GRAY
IRON FOUNDRIES 12.10
AP-42 Section ~~7.10~~
Reference Number
28

PARTICULATE EMISSION TEST REPORT

For a Gray Iron Cupola at

HARDY & NEWSOM, INC.

La Grange, North Carolina

Note: This is a reference cited in *AP 42, Compilation of Air Pollutant Emission Factors, Volume I Stationary Point and Area Sources.* AP42 is located on the EPA web site at www.epa.gov/ttn/chief/ap42/

The file name refers to the reference number, the AP42 chapter and section. The file name "ref02_c01s02.pdf" would mean the reference is from AP42 chapter 1 section 2. The reference may be from a previous version of the section and no longer cited. The primary source should always be checked.

20

Performed by the Source Testing Staff
of the
North Carolina Department
of Natural Resources & Community Development
Division of Environmental Management
Air Quality Section
August 2 & 3, 1977

CONTENTS

	Page
Introduction	1
Process Description	2
Process Rate and Allowable Emissions	3
Sampling and Analytical Procedures	4
Summary of Results	5
References	5
Test Summary	6
APPENDIX A - Calculation Summary, Equations, and Nomenclature	7
APPENDIX B - Dry Molecular Weight Determination	12
APPENDIX C - Analytical Data	13
APPENDIX D - Field Data	16
APPENDIX E - Preliminary Field Data	19
APPENDIX F - Nomograph Data	20
APPENDIX G - Determination of Emission Limits	22

INTRODUCTION

This report presents the results of tests performed on August 2 and 3, 1977 on a gray iron cupola at Hardy & Newsom, Inc. in La Grange, North Carolina.

John R. Jernigan, Victor D. Copelan and Julius A. Shanklin of the North Carolina Division of Environmental Management's Source Testing Staff of the Air Quality Section conducted particulate sampling to determine if this source was in compliance with North Carolina Emission Control Standard, 15 NCAC 2D .0514, "Control of Particulates From Ferrous Jobbing Foundries," (Reference 1).

Buddy Bulow of the Northeastern Field Office assisted in the performance of the tests.

PROCESS DESCRIPTION

Hardy & Newson, Inc. uses a conventional cupola furnace to melt scrap iron for the production of gray iron castings. Iron, coke and limestone are fed directly into the charge door by the use of a skip hoist.

The exhaust gases from the cupola are vented thru the following equipment before being vented to the atmosphere: a settling chamber, a water cooled heat exchanger, a mechanical centrifugal separator and a filtration system.

The filters in the filtration system consisted of Nomex sock type filters. During test run #2A (8/2/77) an upset in the filtration system was discovered, subsequently that test run was aborted. It was agreed upon that the upset in the filtration system occurred during test run #1, therefore, test run #1 would not be used in the average emission rate.

PROCESS RATE AND ALLOWABLE EMISSIONS

The process rate and allowable emissions were determined as follows:

(1) Cupola charging time interval: approximately 11 hours or 660 minutes

(2) Weight per charge: 480 lbs.

Normal charge =	400 lbs.	iron
	50 lbs.	coke
	30 lbs.	limestone
	480 lbs.	

(3) Total number charges: 82

(4) Total pounds charged during time interval: 39,360

82 charges x 480 lbs. = 39,360 lbs.

(5) Average charge rate: 3,578 lbs./hr.

$$\frac{39{,}360 \text{ lbs.}}{660 \text{ minutes}} \times 60 \text{ minutes/hour} = 3{,}578 \text{ lbs./hr.}$$

(6) Maximum allowable emission rate: 8 lbs./hr.

From Table Appendix G.

SAMPLING AND ANALYTICAL PROCEDURES

Particulate testing and analysis of samples were performed according to procedures developed by the U. S. Environmental Protection Agency and referred to as Method 5. Sampling port locations and number of test points to be used were determined according to Method 1. The above federal test methods appear in their original form in the December 23, 1971 Federal Register (Reference 2), with updated versions appearing in the Environmental Reporter (Reference 3).

Test point locations and sampling port placement are shown in Appendix E.

The composition of the flue gas was determined in accordance with Method 3 of Reference 2. During each test run a continuous gas sample was drawn into a Tedlar bag from the sample points and then analyzed for its components using an Orsat analyzer.

