AP-42 Section Number: 9.9.1

Reference Number: 23

Title: Grain Handling Dust Collection Systems Evaluation For Farmer's Elevator Company

Pollution Curbs, Inc.

August 1972

Contract #208127

Purchase Order #M88835

August 28, 1972

GRAIN HANDLING DUST COLLECTION SYSTEMS EVALUATION FOR FARMER'S ELEVATOR COMPANY MINOT, NORTH DAKOTA

Prepared For:

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CONTENTS

1. SUMMARY

The particulate emission rate from the cleaners system was found to be within the limitations of North Dakota Air Pollution Control Regulation R23-25-05.

The particulate emission rate from the house dust control system was found to be within the limitations of North Dakota Air Pollution Control Regulation R23-25-05.

2. INTRODUCTION

2.1 Purpose

Gerber Industries, Inc. had designated and installed two air pollution abatement systems, employing cyclone separators, at the Minot Farmers Elevator Company, Minot, North Dakota. Pollution Curbs, Inc. (PCI) was subsequently retained by Gerber Industries, Inc. to measure the particulate emission rates from, and to determine the collection efficiencies, of these systems.

2.2 Background

PCI engineers, together with Mr. Charles Ramberg of Gerber Industries, made measurements and collected samples and other pertinent data at the two Minot installations on August 22, 1972.

System Number 1 controlled dust generated from the operation of one Carter Model 2564 cleaner and one Crippen Model M5472 cleaner. Both cleaners were handling grain during the period in which that system was being evaluated.

System Number 2, the house dust control system, consisted of dust pick-ups located in the following areas:

1.	Distributor heads	2 hoods
2.	Scale hopper	1 hood
3.	Screw conveyors (2)	2 hoods
4.	Front pit	2 hoods
5.	Back pits (2)	2 hoods
6.	Annex pit	1 hood
7.	Legs (3)	3 hoods
8.	Floor sweeps	3 installed

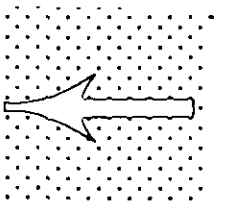
All of the above listed equipment, except the floor sweeps, was handling grain during the period in which the house dust control system was being evaluated.

Mr. Dana Mount of the North Dakota State Department of Health witnessed the test procedures and participated in the collection of dust samples.

3. RESULTS

3.1 Grain Cleaners System

Item	Cyclone[1] Inlet	Cyclone[1] Exhaust
Grain cleaning rate (bu/hr)[2]		
Process weight rate (ton/hr)[3]	36.87	36.87
Source gas volume (scfm)	4920	4920
Duct static pressure ("WC)		
At Cyclone	-7.0	-9.9
At Fan	-11.0	0.6
Fan speed (rpm)	1200	1200
Dust concentration (gr/scf)	0.372	0.061
Dust emission rate (lb/hr)	15.68	2.56
Allowable dust emission rate (lb/hr)[4]		41.79
Collector efficiency (%)		82.92
Opacity (%)		<15



NOTES:

[1]Average of two determinations

[2]Supplied by Minot Farmers Elevator Company personnel.

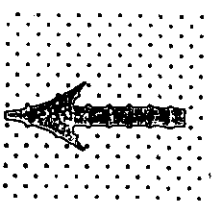
[3]Calculation shown in Appendix.

[4]Interpolated from Table 3 of North Dakota Air Pollution Control Regulation R23-25-05.

lb/hr .425

3.2 House Dust Control System

Item	Cyclone[1] Inlet	Cyclone[1] Exhaust
Grain handling rate (bu/hr)[2]	7516	7516
Process weight rate (ton/hr)[3]	167.50	167.50
Source gas volume (scfm)	11,190	11,190
Duct static pressure ("WC)		
At Cyclone	-5.3	-11.0
At Fan	-11.8	0.2
Dust concentration (gr/scf)	0.847	0.142
Dust emission rate (lb/hr)	81.21	13.65
Allowable dust emission rate (lb/hr)[4]		51.61
Collector efficiency (%)		83.19
Opacity (%)		< 20



NOTES:

[1]Average of two determinations

[2]Supplied by Minot Farmers Elevator Company personnel.

