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.

Background Report Reference

AP-42 Section Number: 1.4

Background Chapter: 2

Reference Number: 21

Title: Compliance Test Report
Determination of NOx emission rates from Boilers 3, 4, and 5. harrison Radiator, Dayton, Ohio

Hayden Environmental Group, Inc.

Hayden Environmental Group, Inc.

March 1990

109.1, 109.2
AP-42 #21
Section 1.4
(BID Ch. 2)

RECEIVED
MAR 2 5 1990
REGIONAL AIR
POLLUTION
CONTROL AGENCY

COMPLIANCE TEST REPORT
DETERMINATION OF NO_x EMISSION RATES
FROM BOILERS 3, 4, AND 5
HARRISON RADIATOR
DAYTON, OHIO

prepared for

Harrison Radiator
P. O. Box 824
Dayton, Ohio 45401

by

HAYDEN ENVIRONMENTAL GROUP, INC.
6015 Manning Road
Miamisburg, OH 45342
(513) 866-5908

Tom Bayer

Thomas E. Bayer
Project Manager

PN 205.011 Revised
March 20, 1990

1.0 EXECUTIVE SUMMARY

Hayden Environmental Group, Inc. was retained by Harrison Radiator to determine the NO_x emission rates from Boilers 3, 4, and 5. The purpose of the test series was to demonstrate compliance with applicable Ohio Environmental Protection Agency (OEPA) emission regulations. The tests were conducted on February 6, through 8, 1990. The results of the tests are summarized in the table below:

BOILER NO.	NO_x EMISSION RATE (lbs/hr)	(lbs/MM Btu)
3	7.0	2.98 E-02
4	3.2	2.52 E-02
5	1.9	1.52 E-02

2.0 INTRODUCTION

Hayden Environmental was retained by Harrison Radiator to determine NO_x emission rates from Boilers 3, 4, and 5 at the company's Dayton - Moraine facility. Triplicate test runs were made at each site using USEPA Reference Methods for stationary source sampling.

Mr. Mike Woodall of Harrison Radiator coordinated the test schedules with plant operations. Mr. Jon Hilty from the Regional Air Pollution Control Agency was present to witness the testing. The emission tests were performed under the direction of Mr. Thomas Bayer of Hayden Environmental Group. Mr. Bruce Sarven assisted with sampling and data reduction. The emission samples were analyzed at the Hayden Environmental laboratory.

3.0 PROCESS DESCRIPTION

Harrison Radiator operates three natural gas fired boilers in the production of steam for space heating. The three Boilers have the ability to use #2 heating oil as a back-up fuel. Boilers 4 and 5 are rated at 120,000 PPH and Boiler 3 is rated at 200,000 PPH. The emissions from Boilers 4 and 5 are ducted to a common stack. The boilers were isolated from one another during the testing by closing off dampers. Boiler 3 emissions are ducted to a separate stack.

During the emission tests Boilers 3 and 4 were operated on natural gas. Boiler 5 was operated on #2 heating oil. All three Boilers were operated at approximately 90 % of full capacity.

4.0 SAMPLING AND ANALYTICAL PROCEDURES

The sampling and analytical procedures used in this test series conform to the most recent revisions of USEPA Reference Methods 1, 2, 3, 4, and 7a. These procedures are approved by the OEPA. The following specific procedures were used:

4.1 Measurement Sites

Location of measurement sites and the number of traverse points were determined as specified in USEPA Reference Method 1, "Sample and Velocity Traverses for Stationary Sources." Drawings of the sampling sites are included in Figure 4.1 and Figure 4.2.

4.2 Velocity and Temperature

Stack gas velocity and temperature were determined using USEPA Reference Method 2, "Determination of Stack Gas Velocity and Volumetric Flow Rate (Type S Pitot Tube)." Velocities were measured with Type "S" pitot tubes and temperatures were measured with calibrated Type "K" thermocouples. A drawing of the sampling equipment is included in Figure 4.3.

4.3 Dry Molecular Weight

Dry Molecular Weight was determined using USEPA Reference Method 3, "Gas Analysis for Carbon Dioxide, Oxygen, Excess Air, and Dry Molecular Weight." Several grab samples were collected during each test and analyzed directly with Fyrite combustion gas analyzers. A Fyrite combustion gas analyzer was used on Boiler 4 test runs because of equipment problems associated with the Orsat analyzer sample collection pump. This was approved on site by Mr. Jon Hilty from RAPCA.

4.4. Gas Analysis for Carbon Dioxide, Oxygen, and Carbon Monoxide

Gas analysis was determined using USEPA Reference Method 3, "Gas Analysis for Carbon Dioxide, Oxygen, Excess Air, and Dry Molecular Weight." An intergraded multi-point bag sample was collected during each sample run for Boilers 3 and 5. Analysis was performed with a calibrated Orsat analyzer.

4.4 Moisture

Moisture content was determined using USEPA Reference Method 4, "Determination of Moisture Content in Stack Gases." A drawing of the sampling equipment is included in Figure 4.4.

4.5 Nitrogen Oxide

Nitrogen oxide emissions were determined using USEPA Reference Method 7A, "Determination of Nitrogen Oxide Emissions From Stationary Sources - Ion Chromatographic Method." A grab sample was collected in an evacuated flask containing a sulfuric acid-hydrogen peroxide solution. Nitrogen oxides were oxidized to nitrate and measured by ion chromatography. Four (4) grab samples were collected during each one (1) hour test and the four (4) individual analyses were averaged. A drawing of the sampling apparatus is presented in Figure 4.5.

4.6 Quality Assurance

The Hayden Environmental Group air sampling Quality Assurance program includes procedures for equipment calibration as per USEPA and manufacturers guidelines, use of and strict adherence to standard published procedures, and traceability protocols for the recording and calculation of data. Hayden Environmental Group participates in the USEPA's National Source Audit Program for Methods 3, 5, 6, and 7.