The results of the Orsat analysis were used for the molecular weight determination shown in Appendix B.

SUMMARY OF RESULTS

As shown in the following test summary, emissions during the particulate emissions test indicates that Hardy & Newsom, Inc. is in compliance with North Carolina Emission Control Standard, 15 NCAC 2D .0514, "Control of Particulates From Ferrous Jobbing Foundries."

John R. Jernigan
Environmental Engineer
Air Quality Section
August 18, 1977

REFERENCES

1. *North Carolina Administrative Code*, Title 15, Chapter 2, Subchapter 2D, Section .0514 "Control of Particulates From Ferrous Jobbing Foundries." Environmental Management Commission, Raleigh, N. C. (February 1, 1976).

2. *Federal Register*, Standards of Performance for New Stationary Sources, Volume 36, Number 247, U. S. Government Printing Office, Washington, D. C. (December 23, 1971).

3. *Environmental Reporter*, pp 121:0401 - 121:0485 updated thru November 12, 1974, The Bureau of National Affairs, Washington, D. C.

TEST SUMMARY - HARDY & NEWSOM, INC.

	Parameter	Run 1	Run 2	Run 3
Q_s	Stack volume flow rate, acfm	9354.0	6312.6	5441.5
Q_{std}	Stack volume flow rate, scfm	7945.4	5085.8	4218.8
V_{std}	Sample volume, scf	46.99	29.79	24.48
%I	Percent isokinetic	106.6	105.5	100.3
pmr	Emission rate, lb/hr	10.77	4.46	7.14
	Maximum allowable emission rate based on 15 NCAC 2D .0514*, lb/hr	. . . . .	8.0	. . . . .
$\overline{pmr}$	Average emission rate, lb/hr (Run 2 & 3)	. . . . .	5.8	. . . . .
	Average emission rate with respect to allowable expressed in percentage		27.5 under	

*Reference 1

APPENDIX A

Calculation Summary

SOURCE HARDY & NEWSOM

DATE 8/2-3/77

LOCATION LA GRANGE

TRY	RUN 1	RUN 2	RUN 3	ANSWER
ΔH (in H_2O)	2.1375	0.8000	0.5500	
atm (in Hg)	29.9300	29.9800	29.9800	P_m (in Hg)
	30.0871	30.0388	30.0204	
ge) (in H_2O)	0.3600	0.3600	0.3600	P_s (in Hg)
	29.9564	30.0064	30.0064	
T_m (°R)	557.2000	550.3000	558.6700	
V_m (ft^3)	47.9120	29.7200	24.9790	$V_{m_{std}}$ (ft^3)
	45.8176	28.7310	23.7714	
V_{lq} (ml)	24.7000	22.3000	14.9000	
	1.1679	1.0544	0.7045	$V_{v_{std}}$ (ft^3)
	46.9856	29.7854	24.4759	V_{std} (ft^3)
	2.4857	3.5402	2.8785	%M
	0.9751	0.9645	0.9712	M_d
MW_d	26.9960	29.0640	29.2320	
	28.7246	28.6723	28.9086	M
T_s (°R)	624.5800	659.6000	685.4200	
	0.8519	0.8755	0.8889	
$\Sigma\sqrt{\Delta p}$	9.0460	5.9400	5.0436	
$n_{\Delta p}$	12.0000	12.0000	12.0000	
	0.7538	0.4950	0.4203	Ave $\sqrt{\Delta p}$
C_p	0.8500	0.8500	0.8500	
	46.6638	31.4912	27.1456	v_s (ft/sec)
D_s (in)	24.7500	24.7500	24.7500	
	3.3409	3.3409	3.3409	A_s (ft^2)
	9353.9959	6312.5808	5441.4722	Q_s (ft^3/min)
	7945.4465	5085.8059	4218.8406	Q_{std} (ft^3/min)
W_t (gm)	0.4659	0.1922	0.3127	
	10.4233	4.3417	7.1308	pmr_c (lb/hr)
D_n (in)	0.2380	0.2380	0.2430	
	0.0444	0.0444	0.0463	A_n (in^2)
θ (min)	60.0000	60.0000	60.0000	
	11.1085	4.5826	7.1521	pmr_a (lb/hr)
	106.5740	105.5478	100.2981	%I
	10.7659	4.4622	7.1414	pmr_{avg} (lb/hr)
%CO				
$\%N_2$				
$\%O_2$				%EA
F factor				HI (10^6 BTU)
				pmr_u (lbs/10^6BTU)

