AP-42 Section Number: 9.9.1

Reference Number: 22

Title: Particulate Emissions Evaluation And Performance Test Of The Dust Control Systems At Farmers Coop Elevator In Enderlin, N.D

Pollution Curbs, Inc.

October 1974

AP-42 Section 9.9.1
Reference 22
Report Sect.
Reference

Contract No. 408286

PCI Proposal No. 344

Purchase Order No. 2490

October 23, 1974

PARTICULATE EMISSIONS EVALUATION AND PERFORMANCE TEST OF THE DUST CONTROL SYSTEMS AT FARMERS COOP ELEVATOR IN ENDERLIN, N.D.

Prepared For:

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Environmental Engineer

Contract No. 408286

TABLE OF CONTENTS

1. INTRODUCTION

Pollution Curbs, Inc. (PCI) was retained by Hogenson Construction Company to test their recently installed dust control system at the Farmers Coop Elevator in Enderlin, North Dakota. The tests were carried out by PCI personnel on September 3 and 4, 1974. Samples were taken at the inlet and outlet of each of the three cyclones so that both emissions and performance determinations could be made. The American Society of Mechanical Engineers (ASME) Power Test Code PTC-27 method was used to obtain samples.

In addition to sampling the cyclones, airflow measurements were taken in accessible branches of the ductwork. The results of these measurements are included in Section 4 of this report and give an overall view of the system.

The three cyclones tested serve the following systems:

Designation	Description	Process Weight Rate
Cyclone #1	House Dust Control	13,000 BPH
Cyclone #2	Ideal Cleaner	400 BPH
Cyclone #3	Crippen Cleaner	150 BPH

The figure given for capacity of the house dust control system is based on the combined maximum capacity of the legs.

2. RESULTS

2.1 Cyclone 1 (House Dust Control)

	Run 1	Run 2	Average
Gas Flow Rate (scfm)	---	---	7,255
Gas Temperature (°F)	---	---	73
Inlet Dust Loading (gr/scf)	0.35	0.39	0.37
Outlet Dust Loading (gr/scf)	0.080	0.056	0.068
Efficiency (%)	77	86	82
Dust Emission Rate (lb/hr)	4.97	3.48	4.23
Process Weight Rate* (lb/hr)	---	---	7.54×10^5
Allowable Emissions (lb/hr)	---	---	59.1

Visible Emissions:

Time	Opacity (%)
3:51	15%
3:54	15%
3:57	0%
4:00	35%
4:03	30%
4:06	20%

* Process weight rate based on 13,000 bu/hr capacity of legs.

2.2 Cyclone 2 (Ideal Cleaner)

Gas Flow Rate (scfm)	---	---	2,080
Gas Temperature (°F)	---	---	64
Inlet Dust Loading (gr/scf)	0.55	0.51	0.53
Outlet Dust Loading (gr/scf)	0.32	0.33	0.33
Efficiency (%)	42	35	38
Dust Emission Rate (lb/hr)	5.89	6.08	5.99

2.2 Cyclone 2 (continued)	Run 1	Run 2	Average
Process Weight Rate* (lb/hr)	---	---	23,200
Allowable Emissions (lb/hr)	---	---	21.2

Visible Emissions:

Time	Opacity (%)
4:12	25%
4:15	5%
4:18	15%
4:21	5%
4:24	25%
4:27	20%

* 400 bu/hr x 58 lb/bu

2.3 Cyclone 3 (Crippen Cleaner)

	Run 1	Run 2	Average
Gas Flow Rate (scfm)	---	---	2,686
Gas Temperature (°F)	---	---	73
Inlet Dust Loading (gr/scf)	0.32	0.36	0.34
Outlet Dust Loading (gr/scf)	0.017	0.013	0.015
Efficiency (%)	95	96	96
Dust Emission Rate (lb/hr)	0.39	0.30	0.35
Process Weight Rate* (lb/hr)	---	---	7,800
Allowable Emissions (lb/hr)	---	---	10.2

Visible Emissions:

Time	Opacity (%)
3:30	0%
3:33	5%
3:36	0%
3:39	0%
3:42	0%
3:45	0%

* 150 bu/hr x 52 lb/bu

3. PROCEDURES

3.1 Volumetric Flow Rates

Gas velocities were determined in the inlet and outlet ducts using a multipoint pitot traverse. A standard pitot and an inclined manometer were used at the inlet while an "S" type pitot and inclined gage were used at the outlet. Corrections for density were made and the velocities were combined with respective cross sectional areas to determine volumetric flow rates.

3.2 Dust Samples

Two samples were collected from the outlet and inlet of each of the three cyclones tested. The samples were obtained isokinetically using the ASME Power Test Code method, PTC-27 dated 1957, and entitled "Determining Dust Concentration in a Gas Stream". The validity of the results is supported in all cases by the close agreements of the two sample weights.

Inlet and outlet samples from each of the cyclones were collected virtually simultaneously. These runs commenced at the same time; however, the inlet sample runs terminated earlier than the outlet runs due to the difference in dust loading. Field data sheets containing the information from which the results were calculated have been reproduced and appended.

3.3 Opacity Readings

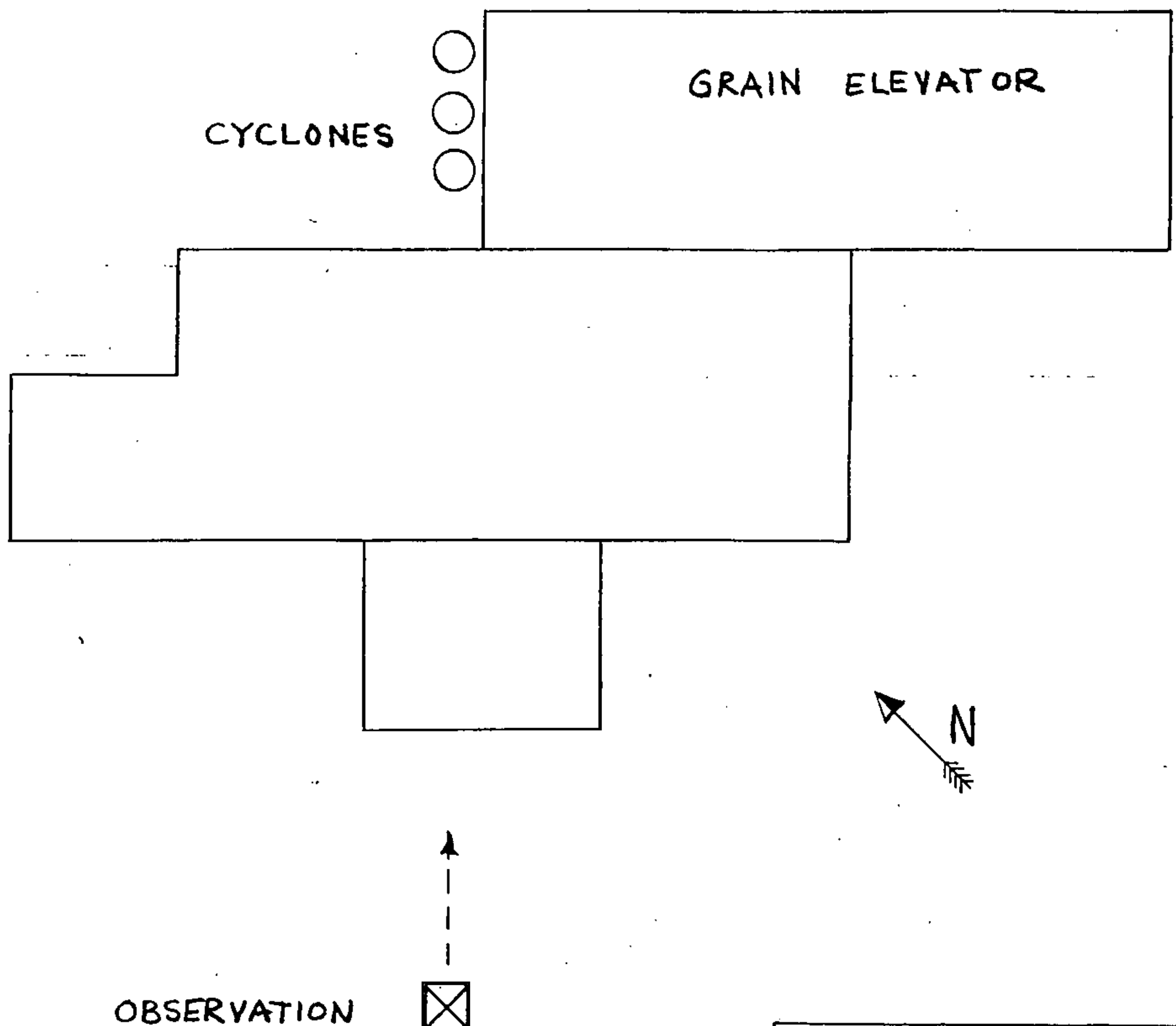
Opacity readings were taken visually by Dean F. Franke, a certified Smoke Reader. During readings, two systems were shut down so that readings could be made of the third system alone.