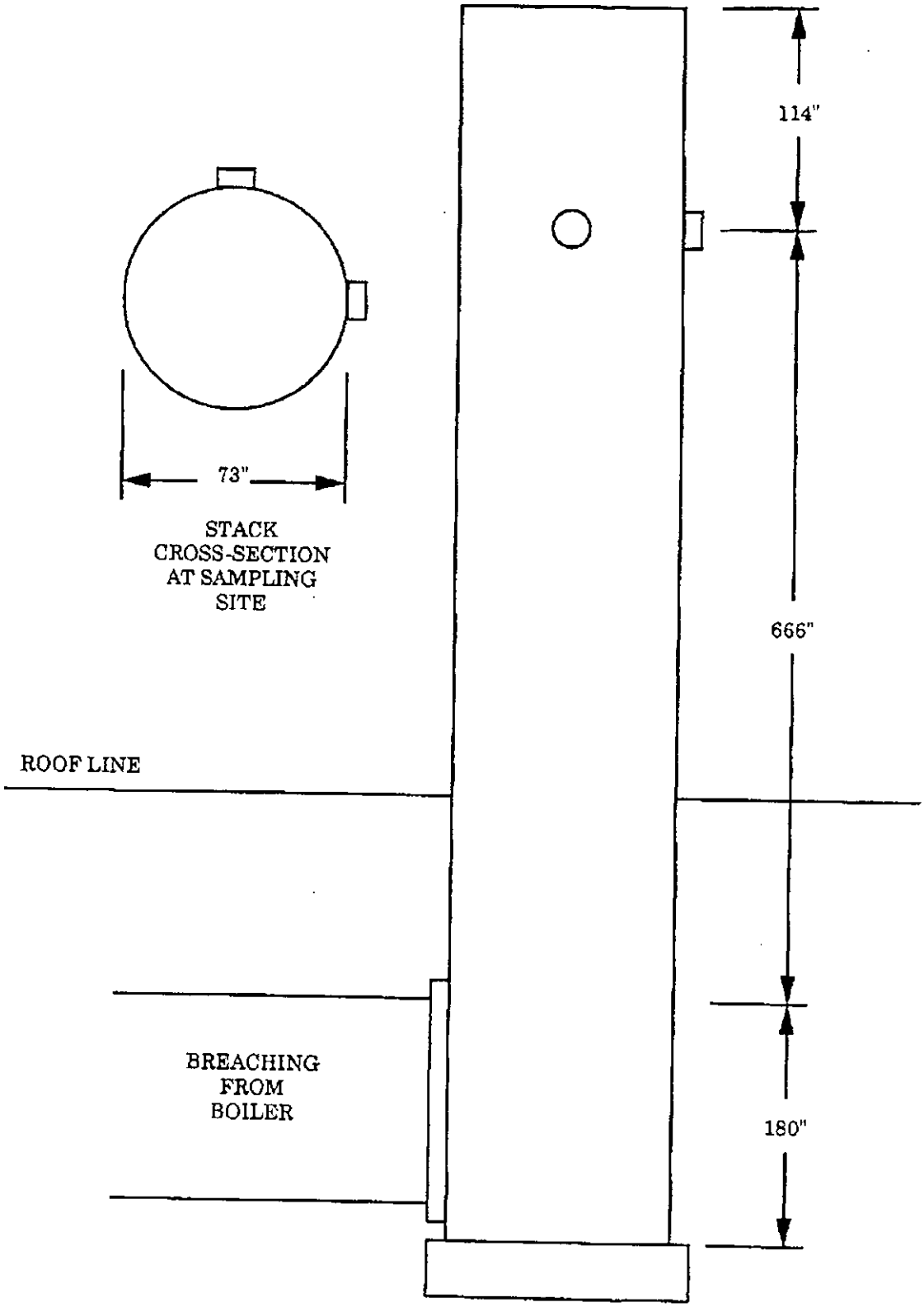


FIGURE 4.1 BOILER 3 SAMPLING SITE DETAIL

HAYDEN
ENVIRONMENTAL GROUP, INC

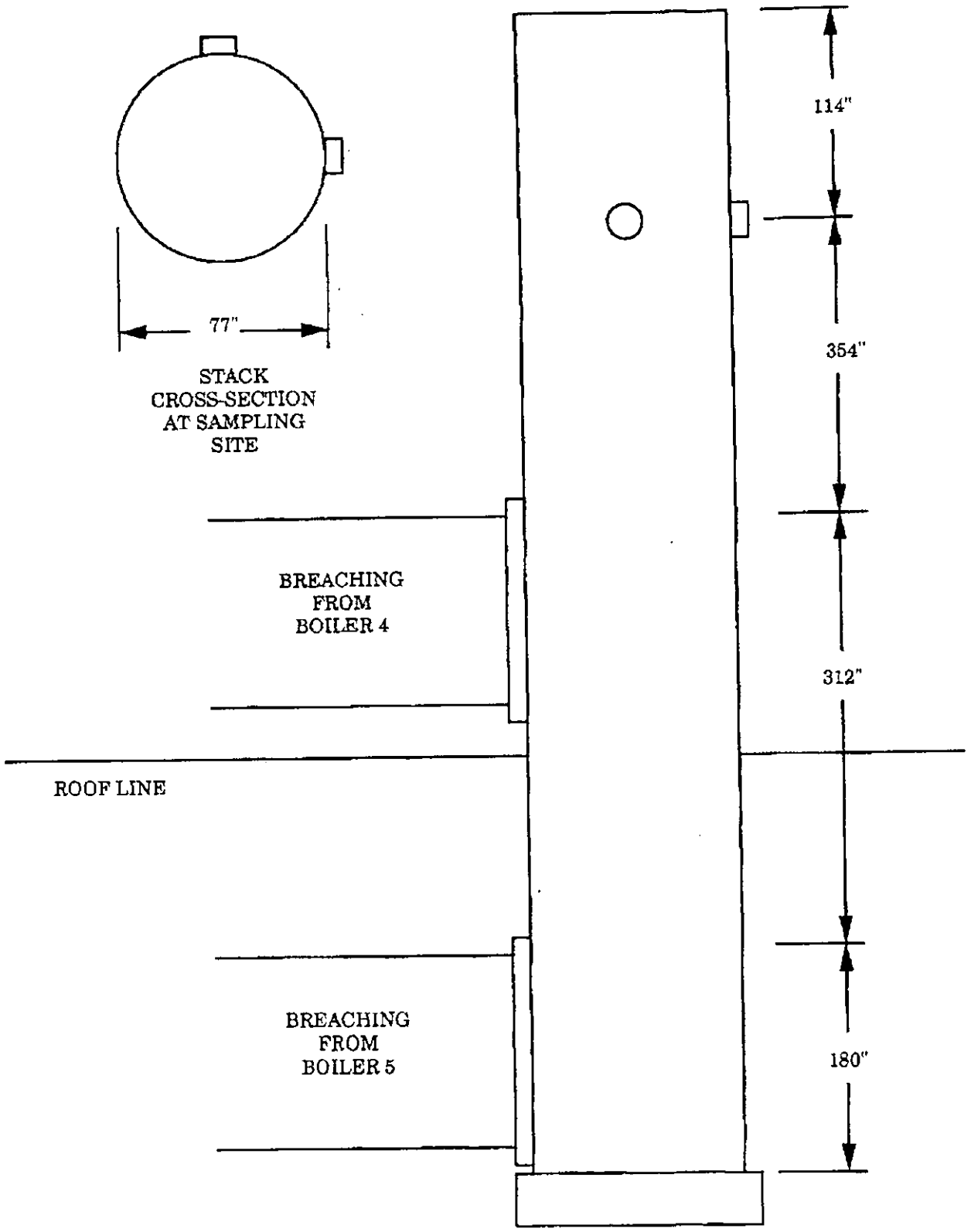


FIGURE 4.2 BOILERS 4 & 5 SAMPLING SITE DETAIL

HAYDEN
ENVIRONMENTAL GROUP, INC

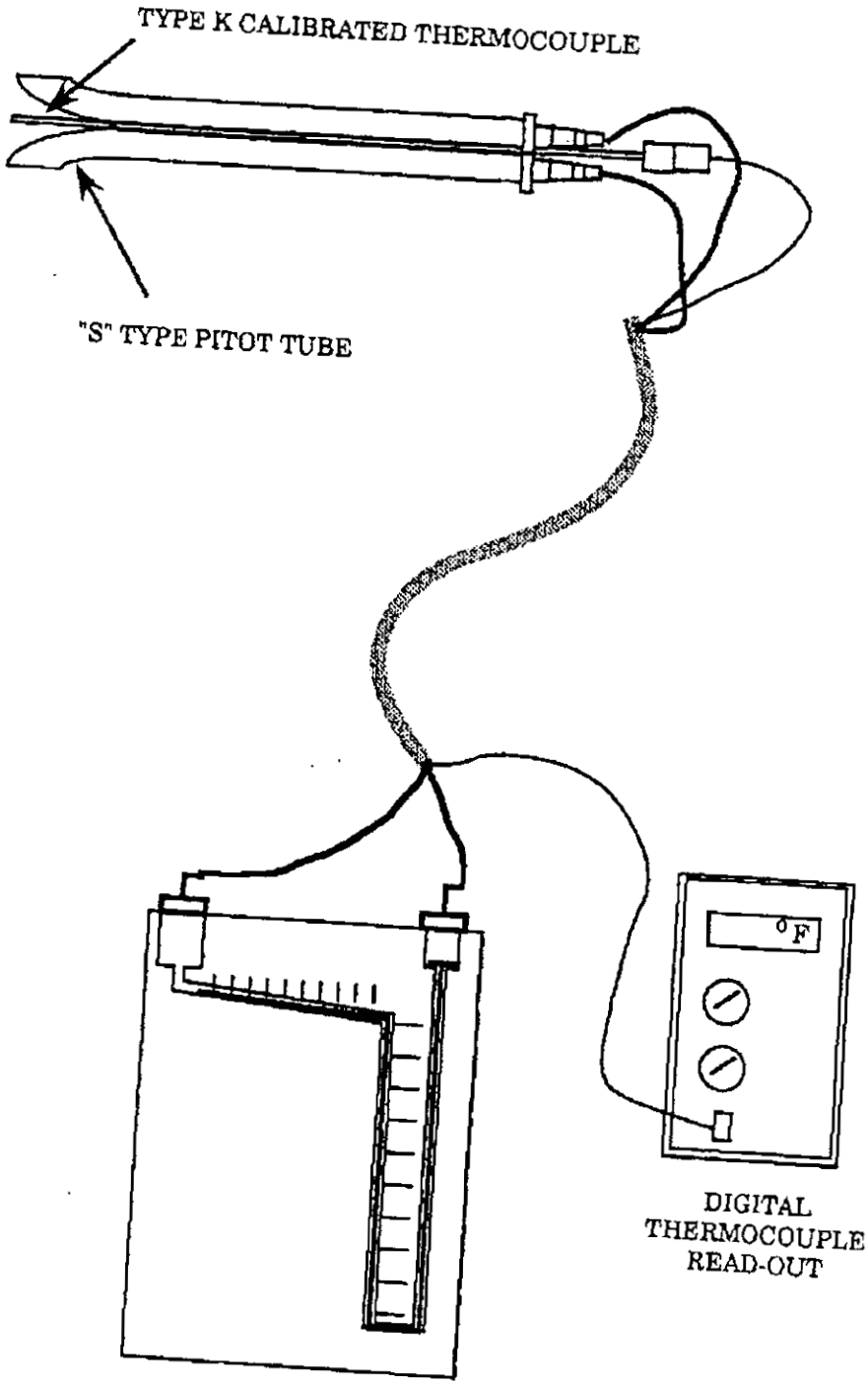


FIGURE 4.3 VELOCITY AND TEMPERATURE APPARATUS

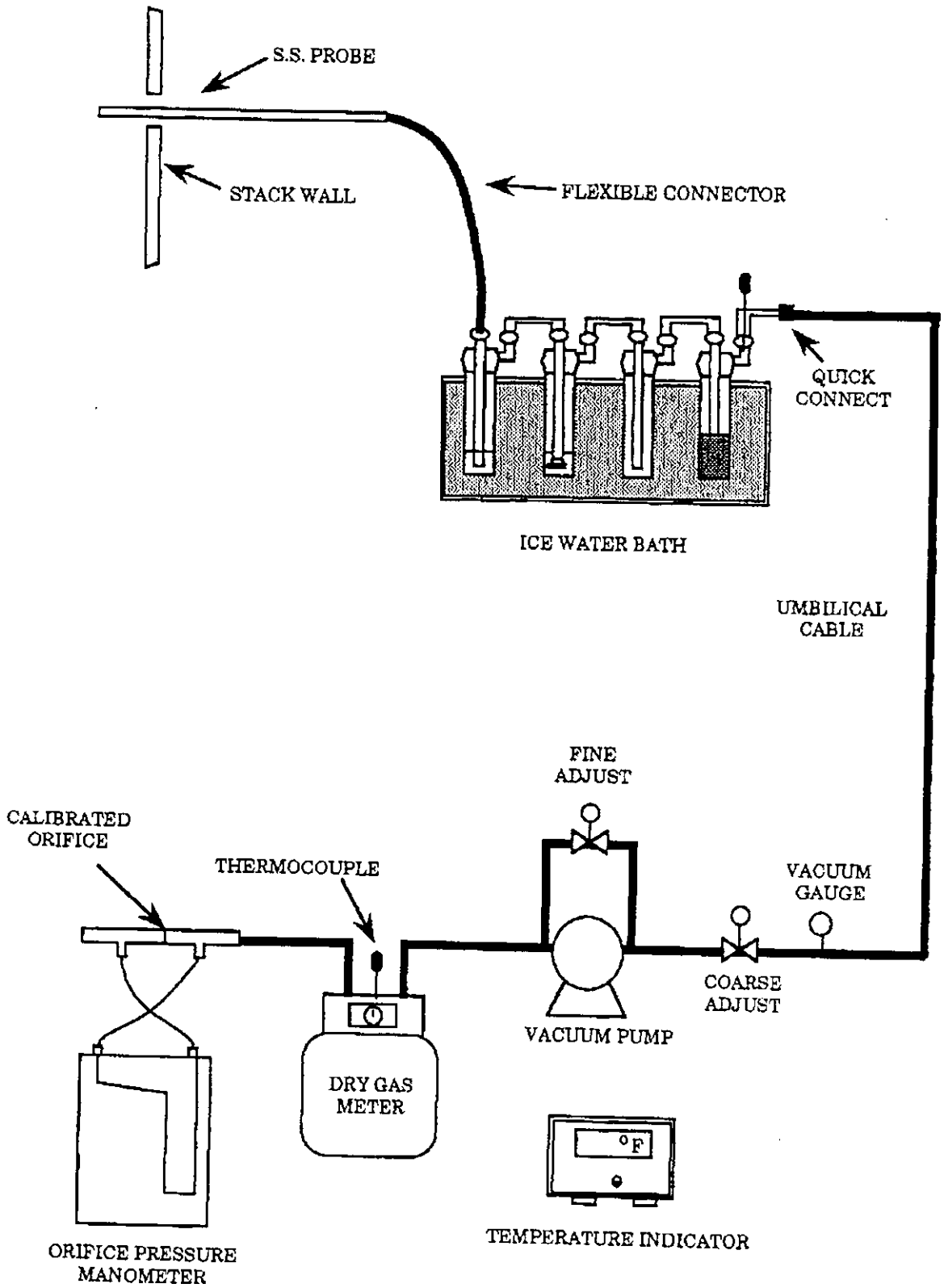


FIGURE 4.4 METHOD 4 SAMPLING TRAIN

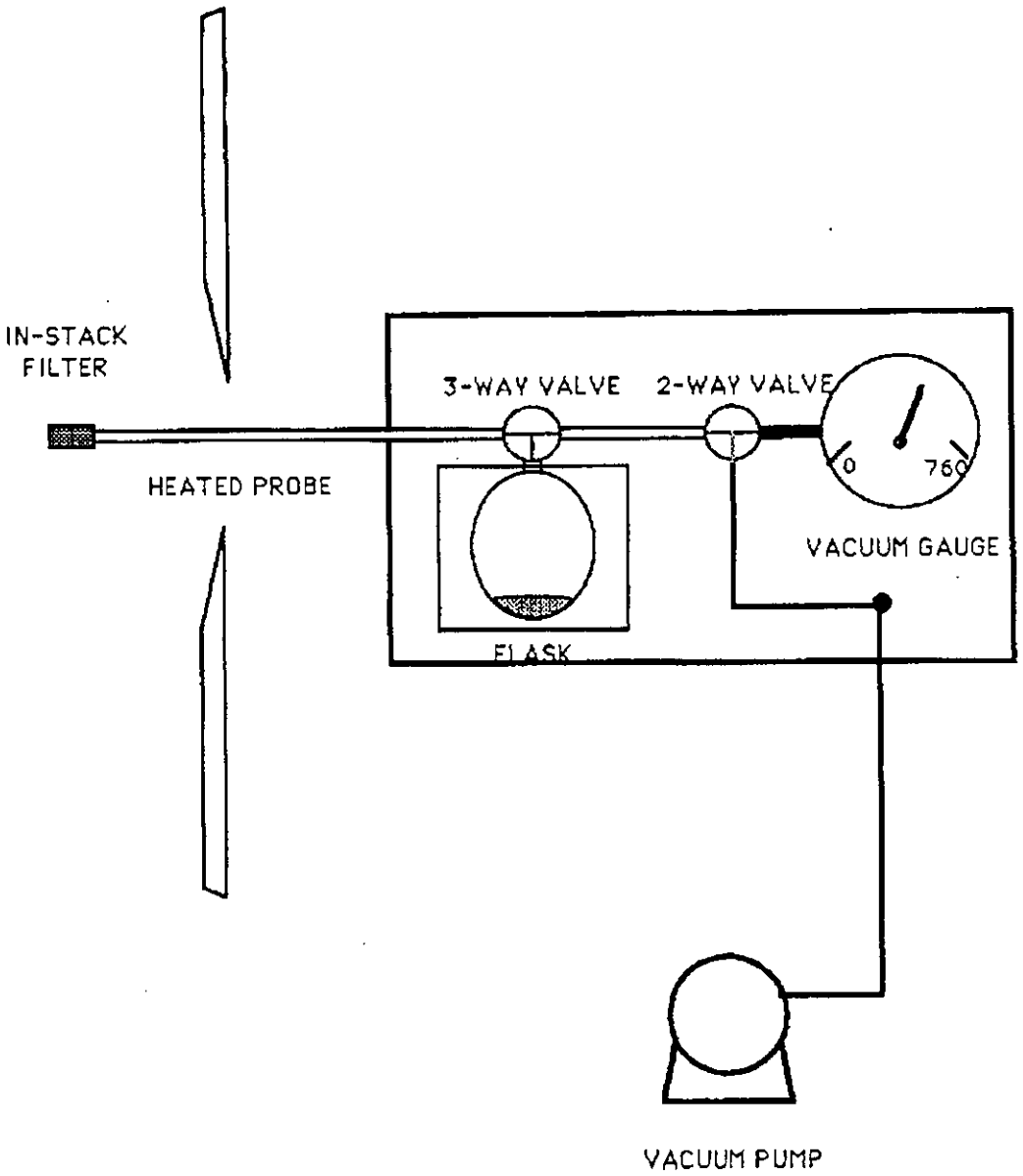


FIGURE 4.5 METHOD 7A SAMPLING TRAIN

5.0 TEST RESULTS

Boiler # 3

The stack gas conditions and related parameters are summarized in Table 5.1. The average stack gas flow rate was 69,813 acfm (38,283 dscfm) at 322°F and 17.2% water vapor.

The results of the NO_x tests are summarized in Table 5.2. The average concentration was 25.5 ppm which is equivalent to a mass emission rate of 7.0 lbs/hr.

Boiler # 4

The stack gas conditions and related parameters are summarized in Table 5.3. The average stack gas flow rate was 47,276 acfm (25,638 dscfm) at 341°F and 16.8% water vapor.

The results of the NO_x tests are summarized in Table 5.4. The average concentration was 17.6 ppm which is equivalent to a mass emission rate of 3.2 lbs/hr.

Boiler # 5

The stack gas conditions and related parameters are summarized in Table 5.5. The average stack gas flow rate was 39,903 acfm (21,864 dscfm) at 367°F and 13.0 % water vapor.

The results of the NO_x tests are summarized in Table 5.6. The average concentration was 11.7 ppm which is equivalent to a mass emission rate of 1.9 lbs/hr.