EQUATIONS

1. Absolute Pressure in Dry Gas Meter - P_m (in. Hg.)

$$P_m = P_{atm} + \frac{\Delta H}{13.6}$$

2. Absolute Stack Pressure - P_s (in. Hg.)

$$P_s = P_{atm} + \frac{P_{s(gage)}}{13.6}$$

3. Sample Volume at Standard Conditions - $V_{m_{std}}$ (ft^3)

$$V_{m_{std}} = V_m \frac{T_{std}}{T_m} \frac{P_m}{P_{std}}$$

4. Volume of Water Vapor Collected, Corrected to Standard Conditions - $V_{v_{std}}$ (ft^3

$$V_{v_{std}} = K_2 V_{lq} \frac{T_{std}}{P_{std}} \qquad K_2 = 0.00267 \text{ (units conversion)}$$

5. Total Sample Volume at Standard Conditions - V_{std} (ft^3)

$$V_{std} = V_{m_{std}} + V_{v_{std}}$$

6. Percent Moisture in Stack Gas - %M

$$\%M = \frac{V_{v_{std}}}{V_{std}} \times 100$$

7. Mole Fraction of Dry Gas - M_d

$$M_d = \frac{100 - \%M}{100}$$

8. Molecular Weight of Wet Gas - M (lb/lb mole)

$$M = (MW_d \times M_d) + 18(1 - M_d)$$

9. Stack Velocity - v_s (ft/sec)

$$v_s = K_p C_p \sqrt{\frac{T_s}{P_s M}} \frac{\Sigma\sqrt{\Delta p}}{n_{\Delta p}}$$

$$K_p = 85.48 \text{ (units conversion factor)}$$

10. Stack Volume Flow Rate - Q_s (ft^3/min)

$$Q_s = K_1 \, v_s \, A_s' \qquad K_1 = 60 \text{ (units conversion)}$$

11. Stack Volume Flow Rate at Standard Conditions - Q_{std} (ft^3/min)

$$Q_{std} = \frac{T_{std}}{P_{std}} \, \frac{P_s}{T_s} \, Q_s$$

12. Pollutant Mass Rate Based on Particulate Concentration - pmr_c (lb/hr)

$$pmr_c = K_3 \, \frac{W_t \, Q_{std}}{V_{std}} \qquad K_3 = 0.1323 \text{ (units conversion)}$$

13. Pollutant Mass Rate Based on the Ratio of the Cross Sectional Area of the Stack and the Sampling Nozzle - pmr_a (lb/hr)

$$pmr_a = K_3 \, \frac{W_t \, A_s}{\theta \, A_n} \qquad K_3 = 0.1323 \text{ (units conversion)}$$