During the test period for visible emissions and particulate emissions, the test dust control system was operated at its design capacity. While the house dust control system was being tested, dust was generated in the pit continuously either by actual unloading operations or by supplying grain from a load out spout to the pit.

Process weight rate data were supplied by the elevator manager.

CONDITIONS:

SKY - 100% CLEAR
SUN - DIRECTLY BEHIND OBSERVOR
WIND - 13-18 MPH WEST TO EAST
TEMP - APROX 75 F
STACK HEIGHT - APROX 90' ABOVE GRADE
TIME - 3:30 - 4:30 PM 9-4-74



OBSERVOR'S POSITION DURING OPACITY READINGS

C HULBURT 9-23-74

4. HOUSE DUST CONTROL SYSTEM

Along with emission and performance evaluations of the three cyclones, airflow measurements were taken in various branches of the ventilation system. to confirm design parameters. The locations of the points where measurements were taken are indicated on the sketch of the system included in this report. Two sets of measurements were taken; one set with the blast gates in their normal position and another with them fully open. The table included in this section summarizes design and measured airflows. All measurements were taken with the blast gate on the scale vent in the closed position unless otherwise indicated. The scale vent is normally closed and the ventilation system was tested in its normal operating configuration.

A six (6) point pitot traverse was made in each of the ducts using a standard pitot tube in conjunction with an inclined manometer.

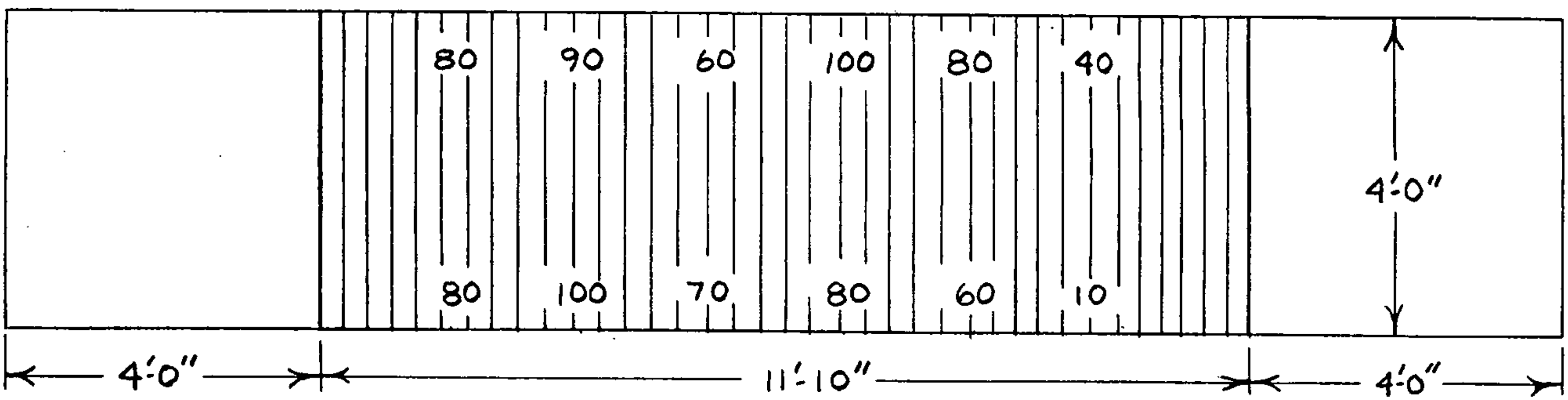
Observations of the ventilation systems indicate that, generally, the system is adequately controlling dust. Dust emissions from trucks dumping grain were minimal. The small amount of dust settled on the lower floors indicated that the ventilation there is doing a good job of controlling dust. The headhouse, however, had large amounts of dust settled on the floors and equipment. No dust could be seen coming from the legs and only slight leaks were observed from the spouts. Investigation of the distributor showed that it was under negative pressure indicating that the ventilation system was functioning properly. The air in the headhouse was clear until the automatic scale was used during the loading of rail cars. When the scale was operating, large amounts of dust escaped from openings below the scale, the scale itself, and the receiver bin above the scale. Little improvements in air quality were made with the scale vent open. The present scale ventilation does not adequately control dust from any of its three sources. A large improvement in the quality of the headhouse air and a reduction of settled dust in that area could be made by building an enclosure around the scale and drawing air directly from it. Since the scale is the only remaining large source of dust in the headhouse, this would be worth doing from the standpoint of both housekeeping and working environment. An enclosure would most effectively control the dust and would not require extensive modifications for the existing ductwork.

HOUSE DUST CONTROL VENTILATION SYSTEM

Location	Duct Dia.	Design Flow Rate (cfm)	Actual Flow Rate (cfm)	Duct Velocity (fpm)
Leg Boot Pickups (gate normally open)				
Leg #4	4"	270	91	1,070
Leg #1	4"	270	155	1,830
Leg #2	4"	270	256	3,020
Leg #3	4"	270	0	0
Back Pit Pickups (2)	4"ea.	270 ea.	---	---
Truck Dump Pit Pickups (3)	8"ea.	1,066 ea.	---	---
Lower Main Duct	17"	4,820	5,172	3,455
Boot Sweeps	7"	829	---	---
Elevator Leg Heads				
Leg #1	4"	270	235	2,830
Leg #2	4"	270	283	3,410
Leg #3	4"	270	223	2,690
Leg #4	4"	270	243	2,920
Bin Vent (Closed)	6"	---	811	4,342
Scale Vent (bin vent closed)	6"	609	561	3,003
Upper Main	10"ø			
Scale vent open, bin vent closed		1,689	1,355	2,613
Scale vent closed		1,080	1,021	1,970
Leg Boot Pickups (gate fully open)				
Leg #1	4"ø	270	137	1,615
Leg #2	4"ø	270	407	4,804
Leg #3	4"ø	270	389	4,588
Leg #4	4"ø	270	361	4,268
Main	21"ø	7,388	7,255	3,020
		7,338		