[3]Calculation shown in Appendix.

[4]Interpolated from Table 3 of North Dakota Air Pollution Control Regulation R23-25-05.

lb/ton .485

4. PROCEDURES

4.1 Particulate Emissions

Samples were obtained from the inlet and exhaust ducts serving the cyclone separators of each system according to the standards of the American Society of Mechanical Engineers Power Test Code PTC-27, dated 1957 and entitled "Determining Dust Concentration in a Gas Stream".

Isokinetic conditions were maintained during each test run. A null balance probe was employed for this purpose at the cyclone exhausts. Standard probe nozzles were employed at the cyclone inlets. Samples were collected in Whatman paper thimbles which had been pre-weighed. The probe was carefully burhsed out at the end of each sample run and the brushings were added to the thimble catch.

Two sample runs were made at each test site and the results reported as the average values. Individual field data sheets were reproduced for presentation in the Appendix of this report.

4.2 Source Gas Volumes

Gas velocities were determined by multipoint pitot tube traverse. For this purpose, a standard pitot tube in conjunction with an inclined manometer was employed. Two traverses were made at each sampling site through ports located 90° apart circumferentially. The results were averaged, corrected for density and moisture and combined with respective duct cross-sectional areas to yield standard volumetric

gas flow rates. Moisture contents were determined psychrometrically.

Field data sheets showing calculations were reproduced for presentation in the Appendix.

4.3 Process Weight Rate Determination

Process weight rates were determined by measuring grain bin levels before and after processing on a time rate basis. This volumetric data was combined with appropriate grain bulk densities to yield process weight rates. The measurements were made by Minot Farmers Elevator Company personnel and supplied to PCI by the elevator manager, Mr. Lyle Fossen.

Mr. Dana Mount indicated that the process weight rate for the house dust control system should be computed as the sum of weight of grain handled by the three legs only. This method was followed and the calculations were prepared for inclusion in the Appendix.

5. CONCLUSIONS

5.1 Cleaners System

The results reported herein indicate that the exhaust gas from the cleaner system is in compliance with North Dakota State Health Department Air Pollution Control Regulation R23-25-05 and R23-25-03. High collector efficiency (82.92%) and the absence of fugative dust testify to a properly designed system.

5.2 House Dust Control System

The results reported herein indicate that the particulate emissions from the house dust control system are within the limitations of North Dakota Air Pollution Control Regulations R23-25-05 and R23-25-03.

This system was tested while grain was being handled by all components listed in Section 2.2, except the floor sweeps. This is a maximum dust producing condition which would very infrequently occur during the course of normal operations. Particulate emissions from the house dust control system could reasonably be expected to be significantly less under normal circumstances than reported herein (13.65 lb/hr).

6. APPENDIX

6.1 Symbols and Abbreviations

Avg	Average
°F	Degrees Fahrenheit
cfm	Cubic feet per minute
acfm	Actual cubic feet per minute
scfm	Standard cubic feet per minute
bu	Bushels
lb	Pounds
hr	Hours
lb/bu	Pounds per bushel
bu/hr	Bushels per hour
lb/hr	Pounds per hour
gr/scf	Grains per standard cubic foot
ton/hr	Tons per hour
%	Per cent
rpm	Revolutions per minute
"WC	Inches water column
Min	Minute
VP	Velocity pressure
Vs	Stack gas velocity (uncorrected)
DB	Dry bulb temperature
WB	Wet bulb temperature
SP	Static pressure
DF	Density factor
H	Pounds water per pound dry air
<	Less than

APPENDIX 6.2

POLLUTION CURBS, INC.