14. Percent Isokineticity - %I

$$\%I = \frac{pmr_a}{pmr_c} \times 100$$

15. Average Pollutant Mass Rate - pmr_{avg} (lb/hr)

$$pmr_{avg} = \frac{pmr_a + pmr_c}{2}$$

16. Percent Excess Air - %EA

$$\%EA = \frac{\%O_2 - .5(\%CO)}{.264(\%N_2) - \%O_2 + .5(\%CO)}$$

17. Heat Input Rate - HI (10^6 BTU/hr)

$$HI = \frac{60 \; Q_{std} \; M_d}{F(100 + \%EA)}$$

18. Specific Emission Rate - pmr_u (lb/10^6 BTU)

$$pmr_u = \frac{pmr_{avg}}{HI}$$

NOMENCLATURE

A_n	(in^2), Cross sectional area of nozzle
A_s	(in^2), Cross sectional area of stack
A'_s	(ft^2), Cross sectional area of stack
C_p	Pitot tube calibration coefficient
%EA	Percent Excess Air
F	($scfd/10^4$ BTU), F factor
ΔH	(in H_2O), Average orifice meter reading
HI	(10^6 BTU/hr), Heat Input Rate
%I	Percent Isokineticity
M	(lb/lb mole), Molecular Weight of wet gas
%M	Percent Moisture
M_d	Mole fraction of dry gas
MW_d	(lb/lb mole) Molecular weight of dry gas
$n_{\Delta p}$	Number of Δp readings
P_{atm}	(in Hg), Local atmospheric pressure
P_m	(in Hg), Absolute pressure in dry gas meter
P_s	(in Hg), Absolute stack pressure
$P_{s(gage)}$	(in H_2O), Measured static stack pressure
P_{std}	(29.92 in Hg), Standard pressure
pmr_a	(lb/hr), Pollutant mass rate based on ratio of areas
pmr_{avg}	(lb/hr), Average pollutant mass rate
pmr_c	(lb/hr), Pollutant mass rate based on concentration
pmr_u	($lb/10^6$ BTU), Specific emission rate
Δp	(in H_2O), Velocity pressure
Q_s	(ft^3/min), Actual stack volume flow rate
Q_{std}	(ft^3/min), Stack volume flow rate at standard conditions

T_m (^oR), Average dry gas meter temperature

T_s (^oR), Average stack temperature

T_{std} (530 ^oR), Standard temperature

V_{lq} (ml), Liquid volume

V_m (ft^3), Sample volume measured by dry gas meter

$V_{m_{std}}$ (ft^3), Sample volume at standard conditions

V_{std} (ft^3), Total sample volume at standard conditions

$V_{v_{std}}$ (ft^3), Volume of water vapor collected, corrected to standard conditions

v_s (ft/sec), Stack velocity

W_t (gm), Total weight of particulate collected

θ (min), Duration of test

Determination of Dry Molecular Weight (MW_d)

WHERE:

$$MW_d = \frac{\%CO_2}{100} \times 44 + \frac{\%O_2}{100} \times 32 + \frac{\%CO}{100} \times 28 + \frac{(100-\%CO_2-\%O_2-\%CO)}{100} \times 28$$

ENTRY	RUN 1 ORSAT	RUN 2 ORSAT	RUN 3 ORSAT	Ans.
% CO_2	1.6500	2.2000	3.5000	
% O_2	18.3500	17.8000	16.8000	
% CO*	0.0000	0.0000	0.0000	
	28.9980	29.0640	29.2320	MW_d
	80.0000	80.0000	79.7000	N_2

* Assumed

ANALYTICAL DATA

Lab No. 9016

-77
8
TD

Plant HARDY & NEWSOM

Run Number 1 A Date 8/2/77

Location LA GRANGE

RECD AUG 17 1977

FILTER WEIGHTS

Filter Number	55429			
Final Weight (g)	.			*
Tare Weight (g)	.4170			

WASHINGS

				TOTALS
Beaker Number	12-C			
Volume (Acetone)	250			
Final Weight (g)	179.4277			
Tare Weight (g)	178.5399			

ACETONE BLANK

Lot Number	WCSR
Beaker Number	2-C
Volume (ml)	300
Final Weight (g)	179.6146
Tare Weight (g)	179.6087
Blank Residue (g)	.0059

TOTAL PARTICULATE CATCH

Filter Final Weight	* 1
+ Washings, Final Weight	179.4277
- Filter Tare	.4170
- Beaker Tare (Washings)	178.5399
- Corrected Blank	.0049
= Total Particulate (g)	0.4659

BLANK CORRECTION =

$$\frac{(\text{Vol. Washings})}{(\text{Vol. Blank})} \times (\text{Blank Residue})$$

$$\left(\frac{250}{300}\right) \times (.0059) = .0049$$

IMPINGERS (1, 2, 3)

Final Volume (ml)	209
Initial Volume (200 ml)	200
Water Collected (ml)	9

SILICA GEL

Final Weight (g)	215.7
Initial Weight (g)	200
Moisture Collected (g)	15.7

Total Water Collected (ml) 24.7

*These blocks will be blank if filter is weighed together with the washings.