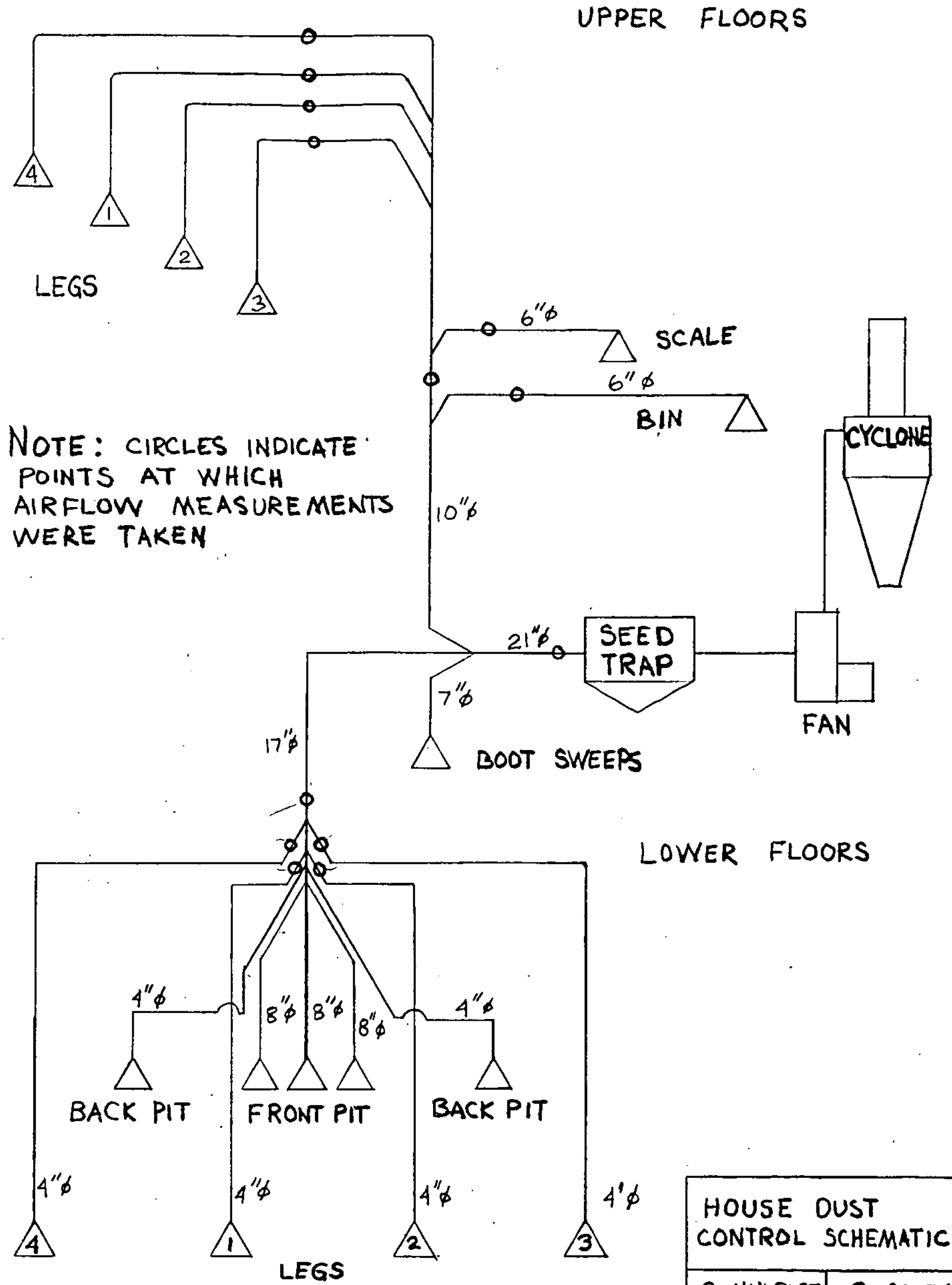
7338
7255

NOTE: INDICATED VELOCITIES ARE IN FPM



Contract No. 408286
Page 10

TRUCK DUMP PIT FACE VELOCITIES		
SCALE 1/2" = 1'-0"	C. HULBURT	9-19-74



HOUSE DUST CONTROL SCHEMATIC

C HULBURT | 9-20-74

5. CONCLUSIONS

None of the cyclones violated Part 5 of the North Dakota Regulation 23-25. All cyclones had rates of emission less than the maximum allowed for their respective process weight rate. The process weight rate for the house dust control system was chosen as the maximum leg capacity. Although this could be interpretted differently, the emissions are so far below the legal limitations that there should be no question of compliance with this section of the code.

Although cyclone #2 complies with Part 5, its low efficiency and low velocities indicate that it is oversized for the system it serves. A smaller cyclone would more effectively separate the grain hulls which the current cyclone does not.

Although complying with Part 5, cyclones #1 and #2 are in violation of Part 3 due to the opacity of their effluent, which periodically exceeds 20% for more than four minutes of a sixty minute period.

Contract No. 408286
Section 6

APPENDIX

6.1 Pitot Traverse and Field Sample Data Sheets

6.2 Explanation of Abbreviations and Symbols

6.3 Thimble Train Assembly Sketch

6.4 EPA Visible Emissions Certification

6.5 North Dakota Regulation 23-25 Parts 3 and 5

POLLUTION CURBS, INC.

PITOT TRAVERSE

CUSTOMER: Hogensen Const Co
JOB NO. ____
SYSTEM: Cyclone 1
DATE: 9-3-74
LOCATION: Inlet Duct
TYPE OF PITOT: Std

Orientation			Orientation	
Dist.	VP	Vs	VP	Vs
1	.80	READINGS	1.10	4200
2	.96	NEAR PORT	1.15	4295
3	.89	NOT	1.05	4103
4	.89	VALID	.89	3779
5	.75	SINCE PORT	.75	3468
6	.30	WAS	.40	2533
7	.29	NOT	.32	2260
8	.31	COVERED	.35	2369
9	.30		.28	2119
10	.25		.25	2003
	Total		Total	31129

Avg. Vs = 3113

V = Avg. Vs x DF = 3113 x 1.03 = 3206

Duct Diam. or Dim. 21"ø

Duct Area A = 2.405 ft²

ACFM = V x A = 7711

SCFM = ACFM x Tc x PC = 7255

SDCFM = SCFM ((100 - % H₂O) / 100) =

GAS ANALYSIS CORR: Fyrite ____ Orsat ____

	Meas	Act		
CO_2			x 44 =	
O_2			x 32 =	
CO			x 28 =	
H_2O			x 18 =	
N_2			x 28 =	
			Total =	

Composition Ratio (CR) = $\frac{\text{Total}}{28.9}$ = ____

Temp. Corr. (TC) = $\frac{520}{\text{Duct temp} + 460}$ = ____

HTC = CR x TC = ____

HUMIDITY & TEMP. CORR:

At test station:
DB 73 WB 56 H .0057 lb/lb
Duct temp 73 Hum Vol. 13.54

HTC = $\frac{1 + H}{\text{Hum Vol} \times 0.076}$

= $\frac{1 + .0057}{13.54 \times 0.076}$ = .98

PRESSURE CORR: PC

Barometric Press. ABS (BPA) ____ "Hg

BPA x 13.6 = ____

Duct SP ± -5"

Duct SP ABS ____

PC = $\frac{\text{Duct SP ABS}}{407}$ = .96

DENSITY

Density = HTC x PC x 0.076 =
.98 x .96 x 0.076 =
.072 lb/cu ft

Density Correction Factor (DF)

DF = $\sqrt{0.076/D}$
= 1.03

BY CSH

POLLUTION CURBS, INC.