PITOT TRAVERSE

Contract #208127
Page 10

CUSTOMER GERBER INDUSTRIES, INC. JOB NO. 208127

SYSTEM MINOT FARMERS ELEVATOR COMPANY DATE 8/22/72

LOCATION GRAIN CLEANERS SYSTEM - CYCLONE INLET

TYPE OF PITOT STANDARD

	Orientation A			Orientation B	
	Dist.	VP	Vs	VP	Vs
1	3/8	1.70	5222	1.70	5222
2	1 1/4	1.90	5521	1.80	5374
3	2 3/8	1.70	5222	1.65	5144
4	3 5/8	1.45	4823	1.50	4905
5	5 1/2	1.40	4739	1.20	4386
6	10 1/2	0.64	3204	0.60	3102
7	12 3/8	0.55	2970	0.56	2997
8	13 5/8	0.65	3229	0.66	3254
9	14 3/4	0.70	3351	0.80	3582
10	15 5/8	0.58	3050	0.62	3153
10	15 5/8	0.50	2832	0.31	2230
9	14 3/4	0.40	2523	0.36	2403
8	13 5/8	0.40	2533	0.41	2563
7	12 3/8	0.46	2716	0.46	2716
6	10 1/2	0.53	2916	0.56	2997
5	5 1/2	0.72	3398	0.73	3422
4	3 5/8	1.00	4000	0.93	3863
3	2 3/8	1.30	4566	1.16	4314
2	1 1/4	1.36	4671	1.36	4671
1	3/8	1.13	4257	1.13	4257
	Total		75,753	Total	74,555

Avg. Vs = 3758

V = Avg. Vs x DF = 3758 x 1.04 = 3918

Duct Diam. or Dim. 16"

Duct Area A = 1.396 sq ft

ACFM = V x A = 5470

SCFM = 4920

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) = $\frac{530}{\text{Duct temp} + 460}$ = ____

HTC = CR x TC = ____

HUMIDITY & TEMP. CORR:

At test station:
DB 67 WB 58 H 0.008 lb/lb
Duct temp 67 Hum Vol. 13.6

$$HTC = \frac{1 + H}{\text{Hum Vol} \times 0.076} = \frac{1 + 0.008}{13.6 \times 0.076} = 0.975$$

PRESSURE CORR: PC

Barometric Press. ABS (BPA) 28.41 "Hg
BPA x 13.6 = 386.38
Duct SP ± - 7.50
Duct SP ABS 378.88

$$PC = \frac{\text{Duct SP ABS}}{407} = 0.931$$

DENSITY

Density = HTC x PC x 0.076
= 0.975 x 0.931 x 0.076
= 0.0693 lb/cu ft

Density Correction Factor (DF)

$DF = \sqrt{0.076/D}$

BY EJB

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POLLUTION CURBS, INC.

PITOT TRAVERSE

Contract #208127
Page 11

CUSTOMER GERBER INDUSTRIES, INC. JOB NO. 208127

SYSTEM MINOT FARMERS ELEVATOR COMPANY DATE 8/22/72

LOCATION HOUSE DUST CONTROL SYSTEM - CYCLONE INLET

TYPE OF PITOT STANDARD

	Orientation A			Orientation B	
	Dist.	VP	Vs	VP	Vs
1	5/8"	1.00	4000	0.87	3729
2	2	1.09	4181	1.11	4219
3	3 1/2	1.08	4162	1.08	4162
4	5 1/2	0.98	3965	0.98	3965
5	8 1/4	1.02	4045	0.98	3965
6	15 3/4	0.82	3625	0.82	3625
7	18 1/2	0.81	3604	0.81	3604
8	20 1/2	0.85	3690	0.80	3582
9	22	0.86	3709	0.86	3709
10	23 3/8	0.81	3604	0.83	3657
10	23 3/8	1.00	4000	1.00	4000
9	22	1.04	4084	1.03	4064
8	20 1/2	1.02	4045	1.01	4025
7	18 1/2	0.99	3985	0.95	3904
6	15 3/4	0.91	3821	0.91	3821
5	8 1/4	0.92	3842	0.90	3800
4	5 1/2	0.84	3669	0.87	3729
3	3 1/2	0.79	3560	0.75	3468
2	2	0.70	3351	0.70	2860
1	5/8	0.50	2832	0.51	2860
	Total		75,774	Total	75,239

