163	152.2302	141.5743
FILTER TARE WEIGHT	G	129.9153	152.2293	141.5733
FILTER WEIGHT GAIN	G	0.0010	0.0009	0.0010
ACETONE WASH NUMBER		96	86	121
ACETONE WASH RESIDUE	MG	61.30	61.90	52.50
ACETONE WASH VOLUME	ML	270	205	317
ACETONE BLANK RESIDUE	MG	0.50	0.50	0.50
ACETONE BLANK VOLUME	ML	200	200	200
TOTAL PARTICULATE MATTER	G	0.0916	0.0621	0.0527
LIQUID COLLECTED	ML	90.0	110.0	110.0
INITIAL SILICA GEL WEIGHT	G	350.0	350.0	350.0
FINAL SILICA GEL WEIGHT	G	367.0	364.5	364.7
TOTAL CONDENSATE	ML	107.0	124.5	124.7

DESCRIPTION OF TESTED FACILITY

NATIONAL STARCH AND CHEMICAL COMPANY

STARCH FLASH DRYER GENERAL DESCRIPTION

The wet corn starch cake is discharged from each centrifuge into a pair of double paddle mixers. Here it can be blended with recycled dry product to produce a suitable feed for the dryer.

From each mixer the conditioned feed passes through a variable speed screw conveyor which, while maintaining an air seal, discharges at a controlled rate into a cascading screen.

Each pair of cascading screens disperses the feed material evenly into the drying air passing through a venturi. The venturi accelerates the starch through the drying column and duct to the Barr & Murphy "simplified manifold" which centrifugally classifies the material. Heavier, wet particles return to the ring duct for further drying, while dry starch continues on to a set of high efficiency cyclones. Here the product is separated from the exhaust air and discharged through a rotary valve/screw conveyor concatenation.

The incoming drying air's temperature is elevated to approximately 410 degrees fahrenheit in a gas-fired heater. The exhaust temperature is controlled at 115-140 degree fahrenheit range. An induced draft fan positioned after the cyclones will draw the drying air through the entire system and vent it to atmosphere via a wet scrubber.

SAMPLING AND ANALYTICAL PROCEDURES

TESTING EQUIPMENT - EPA REFERENCE METHOD 5 (PARTICULATE)

High-Volume Source Sampling Train

An Acurex Corp., Aerotherm High-Volume Stack Sampler (Model HVSS-045) was used at the sampling location(s). The HVSS particulate sampling train consisted basically of a 7-foot effective length x 2-1/2-inch-diameter stainless-steel probe; a variable-heat-controlled filter oven with a calibrated Type K (Chrome/Alumel) thermocouple; a stainless-steel, Teflon-coated filter holder; a standard lexan/stainless-steel impinger assembly with a calibrated Type K (Chromel/Alumel) thermocouple located at the impinger outlet; a 3/4-hp, shaft-sealed, carbon vane vacuum pump assembly with a vacuum gauge; a control unit with an elapse time indicator, a temperature selector switch, a temperature indicator (potentiometer), temperature controllers, calibrated magnehelic gauges, a calibrated dry gas meter and a calibrated variable-diameter orifice; and an umbilical and various interconnecting hoses, fittings and valves. An appropriately sized stainless-steel nozzle, a calibrated Type K (Chromel/Alumel) temperature sensor, a static pressure tube, a calibrated S-type pitot tube and a variable-heat-controlled stainless-steel liner with a calibrated Type K (Chromel/Alumel) thermocouple are integral parts of the probe assembly.

The vacuum pump unit was used to control gas sampling rates. The control unit was used to control probe and oven temperatures. The control unit was also used to monitor elapsed sampling times, temperatures, velocities, static pressure, gas sampling rates and sampled gas volume.

0.3-micron particles were individually numbered, placed separately in similarly numbered glass petri dishes, oven dried at 220 degrees Fahrenheit for two to three hours, cooled in a desiccator for two hours and individually weighed on a Sartorious analytical balance to the nearest 0.1-milligram, and then weighed every six hours, minimum, until two consecutive weights within ±0.5-milligram were obtained. Several 250 milliliter crucibles were desiccated for a minimum of 24 hours and weighed in the same manner as the filters and petri dishes. Also, several 350-gram quantities of Type 6-16 mesh indicating silica gel were weighed-out on an a Mettler top-loader balance and individually placed into separate airtight polypropylene storage bottles.

The number of sampling points and positions of the points in the flue at the sampling location(s), and the sampling time at each point were determined prior to the particulate testing. the sampling procedures were performed in accordance with the Environmental Protection Agency's Reference Method 5, "Determination of Particulate Emissions from Stationary Sources" in the Thursday, August 18, 1977 Federal Register, "Standards of Performance for New Stationary Sources" and subsequent revisions in the July 1, 1985 Code of Federal Regulations, Title 40, "Protection of Environment, Parts 53 to 80.

A HVSS sampling train was prepared inpart at the sampling locations(s), before each test run, in the following manner: An appropriately sized sampling nozzle was installed onto the inlet of a sampling probe and capped. The probe was then dimensioned and marked with glass-cloth tape at increments that corresponded with the predetermined sampling point positions in the flue. A standard

nozzle and orifice size, and the factors that would be used in calculating the isokinetic sampling rate for each sampling point. Knowing the actual pressure differential across the pitot tube used, the isokinetic sampling rate was calculated at each sampling point using a Sharp Model PC-1211 pocket computer.