FIELD SAMPLE DATA

CLIENT Hogenson Const Co JOB NO. 408286

SYSTEM HOUSE DUST CONTROL Cyclone I DATE

LOCATION INLET

SAMPLE NO. 1 SAMPLE TRAIN NO. 13

TRAVERSE POSITION 10 pts CONTAMINANT GRAIN DUST

NOZZLE SIZE 3/8 METER NO. 368

Clock

Gas meter reading end 83.5 at time 7:55 Outage Time ___ min

start 0 at time 7:25 Condensate ___ ml

RDG 83.5 at time 30 min Condenser Temp. ___ °F

Meter corr. factor (MCF) = 1.03

Actual cubic feet (ACF) = MCF x RDG = 86.0

Barometric pressure abs. = Meter pressure abs. MPABS = 29.02 in. Hg

Meter temperature Start 120 End 156 Avg 138 F

Meter temperature abs MTABS 460

+ 138 (Avg. meter temperature)

MTABS = 598 °A

Vapor pressure of water (VP)

VP at ___ °F = ___ in. Hg

Standard dry cubic feet (SDCF) = corrected meter reading

$$SCF = ACF \times \frac{MPABS - VP}{29.92} \times \frac{520}{MTABS}$$

$$= 86 \times \frac{29.02}{29.92} \times \frac{520}{598} = 72.5$$ ~~dry~~ cubic feet

Total Wt. 7.3797 grams

\- 5.7172 tare

Sample Wt. = 1.6625 net

$$\frac{\text{Sample Wt.} \times 15.43}{SCF} = \frac{1.6625 \times 15.43}{72.5} =$$

.35 Loading: grains per std. ~~dry~~ cu ft

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POLLUTION CURBS, INC.

FIELD SAMPLE DATA

CLIENT Hogenson Const Co JOB NO. 408286

SYSTEM HOUSE DUST CONTROL DATE ______

LOCATION Cyclone 1 INLET

SAMPLE NO. 2 SAMPLE TRAIN NO. 4

TRAVERSE POSITION 10 pts CONTAMINANT GRAIN DUST

NOZZLE SIZE 3/8" METER NO. 368

Clock

Gas meter reading end 80.1 at time 8:31 Outage Time ____ min

start 0 at time 8:01 Condensate ____ ml

RDG 80.1 at time 30 min Condenser Temp. ____ °F

Meter corr. factor (MCF) = 1.03

Actual cubic feet (ACF) = MCF x RDG = 82.5

Barometric pressure abs. = Meter pressure abs. MPABS = 29.02 in. Hg

Meter temperature Start 130 End 152 Avg 141 F

Meter temperature abs MTABS 460

+ 141 (Avg. meter temperature)

MTABS = 601 °A

Vapor pressure of water (VP)

VP at ___ °F = ____ in. Hg

Standard dry cubic feet (SDCF) = corrected meter reading

$$SCF = ACF \times \frac{MPABS - VP}{29.92} \times \frac{520}{MTABS}$$

$$= 82.5 \times \frac{29.02}{29.92} \times \frac{520}{601} = 69.2$$ ~~dry~~ cubic feet

Total Wt. 7.3531 grams

\- 5.6045 tare

Sample Wt. = 1.7486 net

$$\frac{\text{Sample Wt.}}{SCF} \times 15.43 = \frac{1.7486}{69.2} \times 15.43 =$$

.39 Loading: grains per std. ~~dry~~ cu ft

POLLUTION CURBS, INC.

FIELD SAMPLE DATA

CLIENT Hogenson Const Co JOB NO. 408286

SYSTEM HOUSE DUST CONTROL DATE 9-3-74

LOCATION CYCLONE #1 OUTLET

SAMPLE NO. 1 SAMPLE TRAIN NO. 6

TRAVERSE POSITION 19 PTS CONTAMINANT GRAIN DUST

NOZZLE SIZE 1/4" METER NO. 146

			Clock	
Gas meter reading end	61.4	at time	7:42	Outage Time ____ min
start	0	at time	6:45	Condensate ____ ml
RDG	61.4	at time	57 min	Condenser Temp. ____ °F

Meter corr. factor (MCF) = 1.00

Actual cubic feet (ACF) = MCF x RDG = 61.4

Barometric pressure abs. = Meter pressure abs. MPABS = 29.02 in. Hg

Meter temperature Start 76 End 104 Avg 100 F

Meter temperature abs MTABS 460

+ 100 (Avg. meter temperature)

MTABS = 560 °A

Vapor pressure of water (VP)

VP at ___ °F = ___ in. Hg

Standard dry cubic feet (SDCF) = corrected meter reading

$$SCF = ACF \times \frac{MPABS - VP}{29.92} \times \frac{520}{MTABS}$$

$$= 61.4 \times \frac{29.02}{29.92} \times \frac{520}{560} = 55.3$$ ~~dry~~ cubic feet

Total Wt. 5.7659 grams

\- 5.4776 tare

Sample Wt. = .2883 net

$$\frac{\text{Sample Wt.} \times 15.43}{SCF} = \frac{.2883 \times 15.43}{55.3} =$$

.08 Loading: grains per std. ~~dry~~ cu ft

POLLUTION CURBS, INC.

FIELD SAMPLE DATA

CLIENT Hogenson Const Co JOB NO. 408286

SYSTEM House Dust Control DATE 9-3-73

LOCATION Cyclone #1 Outlet

SAMPLE NO. 2 SAMPLE TRAIN NO. 3

TRAVERSE POSITION 19 CONTAMINANT Grain Dust

NOZZLE SIZE 1/4 METER NO. 146

Clock

Gas meter reading end 60.2 at time 8:51 Outage Time ____ min

start 0 at time 7:54 Condensate ____ ml

RDG 60.2 at time 57 Condenser Temp. ____ °F

Meter corr. factor (MCF) = 1.0

Actual cubic feet (ACF) = MCF x RDG = 60.2

Barometric pressure abs. = Meter pressure abs. MPABS = 29.02 in. Hg

Meter temperature Start 100 End 110 Avg 105 F

Meter temperature abs MTABS 460

+ 105 (Avg. meter temperature)

MTABS = 565 °A

Vapor pressure of water (VP)

VP at ___ °F = ____ in. Hg

Standard dry cubic feet (SDCF) = corrected meter reading

$$SCF = ACF \times \frac{MPABS - VP}{29.92} \times \frac{520}{MTABS}$$

$$= 60.2 \times \frac{29.02}{29.92} \times \frac{520}{565} = 53.7 \text{ dry cubic feet}$$

Total Wt. 5.4480 grams

\- 5.2546 tare

Sample Wt. = .1934 net

$$\frac{\text{Sample Wt.} \times 15.43}{SCF} = \frac{.1934 \times 15.43}{53.7} =$$

.056 Loading: grains per std. dry cu ft

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POLLUTION CURBS, INC.

PITOT TRAVERSE

CUSTOMER Hogenson Const Co JOB NO. 408286

SYSTEM Cyclone # 2 DATE 9-4-74

LOCATION INLET

TYPE OF PITOT Std

Orientation		
Dist.	VP	Vs
1	.12	1387
2	.16	1602
3	.17	1651
4	.17	1651
5	.18	1699
6	.18	1699
7	.17	1651
8	.14	1498
9	.09	1201
10	.09	1201
	Total	15240

Orientation	
VP	Vs
Total	

Avg. Vs = 1524

V = Avg. Vs x DF = 1524 x 1.01 = 1539

Duct Diam. or Dim. 16"ø

Duct Area A = 1.396

ACFM = V x A = 2148

SCFM = ACFM x Tc x PC = 2083 ✓

SDCFM = SCFM$\left(\frac{100-\%H_2O}{100}\right)$ =

GAS ANALYSIS CORR: Fyrite ______ Orsat ______

	Meas	Act			
CO_2			x 44 =		
O_2			x 32 =		
CO			x 28 =		
H_2O			x 18 =		
N_2			x 28 =		
			Total =		

Composition Ratio (CR) = $\frac{\text{Total}}{28.9}$ = ______

Temp. Corr. (TC) = $\frac{520}{\text{Duct temp} + 460}$ = ______

HTC = CR x TC = ______

HUMIDITY & TEMP. CORR:

At test station:

DB 64 WB 54 H .0066 lb/lb

Duct temp 64 Hum Vol. 13.3

$$HTC = \frac{1 + H}{\text{Hum Vol} \times 0.076}$$

$$= \frac{1 + .0066}{13.3 \times 0.076} = .996$$

PRESSURE CORR: PC

Barometric Press. ABS (BPA) ______ "Hg

BPA x 13.6 = ______

Duct SP ± +.48"

Duct SP ABS ______

PC = $\frac{\text{Duct SP ABS}}{407}$ = .97

DENSITY

Density = HTC x PC x 0.076 =

1.0 x .97 x 0.076 =

.074 lb/cu ft

Density Correction Factor (DF)

DF = $\sqrt{0.076/D}$

= 1.01

BY DEF

POLLUTION CURBS, INC.