The Appendices to this report contain the process data, field data, the laboratory data, calculations and Quality Assurance procedures and results.

TABLE 5.1
SUMMARY OF STACK GAS CONDITIONS
BOILER 3

RUN NO.	DATE 1990	VELOCITY (fps)[a]	FLOW RATE (acfm)[b]	FLOW RATE (dscfm)[c]	TEMP. (°F)	MOISTURE (%)	O_2 (%)	CO_2 (%)
Inlet								
1	2/8	40.6	70,801	39,374	312	17.1	1.9	7.5
2	2/8	38.7	67,487	36,808	326	17.3	2.7	8.8
3	2/8	40.8	71,150	38,667	329	17.2	2.1	8.5
Average		40.0	69,813	38,283	322	17.2	2.2	8.3

[a]Feet per second at stack conditions.
[b]Actual cubic feet per minute at stack conditions.
[c]Dry standard cubic feet per minute at 68°F and 29.92" Hg.

TABLE 5.2 SUMMARY OF NO_x EMISSIONS
BOILER 3

RUN #	CONCENTRATION (ppm)	CONCENTRATION (lb/dscf)	EMISSION RATE (lb/hr)	EMISSION RATE (lb/MM Btu)
1	19.8	2.35 E-06	5.6	2.37 E-02
2	23.8	2.84 E-06	6.2	2.68 E-02
3	33.0	3.97 E-06	9.1	3.90 E-02
Average	25.5	3.04 E-06	7.0	2.98 E-02

TABLE 5.3
SUMMARY OF STACK GAS CONDITIONS
BOILER 4

RUN NO.	DATE 1990	VELOCITY (fps)[a]	FLOW RATE (acfm)[b]	FLOW RATE (dscfm)[c]	TEMP. (°F)	MOISTURE (%)	O_2 (%)	CO_2 (%)
Inlet								
1	2/6	21.7	42,102	22,015	370	16.6	4.5	9.7
2	2/6	25.3	49,087	27,004	327	16.8	3.2	9.7
3	2/6	26.1	50,639	27,896	325	16.9	3.0	9.7
Average		24.4	47,276	25,638	341	16.8	3.6	9.7

[a]Feet per second at stack conditions.
[b]Actual cubic feet per minute at stack conditions.
[c]Dry standard cubic feet per minute at 68°F and 29.92" Hg.