ANALYTICAL DATA

Lab No. 2615

Plant HARDY & NEWSOM

Run Number 2 Date 8/3/77

Location LA GRANGE

RECD AUG 17 1977

FILTER WEIGHTS				TOTALS
Filter Number	55430			
Final Weight (g)				*
Tare Weight (g)	.4140			

WASHINGS				TOTALS
Beaker Number	0			
Volume (Acetone)	200			
Final Weight (g)	182.2343			
Tare Weight (g)	181.6242			

ACETONE BLANK

Lot Number WCSR

Beaker Number 2-C

Volume (ml) 300

Final Weight (g) 179.6146

Tare Weight (g) 179.6087

Blank Residue (g) .0059

TOTAL PARTICULATE CATCH

Filter Final Weight *

+ Washings, Final Weight 182.2343

- Filter Tare .4140

- Beaker Tare (Washings) 181.6242

- Corrected Blank ~~.0059~~ .0039

= Total Particulate (g) ~~0.1902~~ 0.1922

BLANK CORRECTION =

$$\frac{(\text{Vol. Washings})}{(\text{Vol. Blank})} \times (\text{Blank Residue})$$

$$\frac{(200)}{(300)} \times (.0059) = .0039$$

IMPINGERS (1, 2, 3)

Final Volume (ml) 216

Initial Volume (200 ml) 200

Water Collected (ml) 16

SILICA GEL

Final Weight (g) 206.3

Initial Weight (g) 200

Moisture Collected (g) 6.3

Total Water Collected (ml) 22.3

*These blocks will be blank if filter is weighed together with the washings.

10-23-75

ANALYTICAL DATA

Lab No. 2614

Plant HARDY & NEWSON

Run Number 3 Date 8/3/77

Location LA GRANGE

				TOTALS
FILTER WEIGHTS				
Filter Number	55431			
Final Weight (g)				*
Tare Weight (g)	.4191			
WASHINGS				TOTALS
Beaker Number	1			
Volume (Acetone)	250			
Final Weight (g)	178.8466			
Tare Weight (g)	178.1099			

ACETONE BLANK

Lot Number WCSR

Beaker Number 2-C

Volume (ml) 300

Final Weight (g) 179.6146

Tare Weight (g) 179.6087

Blank Residue (g) .0059

TOTAL PARTICULATE CATCH

Filter Final Weight *

+ Washings, Final Weight 178.8466

- Filter Tare .4191

- Beaker Tare (Washings) 178.1099

- Corrected Blank .0049

= Total Particulate (g) 0.3127

BLANK CORRECTION =

$$\frac{(\text{Vol. Washings})}{(\text{Vol. Blank})} \times (\text{Blank Residue})$$

$$\left(\frac{250}{300}\right) \times (.0059) = .0049$$

IMPINGERS (1, 2, 3)

Final Volume (ml) 209

Initial Volume (200 ml) 200

Water Collected (ml) 9

SILICA GEL

Final Weight (g) 205.9

Initial Weight (g) 200

Moisture Collected (g) 5.9

Total Water Collected (ml) 14.9

*These blocks will be blank if filter is weighed together with the washings.

B

A

AIR QUALITY SECTION

SOURCE SAMPLING FIELD DATA

Plant HARDY & NEWSOM
Date AUG 2, 1977
Location LA GRANGE
Sample Type PART.
Run Number 2B
Operator JRJ
Sample Box No. 4
Meter Box No. 3

Meter $\Delta H_@$ 1.86
C Factor 1.1
Probe Type PYREX
Probe Length 3'
Probe Tip Dia., In. .238
Probe Heater Setting HI
Heater Box Setting HI
Assumed Moisture % 2.5

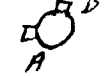
Ambient Temperature 90
Barometric Pressure, In. Hg. 29.98
Static Pressure (P_s), +.36
Stack Dimension(s) 24.75"
Distance: Disturbance to port > 8 DIA.
Distance: Port to exit > 2 DIA.
Leak Rate .005 cfm@ 15 IN Hg.
Filter number(s) 55430

Remarks:

TRAVERSE POINT NUMBER	CLOCK TIME (24-hr CLOCK) / SAMPLING TIME, min	GAS METER READING (V_m), ft^3	VELOCITY HEAD (Δp_s), in. H_2O	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O DESIRED	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O ACTUAL	STACK TEMPERATURE (T_s), °F	DRY GAS METER TEMPERATURE INLET ($T_{m\ in}$), °F	DRY GAS METER TEMPERATURE OUTLET ($T_{m\ out}$), °F	PUMP VACUUM, in. Hg	SAMPLE BOX TEMPERATURE, °F	IMPINGER TEMPERATURE, °F
	~~0955~~										
A-1	00	222.875	.24		.84	160		85	0	214	75
2	05	225.395	.25		.86	170		86	1	200	60
3	10	228.00	.24		.64	240		87	1	212	53
4	15	230.295	.26		.78	250		89	1	214	53
5	20	232.675	.27		.80	250		91	1.5	215	53
6	25	235.14	.26		.78	245		91	1.5	212	54
6	30	237.586									
B-1	00	237.586	.19		.56	240		90	1.5	216	59
2	05	239.735	.22		.72	190		91	1.5	214	58
3	10	242.05	.23		.78	170		92	2	210	57
4	15	244.50	.26		.92	160		93	2½	222	56
5	20	247.12	.27		.94	160		94	4	218	56
6	25	249.81	.29		1.02	160		94	4½	211	58
6	30	252.595									
					.80	199.6		90.3			
	1059	29.72	.94								

FINAL LEAK TEST

AQ-44



AIR QUALITY SECTION

SOURCE SAMPLING FIELD DATA

Plant HARDY & NEWSOM
Date AUG. 3, 1977
Location LA GRANGE
Sample Type PART
Run Number 3
Operator JAB
Sample Box No. 6
Meter Box No. 3

Meter $\Delta H_@$ 1.86
C Factor 1.1
Probe Type PYREX
Probe Length 3'
Probe Tip Dia., In. .243
Probe Heater Setting HI
Heater Box Setting HI
Assumed Moisture % 2.5

Ambient Temperature 85
Barometric Pressure, In. Hg. 29.98
Static Pressure (P_s), +.36
Stack Dimension(s) 24.75"
Distance: Disturbance to port > 8 DIA.
Distance: Port to exit > 2 DIA
Leak Rate .006/.002 cfm@ 15#/15"
Filter number(s) 55431

Remarks:

TRAVERSE POINT NUMBER	SAMPLING TIME, min / CLOCK TIME (24-hr CLOCK)	GAS METER READING (V_m), ft^3	VELOCITY HEAD (Δp_s), in. H_2O	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O DESIRED	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O ACTUAL	STACK TEMPERATURE (T_s), °F	DRY GAS METER TEMPERATURE INLET ($T_{m\,in}$), °F	DRY GAS METER TEMPERATURE OUTLET ($T_{m\,out}$), °F	PUMP VACUUM, in. Hg	SAMPLE BOX TEMPERATURE, °F	IMPINGER TEMPERATURE, °F
B 1	0 1216	262.500	.15		.45	220		94	1	190	60
2	5	264.38	.17		.52	210		95	1½	200	55
3	10	266.41	.17		.52	230		97	1½	205	55
4	15	268.45	.19		.58	240		98	2	215	56
5	20	270.59	.20		.62	240		98	2	222	56
6	25	272.78	.20		.62	240		98	2½	230	56
6	30	275.02									
A 1	30 (0) 1248	275.02	.14	.45	.45 .42	200		99	2	220	68
2	35 (5)	276.90	.15		.48	210		99	2½	217	62
3	40 (10)	278.86	.15		.46	230		101	2½	230	60
4	45 (15)	280.79	.20		.62	230		101	3	225	66
5	50 (20)	282.97	.21		.65	225		102	3½	238	62
6	55 (25)	285.23	.20		.63	230		102	3½	226	60
6	60 (30)	287.479									
		24.979	5.0436		.55	225.42		98.67			

1218 Turbines off

1251½ 1255½

AQ-44

12-15-72 6-2-76

APPENDIX D

A
B

AIR QUALITY SECTION

SOURCE SAMPLING FIELD DATA

Plant HARDY & NEWSOM
Date AUG. 2, 1977
Location LA GRANGE
Sample Type PART.
Run Number 1
Operator JRJ
Sample Box No. 4
Meter Box No. 3