FIELD SAMPLE DATA

CLIENT Hogenson Const Co JOB NO. 408268

SYSTEM IDEAL CLEANER Cyclone 2 DATE 9-4-74

LOCATION OUTLET

SAMPLE NO. 1 SAMPLE TRAIN NO. 5

TRAVERSE POSITION 20 pt CONTAMINANT GRAIN DUST

NOZZLE SIZE 3/8 METER NO. 146

Clock

Gas meter reading end 38.6 at time 10:33 Outage Time ____ min

start 0 at time 9:36 Condensate ____ ml

RDG 38.6 at time 57 min Condenser Temp. ____ °F

Meter corr. factor (MCF) = 1.0

Actual cubic feet (ACF) = MCF x RDG = 38.6

Barometric pressure abs. = Meter pressure abs. MPABS = 29.02 in. Hg

Meter temperature Start 66 End 96 Avg 81 F

Meter temperature abs MTABS 460

+ 81 (Avg. meter temperature)

MTABS = 541 °A

Vapor pressure of water (VP)

VP at ___ °F = ____ in. Hg

Standard dry cubic feet (SDCF) = corrected meter reading

$$SCF = ACF \times \frac{MPABS - VP}{29.92} \times \frac{520}{MTABS}$$

$$= 38.6 \times \frac{29.02}{29.92} \times \frac{520}{541} = 36.0$$ ~~dry~~ cubic feet

Total Wt. 6.7801 grams

\- 6.0327 tare

Sample Wt. = .7474 net

$$\frac{\text{Sample Wt.} \times 15.43}{\text{SCF}} = \frac{.7474 \times 15.43}{36.0} =$$

.32 Loading: grains per std. ~~dry~~ cu ft

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POLLUTION CURBS, INC.

FIELD SAMPLE DATA

CLIENT Hogenson Const Co JOB NO. 408286

SYSTEM IDEAL CLEANER CYCLONE 2 DATE 9-4-74

LOCATION OUTLET

SAMPLE NO. 2 SAMPLE TRAIN NO. 10

TRAVERSE POSITION 19 PT CONTAMINANT GRAIN DUST

NOZZLE SIZE 3/8" METER NO. 146

Clock

Gas meter reading end 38.30 at time 11:36 Outage Time ____ min

start 0 at time 10:39 Condensate ____ ml.

RDG 38.3 at time 57 Condenser Temp. ____ °F

Meter corr. factor (MCF) = 1.0

Actual cubic feet (ACF) = MCF x RDG = 38.3

Barometric pressure abs. = Meter pressure abs. MPABS = 29.02 in. Hg

Meter temperature Start 84 End 104 Avg 90 F

Meter temperature abs MTABS 460

+ 90 (Avg. meter temperature)

MTABS = 550 °A

Vapor pressure of water (VP)

VP at ___ °F = ____ in. Hg

Standard dry cubic feet (SDCF) = corrected meter reading

$$SCF = ACF \times \frac{MPABS - VP}{29.92} \times \frac{520}{MTABS}$$

$$= 38.3 \times \frac{29.02}{29.92} \times \frac{520}{550} = 35.1$$ dry cubic feet

Total Wt. 6.5705 grams

\- 5.8209 tare

Sample Wt. = .7496 net

$$\frac{\text{Sample Wt.} \times 15.43}{\text{SCF}} = \frac{.7496 \times 15.43}{35.1} =$$

.33 Loading: grains per std. dry cu ft

Form #3702 Rev. 1-74

POLLUTION CURBS, INC.

FIELD SAMPLE DATA

CLIENT Hogenson Const Co JOB NO. 408286

SYSTEM IDEAL CLEANER CYCLONE .2 DATE 9-4-74

LOCATION INLET

SAMPLE NO. 2 SAMPLE TRAIN NO. 14

TRAVERSE POSITION 10 pts CONTAMINANT GRAIN DUST

NOZZLE SIZE 3/8 METER NO. 368

			Clock	
Gas meter reading end	41.24	at time	11:21	Outage Time ____ min
start	0	at time	10:51	Conoensate ____ ml
RDG	41.24	at time	30 min	Condenser Temp. ____ °F

Meter corr. factor (MCF) = 1.03

Actual cubic feet (ACF) = MCF x RDG = 42.48

Barometric pressure abs. = Meter pressure abs. MPABS = 29.02 in. Hg

Meter temperature Start 100 End 140 Avg 120 F

Meter temperature abs MTABS 460

\+ 120 (Avg. meter temperature)

MTABS = 580 °A

Vapor pressure of water (VP)

VP at ___ °F = ____ in. Hg

Standard dry cubic feet (SDCF) = corrected meter reading

$$SCF = ACF \times \frac{MPABS - VP}{29.92} \times \frac{520}{MTABS}$$

$$= 42.48 \times \frac{29.02}{29.92} \times \frac{520}{580} = 36.94$$ ~~dry~~ cubic feet

Total Wt. 6.3447 grams

\- 5.1239 tare

Sample Wt. = 1.2208 net

$$\frac{\text{Sample Wt.} \times 15.43}{\text{SCF}} = \frac{1.2208 \times 15.43}{36.94} =$$

.51 Loading: grains per std. ~~dry~~ cu ft

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POLLUTION CURBS, INC.

FIELD SAMPLE DATA

CLIENT Hogenson Const Co JOB NO. 408286

SYSTEM IDEAL CLEANER CYCLONE 2 DATE 9-4-74

LOCATION INLET

SAMPLE NO. 1 SAMPLE TRAIN NO. 18

TRAVERSE POSITION 10 pts CONTAMINANT GRAIN DUST

NOZZLE SIZE 3/8 METER NO. 368

Clock

Gas meter reading end 42.12 at time 10:24 Outage Time ____ min

start 0 at time 9:54 Condensate ____ ml

RDG 42.12 at time 30 min Condenser Temp. ____ °F

Meter corr. factor (MCF) = 1.03

Actual cubic feet (ACF) = MCF x RDG = 43.38

Barometric pressure abs. = Meter pressure abs. MPABS = 29.02 in. Hg

Meter temperature Start 80 End 130 Avg 105 F

Meter temperature abs MTABS 460

+ 105 (Avg. meter temperature)

MTABS = 565 °A

Vapor pressure of water (VP)

VP at ___ °F = ____ in. Hg

Standard dry cubic feet (SDCF) = corrected meter reading

$$SCF = ACF \times \frac{MPABS - VP}{29.92} \times \frac{520}{MTABS}$$

$$= 43.38 \times \frac{29.02}{29.92} \times \frac{520}{565} = 37.93$$ dry cubic feet

Total Wt. 6.7108 grams

- 5.3600 tare

Sample Wt. = 1.3508 net

$$\frac{\text{Sample Wt.} \times 15.43}{SCF} = \frac{1.3508 \times 15.43}{37.93} =$$

.55 Loading: grains per std. dry cu ft

Form #3702 Rev. 1-74

POLLUTION CURBS, INC.