TABLE 5.4 SUMMARY OF NO_x EMISSIONS
BOILER 4

RUN #	CONCENTRATION (ppm)	CONCENTRATION (lb/dscf)	EMISSION RATE (lb/hr)	EMISSION RATE (lb/MM Btu)
1	18.2	2.16 E-06	2.9	2.25 E-02
2	17.8	2.12 E-06	3.4	2.68 E-02
3	16.9	2.02 E-06	3.4	2.63 E-02
Average	17.6	2.10 E-06	3.2	2.52 E-02

TABLE 5.5
SUMMARY OF STACK GAS CONDITIONS
BOILER 5

RUN NO.	DATE 1990	VELOCITY (fps)[a]	FLOW RATE (acfm)[b]	FLOW RATE (dscfm)[c]	TEMP. (°F)	MOISTURE (%)	O_2 (%)	CO_2 (%)
Inlet								
1	2/7	20.6	39,968	21,792	368	13.3	2.2	10.0
2	2/7	20.3	39,386	21,689	366	12.7	2.3	10.7
3	2/7	20.8	40,356	22,111	368	12.9	2.2	10.4
Average		20.6	39,903	21,864	367	13.0	2.2	10.4

[a]Feet per second at stack conditions.
[b]Actual cubic feet per minute at stack conditions.
[c]Dry standard cubic feet per minute at 68°F and 29.92" Hg.

TABLE 5.6 SUMMARY OF NO_x EMISSIONS
BOILER 5

RUN #	CONCENTRATION (ppm)	CONCENTRATION (lb/dscf)	EMISSION RATE (lb/hr)	EMISSION RATE (lb/MM Btu)
1	11.0	1.31 E-06	1.7	1.41 E-02
2	12.0	1.41 E-06	1.9	1.52 E-02
3	12.2	1.46 E-06	2.0	1.62 E-02
Average	11.7	1.40 E-06	1.9	1.52 E-02

BOILER FUEL FEED RATE

BOILER #3 (GAS)

DATE 2-8-90	TEST - 1	FUEL FEED RATE	229.35 KSCF/Hr
DATE 2-8-90	TEST - 2	FUEL FEED RATE	229.09 KSCF/Hr
DATE 2-8-90	TEST - 3	FUEL FEED RATE	229.38 KSCF/Hr

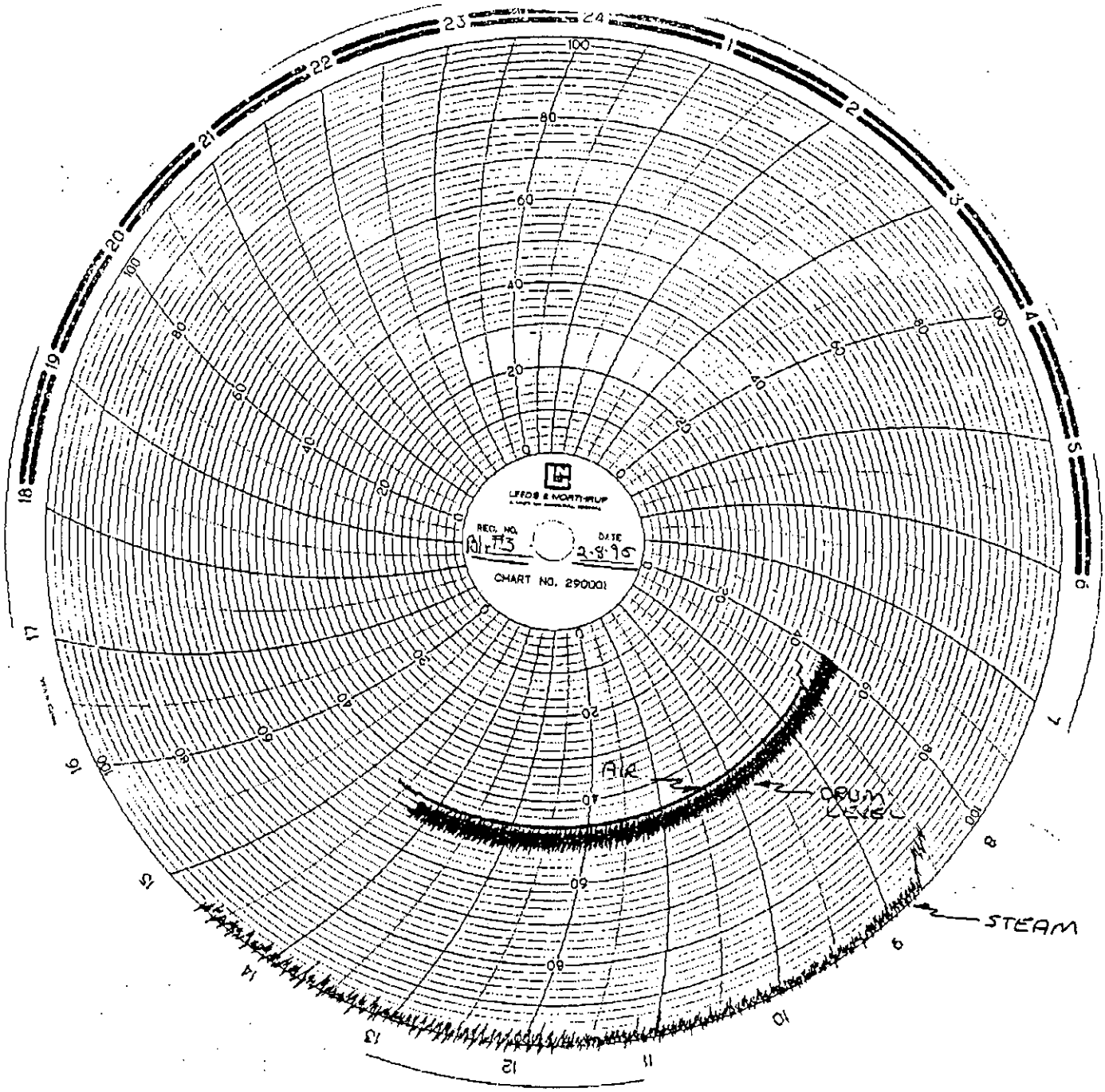
BOILER #4 (GAS)

DATE 2-6-90	TEST - 1	FUEL FEED RATE	124.20 KSCF/Hr
DATE 2-6-90	TEST - 2	FUEL FEED RATE	125.60 KSCF/Hr
DATE 2-6-90	TEST - 3	FUEL FEED RATE	125.40 KSCF/Hr

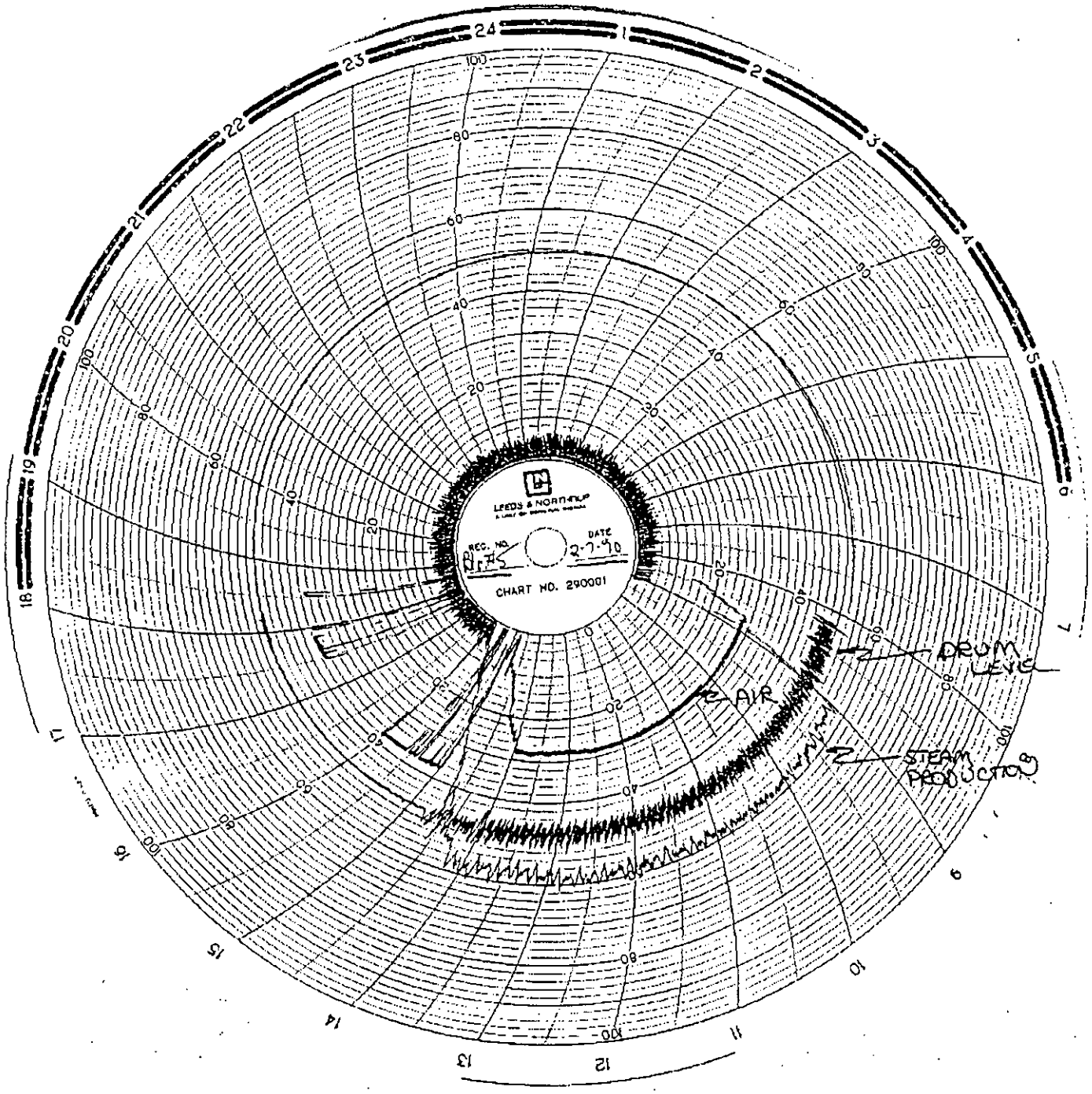
BOILER #5 (OIL)