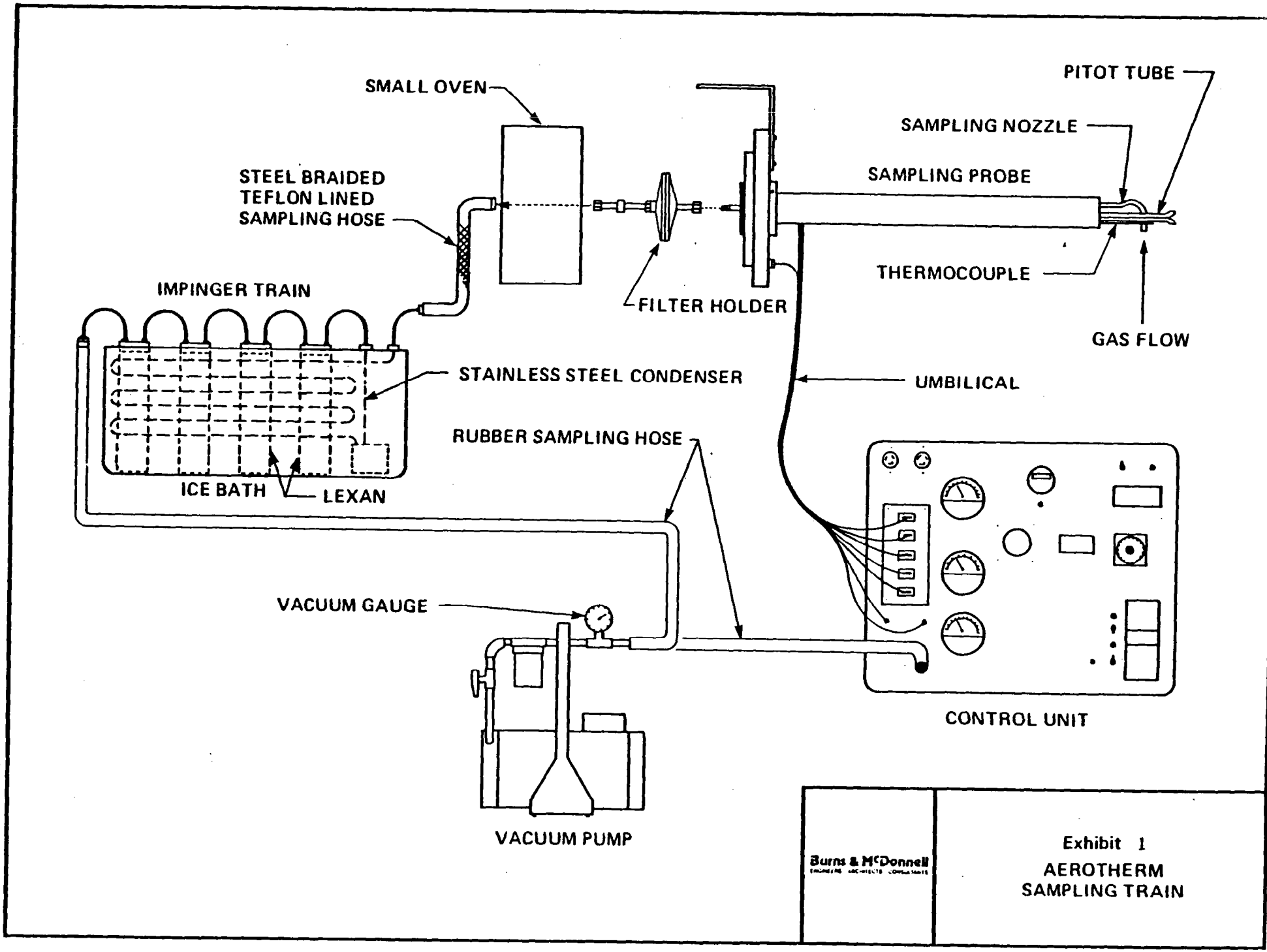
Three test runs were performed at the sampling locations. A total of 24 points (12 points from each of the two sampling ports) were sampled in the flue. Each point was sampled for a period of 3 minutes at a calculated isokinetic sampling rate. The sampling data for each test run was recorded on a field test form during each of the sampling periods.

After the completion of a test run, the following procedures were performed: A final leak-check was performed at 15 inches of mercury vacuum, minimum, for one minute and the leakage rate recorded. The flue gas moisture collected in the first three impingers was measured and recorded. The moisture laden silica gel in the fourth impinger was transferred to an appropriately marked, airtight polypropylene storage bottle and retained for later weighing. The weight gain of the silica gel moisture collection was added to the measured moisture condensed during the test run to determine the total moisture collected for that run. The sampling nozzle, sampling probe and filter holder were capped and taken to a clean area for sample recovery. At the recovery area, the disc filter was carefully removed from the filter holder and transferred to its petri dish for later desiccation and weighing. The sampling nozzle, probe, and filter holder were washed with nanograde acetone. The acetone washing and an acetone blank were collected in appropriately labeled polypropylene sample bottles and retained for later evaporation, desiccation and weighing.

evaporation on a low-temperature water bath at 130 degrees Fahrenheit. when the acetone in a crucible had completely evaporated, the crucible was transferred to a desiccator for further drying at room temperature for a minimum of 24 hours before weighing, and weighed every six hours, minimum, until two consecutive weights within ±0.5-milligram were obtained. Each acetone blank collected was used to determine the amount of residual weight each crucible retained due to acetone impurities. Each disc filter and petri dish, acetone washing and acetone blank was individually weighed on a Sartorious analytical balance with a sensitivity of 0.1-milligram.

All test instruments were recalibrated to determine the deviation percentage.

* * * * *



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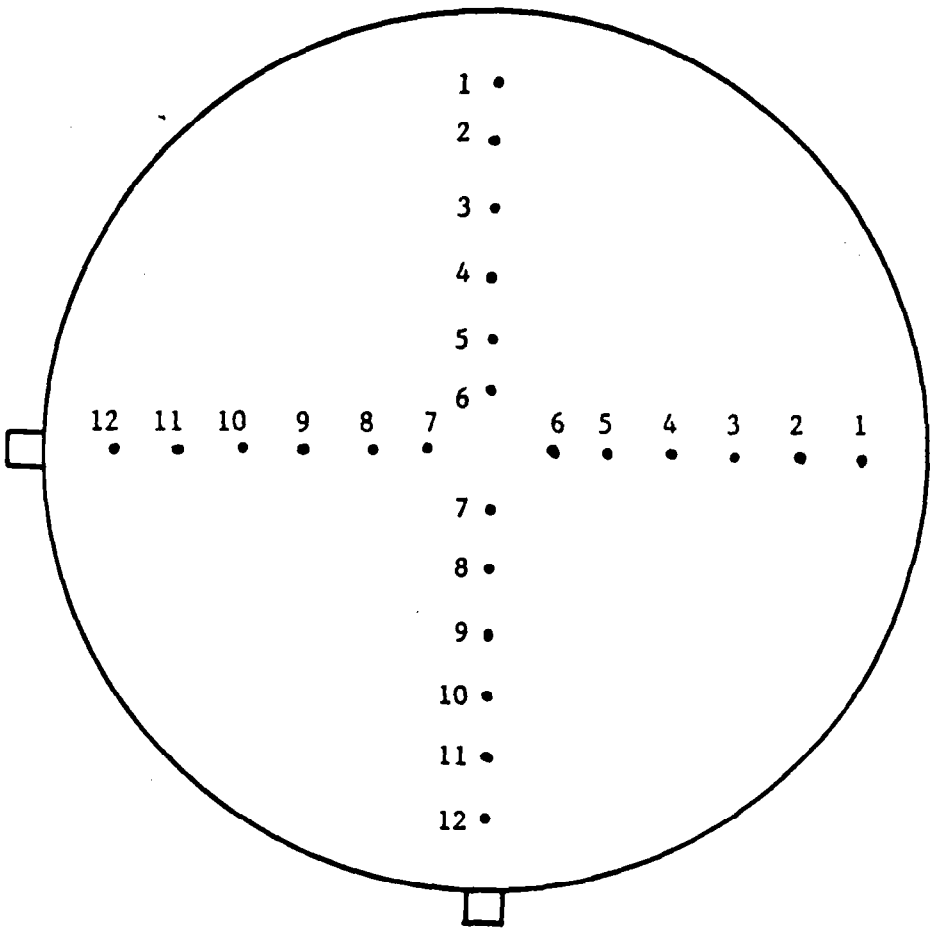