PITOT TRAVERSE

CUSTOMER Hogenson Const Co. JOB NO. 408286

SYSTEM Cyclone # 3 DATE 9-4-74

LOCATION Inlet

TYPE OF PITOT Std

Orientation		
Dist.	VP	Vs
1	.14	1498
2	.16	1602
3	.17	1651
4	.17	1651
5	.17	1651
6	.17	1651
7	.16	1602
8	.16	1602
9	.16	1602
10	.07	1060
	Total	15570

Orientation	
VP	Vs
Total	

Avg. Vs = 1557

V = Avg. Vs x DF = 1557 x 1.03 = 1600

Duct Diam. or Dim. 18"ϕ

Duct Area A = 1.767

ACFM = V x A = 2827

SCFM = 2686

SDCFM = SCFM $\left(\frac{100-\%H_2O}{100}\right)$ =

GAS ANALYSIS CORR: Fyrite ____ Orsat ____

	Meas	Act		
CO_2			x 44 =	
O_2			x 32 =	
CO			x 28 =	
H_2O			x 18 =	
N_2			x 28 =	
			Total =	

Composition Ratio (CR) = $\frac{\text{Total}}{28.9}$ = ____

Temp. Corr. (TC) = $\frac{520}{\text{Duct temp} + 460}$ = ____

HTC = CR x TC = ____

HUMIDITY & TEMP. CORR:

At test station:

DB 73 WB 60 H .0082 lb/lb

Duct temp 73 Hum Vol. 13.6

$$HTC = \frac{1 + H}{\text{Hum Vol} \times 0.076}$$

$$= \frac{1 + .0082}{13.6 \times 0.076} = .98$$

PRESSURE CORR: PC

Barometric Press. ABS (BPA) ____ "Hg

BPA x 13.6 = ____

Duct SP ± +1"

Duct SP ABS ____

PC = $\frac{\text{Duct SP ABS}}{407}$ = .97

DENSITY

Density = HTC x PC x 0.076 = .98 x .97 x 0.076 = .072 lb/cu ft

Density Correction Factor (DF)

DF = $\sqrt{0.076/D}$ = 1.03

BY DFE

Form 3701-9/73 (A)

POLLUTION CURBS, INC.

FIELD SAMPLE DATA

CLIENT Hogenson Const. Co JOB NO. 408286

SYSTEM CRIPPEN CLEANER CYCLONE 3 DATE 9-4-74

LOCATION OUTLET

SAMPLE NO. 1 SAMPLE TRAIN NO. 16

TRAVERSE POSITION 19 pts CONTAMINANT GRAIN DUST

NOZZLE SIZE 3/8 METER NO. 146

Clock

Gas meter reading end 55.43 at time 2:25 Outage Time ____ min

start 0 at time 1:28 Condensate ____ ml

RDG 55.43 at time 57 min Condenser Temp. ____ °F

Meter corr. factor (MCF) = 1.0

Actual cubic feet (ACF) = MCF x RDG = 55.43

Barometric pressure abs. = Meter pressure abs. MPABS = 29.02 in. Hg

Meter temperature Start 75 End 127 Avg 101 F

Meter temperature abs MTABS 460

+ 101 (Avg. meter temperature)

MTABS = 561 °A

Vapor pressure of water (VP)

VP at ___ °F = ____ in. Hg

Standard dry cubic feet (SDCF) = corrected meter reading

$$SCF = ACF \times \frac{MPABS - VP}{29.92} \times \frac{520}{MTABS}$$

$$= 55.43 \times \frac{29.02}{29.92} \times \frac{520}{561} = 49.83$$ ~~dry~~ cubic feet

Total Wt. 5.5300 grams

\- 5.4735 tare

Sample Wt. = .0565 net

$$\frac{\text{Sample Wt.} \times 15.43}{SCF} = \frac{.0565 \times 15.43}{49.83} =$$

.017 Loading: grains per std. dry cu ft

Form #3702 Rev. 1-74

POLLUTION CURBS, INC.

FIELD SAMPLE DATA

CLIENT: Hogenson Const Co JOB NO. 408286

SYSTEM: Crippen Cleaner - Cyclone 3 DATE 9-4-74

LOCATION: Outlet

SAMPLE NO. 2 SAMPLE TRAIN NO. 19

TRAVERSE POSITION 19 pts CONTAMINANT Grain Dust (Flax)

NOZZLE SIZE 3/8" METER NO. 146

Clock

Gas meter reading end 55.12 at time 3:25 Outage Time ____ min

start 0 at time 2:28 Condensate ____ ml

RDG 55.12 at time 57 min Condenser Temp. ____ °F

Meter corr. factor (MCF) = 1.00

Actual cubic feet (ACF) = MCF x RDG = 55.12

Barometric pressure abs. = Meter pressure abs. MPABS = 29.02 in. Hg

Meter temperature Start 104 End 118 Avg 111 F

Meter temperature abs MTABS 460

+ 111 (Avg. meter temperature)

MTABS = 571 °A

Vapor pressure of water (VP)

VP at ___ °F = ____ in. Hg

Standard dry cubic feet (SDCF) = corrected meter reading

$$SCF = ACF \times \frac{MPABS - VP}{29.92} \times \frac{520}{MTABS}$$

$$= 55.12 \times \frac{29.02}{29.92} \times \frac{520}{571} = 48.69 \text{ dry cubic feet}$$

Total Wt. 5.9187 grams

\- 5.8767 tare

Sample Wt. = .0420 net

$$\frac{\text{Sample Wt.} \times 15.43}{SCF} = \frac{.0420 \times 15.43}{48.69} =$$

.013 Loading: grains per std. dry cu ft

Form #3702 Rev. 1-74

POLLUTION CURBS, INC.

FIELD SAMPLE DATA

CLIENT HOGENSON CONST. CO JOB NO. 408286

SYSTEM CRIPPEN CLEANER - CYCLONE 3 DATE 9-4-74

LOCATION INLET

SAMPLE NO. 1 SAMPLE TRAIN NO. 2

TRAVERSE POSITION 10 pts CONTAMINANT FLAX DUST

NOZZLE SIZE 3/8 METER NO. 68

Clock

Gas meter reading end 34.38 at time 2:10 Outage Time - min

start 0 at time 1:40 Condensate ___ ml

RDG 34.38 at time 30 min Condenser Temp. ___ °F

Meter corr. factor (MCF) = 1.03

Actual cubic feet (ACF) = MCF x RDG = 35.41

Barometric pressure abs. = Meter pressure abs. MPABS = 29.02 in. Hg

Meter temperature Start 80 End 139 Avg 110 F

Meter temperature abs MTABS 460

+ 110 (Avg. meter temperature)

MTABS = 570 °A

Vapor pressure of water (VP)

VP at ___ °F = ___ in. Hg

Standard dry cubic feet (SDCF) = corrected meter reading

$$SCF = ACF \times \frac{MPABS - VP}{29.92} \times \frac{520}{MTABS}$$

$$= 35.41 \times \frac{29.02}{29.92} \times \frac{520}{570} = 31.33$$ dry cubic feet

Total Wt. 6.0148 grams

\- 5.3627 tare

Sample Wt. = .6521 net

$$\frac{\text{Sample Wt.} \times 15.43}{SCF} = \frac{.6521 \times 15.43}{31.33} =$$

.32 Loading: grains per std. dry cu ft

Form #3702 Rev. 1-74

POLLUTION CURBS, INC.