Avg. Vs = 3775

V = Avg. Vs x DF = 3775 x 1.05 = 3962

Duct Diam. or Dim. 24"

Duct Area A = 3.142 sq ft

ACFM = V x A = 12,450

SCFM = 11,190

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) = $\frac{530}{\text{Duct temp} + 460}$ = _____

HTC = CR x TC = _____

HUMIDITY & TEMP. CORR:

At test station:

DB 70 WB 56 H 0.006 lb/lb

Duct temp 70 Hum Vol. 13.6

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

$$= \frac{1 + 0.006}{13.6 \times 0.076} = 0.973$$

PRESSURE CORR: PC

Barometric Press. ABS (BPA) 28.32 "Hg

BPA x 13.6 = 385.13

Duct SP ± - 5.30

Duct SP ABS 379.73

$$PC = \frac{\text{Duct SP ABS}}{407} = 0.933$$

DENSITY

Density = HTC x PC x 0.076

$$= \frac{0.973 \times 0.933 \times 0.076}{0.069} \text{ lb/cu ft}$$

Density Correction Factor (DF)

$DF = \sqrt{0.076/D}$

BY FJB

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POLLUTION CURBS, INC.

FIELD SAMPLE DATA - NULL PROBE

CUSTOMER GERBER INDUSTRIES, INC. JOB NO. 208127

SYSTEM MINOT FARMERS ELEVATOR COMPANY DATE 8/22/72

LOCATION GRAIN CLEANERS SYSTEM - CYCLONE INLET

SAMPLE NO. 1 SAMPLE TRAIN NO. 199

TRAVERSE POSITION 20 POINTS

NOZZLE SIZE 1/4" STD. METER NO. S 1748146

		Clock
Gas meter reading end	77.55	at time 1315
start	0	at time 1215
RDG	77.55	at time 60 min

MOISTURE CORRECTION
MC = 0.99

Meter corr. factor (MCF) = 1.04

Actual cubic feet (ACF) = MCF x RDG = 80.65

Barometric pressure abs. = Meter pressure abs. MPABS = 28.41

Meter temperature Start 80 End 126 Avg 103

Meter temperature abs MTABS 460

\+ 103 (Avg. meter temperature)

MTABS = 563

Dry standard cubic feet (DSCF) = corrected meter reading

$$DSCF = ACF \times \frac{MPABS}{29.92} \times \frac{520}{MTABS} \times MC$$

$$= \frac{80.65}{} \times \frac{28.41}{29.92} \times \frac{520}{563} \times \frac{0.99}{} = \frac{70.02}{} \text{ cubic feet}$$

Total Wt. 8.4861 grams

\- 6.3183 tare

Sample Wt. = 2.1678 net

$$\frac{\text{Sample Wt.} \times 15.43}{\text{DSCF}} = \frac{2.1678 \times 15.43}{70.02} =$$

0.4777 Loading: grains per dry std cu ft

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POLLUTION CURBS, INC.

FIELD SAMPLE DATA - NULL PROBE

CUSTOMER GERBER INDUSTRIES, INC. JOB NO. 208127

SYSTEM MINOT FARMERS ELEVATOR COMPANY DATE 8/22/72

LOCATION GRAIN CLEANERS SYSTEM - CYCLONE INLET

SAMPLE NO. 2 SAMPLE TRAIN NO. 184

TRAVERSE POSITION 20 POINTS

NOZZLE SIZE 1/4" STD. METER NO. S1748146

		Clock	
Gas meter reading end	76.15	at time 1554	MOISTURE CORRECTION
start	0	at time 1454	MC = 0.99
RDG	76.15	at time 60 min.	