DATE 2-7-90	TEST - 1	FUEL FEED RATE	853.53 GAL/Hr
DATE 2-7-90	TEST - 2	FUEL FEED RATE	854.61 GAL/Hr
DATE 2-7-90	TEST - 3	FUEL FEED RATE	840.30 GAL/Hr

DENSITY #2 HEATING OIL = 7.296 lb/Gal


LEEDS & NORTHRUP
REG. NO. Air #3
DATE 2-8-96
CHART NO. 290001
AIR
STEAM

STEAM
AIR
Drum Level
CHART NO. 29000
REC. NO.
DATE
LEEDS & NORTHRUP


LEEDS & NORTHRUP
REC. NO. Blr #5
DATE 2-7-90
CHART NO. 290001
AIR
DRUM LEVEL
STEAM PRODUCTION

HARRISON RADIATOR DIVISION
GENERAL MOTORS CORPORATION
MORAINE, OHIO

C-E CONTRACT 45088
(1) TYPE A BOILER UNIT #3

PREDICTED PERFORMANCE*

FUEL		NO. 2 OIL	NATURAL GAS
Evaporation	lb/hr	200,000	200,000
Feed Water Temperature	°F	240	240
Boiler Outlet Temperature	°F	SAT	SAT
Boiler Outlet Pressure at MSSV**	psig	100	100
Blowdown	lb/hr	20,000	20,000
Water Temp. Leaving Economizer	°F	299	299
Economizer Pressure Drop	psi	15	15
Efficiency	%	85.67	82.38
Fuel Fired - #2 Oil	lb/hr	11,900 27.5 gpm	----
Natural Gas	SCFH	-----	236,000
Excess Air Leaving Boiler	%	15	10
Gas Leaving Boiler	lb/hr	211,000	205,000
Gas Temp. Leaving Boiler	°F	600	600
Gas Temp. Leaving Economizer	°F	365	365
Ambient Air	°F		
- Temperature		80	80
- Relative Humidty	%	60	60
Air Leaving FD Fan	lb/hr	199,000	194,000
Heat Input	Btu/hr	231×10^6	241×10^6
Pressure Drop (at Elev. 734 ft)			
Windbox	"w.g.	6.0	5.6
Air Ducts	"w.g.	0.2	0.2
FD Fan Inlet Duct & Silencer	"w.g.	1.0	1.0
Boiler Bank	"w.g.	10.0	9.4
Economizer	"w.g.	1.8	1.7
Gas Ducts	"w.g.	0.5	0.5
Total	"w.g.	19.5	18.4

*NOTES: * These performance figures are predicted only and are not to be construed as being guaranteed except where the points coincide with the guarantees.

** MSSV - Main Steam Stop Valve

#2 Oil - % by wgt.

Carbon	86.5
Hydrogen	13.0
Oxygen	0.1
Nitrogen	0.1
Sulfur	0.3

HHV = 19,500 Btu/lb

Natural Gas - % by Volume

Methane	96.02	N - Pentane	0.01
Ethane	2.09	I - Pentane	0.02
Propane	0.23	N - Hexane	0.03
N - Butane	0.04	Nitrogen	0.58
I - Butane	0.03	Carbon Dioxide	0.95

HHV = 1,022 Btu/SCF

HARRISON RADIATOR DIVISION
GENERAL MOTORS CORPORATION
MORAINE, OHIO

C-E CONTRACT 45088
(2) TYPE A BOILERS UNITS #4 and #5

PREDICTED PERFORMANCE*

FUEL		NO. 2 OIL	NATURAL GAS
Evaporation	lb/hr	120,000	120,000
Feed Water Temperature	°F	240	240
Boiler Outlet Temperature	°F	SAT	SAT
Boiler Outlet Pressure at MSSV**	psig	100	100
Blowdown	lb/hr	12,000	12,000
Water Temp. Leaving Economizer	°F	286	287
Economizer Pressure Drop	psi	15	15
Efficiency	%	85.58	82.29
Fuel Fired - #2 Oil	lb/hr	7,130 16.5gpm	-----
Natural Gas	SCFH	-----	142,000
Excess Air Leaving Boiler	%	15	10
Gas Leaving Boiler	lb/hr	127,000	123,000
Gas Temp. Leaving Boiler	°F	550	550
Gas Temp. Leaving Economizer	°F	365	365
Ambient Air	°F		
- Temperature		80	80
- Relative Humidty	%	60	60
Air Leaving FD Fan	lb/hr	120,000	117,000
Heat Input	Btu/hr	139×10^6	145×10^6
Pressure Drop (at Elev. 734 ft)			
Windbox	"w.g.	5.3	5.1
Air Ducts	"w.g.	0.2	0.2
FD Fan Inlet Duct & Silencer	"w.g.	1.0	1.0
Boiler Bank	"w.g.	4.0	3.8
Economizer	"w.g.	1.2	1.1
Gas Ducts	"w.g.	1.0	1.0
Total	"w.g.	12.7	12.2

*NOTES: * These performance figures are predicted only and are not to be construed as being guaranteed except where the points coincide with the guarantees.

** MSSV - Main Steam Stop Valve

#2 Oil - % by wgt.

Carbon	86.5
Hydrogen	13.0
Oxygen	0.1
Nitrogen	0.1
Sulfur	0.3

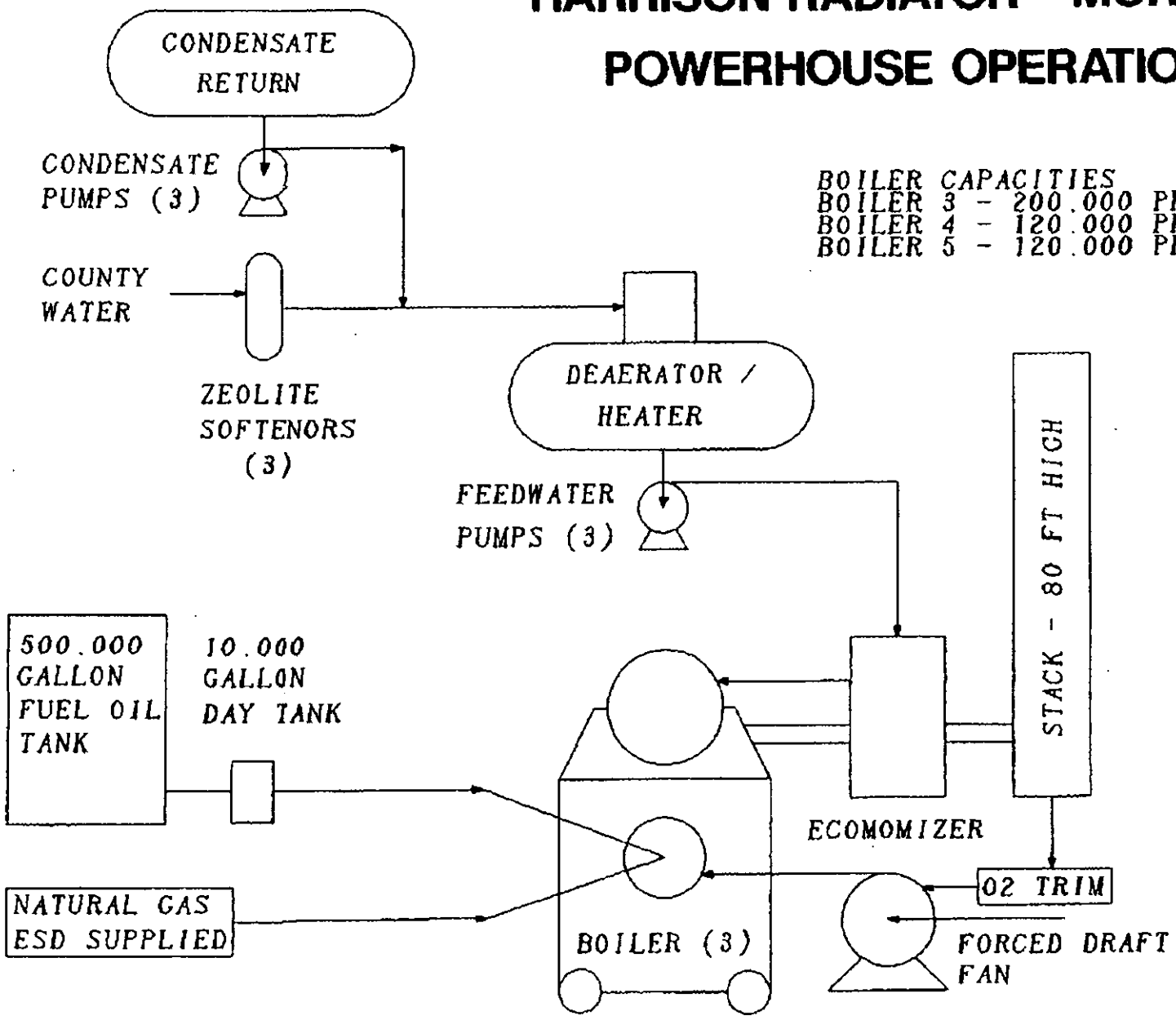
HHV = 19,500 Btu/lb

Natural Gas - % by Volume

Methane	96.02	N - Pentane	0.01
Ethane	2.09	I - Pentane	0.02
Propane	0.23	N - Hexane	0.03
N - Butane	0.04	Nitrogen	0.58
I - Butane	0.03	Carbon Dioxide	0.95