FIELD SAMPLE DATA

CLIENT HOGENSON CONST. CO JOB NO. 408286

SYSTEM CRIPPEN CLEANER - CYCLONE 3 DATE 9-4-74

LOCATION INLET

SAMPLE NO. 2 SAMPLE TRAIN NO. 17

TRAVERSE POSITION 10 PTS CONTAMINANT FLAX DUST

NOZZLE SIZE 3/8 METER NO. 68

Clock

Gas meter reading end 42.80 at time 3:18 Outage Time ____ min

start 0 at time 2:48 Condensate ____ ml

RDG 42.80 at time 30min Condenser Temp. ____ °F

Meter corr. factor (MCF) = 1.03

Actual cubic feet (ACF) = MCF x RDG = 44.08

Barometric pressure abs. = Meter pressure abs. MPABS = 29.02 in. Hg

Meter temperature Start 95 End 135 Avg 110 F

Meter temperature abs MTABS 460

+ 110 (Avg. meter temperature)

MTABS = 570 °A

Vapor pressure of water (VP)

VP at ___ °F = ____ in. Hg

Standard dry cubic feet (SDCF) = corrected meter reading

$$SCF = ACF \times \frac{MPABS - VP}{29.92} \times \frac{520}{MTABS}$$

$$= 44.08 \times \frac{29.02}{29.92} \times \frac{520}{570} = 39.01$$ ~~dry~~ cubic feet

Total Wt. 7.3898 grams

- 6.4798 tare

Sample Wt. = .9100 net

$$\frac{\text{Sample Wt.} \times 15.43}{\text{SCF}} = \frac{.91 \times 15.43}{39.01} =$$

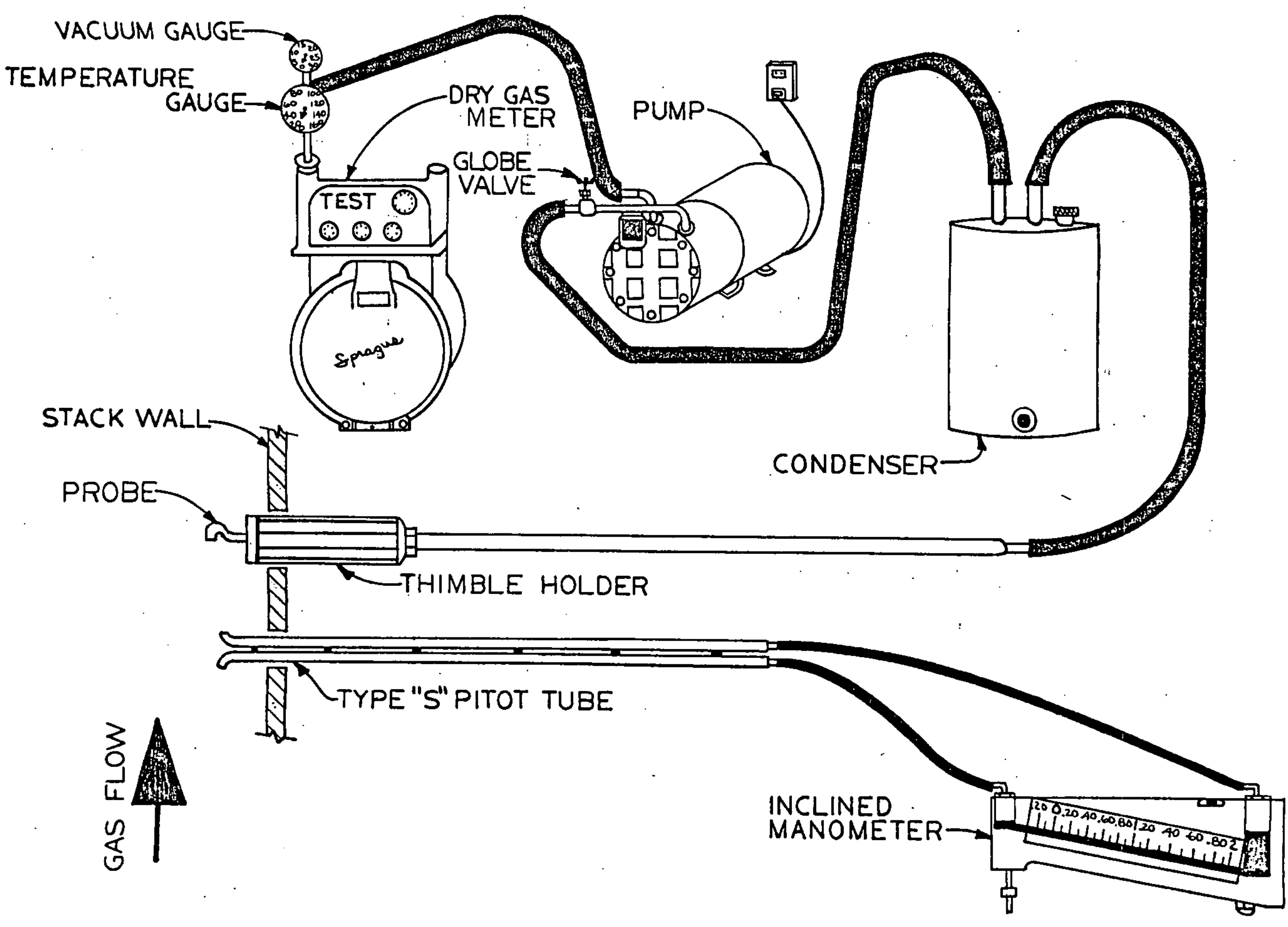
.36 Loading: grains per std. ~~dry~~ cu ft

Form #3702 Rev. 1-74

STANDARD ABBREVIATIONS AND SYMOBLS USED IN REPORTS

°A	Degrees absolute
ABS	Absolute
Avg.	Average
acf,	Actual cubic feet per minute
BPA	Barometric pressure, absolute, inches of mercury
cfh	Cubic feet per hour
cfm	Cubic feet per minute
CO	Carbon monoxide
CO_2	Carbon dioxide
CPS	Cycles per second
DB	Dry bulb temperature
dB	Decibel
dBA	Decibel as measured on the "A" scale of a sound level meter
DF	Density factor
ft	Feet
gpd	Gallons per day
gpm	Gallons per minute
g	Grams
gr	Grains
h.p.	Horse power
H	Pounds of water per pound of dry air
h	Head, inches of water
H_2O	Water or moisture
HTC	Humidity temperature correction
"Hg	Inches of mercury
Hz	Hertz
KHz	Kilo Hertz
l	Liter
lb	Pound
lpm	Liters per minute
mg	Milligram
mg/l	Milligrams per liter
mg/m^3	Milligrams per cubic meter
ml	Milliliter
M^2	Square meter
M^3	Cubic meter
μ	Micron - Micro
μg	Micro gram
o.u.	Odor unit
o.u./min.	Odor unit per minute
N	Nitrogen
O_2	Oxygen
PC	Pressure correction
scf	Standard cubic feet; a cubic foot of air or gas having a weight of 0.075 lb
scfh	Standard cubic feet per hour
scfm	Standard cubic feet per minute
sdcfm	Standard dry cubic feet per minute
SP	Static pressure, inches of water
TWA	Time weighted average

MCF	Meter correction factor
MPABS	Meter pressure absolute
MTABS	Meter temperature absolute
MBtu	Million British thermal units
min	Minute
rpm	Revolutions per minute
VP	Vapor pressure, inches of mercury
Vol.%	Volume percent
WB	Wet bulb temperature
WBGT	Wet bulb globe temperature
Wt.%	Weight percent



THIMBLE TRAIN ASSEMBLY

ENVIRONMENTAL PROTECTION AGENCY
RESEARCH TRIANGLE PARK, NORTH CAROLINA 27711

September 24, 1974

Mr. Dean F. Franke
Pollution Curbs Inc.
502 North Prior Avenue
St. Paul, Minnesota 55104