POINTS	DISTANCE FROM INSIDE WALL
1	1.6"
2	5.2"
3	9.2"
4	13.8"
5	19.5"
6	27.7"
7	50.2"
8	58.5"
9	64.2"
10	68.8"
11	72.7"
12	76.4"

DIAMETER STACK 6'-6"

PORT LENGTH 3" (4" ϕ)

Burns & McDonnell
ENGINEERS · ARCHITECTS · CONSULTANTS

Exhibit 2

STACK TEST POINT LOCATIONS

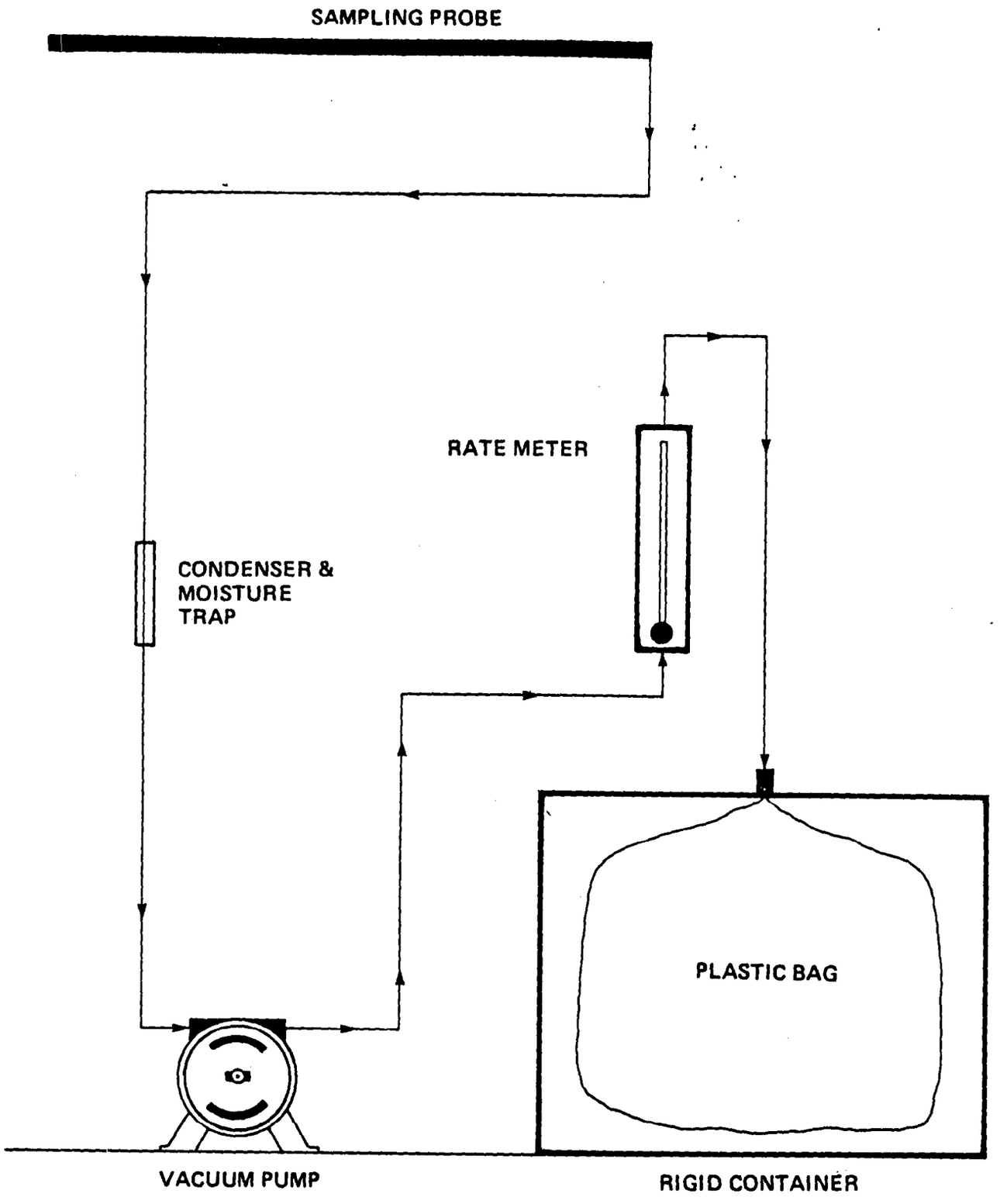

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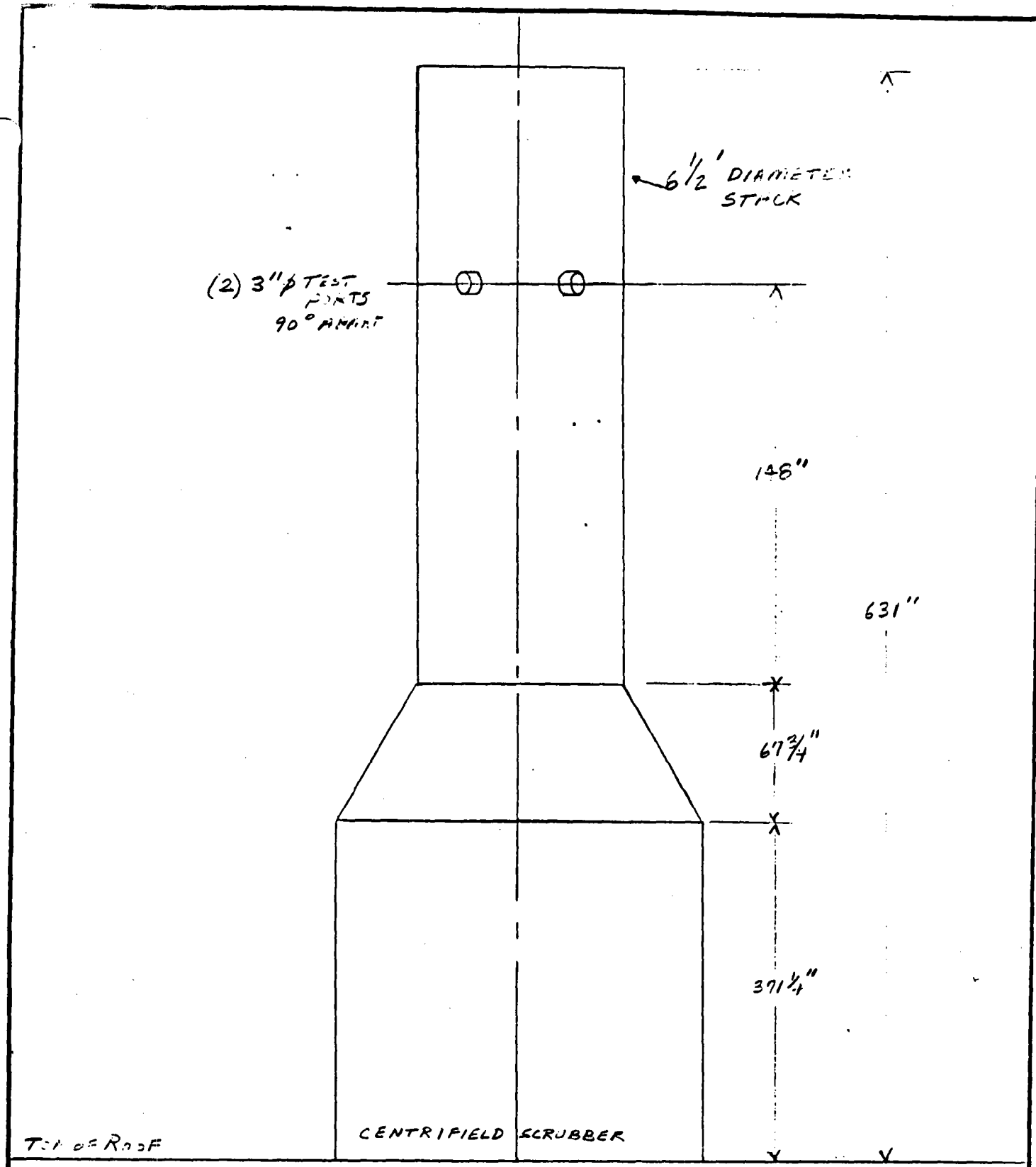
Exhibit 3