HHV = 1,022 Btu/SCF

HARRISON RADIATOR - MORAINE
POWERHOUSE OPERATION



METHOD 1 TRAVERSE POINT LOCATION FOR CIRCULAR DUCTS

Client: HARRISON Radiator PN: 205.011 Date: 2-8-90

Source: Boiler 3 Site: Outlet Run: 1,2,3

Calculated By: TB

INSIDE OF FAR WALL TO OUTSIDE OF NIPPLE: 78"

INSIDE OF NEAR WALL TO OUTSIDE OF NIPPLE: 5"

STACK I.D.: 73"

NEAREST UPSTREAM DISTURBANCE: 114" (1.56 DIA)

NEAREST DOWNSTREAM DISTURBANCE: 666" (9.12 DIA)

TRAVERSE POINT NUMBER	FRACTION OF STACK I.D. (Y)	STACK DIAMETER (Ø)	(Y) X (Ø)	NIPPLE DEPTH	TRAVERSE POINT LOCATION
1	3.2	73"	2.34	5"	7 3/8
2	10.5	↓	7.67	↓	12 5/8
3	19.4	↓	14.16	↓	19 1/8
4	32.3	↓	23.58	↓	28 5/8
5	67.7	↓	49.42	↓	54 3/8
6	80.6	↓	58.84	↓	63 7/8
7	89.5	↓	65.34	↓	70 3/8
8	96.5	↓	70.66	↓	75 5/8

HAYDEN ENVIRONMENTAL GROUP, INC.

METHOD 7 NOx DATA

Client: HARRISON RADIATOR PN: 205.011 Date: 2-9-90
Source: OUTLET Site: BOILER 7 Run: 1
Operator: BS

	DATA \ RUN	1A	1B	1C	1D
DATE		2-8-90	2-8-90	2-8-90	2-8-90
TIME		0910	0925	0940	0955
FLASK I.D.		16P	17P	18P	19P
FLASK VOL (Vf, mls)		2137 ~~2045~~	2075	2116	2196
Pb (i) (mm Hg)		746.5	746.5	746.5	746.5
VACUUM (mm Hg)		690	690	690	690
ABSOLUTE PRESSURE (Pi, mm Hg)					
TEMP. (Ti, °C)		8.3	9.1	9.3	12.7

SAMPLING DATA

	DATA \ RUN	1A	1B	1C	1D
DATE		2-9-90	2-9-90	2-9-90	2-9-90
TIME		0818	0826	0834	0843
Pb (f) (mm Hg)		740.5	740.5	740.5	740.5
VACUUM (mm Hg)		18	106	54	22
ABSOLUTE PRESSURE (Pf, mm Hg)					
TEMP. (Tf, °C)		16.8	15.3	19.5	20.5
SAMPLE VOL (Vsc, mls)		35	35	35	35

RECOVERY DATA

$$Vsg = (0.3858)(Vf - 25)[(Pf + [Tf + 273)] - [Pi \div (Ti + 273)]]$$

HAYDEN ENVIRONMENTAL GROUP, INC.

METHOD 2 VELOCITY FIELD DATA

Client: HARRISON Radiator
PN: 205.011
Date: 2-8-90
Source: Boiler 3 GAS
Site: Outlet
Run: 1
Operators: TB, BS
Barometric Pressure (Pb): 29.39
Static Pressure (Pg): -0.28

Pitot Tube I.D.: 8A
Thermocouple I.D.: 8A
Pre-Test Leak Check: OK
Post-Test Leak Check: OK
Stack I.D.: 73"

METHOD 4 DATA
Wet Bulb Thermocouple I.D.:
Dry Bulb Thermocouple I.D.:
Tempertures (°F); Wet: Dry:

TRAVERSE POINT NUMBER	ΔP (" H20)	STACK TEMPERATURE (°F)	TRAVERSE POINT NUMBER	ΔP (" H20)	STACK TEMPERATURE (°F)
1	0.29	320	1	0.31	322
2	0.33	324	2	0.33	330
3	0.36	330	3	0.37	332
4	0.37	332	4	0.37	333
5	0.37	333	5	0.38	333
6	0.36	334	6	0.39	334
7	0.35	333	7	0.34	333
8	0.20	332	8	0.27	329

NOTES:
O2:
CO2:
Bws:
ΔP:
√ΔP: 0.5767
Ts: 312
Vs:
Qa:
Qstd:

SKETCH

HAYDEN ENVIRONMENTAL GROUP INC.

EMISSION TESTING FIELD DATA

Client: Harrison Radiator
PN: 205.011
Date: 2-8-90
Source: Boiler 3
Site: Outlet
Sample Type: Moisture
Run: 1
Operators: TB, BS
Barometric Pressure (Pb):
Static Pressure (Pg):

Meter Box #: N-3
Sample Box #: 4
Filter #:
Probe Length/Type:
Stack Thermocouple #:
Oven Thermocouple #: ~~I-7~~
Impinger Thermcouple #: I-4
Pitot Tube #:
Stack I.D.: 23"
Record Data Every 10 Minutes

Meter ΔH@: 1.98
Meter Y Factor: 0.988
C Factor:
Reference ΔP:
Nozzle I.D.: — — — Avg.
Pre-Test Leak Rate: .002 cfm@ 10 "Hg
Post-Test Leak Rate: .002 cfm@ 10 "Hg
Pitot Tube Leak Check: Pre: — Post: —
Orsat Train Leak Check: Pre: ✓ Post: ✓
Page 1 of 1

TRAVERSE POINT NUMBER	SAMPLING TIME (min)	CLOCK TIME (hr)	METER READING (cu ft)	VELOCITY PRESSURE ΔP ("H2O)	ORIFICE PRESSURE ΔH@ ("H2O) DESIRED	ORIFICE PRESSURE ΔH@ ("H2O) ACTUAL	TRAIN VACUUM ("Hg)	TEMPERATURES (°F) STACK	FILTER	PROBE	IMP	METER
	0	0910	321.935									
	10	0920	330.180			2	4				42	46
	20	0930	336.800			2	4				46	49
	30	0940	343.915			2	4				46	50
	40	0950	350.970			2	4				46	51
	50	1000	358.010			2	4				48	52
	60	1010	365.039			2	4				46	53
	60		43.104			2						50

HAYDEN
ENVIRONMENTAL GROUP, INC.

SAMPLE RECOVERY DATA

Client: HARRISON RADIATOR PN: 205.011 Date: 2-7-90

Source: OUTLET Site: BOILER 3 Run: 1

Sample Date: 2-8-90 Recovery Date: 2-8-90

FILTER NO.: NA GLASSWARE SET NO.: 7 SAMPLE BOX NO.: 4

IMPINGER DATA

GRAVIMETRIC: ✓ VOLUMETRIC: _____

	#1	#2	#3	#4	#5	TOTAL
FINAL	640.4	596.8	433.0	521.6		
INITIAL	502.2	557.5	432.4	512.7		
NET	138.2	39.3	0.6	8.9		187.0

RECOVERED SAMPLE

DESCRIPTION OF PARTICULATE ON FILTER: NA

COLOR OF SILICA GEL: 90 % BLUE

BY: BJ

HAYDEN ENVIRONMENTAL GROUP, INC.

METHOD 3 ORSAT DATA

Client: HARRISON Radiator PN: 205.011 Date: 2-8-90
Source: Boiler 3 Site: outlet Run: 1
Operator: TB

		Carbon Dioxide (CO2)	Oxygen (O2) (1)	Carbon Monoxide (CO) (2)	Nitrogen (N2) (3)
Run 1	Actual %	7.8	9.8		
	Net %	7.8	2.0		
Run 2	Actual %	7.4	8.8		
	Net %	7.4	1.4		
Run 3	Actual %	7.4	9.8		
	Net %	7.4	2.4		
Average		7.5	1.9		

$$Fo = \frac{20.9\% - \%O2}{\%CO2}$$

$$Fo = \frac{20.9\% - (\quad)}{(\quad)}$$

Fo = _____

Expected Fo Value = _____

(1) Net is Actual O2 reading minus the Actual CO2 reading.

(2) Net is Actual CO reading minus the Actual O2 reading.

(3) Net is 100 minus the Actual CO reading.

HAYDEN ENVIRONMENTAL GROUP, INC.

METHOD 7 NOx DATA

Client: HARRISON RADIATOR PN: 205.017 Date: 2-8-90
Source: OUTLET Site: BOILER 3 Run: 2
Operator: BS

SAMPLING DATA	RUN / DATA	2A	2B	2C	2D
DATE		2-8-90	2-8-90	2-8-90	2-8-90
TIME		1050	1105	1120	1135
FLASK I.D.		20P	21P	22P	25P ~~23P~~
FLASK VOL (Vf, mls)		2110	2064	2124	2120 ~~2089~~
Pb (i) (mm Hg)		746.5	746.5	746.5	746.5
VACUUM (mm Hg)		690	690	690	690
ABSOLUTE PRESSURE (Pi, mm Hg)					
TEMP. (Ti, °C)		15.6	15.0	15.1	14.5 ~~15.8~~

RECOVERY DATA	RUN / DATA	2A	2B	2C	2P
DATE		2-9-90	2-9-90	2-9-90	2-9-90
TIME		1101	1102	1110	1110
Pb (f) (mm Hg)		740.5	740.5	740.5	740.5
VACUUM (mm Hg)		0	0	0	8
ABSOLUTE PRESSURE (Pf, mm Hg)					
TEMP. (Tf, °C)		18.6	18.7	18.6	18.6
SAMPLE VOL (Vsc, mls)		35	35	35	35

$$Vsg = (0.3858)\ (Vf - 25)\ \{(Pf \div [Tf + 273]) - (Pi \div [Ti + 273])\}$$

HAYDEN ENVIRONMENTAL GROUP, INC.