Meter corr. factor (MCF) = 1.04

Actual cubic feet (ACF) = MCF x RDG = 79.20

Barometric pressure abs. = Meter pressure abs. MPABS = 28.41

Meter temperature Start 100 End 124 Avg 112

Meter temperature abs MTABS 460

\+ 112 (Avg. meter temperature)

MTABS = 572

Dry standard cubic feet (DSCF) = corrected meter reading

$$DSCF = ACF \times \frac{MPABS}{29.92} \times \frac{520}{MTABS} \times MC$$

$$= 79.20 \times \frac{28.41}{29.92} \times \frac{520}{572} \times 0.99 = 68.88 \text{ cubic feet}$$

Total Wt. 7.4065 grams

\- 5.5186 tare

Sample Wt. = 1.1879 net

$$\frac{\text{Sample Wt.} \times 15.43}{\text{DSCF}} = \frac{1.1879 \times 15.43}{68.88} = 0.2661$$

Loading: grains per dry std cu ft

POLLUTION CURBS, INC.

FIELD SAMPLE DATA - NULL PROBE

CUSTOMER GERBER INDUSTRIES, INC. JOB NO. 208127

SYSTEM MINOT FARMERS ELEVATOR COMPANY DATE 8/22/72

LOCATION GRAIN CLEANERS SYSTEM - CYCLONE DISCHARGE

SAMPLE NO. 1 SAMPLE TRAIN NO. 187

TRAVERSE POSITION 20 POINTS

NOZZLE SIZE 8 MM NULL METER NO. S 1729440

		Clock
Gas meter reading end	96.06	at time 1403
start	0	at time 1303
RDG	96.06	at time 60 min.

MOISTURE CORRECTION
MC = 0.99

Meter corr. factor (MCF) = 1.04

Actual cubic feet (ACF) = MCF x RDG = 99.90

Barometric pressure abs. = Meter pressure abs. MPABS = 28.41

Meter temperature Start 68 End 88 Avg 78

Meter temperature abs MTABS 460

\+ 78 (Avg. meter temperature)

MTABS = 538

Dry standard cubic feet (DSCF) = corrected meter reading

$$DSCF = ACF \times \frac{MPABS}{29.92} \times \frac{520}{MTABS} \times MC$$

$$= \frac{99.90}{} \times \frac{28.41}{29.92} \times \frac{520}{538} \times \frac{0.99}{} = \frac{90.77}{} \text{ cubic feet}$$

Total Wt. 7.5070 grams

\- 7.0990 tare

Sample Wt. = 0.4080 net

$$\frac{\text{Sample Wt.} \times 15.43}{DSCF} = \frac{0.4080 \times 15.43}{90.77} =$$

0.0694 Loading: grains per dry std cu ft

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POLLUTION CURBS, INC.

FIELD SAMPLE DATA - NULL PROBE

CUSTOMER GERBER INDUSTRIES, INC. JOB NO. 208127

SYSTEM MINOT FARMERS ELEVATOR COMPANY DATE 8/22/72

LOCATION GRAIN CLEANERS SYSTEM - CYCLONE DISCHARGE

SAMPLE NO. 2 SAMPLE TRAIN NO. 192

TRAVERSE POSITION 20 POINTS

NOZZLE SIZE 8 MM NULL METER NO. S 1729440

		Clock
Gas meter reading end	96.52	at time 1548
start	0	at time 1448
RDG	96.52	at time 60 min

MOISTURE CORRECTION

MC = 0.99

Meter corr. factor (MCF) = 1.04

Actual cubic feet (ACF) = MCF x RDG = 100.38

Barometric pressure abs. = Meter pressure abs. MPABS = 28.41

Meter temperature Start 82 End 84 Avg 83

Meter temperature abs MTABS 460

\+ 83 (Avg. meter temperature)

MTABS = 543

Dry standard cubic feet (DSCF) = corrected meter reading

$$DSCF = ACF \times \frac{MPABS}{29.92} \times \frac{520}{MTABS} \times MC$$

$$= 100.38 \times \frac{28.41}{29.92} \times \frac{520}{543} \times 0.99 = 90.36 \text{ cubic feet}$$

Total Wt. 6.1699 grams

\- 5.8638 tare

Sample Wt. = 0.3061 net

$$\frac{\text{Sample Wt.} \times 15.43}{DSCF} = \frac{0.3061 \times 15.43}{90.36} = 0.0522$$

Loading: grains per dry std cu ft

POLLUTION CURBS, INC.