INTEGRATED BAG
SAMPLING TRAIN



NOT TO SCALE

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Exhibit 4
TEST PORT LOCATIONS
NATIONAL STARCH & CHEMICAL CORP.

APPENDIX

NOMENCLATURE

acf = actual cubic feet
acfm = actual cubic feet per minute
A = effective area of flue in square feet
acm = actual cubic meters
acmm = actual cubic meters per minute
A_n = inside area of sampling nozzle in square feet
B_{ws} = water vapor in gas stream, proportion by volume
%C = percent carbon by weight, dry basis
%CO = percent carbon monoxide by volume, dry basis
$\%CO_2$ = percent carbon dioxide by volume, dry basis
C_p = pitot tube coefficient
D_I = dust loading per heat input in pounds (grams) per million Btu (calories) per Fr constant
D_I' = dust loading per heat input in pounds (grams) per million Btu (calories) per Fr calculated
dscf = dry standard cubic feet
dscfh = dry standard cubic feet per hour
dscm = dry standard cubic meters
dscmh = dry standard cubic meters per hour
fps = feet per second
F_r = ratio factor of dry flue gas volume to heat value of combusted fuel in dry standard cubic feet (meters) per million Btu (calories)
gms = grams
gm-mole = gram-mole
grs = grains
ΔH = orifice pressure drop in inches water, average
%H = percent hydrogen by weight, dry basis
H_c = heat of combustion in Btu per pound, dry basis
hr = hour
%I = percent isokinetic
in. Hg = inches mercury
lbs = pounds
lb-mole = pound-mole
%M = percent moisture by volume
mmBtu = million Btu
mmcal = million calories
mm Hg = millimeters mercury
mps = meters per second
M_s = molecular weight in pound (gram) per pound (gram) mole (wet basis)
%N = percent nitrogen by weight, dry basis
$\%N_2$ = percent nitrogen by difference, dry basis
%O = percent oxygen by difference, dry basis
$\%O_2$ = percent oxygen by volume, dry basis
P_b = barometric pressure in inches mercury
P_{std} = standard absolute pressure (29.92 in Hg)
P_s = absolute pressure in flue in inches (millimeters) mercury
P_f = static pressure in flue in inches water, average
$\sqrt{\Delta P}$ = square root of velocity head in inches water, average
%S = percent sulfur by weight, dry basis
scf = standard cubic feet
scm = standard cubic meters
T_{std} = absolute temperature of air in degrees Rankine at standard conditions (528 degrees)
T_s = absolute temperature of flue gas in degrees Rankine, average
T_m = absolute temperature at meter in degrees Rankine, average
V_s = velocity of flue gas in feet (meters) per second
V_l = volume of condensate through the impingers in milliliters
V_{lc} = volume of liquid collected in condenser in milliliters plus weight of liquid absorbed in silica gel in grams indicated as milliliters
V_m = volume of metered gas measured at meter conditions in cubic feet
V_{ms} = volume of metered gas corrected to dry standard conditions in cubic feet (meters)
V_o = volume of flue gas at actual conditions in cubic feet (meters) per minute
Q_{sd} = volume of flue gas corrected to dry standard conditions in cubic feet (meters) per hour
V_t = total volume of flue gas sampled at actual conditions in cubic feet (meters)
V_w = volume of water vapor in metered gas corrected to standard conditions in cubic feet (meters)
V_{wc} = volume of water condensed in impingers corrected to standard conditions
V_{wsg} = volume of water collected in silica gel corrected to standard conditions
W_a = total weight of dust collected per unit volume in grains (grams) per actual cubic feet (meters)
W_d = total weight of dust collected per unit volume in pounds (grams) per dry standard cubic feet (meters)
W_g = total weight of dust collected in grams
W_h = total weight of dust collected per unit volume in pounds (grams) per hour, dry basis
W_p = total weight of dust collected in pounds
W_s = total weight of dust collected per unit volume in grains (grams) per dry standard cubic feet (meters)
W_{sg} = impinger silica gel weight gain in grams
Y = metered gas volume correction factor
Θ = total elapsed sampling time in minutes

EPA DUST LOADING FORMULAS

EPA DUST LOADING FORMULAS (Continued)

(11) DUST CONCENTRATION FOR INDIRECT HEATING UNIT AT ACTUAL CONDITIONS AND STANDARD CONDITIONS

W_g = gms

$W_p = 0.002205 \times W_g$ (lb)

$W_d = \frac{W_p}{V_{ms}}$ (lb/dscf)

$W_h = W_d \times Q_{sd}$ (lb/hr dry)

$W_a = \frac{7000 \times W_p}{V_t}$ (gr/acf)

$W_s = 7000 \times W_d$ (gr/dscf)

$D_I = \frac{9820 \times 20.9 \times W_d}{(20.9 - \%O_2)}$ (lb/mmBtu with constant 9820 F_r)

$F_r = \frac{10^6 \times [(3.64 \times \%H) + (1.53 \times \%C) + (0.57 \times \%S) + (0.14 \times \%N) - (0.46 \times \%O)]}{H_c}$ (dscf/mmBtu)

$D_I' = \frac{20.9 \times W_d \times F_r}{(20.9 - \%O_2)}$ (lb/mmBtu with calculated F_r)

(12) PERCENT OF ISOKINETIC SAMPLING

$$\%I = \frac{1.667 \times T_s \times \left\{0.00267 \times V_{lc} + \left[\frac{V_m \times Y}{T_m} \times \left(P_b + \Delta H/13.6\right)\right]\right\}}{\Theta \times V_s \times P_s \times A_n}$$