METHOD 2 VELOCITY FIELD DATA

Client: HARRISON Radiator
PN: 205.011
Date: 2-8-90
Source: Boiler 3 GAS
Site: Outlet
Run: 2
Operators: TB, BS
Barometric Pressure (Pb): 29.39
Static Pressure (Pg): -0.28

Pitot Tube I.D.: 8A
Thermocouple I.D.: 8A
Pre-Test Leak Check: OK
Post-Test Leak Check: OK
Stack I.D.: 77"

METHOD 4 DATA

Wet Bulb Thermocouple I.D.:
Dry Bulb Thermocouple I.D.:
Tempertures (°F); Wet: Dry:

TRAVERSE POINT NUMBER	ΔP (" H20)	STACK TEMPERATURE (°F)	TRAVERSE POINT NUMBER	ΔP (" H20)	STACK TEMPERATURE (°F)
1	0.27	316	1	0.25	318
2	0.30	315	2	0.29	320
3	0.32	325	3	0.31	324
4	0.33	325	4	0.33	326
5	0.35	328	5	0.34	329
6	0.34	330	6	0.33	331
7	0.32	331	7	0.31	330
8	0.21	331	8	0.21	329

NOTES:
O2:
CO2:
Bws:
ΔP: 0.30
√ΔP: 0.5468
Ts: 326
Vs:
Qa:
Qstd:

SKETCH

HAYDEN

EMISSION TESTING FIELD DATA

Client: Harrison Radiator
PN: 205.011
Date: 2-8-90
Source: Boiler 3 GAS
Site: Outlet
Sample Type: moisture
Run: 2
Operators: TB, BS
Barometric Pressure (Pb):
Static Pressure (Pg):

Meter Box #: N-3
Sample Box #: 4
Filter #:
Probe Length/Type:
Stack Thermocouple #:
Oven Thermocouple #:
Impinger Thermcouple #: I-4
Pitot Tube #:
Stack I.D.: 72"
Record Data Every 10.0 Minutes

Meter ΔH@: 1.98
Meter Y Factor: 0.988
C Factor:
Reference ΔP:
Nozzle I.D.: — — — Avg.
Pre-Test Leak Rate: .002 cfm@ 10 "Hg
Post-Test Leak Rate: .003 cfm@ 7 "Hg
Pitot Tube Leak Check: Pre: — Post: —
Orsat Train Leak Check: Pre: ✓ Post: ✓
Page 1 of 1

TRAVERSE POINT NUMBER	SAMPLING TIME (min)	CLOCK TIME (hr)	METER READING (cu ft)	VELOCITY PRESSURE ΔP ("H2O)	ORIFICE PRESSURE ΔH@ ("H2O)		TRAIN VACUUM ("Hg)	TEMPERATURES (°F)				
					DESIRED	ACTUAL		STACK	FILTER	PROBE	IMP	METER
	0	1050	365.173									
	10	1100	372.180			2	4				50	53
	20	1110	378.985			2	4				47	55
	30	1120	385.870			2	4				50	57
	40	1130	393.135			2	4				49	57
	50	1140	399.530			2	4				49	58
	60	1150	406.350			2	4				50	59
	60		41.177			2						56

HAYDEN

SAMPLE RECOVERY DATA

Client: HARRISON RADIATOR PN: 205.011 Date: 2-8-90

Source: OUTLET Site: BOILER 3 Run: 2

Sample Date: 2-8-90 Recovery Date: 2-8-90

FILTER NO.: NA GLASSWARE SET NO.: 8 SAMPLE BOX NO.: 4

IMPINGER DATA

GRAVIMETRIC: ✓ VOLUMETRIC:

	#1	#2	#3	#4	#5	TOTAL
FINAL	627.3	779.8	434.1	528.7		
INITIAL	640.4	596.8	433.0	521.6		
NET	-13.1	183.0	1.1	7.1		178.1

RECOVERED SAMPLE

DESCRIPTION OF PARTICULATE ON FILTER: NA

COLOR OF SILICA GEL: 80% BLUE

BY: BS

HAYDEN ENVIRONMENTAL GROUP, INC.

METHOD 3 ORSAT DATA

Client: HARRISON Radiator PN: 205.011 Date: 2-8-90
Source: Boiler 3 Site: outlet Run: 2
Operator: TB

		Carbon Dioxide (CO2)	Oxygen (O2) [1]	Carbon Monoxide (CO) [2]	Nitrogen (N2) [3]
Run 1	Actual %	8.4	11.0		
	Net %	8.4	2.6		
Run 2	Actual %	9.2	12.0		
	Net %	9.2	2.8		
Run 3	Actual %	8.8	11.4		
	Net %	8.8	2.6		
Average		8.8	2.7		

$$Fo = \frac{20.9\% - \%O2}{\%CO2}$$

$$Fo = \frac{20.9\% - (\quad)}{(\quad)}$$

Fo = _____

Expected Fo Value = _____

(1) Net is Actual O2 reading minus the Actual CO2 reading.

(2) Net is Actual CO reading minus the Actual O2 reading.

(3) Net is 100 minus the Actual CO reading.

HAYDEN ENVIRONMENTAL GROUP, INC

METHOD 7 NOx DATA

Client: [illegible] PN: 205.011 Date: 2-8-90
Source: OUTLET Site: OUTLET 3 Run: 3
Operator: GS

SAMPLING DATA	RUN / DATA	3A	3B	3C	3D
DATE		2-8-90	2-8-90	2-8-90	2-8-90
TIME		1300	1315	1330	1345
FLASK I.D.		27P	28P	29P	30P
FLASK VOL (Vf, mls)		2037 ~~2435~~	2037	2117	2118
Pb (i) (mm Hg)		746.5	746.5	746.5	746.5
VACUUM (mm Hg)		690	690	690	690
ABSOLUTE PRESSURE (Pi, mm Hg)					
TEMP. (Ti, °C)		15.8	15.1	16.1	17.0

RECOVERY DATA	RUN / DATA	3A	3B	3C	3D
DATE		2-9-90	2-9-90	2-9-90	2-9-90
TIME		1120	1121	1134	1135
Pb (f) (mm Hg)		740.5	740.5	740.5	740.5
VACUUM (mm Hg)		38	0	10	0
ABSOLUTE PRESSURE (Pf, mm Hg)					
TEMP. (Tf, °C)		17.1	17.4	17.7	17.6
SAMPLE VOL (Vsc, mls)		35	35	35	35

$$Vsg = (0.3858)\ (Vf - 25)\ [(Pf \div [Tf + 273)] - [Pi \div (Ti + 273)]]$$

HAYDEN ENVIRONMENTAL GROUP, INC.

METHOD 2 VELOCITY FIELD DATA

Client: HARRISON Radiator
PN: 205.011
Date: 2-8-90
Source: Boiler 3 Gas
Site: Outlet
Run: 3
Operators: TB, BS
Barometric Pressure (Pb): 29.39
Static Pressure (Pg): -0.28

Pitot Tube I.D.: 8A
Thermocouple I.D.: 8A
Pre-Test Leak Check: OK
Post-Test Leak Check: OK
Stack I.D.: 72"

METHOD 4 DATA
Wet Bulb Thermocouple I.D.:
Dry Bulb Thermocouple I.D.:
Tempertures (°F); Wet: Dry:

TRAVERSE POINT NUMBER	ΔP (" H20)	STACK TEMPERATURE (°F)	TRAVERSE POINT NUMBER	ΔP (" H20)	STACK TEMPERATURE (°F)
1	0.28	318	1	0.32	321
2	0.32	320	2	0.33	332
3	0.34	331	3	0.38	333
4	0.37	325	4	0.36	333
5	0.36	332	5	0.38	334
6	0.36	330	6	0.35	332
7	0.35	331	7	0.32	331
8	0.21	329	8	0.28	325

NOTES:
O2:
CO2:
Bws:
ΔP:
√ΔP: 0.5747
Ts: 329
Vs:
Qa:
Qstd:

SKETCH

HAYDEN ENVIRONMENTAL GROUP INC.