Meter $\Delta H_@$ ~~1.925~~ 1.86
C Factor 1.18
Probe Type PYREX
Probe Length 3'
Probe Tip Dia., In. .238
Probe Heater Setting HI
Heater Box Setting HI
Assumed Moisture % 2

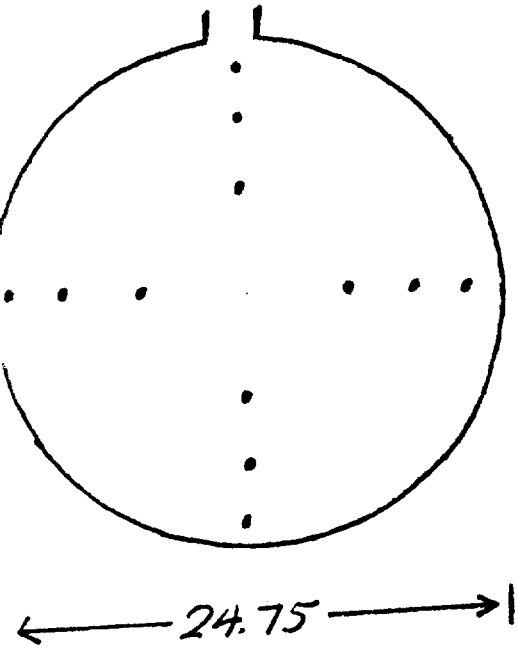
Ambient Temperature 90
Barometric Pressure, In. Hg. 29.93
Static Pressure (P_s), +.36
Stack Dimension(s) 24.75"
Distance: Disturbance to port > 8 DIA
Distance: Port to exit > 2 DIA
Leak Rate .003 cfm@ 16 in Hg
Filter number(s) 55429

Remarks:

TRAVERSE POINT NUMBER	SAMPLING TIME, min / CLOCK TIME (24-hr CLOCK)	GAS METER READING (V_m), ft^3	VELOCITY HEAD (Δp_s), in. H_2O	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O DESIRED	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O ACTUAL	STACK TEMPERATURE (T_s), °F	DRY GAS METER TEMPERATURE INLET ($T_{m\ in}$), °F	DRY GAS METER TEMPERATURE OUTLET ($T_{m\ out}$), °F	PUMP VACUUM, in. Hg	SAMPLE BOX TEMPERATURE, °F	IMPINGER TEMPERATURE, °F
	1100										
A-1	00	152.938	.50		1.82	180		89	2	155	67
2	05	156.52	.54		1.93	185		90	2	181	54
3	10	160.275	.53		1.92	180		92	3	197	53
4	15	164.06	.64		2.35	170		94	5	209	54
5	20	168.16	.70		2.65	170		96	7	219	56
6	25	172.57	.67		2.50	170		98	9	226	60
6	30	176.927									
B-1	00	176.927	.33		1.28	150		99	7	231	65
2	05	180.07	.58		2.2	150		99	9	231	58
3	10	184.065	.58		2.2	150		100	11.5	235	58
4	15	188.195	.61		2.4	150		102	12.5	237	63
5	20	192.485	.60		2.2	160		103	15.5	233	64
6	25	196.69	.59		2.2	160		104	15.5	236	64
6	30	200.85									
	END	47.912	9.048		2.1375	164.58		97.2			

FINAL LEAK TEST

Preliminary Field Data



Plant HARDY & NEWSOM, INC.