TEST DATA SHEETS

AIR QUALITY CONTROL DIVISION
TESTING FORM

Particulate Field Data Sheet

Client: National Stasch				Date: 8-5-86	Page 1 Of 2
Project No.: 86-177-3	Operator: S. WASNER				
Sampling Location: Stack			Run No.: 1		
Filter No.: 254	Acetone No.:	Condensate: 90 ML			
Barometric Pressure: 29.30	Static Pressure: +.6	Probe Number: A-7			
Nozzle Diameter: .251	Nozzle Number: P25a	Pitot Coefficient: .78	Pitot Number: 03..		
Meter Corr. Factor: .996	Meter-Orifice: 2.0/1				
Sample Pt. Time: 3 min	Assumed % Moisture: 5%	Leak Test: Before .010	After .003		

Orsat Analysis

CO_2	$+O_2$	O_2	CO
0	20.9	20.9	

Sample Point	ΔP	√ΔP	ΔH	Temperature °F: Stack	Probe	Imp. Out	Oven	Meter In	Meter Out	Vac. Pr. (In. HG)	Dry Gas Meter Reading in Cu. Ft.
	START 9:27										967.175
A 1	.25	.50	.86	112	236		240	70	70	0	968.74
2	.30	.547	1.03	110	238		241	70	70	0	970.35
3	.30	.547	1.03	110	238		244	70	70	0	971.92
4	.50	.707	1.71	110	240		242	70	70	0	974.65
5	.80	.894	2.74	108	235		241	70	70	0	976.78
6	1.0	1.0	3.43	108	237		240	71	71	0	980.21
7	1.0	1.0	3.43	108	237		240	71	71	0	983.82
8	.90	.948	3.09	108	235		244	71	71	0	985.64
9	.70	.836	2.40	108	235		241	72	71	0	988.20
10	.60	.774	2.06	108	236		240	73	71	0	990.54
11	.50	.70	1.71	108	236		240	73	71	0	992.72
12	.30	.547	1.03	107	236		238	73	71	0	994.356
B 1	.30	.547	1.03	109	236		246	72	71	0	995.99
2	.40	.632	1.37	108	236		241	72	71	0	997.88
3	.50	.707	1.71	108	237		244	72	71	0	999.98
4	.50	.707	1.71	108	237		244	72	71	0	1002.20
5	.60	.774	2.06	108	236		240	72	71	0	4.61
6	.80	.894	2.74	108	236		237	72	71	0	7.30
7	.80	.894	2.74	108	237		235	72	71	0	9.81
8	1.0	1.0	3.43	108	234		232	72	71	0	12.77
9	.70	.836	2.40	107	235		240	72	71	0	15.27
10	.50	.707	1.71	108	235		239	72	71	0	17.50
11	.40	.632	1.37	108	230		238	72	71	0	19.44
12	.30	.547	1.03	108	233		236	72	71	0	21.074
		.744	1.992	108.4				1718	1699		
									71.2		53.899
						% I =	103%				

Pitot Tube Leak Check: Before OK After ok

Integrated Bag Leak Check: Before OK After ok

020580

Barns & McDonnell

Form AQD-T-5-3
Page 1 of 2

AIR QUALITY CONTROL DIVISION
TESTING FORM

Particulate Field Data Sheet

Client: NATIONAL STARCH				Date: 8-5-86	Page 1 Of 2
Project No.: 86-177-3	Operator: S WAISNER				
Sampling Location: STACK			Run No.: 3		
Filter No.: 263	Acetone No.:	Condensate: 110			
Barometric Pressure: 29.30	Static Pressure: +.6	Probe Number: A-7			
Nozzle Diameter: .251	Nozzle Number: P250	Pitot Coefficient: .78	Pitot Number: P3..		
Meter Corr. Factor: .996	Meter-Orifice: 789.1				
Sample Pt. Time: 3 min	Assumed % Moisture: 6.5 %	Leak Test: Before .010	After .008		

Orsat Analysis

CO_2	$+O_2$	O_2	CO
0.0	20.9	20.9	

Sample Point	ΔP	$\sqrt{\Delta P}$	ΔH	Temperature °F: Stack	Probe	Imp. Out	Oven	Meter In	Meter Out	Vac. Pr. (In. HG)	Dry Gas Meter Reading in Cu. Ft.
	Start		12:41								80.492
A 1	.30	.547	.99	111	236		250	72	73	0	82.11
2	.30	.547	.99	110	240		250	73	73	0	83.72
3	.40	.632	1.33	110	240		249	74	74	0	85.58
4	.40	.632	1.33	109	240		248	74	74	0	87.44
5	.60	.774	1.99	109	240		239	74	74	0	89.72
6	.90	.948	2.99	109	241		243	74	74	0	92.51
7	1.0	1.0	3.32	110	246		240	76	74	0	95.45
8	1.0	1.0	3.32	110	245		246	79	75	0	98.39
9	.80	.894	2.66	110	248		239	78	75	0	101.02
10	.60	.774	1.99	110	242		240	81	76	0	103.30
11	.50	.707	1.66	110	240		245	82	77	0	105.38
12	.40	.632	1.33	110	240		244	82	77	0	107.241
B 1	.30	.547	.99	110	242		242	83	79	0	108.85
2	.35	.591	1.16	110	243		242	83	79	0	110.59
3	.50	.707	1.66	110	247		242	83	79	0	112.33
4	.70	.836	2.32	110	245		245	85	81	0	114.79
5	.80	.894	2.66	110	245		245	85	81	0	117.42
6	.90	.948	2.99	110	245		247	85	81	0	120.21
7	1.10	1.048	3.65	110	246		246	87	83	0	123.23
8	1.0	1.0	3.32	110	240		250	87	83	0	126.23
9	.70	.836	2.32	110	241		246	87	83	0	128.69
10	.60	.774	1.99	110	246		245	89	84	0	130.97
11	.40	.632	1.33	110	246		240	89	84	0	132.83
12	.40	.632	1.33	110	245		240	89	84	0	134.691
								X53	1377		
		.7721	2.065	109.9				79.79			54.199
							%I = 100%				