FIELD SAMPLE DATA - NULL PROBE

CUSTOMER GERBER INDUSTRIES, INC. JOB NO. 208127

SYSTEM MINOT FARMERS ELEVATOR COMPANY DATE 8/22/72

LOCATION HOUSE DUST CONTROL SYSTEM - CYCLONE INLET

SAMPLE NO. 1 SAMPLE TRAIN NO. 185

TRAVERSE POSITION 20 POINTS

NOZZLE SIZE 1/4" STD. METER NO. S 1748146

		Clock	
Gas meter reading end	77.26	at time 1847	MOISTURE CORRECTION
start	0	at time 1747	MC = 0.99
RDG	77.26	at time 60 min.	

Meter corr. factor (MCF) = 1.04

Actual cubic feet (ACF) = MCF x RDG = 80.35

Barometric pressure abs. = Meter pressure abs. MPABS = 28.32

Meter temperature Start 100 End 120 Avg 110

Meter temperature abs MTABS 460

\+ 110 (Avg. meter temperature)

MTABS = 570

Dry standard cubic feet (DSCF) = corrected meter reading

$$DSCF = ACF \times \frac{MPABS}{29.92} \times \frac{520}{MTABS} \times MC$$

$$= \frac{80.35}{} \times \frac{28.32}{29.92} \times \frac{520}{570} \times \frac{0.99}{} = \frac{68.69}{} \text{ cubic feet}$$

Total Wt. 10.0286 grams

\- 5.9408 tare

Sample Wt. = 4.0878 net

$$\frac{\text{Sample Wt.} \times 15.43}{\text{DSCF}} = \frac{4.0878 \times 15.43}{68.69} =$$

0.9182 Loading: grains per dry std cu ft

Form D104
Rev.3 10/71

POLLUTION CURBS, INC.

FIELD SAMPLE DATA - NULL PROBE

CUSTOMER GERBER INDUSTRIES, INC. JOB NO. 208127

SYSTEM MINOT FARMERS ELEVATOR COMPANY DATE 8/22/72

LOCATION HOUSE DUST CONTROL SYSTEM - CYCLONE INLET

SAMPLE NO. 2 SAMPLE TRAIN NO. 193

TRAVERSE POSITION 20 POINTS

NOZZLE SIZE 1/4" STD. METER NO. S 1748146

		Clock	
Gas meter reading end	74.85	at time 2033	MOISTURE CORRECTION
start	0	at time 1933	MC = 0.99
RDG	74.85	at time 60 min.	

Meter corr. factor (MCF) = 1.04

Actual cubic feet (ACF) = MCF x RDG = 77.84

Barometric pressure abs. = Meter pressure abs. MPABS = 28.32

Meter temperature Start 100 End 120 Avg 110

Meter temperature abs MTABS 460

\+ 110 (Avg. meter temperature)

MTABS = 570

Dry standard cubic feet (DSCF) = corrected meter reading

$$DSCF = ACF \times \frac{MPABS}{29.92} \times \frac{520}{MTABS} \times MC$$

$$= 77.84 \times \frac{28.32}{29.92} \times \frac{520}{570} \times 0.99 = 66.55 \text{ cubic feet}$$

Total Wt. 10.2348 grams

\- 6.8890 tare

Sample Wt. = 3.3458 net

$$\frac{\text{Sample Wt.} \times 15.43}{DSCF} = \frac{3.3458 \times 15.43}{66.55} = 0.7757$$

Loading: grains per dry std cu ft

POLLUTION CURBS, INC.

FIELD SAMPLE DATA - NULL PROBE

CUSTOMER GERBER INDUSTRIES, INC. JOB NO. 208127

SYSTEM MINOT FARMERS ELEVATOR COMPANY DATE 8/22/72

LOCATION HOUSE DUST CONTROL SYSTEM - CYCLONE DISCHARGE

SAMPLE NO. 1 SAMPLE TRAIN NO. 190

TRAVERSE POSITION 20 POINTS

NOZZLE SIZE 8 MM NULL METER NO. S 1729440

		Clock	
Gas meter reading end	75.11	at time 1841	MOISTURE CORRECTION
start	0	at time 1741	MC = 0.99
RDG	75.11	at time 60 min.	