DEAR Mr. Franke:

PLEASE BE ADVISED THAT YOU SUCCESSFULLY COMPLETED OUR RECENT "VISIBLE EMISSIONS EVALUATION" COURSE. HAVING ATTENDED THE LECTURES (SEPT.11) AND PARTICIPATED IN THE SMOKE EVALUATION SESSIONS, YOU MET THE FOLLOWING STANDARDS:

1) MAINTAIN AN AVERAGE DEVIATION OF LESS THAN 7.5% DEVIATION FOR A SET OF 25 WHITE SMOKE AND 25 BLACK SMOKE

2) DO NOT HAVE ONE READING OFF BY 20% DEVIATION OR ONE WHOLE RINGELMANN NUMBER

SINCERELY YOURS,

Dennis P Holzschuh

DENNIS P. HOLZSCHUH
PHYSICAL SCIENCE TECHNICIAN
ENGINEERING AND ENFORCEMENT SECTION
AIR POLLUTION TRAINING INSTITUTE

R23-25-03 RESTRICTION OF EMISSION OF VISIBLE AIR CONTAMINANTS

3.100 RESTRICTIONS APPLICABLE TO EXISTING INSTALLATIONS

No person shall discharge into the ambient air from any single source of emission whatsoever, with the exception of existing incinerators, any air contaminant

3.110 of a shade or density equal to or darker than that designated as No. 2 on the Ringelmann Chart, or equivalent standard approved by the Department; or

3.120 of such opacity as to obscure an observer's view to a degree equal to or greater than that described in 3.110.

3.200 RESTRICTIONS APPLICABLE TO NEW INSTALLATIONS AND ALL INCINERATORS

No person shall discharge into the ambient air from any single source of emission whatsoever any air contaminant

3.210 of a shade or density equal to or darker than that designated as No. 1 on the Ringelmann Chart, or equivalent standard approved by the Department; or

3.220 of such opacity as to obscure an observer's view to a degree equal to or greater than that described in 3.210.

3.300 EXCEPTIONS

3.310 A person may discharge into the ambient air from any single source of emission for a period or periods aggregating not more than four minutes in any 60 minutes air contaminants

3.311 of a shade or density not darker than No. 3 on the Ringelmann Chart, or equivalent standard approved by the Department; or

3.312 of such opacity as to obscure an observer's view to a degree not greater than that described in 3.311.

3.320 The provisions of 3.100 and 3.200 shall not apply in the following circumstances:

3.321 Where the presence of uncombined water is the only reason for failure of an emission to meet the requirements of 3.100 and 3.200.

3.322 When smoke is emitted for the purpose of training or research when approved by the Department, including training schools for fire fighting personnel.

3.323 Where the limits specified in these regulations cannot be met because of operations or processes such as, but not limited to, oil field service and drilling operations, but only so long as it is not technically feasible to meet said specifications.

3.400 METHOD OF MEASUREMENT

The Ringelmann Chart published and described in the U.S. Bureau of Mines Information Circular 8333 or the U.S. Public Health Service Smoke Inspection Guide as described in the Federal Register, Title 42, Chapter 1, Subchapter F, Part 75, shall be used in grading the shade or opacity of visible air contaminant emissions. The Department may specify other means of measurement which give comparable results or results of greater accuracy. The two publications, or replacements, described in this subsection are hereby made a part of these regulations by reference.

R23-25-05 EMISSIONS OF PARTICULATE MATTER RESTRICTED

5.100 RESTRICTION OF EMISSION OF PARTICULATE MATTER FROM INDUSTRIAL PROCESSES

5.110 GENERAL PROVISIONS

5.111 Section 5.100 applies to any operation, process, or activity from which particulate matter is emitted except the burning of fuel for indirect heating in which the products of combustion do not come into direct contact with process materials, the burning of refuse, and the processing of salvable material by burning.

5.112 The process weight rate per hour referred to in this section shall be based upon the normal operation maximum capacity of the equipment and if such normal maximum capacity should be increased by process or equipment changes, the new normal maximum capacity shall be used as the process weight in determining the allowable emissions.

5.113 Emission tests relating to 5.100 shall be made following the standards in ASME "Power Test Code PTC-27" dated 1957 and entitled "Determining Dust Concentration in a Gas Stream" or its replacement or other method as approved by the Department.

5.120 EMISSION LIMITATIONS

No person shall cause, suffer, allow, or permit the emission of particulate matter in any one hour from any source in excess of the amount shown in Table 3 for the process weight allocated to such source.

5.130 EXCEPTIONS

5.131 Temporary operational breakdowns or cleaning of air pollution equipment for any process are permitted provided the owner or operator immediately advises the Department of the circumstances and outlines an acceptable corrective program and provided such operations do not cause an immediate public health hazard.

5.132 The Department may prescribe air quality control requirements that are more restrictive and more extensive than provided in 5.120 if the particulate matter emitted is a radioactive, toxic, or deleterious substance which may affect human health or well-being or that would cause significant damage to animal or plant life.

5.133 Any existing emission source which has particulate collection equipment with a collection efficiency of 99.7 percent or more by weight shall be considered as meeting the provisions of 5.120. The efficiency of the particulate collection equipment shall be determined as outlined in 5.113 with the process being served by the particulate collection equipment being run at normal operation maximum capacity.

5.134 Any portable emission source, not operated at the same premise for more than six months, shall be considered as meeting the provisions of 5.120 if the following conditions are met:

a. The source must not be located within a city;

b. The source must not be located within one-half mile of any occupied residence, and within one mile of the source there shall be no more than two occupied residences;

c. The source must not be located within one-quarter mile of any highway or public road;.

d. The source stack or stacks must be equipped with particulate collection equipment with a collection efficiency of 85 percent or more by weight. The efficiency of the particulate collection equipment shall be determined as in 5.133; and

e. The source must be equipped with a fugitive dust control system that prevents the emission of particulate matter from any point other than through a stack.

Table 3. Maximum Allowable Rates of Emission of Particulate Matter from Industrial Processes

Process Weight Rate		Rate of Emission	Process Weight Rate		Rate of Emission
Lb/hr	Tons/hr	Lb/hr	Lb/hr	Tons/hr	Lb/hr
100	0.05	0.551	16,000	8.00	16.5
200	0.10	0.877	18,000	9.00	17.9
400	0.20	1.40	20,000	10.00	19.2
600	0.30	1.83	30,000	15.00	25.2
800	0.40	2.22	40,000	20.00	30.5
1,000	0.50	2.58	50,000	25.00	35.4
1,500	0.75	3.38	60,000	30.00	40.0
2,000	1.00	4.10	70,000	35.00	41.3
2,500	1.25	4.76	80,000	40.00	42.5
3,000	1.50	5.38	90,000	45.00	43.6
3,500	1.75	5.96	100,000	50.00	44.6
4,000	2.00	6.52	120,000	60.00	46.3
5,000	2.50	7.58	140,000	70.00	47.8
6,000	3.00	8.56	160,000	80.00	49.0
7,000	3.50	9.49	200,000	100.00	51.2
8,000	4.00	10.4	1,000,000	500.00	69.0
9,000	4.50	11.2	2,000,000	1,000.00	77.6
10,000	5.00	12.0	5,000,000	3,000.00	92.7
12,000	6.00	13.6			

Interpolation of the data in this table for process weight rates up to 60,000 lb/hr shall be accomplished by use of the equation

$$E = 4.10\, p^{0.67}$$

and interpolation and extrapolation of the data for process weight rates in excess of 60,000 lb/hr shall be accomplished by use of the equation:

$E = 55.0\, p^{0.11} - 40$, where E = rate of emission in lb/hr and

p = process weight rate in tons/hr.