Pitot Tube Leak Check: Before OK After ok

Integrated Bag Leak Check: Before OK After ok

PLANT DATA SHEETS

DNR & EPA EMMISSION TEST
NSCC CONTROL ROOM DATA
#1 STARCH FLASH DRYER 8/5/86

ITEM	7:00	7:15	7:30	7:45	8:00	8:15	8:30	8:45	9:00	9:15	9:30	9:45
											STARTED Test #1	
OUTLET TEMPERATURE, SET POINT	138	138	138	138	138	138	135	135	135	135	135	135
ACTUAL OUTLET TEMPERATURE	133	134	137	137	138	140	134	131	135	135	139	134
ACTUAL INLET TEMPERATURE	303	353	378	378	378	383	343	341	360	337	327	301
GAS VALVE POSITION	61.8	85.8	99.9	98.9	95.5	79.7	56.9	78.9	82.0	54.7	188	186
DRAFT FAN AMPERAGE	534	530	522	522	526	522	532	533	529	529	529	535
DRYER DRAFT (INCHES H2O)	17.4	19.1	19.6	19.2	18.6	19.8	19.4	19.5	19.6	18.2	19.4	18.7
ENTOLETOR MILL AMPERAGE	174	192	198	197	199	196	196	196	196	188	189	185
POSITIVE SCRUBBER WATER FLOW	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
MAKEUP WATER FLOW RATE (GPM)	12	12	12	12	12	12	12	12	12	12	12	12
EAST FEED SCREW SPEED (%)	47	55	55	55	55	53	53	53	53	50	50	50
WEST FEED SCREW SPEED (%)	41	54	55	55	55	53	53	53	53	50	50	50
LAST HOUR DRYER RATE	8600	XXX	XXX	XXX	32250	XXX	XXX	XXX	32250	XXX	XXX	XXX
TODAYS PRODUCTION	2150	XXX	XXX	XXX	34400	XXX	XXX	XXX	64500	XXX	XXX	XXX
			Test #1 over		Started Run #2					Test #2 over 12 Hrs		STARTED Test #3 12 Hrs

ITEM	10:00	10:15	10:30	10:45	11:00	11:15	11:30	11:45	12:00	12:15	12:30	12:45
OUTLET TEMPERATURE, SET POINT	135	135	135	135	135	135	135	135	135	135	135	135
ACTUAL OUTLET TEMPERATURE	135	134	134	135	135	135	134	134	136	131	136	135
ACTUAL INLET TEMPERATURE	303	296	296	301	306	301	299	307	309	299	322	321
GAS VALVE POSITION	54.7	50.9	56.8	55.6	56.4	52.8	51.3	59.6	55.2	57.3	60.5	58.6
DRAFT FAN AMPERAGE	530	533	532	534	531	533	532	535	530	530	529	531
DRYER DRAFT (INCHES H2O)	19.0	18.8	19.0	19.0	19.0	19.1	18.5	18.7	18.6	19.0	18.9	19.1
ENTOLETOR MILL AMPERAGE	185	189	192	186	185	190	188	187	186	195	196	194
POSITIVE SCRUBBER WATER FLOW	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
MAKEUP WATER FLOW RATE (GPM)	12	12	12	12	12	12	12	12	12	12	12	12
EAST FEED SCREW SPEED (%)	50	50	50	50	50	50	50	50	50	52	52	52
WEST FEED SCREW SPEED (%)	50	50	50	50	50	50	50	50	50	52	52	52
LAST HOUR DRYER RATE	30100	XXX	XXX	XXX	27950	XXX	XXX	XXX	27950	XXX	XXX	XXX
TODAYS PRODUCTION	94600	XXX	XXX	XXX	122550	XXX	XXX	XXX	150500	XXX	XXX	XXX
				Test #3 over 12 Hrs								

ITEM	1:00	1:15	1:30	1:45	2:00	2:15	2:30	2:45	3:00	3:15	3:30	3:45
OUTLET TEMPERATURE, SET POINT	135	135	135	135	135	135						
ACTUAL OUTLET TEMPERATURE	133	136	133	137	133	136						
ACTUAL INLET TEMPERATURE	314	319	303	322	306	318						
GAS VALVE POSITION	58.1	52.0	54.0	55.7	54.6	52.0						
DRAFT FAN AMPERAGE	532	526	533	530	532	523						
DRYER DRAFT (INCHES H2O)	19.0	19.0	18.9	18.7	18.8	19.3						
ENTOLETOR MILL AMPERAGE	190	189	190	189	184	186						
POSITIVE SCRUBBER WATER FLOW	Yes	Yes	Yes	Yes	Yes	Yes						
MAKEUP WATER FLOW RATE (GPM)	12	12	12	12	12	12						
EAST FEED SCREW SPEED (%)	52	50	50	50	50	50						
WEST FEED SCREW SPEED (%)	52	50	50	50	50	50						
LAST HOUR DRYER RATE	32250	XXX	XXX	XXX	27[illegible]	XXX	XXX	XXX		XXX	XXX	X
TODAYS PRODUCTION	122750	XXX	XXX	XXX	2[illegible]	XXX	XXX	XXX		XXX	XXX	X

OW Run 2 27,950 lbs/hr + 32,250 lbs/hr = 29,000 lbs/hr

Dave Adam

30,100
27,950
27,950
32,250
29,000

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CALIBRATION OF TESTING EQUIPMENT

AIR QUALITY CONTROL DIVISION
TESTING FORM

PRETEST

Dry Gas Meter Calibration Sheet

Client National Starch — Run By R Howes

Project No. 86-177-3 — Date 6-20-86

Module 789.1 — Barometric Press 29.30

Orifice Small

ΔH in. H_2O	Vw initial	Vw final	Vw $ft.^3$	Vd initial	Vd final	Vd $ft.^3$	tw °F	tdi °F	tdo °F	Pw in. H_2O	Time θ min.
.5	5928	5933	5.0	930.980	935.965	4.985	74.5	74	72	.1	12.35
1.0	5934	5939	5.0	936.971	941.955	4.984	75	74.5	73.5	.1	8.9
2.0	5941	5946	5.0	943.948	948.961	5.013	75.5	76.5	74	.1	6.4
4.0	5947	5952	5.0	949.940	954.924	4.984	75.5	78	74	.15	4.6
6.0	5953	5963	10.0	955.920	965.813	9.893	76	81.5	74.5	.15	7.6

ΔH	$\frac{\Delta H}{13.6}$	Mc (Y) $\frac{Vw\ Pb\ (td + 460)}{Vd\ (Pb + \Delta H/13.6)\ (tw + 460)}$	ΔHa (For Small Orifice Only) $\frac{0.0317\ \Delta H}{Pb\ (td + 460)} \left[\frac{(tw + 460)\ \theta}{Vw}\right]^2$
.5	.0368	1.000	
1.0	.0737	.999	
2.0	.147	.992	
4.0	.294	.994	
6.0	.441	.999	
Average		.9968	

ΔH = Orifice Setting
Vw = Volume of Gas of Wet Test Meter
Vd = Volume of Gas of Dry Gas Meter
Pw = Pressure of Wet Test Meter
tw = Temperature of Fluid in Wet Test Meter
tdi = Inlet Temperature of Dry Gas Meter
tdo = Outlet Temperature of Dry Gas Meter
td = Average Temperature of Dry Gas Meter
θ = Time required to pull specified cubic feet
Mc = Dry Gas Meter Correction Factor
ΔHa = Orifice setting that would pull .75 cfm of air at standard conditions