Meter corr. factor (MCF) = 1.04

Actual cubic feet (ACF) = MCF x RDG = 78.11

Barometric pressure abs. = Meter pressure abs. MPABS = 28.32

Meter temperature Start 87 End 93 Avg 90

Meter temperature abs MTABS 460

\+ 90 (Avg. meter temperature)

MTABS = 550

Dry standard cubic feet (DSCF) = corrected meter reading

$$DSCF = ACF \times \frac{MPABS}{29.92} \times \frac{520}{MTABS} \times MC$$

$$= 78.11 \times \frac{28.32}{29.92} \times \frac{520}{550} \times 0.99 = 69.21 \text{ cubic feet}$$

Total Wt. 7.2012 grams

\- 6.4157 tare

Sample Wt. = 0.7855 net

$$\frac{\text{Sample Wt.} \times 15.43}{\text{DSCF}} = \frac{0.7855 \times 15.43}{69.21} =$$

0.1751 Loading: grains per dry std cu ft

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Rev.3 10/71

POLLUTION CURBS, INC.

FIELD SAMPLE DATA - NULL PROBE

CUSTOMER GERBER INDUSTRIES, INC. JOB NO. 208127

SYSTEM MINOT FARMERS ELEVATOR COMPANY DATE 8/22/72

LOCATION HOUSE DUST CONTROL SYSTEM - CYCLONE DISCHARGE

SAMPLE NO. 2 SAMPLE TRAIN NO. 177

TRAVERSE POSITION 20 POINTS

NOZZLE SIZE 8 MM NULL METER NO. S 1729440

		Clock	
Gas meter reading end	86.32	at time 2031	MOISTURE CORRECTION
start	0	at time 1931	MC = 0.99
RDG	86.32	at time 60 min.	

Meter corr. factor (MCF) = 1.04

Actual cubic feet (ACF) = MCF x RDG = 89.77

Barometric pressure abs. = Meter pressure abs. MPABS = 28.32

Meter temperature Start 96 End 104 Avg 100

Meter temperature abs MTABS 460

\+ 100 (Avg. meter temperature)

MTABS = 560

Dry standard cubic feet (DSCF) = corrected meter reading

$$DSCF = ACF \times \frac{MPABS}{29.92} \times \frac{520}{MTABS} \times MC$$

$$= 89.77 \times \frac{28.32}{29.92} \times \frac{520}{560} \times 0.99 = 78.11 \text{ cubic feet}$$

Total Wt. 5.9394 grams

\- 5.3846 tare

Sample Wt. = 0.5548 net

$$\frac{\text{Sample Wt.} \times 15.43}{\text{DSCF}} = \frac{0.5548 \times 15.43}{78.11} =$$

0.1096 Loading: grains per dry std cu ft

Form D104
Rev:3 10/71

POLLUTION CURBS, INC.
EMISSION AND EFFICIENCY CALC - PARTICULATE MATTER

Date 8/25/72
By FJB

Customer GERBER INDUSTRIES, INC. - MINOT FARMERS ELEVATOR CO. - GRAIN CLEANER SYSTEM Job No. 208127

	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
	Thimble No.	Inlet or Outlet	Paired with No.	Sample Volume SCF	Sample Weight grams	Conc. gr/SCF $\frac{V \times 15.3}{IV}$	System Volume ACFM	Dry Gas Dens. lb/cu. ft.	System Volume SCFM $\frac{VII \times VIII}{0.076}$	Contaminant Weight lbs/hr $\frac{VI \times IX}{116.7}$	% Penetration $\frac{X \text{ outlet}}{X \text{ inlet}} \times 100$	%Eff. 100-XI
#1	199	IN	187	70.02	2.1678	0.4777	5470	0.0683	4920	20.14		
#2	184	IN	192	68.88	1.1879	0.2661	5470	0.0683	4920	11.22		
AVG		IN				0.3719	5470	0.0683	4920	15.68		
#1	187	OUT	199	90.77	0.4080	0.0694	5470	0.0683	4920	2.93	14.55	85.45
#2	192	OUT	184	90.36	0.3061	0.0522	5470	0.0683	4920	2.20	19.61	80.39
AVG		OUT				0.0608	5470	0.0683	4920	2.56	17.08	82.92