Date AUG. 2 & 3, 1977

Port Location EXHAUST STACK

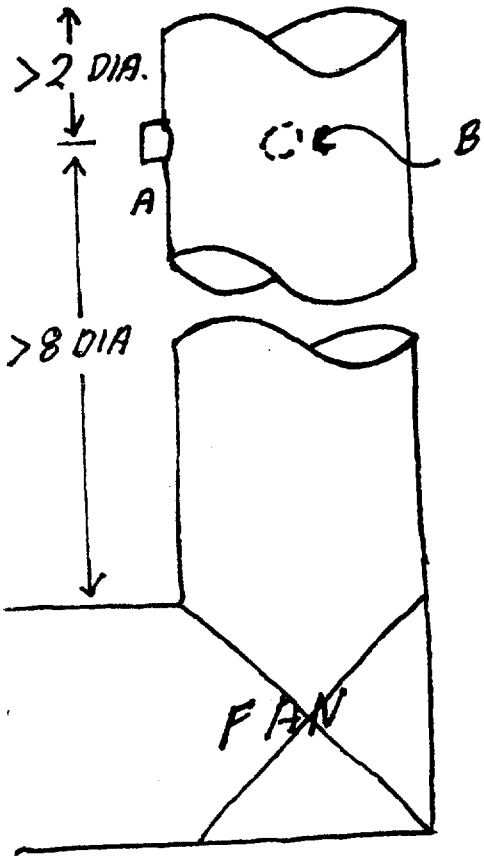
Nearest Disturbance:

Before Port > 8 DIAMETERS

After Port > 2 DIAMETERS

Duct Diameter 24.75 INCHES

Point Number	% of Diameter	Distance From Near Wall
A & B	24 INCHES	
1	4.4	1.056 "
2	14.7	3.528 "
3	29.5	7.08 "
4	70.5	16.92 "
5	85.3	20.472 "
6	95.6	22.944 "



Sketch of stack or duct showing location of sampling ports

NOMOGRAPH DATA

PLANT HARDY & NEWSOM

DATE 8/2/77

SAMPLING LOCATION EXHAUST STACK

CALIBRATED PRESSURE DIFFERENTIAL ACROSS ORIFICE, in. H_2O	$\Delta H_@$	1.86
AVERAGE METER TEMPERATURE (AMBIENT + 20°F), °F	$T_{m\,avg.}$	110
PERCENT MOISTURE IN GAS STREAM BY VOLUME	B_{wo}	2
BAROMETRIC PRESSURE AT METER, in. Hg	P_m	29.93
STATIC PRESSURE IN STACK, in. Hg ($P_m \pm 0.073$ x STACK GAUGE PRESSURE in in. H_2O)	P_s	GAUGE + .36
RATIO OF STATIC PRESSURE TO METER PRESSURE	P_s/P_m	1
AVERAGE STACK TEMPERATURE, °F	$T_{s\,avg.}$	200
AVERAGE VELOCITY HEAD, in. H_2O	$\Delta p_{avg.}$	.46
MAXIMUM VELOCITY HEAD, in. H_2O	$\Delta p_{max.}$	.58
C FACTOR	1.18	
CALCULATED NOZZLE DIAMETER, in.	.25	
ACTUAL NOZZLE DIAMETER, in.	.242	
REFERENCE Δp, in. H_2O	.54	

EPA (Dur) 234
4/72

NOMOGRAPH DATA

PLANT HARDY & NEWSOM

DATE 8/3/77

SAMPLING LOCATION EXHAUST STACK

CALIBRATED PRESSURE DIFFERENTIAL ACROSS ORIFICE, in. H_2O	$\Delta H_@$	1.86
AVERAGE METER TEMPERATURE (AMBIENT + 20 °F), °F	$T_{m\,avg.}$	100
PERCENT MOISTURE IN GAS STREAM BY VOLUME	B_{wo}	2.5
BAROMETRIC PRESSURE AT METER, in. Hg	P_m	29.98
STATIC PRESSURE IN STACK, in. Hg ($P_m \pm 0.073$ x STACK GAUGE PRESSURE in in. H_2O)	P_s	GAUGE + .36
RATIO OF STATIC PRESSURE TO METER PRESSURE	P_s/P_m	1
AVERAGE STACK TEMPERATURE, °F	$T_{s\,avg.}$	170
AVERAGE VELOCITY HEAD, in. H_2O	$\Delta p_{avg.}$	.57
MAXIMUM VELOCITY HEAD, in. H_2O	$\Delta p_{max.}$	.70
C FACTOR	1.1	
CALCULATED NOZZLE DIAMETER, in.	.239	
ACTUAL NOZZLE DIAMETER, in.	.242	
REFERENCE Δp, in. H_2O	.54	

EPA (Dur) 234
4/72