Pitot Calibration Form

Client National Steel
Project No. 86-177-3
Test Location KAL wind tunnel

Run By S WAGNER
Date 6-25-86
Pitot No. D3
Run 1-3

Run No.	● "A" Side Calibration: Δ P std cm H_2O (in. H_2O)	Δ P (s) cm H_2O (in. H_2O)	$C_p(s)$	Deviation $C_p(s) - \bar{C}_p(A)$
1	1.0	1.65	.77	
2	1.0	1.65	.77	
3	1.0	1.65	.77	
Average		$\bar{C}_p$ (Side A)	.77	

Run No.	●● "B" Side Calibration: Δ P std cm H_2O (in. H_2O)	Δ P (s) cm H_2O (in. H_2O)	$C_p(s)$	Deviation $C_p(s) - \bar{C}_p(B)$
1	1.0	1.6	.78	
2	1.0	1.6	.78	
3	1.0	1.6	.78	
Average		$\bar{C}_p$ (Side B)	.78	

Calculations:

$$C_p(s) = 0.99 \sqrt{\frac{\Delta P \text{ (standard)}}{\Delta P \text{ (s)}}}$$

Deviation = $C_{p(s)} - \bar{C}_p$(A or B)

$$\text{Average Deviation} = \sigma(\text{A or B}) = \frac{\sum^{3} |C_p(s) - \bar{C}_p(\text{A or B})|}{3}$$

$|\bar{C}_p(\text{Side A}) - \bar{C}_p(\text{Side B})| = .01$

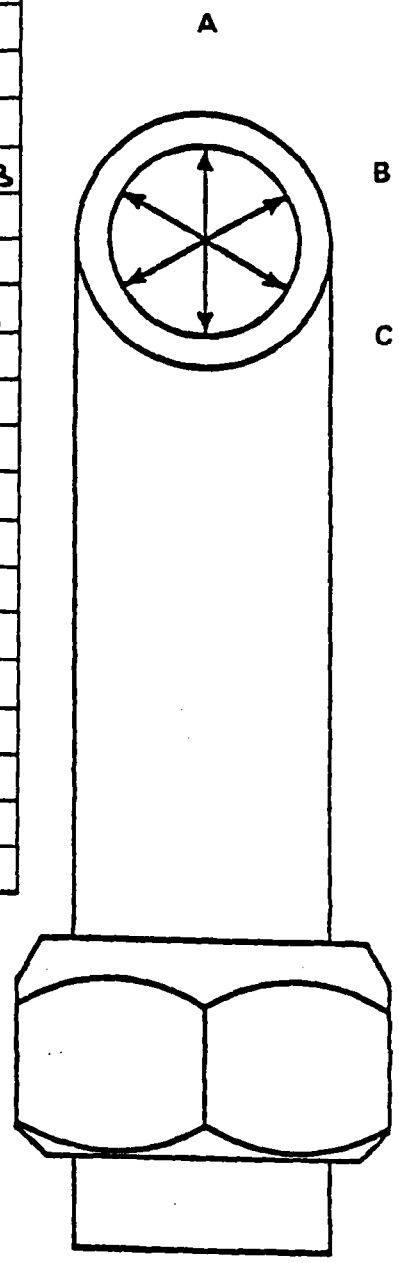
Nozzle size used for Calibrations (inches) .5"

Intercomponent Spacings During Calibrations:
Pitot - Nozzle: 1/2"
Pitot - Thermocouple: 3"
Pitot - Probe Sheath: 5 1/2"

Nozzle Calibration

Sized By R.L. Howes

Date	Nozzle	Dimension A	Dimension B	Dimension C	Difference	Avg. Diameter
4-86	A 125.					
	B 125	.127	.127	.126	.001	.127
	A 187	.184	.185	.185	.001	.185
	B 187	.185	.186	.187	.002	.186
	C 187	.188	.187	.188	.001	.188
	D 187	.185	.185	.184	.001	.185
	A 250	.249	.249	.249	.000	.249
	B	.253	.253	.253	.000	.253
	C	.250	.251	.251	.001	.251
	D	.251	.251	.251	.000	.251
	E	.254	.253	.252	.002	.253
	F	.251	.250	.249	.002	.250
	G					
	H					
	I					
	J	.248	.248	.248	.000	.248
	K	.248	.247	.246	.002	.247
	L	.248	.249	.249	.001	.249
	M	.246	.248	.247	.002	.248
* Run 2	N	.255	.253	.254	.002	.254
	O	.251	.252	.251	.001	.251
& Run 1+3	P	.251	.251	.250	.001	.251
	R	.252	.252	.253	.001	.252



All Dimensions are in Inches.

AIR QUALITY CONTROL DIVISION
TESTING FORM

Thermocouple Calibrations

Oven

Client National Steel Barometric Press 29.48

Project No. PC-1723

Thermocouple Identification	Trendicator	Thermometer	Thermometer Number	Date
			237-637	6-25-86
OVEN A	281	280		
Run 1 & 3 B	279	277		
Run 2 C	290	287		
D	282	281		
E	278	276		
F	289	290		
G	291	289		
H	295	294		
I	276	274		

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Burns & McDonnell

Form AQD-(T-S)-10

CIC

AIR QUALITY CONTROL DIVISION
TESTING FORM

Thermocouple Calibrations

Gas Meter

Client Natural Steel Barometric Press 29.48

Project No. 8477-3

Thermocouple Identification	Ice Bath		Boiling Water		Thermometer Number	Date
	Trendicator	Thermometer	Trendicator	Thermometer		
Meter ID	°F	°F	°F	°F	ASTM 1F	7-15-86
					277-637	
051 IN	32	32	209	210		
OUT	33	32	210	210		
059 IN	32	33	210	210		
OUT	33	33	210	211		
093 IN	32	34	212	211		
OUT	34	34	212	212		
094 IN	33	32	212	213		
OUT	32	33	212	213		
771 IN	32	34	212	212		
OUT	32	33	212	211		
772 IN	33	33	213	211		
OUT	33	34	211	210		
773 IN	32	33	212	211		
OUT	33	34	210	209		
774 IN	34	34	209	209		
OUT	33	34	209	208		
* 789 IN	32	33	209	209		
OUT	32	33	210	209		
790 IN	33	33	210	210		
OUT	33	34	209	210		

AIR QUALITY CONTROL DIVISION
TESTING FORM

Thermocouple Calibrations

Probe

Client National Steel

Project No. EC-137-2

Barometric Press 29.52

Thermocouple Identification	Trendicator	Thermometer	Thermometer Number	Date
PROBE A-3	258	ASTM	227-627	2-26-86
B-3	260	257		
C-3	260	259		
		259		
A-5	255			
B-5	258	256		
C-5	263	258		
D-5	255	261		
E-5	253	254		
S-5	252	252		
A-7	267	252		
B-7	270	266		
		271		
A-10	276			
B-10	252	275		
C-10	263	254		
D-10	273	267		
E-10	270	275		
F-10	273	276		
		277		
A-15	277			
B-15	272	276		
C-15	275	270		
D-15	264	276		
		266		
A-20	271			
B-20	267	270		
		267		