Contract #208127
Page 20

FORM D 105 Rev 1 7/70

POLLUTION CURBS, INC.
EMISSION AND EFFICIENCY CALC - PARTICULATE MATTER

Date 8/25/72
By FJB

Customer GERBER INDUSTRIES, INC. - MINOT FARMERS ELEVATOR CO., HOUSE DUST CONTROL SYSTEM Job No. 208127

	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
	Thimble No.	Inlet or Outlet	Paired with No.	Sample Volume SCF	Sample Weight grams	Conc. gr/SCF $\frac{V \times 15.3}{IV}$	System Volume ACFM	Dry Gas Dens. lb/cu. ft.	System Volume SCFM $\frac{VII \times VIII}{0.076}$	Contaminant Weight lbs/hr $\frac{VI \times IX}{116.7}$	% Penetration $\frac{X \text{ outlet}}{X \text{ inlet}} \times 100$	%Eff. 100-XI
#1	185	IN	190	68.69	4.0878	0.9182	12,450	0.0690	11,190	88.04		
#2	193	IN	177	66.55	3.3458	0.7757	12,450	0.0690	11,190	74.38		
AVG		IN				0.8470	12,450	0.0690	11,190	81.21		
#1	190	OUT	185	69.21	0.7855	0.1751	12,450	0.0690	11,190	16.79	19.07	80.93
#2	177	OUT	193	78.11	0.5548	0.1096	12,450	0.0690	11,190	10.51	14.13	85.87
AVG		OUT				0.1424	12,450	0.0690	11,190	13.65	16.81	83.19

PROCESS WEIGHT RATE CALCULATIONS

CLEANERS SYSTEM -

Cleaner	Run No. 1[1]	Run No. 2[2]	Average
Carter Model 2564	1433 bu/1 hr-20 min x 60 lb/bu = 64,647 lb/hr	897 bu/1 hr-5 min x 60 lb/bu = 49,695 lb/hr	57,171 lb/hr
Crippen Model M5472	220 bu/1 hr-20 min x 52 lb/bu = 8,602 lb/hr	443 bu/1 hr-5 min x 60 lb/bu - 24,543 lb/hr	16,572 lb/hr
TOTALS	36.62 ton/hr	37.12 ton/hr	36.87 ton/hr

HOUSE DUST CONTROL SYSTEM -

Leg	Run No. 1[3,4]	Run No. 2[4,5]	Average
Back (annex) leg	3333 bu/1 hr-5 min x 48 lb/bu = 147,773 lb/hr	2600 bu/1 hr-5 min x 58 lb/bu = 139,243 lb/hr	143,508 lb/hr
East front leg	2700 bu/1 hr-5 min x 48 lb/bu = 119,668 lb/hr	2100 bu/1 hr-5 min x 58 lb/bu - 112,465 lb/hr	116,066 lb/hr
West front leg	2200 bu/1 hr-5 min 38 lb/bu - 77,193 lb/hr	2100 bu/1 hr-5 min 38 lb/bu = 73,684 lb/hr	75,438 lb/hr
TOTALS	172.29 ton/hr	162.70 ton/hr	167.50 ton/hr

NOTES:

[1] Carter cleaner was handling No. 1 heavy dark northern spring wheat having a bulk density of 60 lb/bu. The Crippen cleaner was handling rye having a bulk density of 52 lb/bu.

[2] Both cleaners were handling No. 1 heavy dark northern spring wheat.

[3] Back leg and east front leg were handling barlay having a bulk density of 48 lb/bu.

[4] West front leg was handling oats having a bulk density of 38 lb/bu.

[5] Back leg and east front leg were handling wheat having a bulk density of 58 lb/bu.

APPENDIX 6.3

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.