051579

Burns & McDonnell
Engineers-Architects-Consultants

Form AQD-(T-S)-10

LABORATORY REPORTS

Analytical Data Sheet

Client National Stack Project No. 86-177-3 Date 8-7-86

Run No. 1
Filter No. 254
Acetone No. 96
Amount liquid lost during transport —
Acetone blank volume, ml 200 ml.
Acetone wash volume, ml 276 ml.
Acetone blank concentration, mg/mg (equation 5-4)** $\frac{.5}{200}$ = .0025 mg.
Acetone wash blank, mg (equation 5-5)** .69 mg or .00069 gram

Container Number	Weight of Particulate Collected, g		
	Final Weight	Tare Weight	Weight Gain
1	129.9163	129.9153	0.0010
2	46.1603	46.0990	0.0613
Total			0.0623
		Less acetone blank	-0.0007
		Weight of particulate matter	0.0616

	Volume of Liquid Water Collected		
	Impinger Volume, ml.	Silica Gel Weight, g	
Final	590	367	
Initial	500	350	
Liquid Collected	90	17	
Total Volume Collected	107	g*	ml

Run No. 2
Filter No. 291
Acetone No. 86
Amount liquid lost during transport —
Acetone blank volume, ml 200 ml.
Acetone wash volume, ml 265 ml.
Acetone blank concentration, mg/mg (equation 5-4)** $\frac{.5}{200}$ = .0025 mg
Acetone wash blank, mg (equation 5-5)** .0025 mg x 265 ml / 1000 = .00066 gram

Container Number	Weight of Particulate Collected, g		
	Final Weight	Tare Weight	Weight Gain
1	152.2302	152.2293	0.0009
2	73.1737	73.1118	0.0619
Total			0.0628
		Less acetone blank	0.0007
		Weight of particulate matter	0.0621

	Volume of Liquid Water Collected		
	Impinger Volume, ml.	Silica Gel Weight, g	
Final	610	364.5	
Initial	500	350	
Liquid Collected	110	14.5	
Total Volume Collected	124.5	g*	ml

*Convert weight of water to volume by dividing total weight increase by density of water (1g/ml): $\frac{\text{Increase, g}}{\text{1g/ml}}$ = Volume Water, ml

**See Federal Register, Method 5, 6.6 & 6.7.

Filters

089-797 Series

Glass Fiber Filters, Type A/E, Gelman, manufactured from microfilaments of glass. The versatile filters can be used in many types of filtration applications. Widely used to determine air polluting substances in municipal and industrial atmospheres. They are pure, organic-free, binder-free and ideal for gravimetric analyses.

Designed for general use as pre-filters upstream of membrane filters. Rated at 99.9% efficiency (0.3 micron) by the Dioctyl Phthalate Penetration (DOP) test.

Type A/E Glass Fiber Filters also offer high flow rates, ultrapurity (low trace elements and no organics), and good wet strength for liquid filtration work.

	Mfr No.	Dia, mm	Pkg Lot
089-797	61628	13	500
089-805	61630	25	500
089-813	61631	47	100
089-821	61632	50	100
387-761	61669	127	100
387-779	61635	142	100

QUALITY ASSURANCE

AIR QUALITY CONTROL DIVISION
TESTING FORM

Chain of Custody

Client	Project No.	Plant Name
National Starch	86-177-3	National Starch
Laboratory	Type of Sample	Sampling Location
B & McD. Lab	Filters & Acetone Residue	Process Stack #1

Run No. 1	Run No. 2	Run No. 3
Filter No. 254	Filter No. 291	Filter No. 263
Acetone No. 96	Acetone No. 56	Acetone No. 121
Sample Recovery:	Sample Recovery:	Sample Recovery:
By R. Howes	By R. Howes	By R. Howes
Date 8-5-86	Date 8-5-86	Date 8-5-86
Samples received in laboratory:	Samples received in laboratory:	Samples received in laboratory:
By R. Howes	By R. Howes	By R. Howes
Date 8-5-86	Date 8-5-86	Date 8-5-86
Samples handled in laboratory:	Samples handled in laboratory:	Samples handled in laboratory:
By R. Howes	By R. Howes	By R. Howes
Date 8-6-86	Date 8-6-86	Date 8-6-86
Time 10:00 AM	Time 11:10 AM	Time 12:25 PM
Laboratory Report received:	Laboratory Report received:	Laboratory Report received:
By R. Howes	By R. Howes	By R. Howes
Date 8-7-86	Date 8-7-86	Date 8-7-86

Comments:

METHOD 5

TEST CONDITIONS

1. Determine testing dates and time for start and estimated completion.

2. Units to be tested will be checked thoroughly before testing commences to minimize the possibility of operational problems during the test. The test equipment, as well as other items required for testing, such as the electrical power sources will also be checked thoroughly beforehand to prevent unnecessary delays during testing.

3. Sampling port location and traverse point locations shall be determined as outlined in Method 1 of EPA. Cyclonic flow shall not occur at any of these locations. Safe sampling platform(s) and access shall be provided by the source for approval by a representative of MDNR prior to testing.

4. During testing, each unit will be baseloaded to maintain a steady-state level of operation. Each unit and its related air pollution control equipment will be operated in the same manner as for normal day-to-day operation except for those changes necessary to maintain the steady-state levels. Soot blowing or other normal operations that may effect emissions must be performed during the test to give representative results. Every effort must be made to test at the maximum operating rate. If this rate cannot be achieved due to circumstances beyond the sources' control, a deviation can be allowed, providing the deviation does not exceed 10% of the maximum operating rate. The testing personnel will record, at 15 minute intervals and in ink, the operational data necessary to define the operating conditions for testing. The operational data will be included in the source test report.

5. Fuel used, shall be of the same type and mixture normally used. A coal sample increment of approximately 2 pounds will be obtained from each of the coal feeders every 15 minutes during testing. A composite sample will be formed for each test run from the individual sample increments. Proximate and ultimate analyses will be performed on the composite samples using the appropriate ASTM methods. The test report will include descriptions of the sample preparation and analytical procedures.

6. The emission rates shall be determined by the use of F factors as described in 40 CFR 60, Subpart D. The F factors will be calculated from analytical data for the coal as outlined in 40 CFR 60.45 (f)(5). Calculation of the emission rate using F factors requires a very accurate determination of the oxygen content of the stack gas obtained in accordance with 40 CFR 60.46 (f).

7. Copies of the calibration work sheets for the dry gas meter, pitot tube assemblies, temperature gauges, probe nozzles, probe heaters, and barometer (if used) shall be presented to the MDNR observer prior to the commencement of testing. The calibration and use of the type S pitot tube assemblies continues to be of special concern. They must be calibrated and used in accordance with the requirements of Method 2. The calibration records must show the values of the intercomponent spacings (pitot-nozzle, pitot-thermocouple, pitot-probe sheath) and the sizes of temperature gauges used for determination of stack temperatures