EMISSION TESTING FIELD DATA

Client: HARRISON Radiator
PN: 205.011
Date: 2-8-90
Source: Boiler 3
Site: Outlet
Sample Type:
Run: 3
Operators: TB, BS
Barometric Pressure (Pb):
Static Pressure (Pg):

Meter Box #: N-3
Sample Box #: 4
Filter #:
Probe Length/Type:
Stack Thermocouple #:
Oven Thermocouple #:
Impinger Thermocouple #: I-4
Pitot Tube #:
Stack I.D.: 72"
Record Data Every 10.0 Minutes

Meter ΔH@: 1.98
Meter Y Factor: 0.988
C Factor:
Reference ΔP:
Nozzle I.D.: — — — Avg.
Pre-Test Leak Rate: .002 cfm@ 10 "Hg
Post-Test Leak Rate: .002 cfm@ 7 "Hg
Pitot Tube Leak Check: Pre: — Post: —
Orsat Train Leak Check: Pre: ✓ Post: ✓
Page 1 of 1

TRAVERSE POINT NUMBER	SAMPLING TIME (min)	CLOCK TIME (hr)	METER READING (cu ft)	VELOCITY PRESSURE ΔP ("H2O)	ORIFICE PRESSURE ΔH@ ("H2O)		TRAIN VACUUM ("Hg)	TEMPERATURES (°F)				
					DESIRED	ACTUAL		STACK	FILTER	PROBE	IMP	METER
	0	0100	406.471									
	10	0110	413.680			2	4				47	60
	20	0120	420.830			2	4				49	62
	30	0130	427.935			2	4				50	63
	40	0140	434.980			2	4				50	64
	50	0150	441.950			2	4				50	64
	60	0200	448.920			2	2				51	65
	60		42.449			2						63

HAYDEN

9.0 2.0

SAMPLE RECOVERY DATA

Client: HARRISON RADIATOR PN: 205.011 Date: 7-8-90

Source: OUTLET Site: BOILER 7 Run: 3

Sample Date: 2-8-90 Recovery Date: _____

FILTER NO.: NA GLASSWARE SET NO.: 9 SAMPLE BOX NO.: 4

IMPINGER DATA

GRAVIMETRIC: _____ VOLUMETRIC: _____

	#1	#2	#3	#4	#5	TOTAL
FINAL	636.7	594.3	435.1	535.4		
INITIAL	470.5	587.3	434.1	528.7		
NET	166.2	7.0	1.0	6.7		180.9

RECOVERED SAMPLE

DESCRIPTION OF PARTICULATE ON FILTER: _____

COLOR OF SILICA GEL: 10% BLUE

BY: BS

HAYDEN ENVIRONMENTAL GROUP, INC.

METHOD 3 ORSAT DATA

Client: HARRISON Radiator PN: 205.011 Date: 2-8-90
Source: BOILER 3 Site: outlet Run: 3
Operator: TB

		Carbon Dioxide (CO2)	Oxygen (O2) (1)	Carbon Monoxide (CO) (2)	Nitrogen (N2) (3)
Run 1	Actual %	8.6	10.6		
	Net %	8.6	2.0		
Run 2	Actual %	8.4	10.6		
	Net %	8.4	2.2		
Run 3	Actual %	8.6	10.8		
	Net %	8.6	2.2		
Average		8.5	2.1		

$$Fo = \frac{20.9\% - \%O2}{\%CO2}$$

$$Fo = \frac{20.9\% - (\quad)}{(\quad)}$$

Fo = _____

Expected Fo Value = _____

(1) Net is Actual O2 reading minus the Actual CO2 reading.

(2) Net is Actual CO reading minus the Actual O2 reading.

(3) Net is 100 minus the Actual CO reading.

HAYDEN ENVIRONMENTAL GROUP, INC.

METHOD 1 TRAVERSE POINT LOCATION FOR CIRCULAR DUCTS

Client: HARRISON Radiator PN: 205.011 Date: 2-5-90

Source: Boiler 4+5 Site: Outlet Run: 1,2,3

Calculated By: TB

INSIDE OF FAR WALL TO OUTSIDE OF NIPPLE: 82"

INSIDE OF NEAR WALL TO OUTSIDE OF NIPPLE: 5"

STACK I.D.: 77"

NEAREST UPSTREAM DISTURBANCE: 114" (1.5 DIA)

NEAREST DOWNSTREAM DISTURBANCE: 354" (4.60 DIA)

TRAVERSE POINT NUMBER	FRACTION OF STACK I.D. (Y)	STACK DIAMETER (Ø)	(Y) X (Ø)	NIPPLE DEPTH	TRAVERSE POINT LOCATION
1	3.2	77"	2.50	5"	7 1/2
2	10.5		8.10		13 1/8
3	19.4		14.9		19 7/8
4	32.3		24.9		29 7/8
5	67.7		52.1		57 1/8
6	80.6		62.1		67 1/8
7	89.5		68.9		73 7/8
8	96.8		74.5		79 1/2

HAYDEN ENVIRONMENTAL GROUP, INC.

METHOD 7 NOx DATA

Client: HARRISON RADIATOR PN: 205.011 Date: 2-6-90
Source: OUTLET Site: BOILER 4 Run: 1
Operator: BS

SAMPLING DATA

DATA \ RUN		1A	1B	1C	1D
DATE		2-6-90	2-6-90	2-6-90	2-6-90
TIME		0945	1000	1015	1030
FLASK I.D.		1H	2H	3H	4H
FLASK VOL (Vf, mls)		2073	2042	2090	2042
Pb (i) (mm Hg)		749.5	749.5	749.5	749.5
VACUUM (mm Hg)		690	690	690	690
ABSOLUTE PRESSURE (Pi, mm Hg)					
TEMP. (Ti, °C)		9.3	11.1	10.9	10.6

RECOVERY DATA

DATA \ RUN		1A	1B	1C	1D
DATE		2-9-90	2-9-90	2-9-90	2-9-90
TIME		1422	1423	1439	1439
Pb (f) (mm Hg)		740.5	740.5	740.5	740.5
VACUUM (mm Hg)		0	0	~~19.2~~ 0	0
ABSOLUTE PRESSURE (Pf, mm Hg)					
TEMP. (Tf, °C)		19.9	20.0	19.2	19.5
SAMPLE VOL (Vsc, mls)		35	35	35	35

$$Vsg = (0.3858)\ (Vf - 25)\ \{(Pf \div [Tf + 273]) - [Pi \div (Ti + 273)]\}$$

HAYDEN ENVIRONMENTAL GROUP, INC.

METHOD 2 VELOCITY FIELD DATA

Client: HARRISON Radiator
PN: 205.011
Date: 1-7-90
Source: Boiler 4 OIL
Site: outlet
Run: 1
Operators: TB, BS
Barometric Pressure (Pb): 749.5 29.51
Static Pressure (Pg): ~ 0.11

Pitot Tube I.D.: 8A
Thermocouple I.D.: 8A
Pre-Test Leak Check: OK
Post-Test Leak Check: OK
Stack I.D.: 77"

METHOD 4 DATA

Wet Bulb Thermocouple I.D.:
Dry Bulb Thermocouple I.D.:
Tempertures (°F); Wet: Dry:

TRAVERSE POINT NUMBER	ΔP (" H20)	STACK TEMPERATURE (°F)	TRAVERSE POINT NUMBER	ΔP (" H20)	STACK TEMPERATURE (°F)
1	0.10	360	1	0.09	364
2	0.10	363	2	0.10	363
3	0.10	366	3	0.11	364
4	0.10	368	4	0.11	368
5	0.09	376	5	0.10	372
6	0.09	379	6	0.09	375
7	0.08	383	7	0.07	374
8	0.06	382	8	0.06	367

NOTES:
O2:
CO2:
Bws:
ΔP:
√ΔP: 0.2999
Ts: 370
Vs:
Qa:
Qstd:

SKETCH

HAYDEN ENVIRONMENTAL GROUP, INC.

EMISSION TESTING FIELD DATA

Client: HARRISON Radiator
PN: 205.011
Date: 2-6-90
Source: Boiler 4
Site: outlet
Sample Type: Moisture
Run: 1
Operators: TB
Barometric Pressure (Pb):
Static Pressure (Pg):

Meter Box #: N-3
Sample Box #: 3
Filter #:
Probe Length/Type:
Stack Thermocouple #:
Oven Thermocouple #:
Impinger Thermocouple #: I-3
Pitot Tube #:
Stack I.D.: 77"
Record Data Every 10.0 Minutes

Meter ΔH@: 1.98
Meter Y Factor: 0.988
C Factor:
Reference ΔP:
Nozzle I.D.: — — — Avg.
Pre-Test Leak Rate: .001 cfm@ 10 "Hg
Post-Test Leak Rate: .001 cfm@ 7 "Hg
Pitot Tube Leak Check: Pre: — Post: —
Orsat Train Leak Check: Pre: — Post: —
Page 1 of 1

TRAVERSE POINT NUMBER	SAMPLING TIME (min)	CLOCK TIME (hr)	METER READING (cu ft)	VELOCITY PRESSURE ΔP ("H2O)	ORIFICE PRESSURE ΔH@ ("H2O) DESIRED	ORIFICE PRESSURE ΔH@ ("H2O) ACTUAL	TRAIN VACUUM ("Hg)	TEMPERATURES (°F) STACK	FILTER	PROBE	IMP	METER
	0	945	063.488								39	42
	10	955	070.590			2.0	5				45	46
center of stack	20	1005	077.520			2.0	5				51	50
	30	1015	084.550			2.0	5				54	52
	40	1025	091.540			2.0	5				51	55
	50	1035	098.500			2.0	5				52	56
	60	1045	105.454			2.0	5					
						2						
	60		41.966			2.0						50

HAYDEN

SAMPLE RECOVERY DATA

Client: HARRISON RADIATOR PN: 205.011 Date: 7-5-90

Source: OUTLET Site: BOILER 4 Run: 1

Sample Date: 2-6-90 Recovery Date: 2-6-90

FILTER NO.: NA GLASSWARE SET NO.: 1 SAMPLE BOX NO.: 3

IMPINGER DATA

GRAVIMETRIC: ✓ VOLUMETRIC: _____

	#1	#2	#3	#4	#5	TOTAL
FINAL	696.7	546.5	455.7	651.5		
INITIAL	544.8	541.9	454.3	633.4		
NET	151.9	4.6	1.4	18.1		176.0

RECOVERED SAMPLE

DESCRIPTION OF PARTICULATE ON FILTER: NA

COLOR OF SILICA GEL: 70% BLUE

BY: BS, TB

HAYDEN ENVIRONMENTAL GROUP, INC.

METHOD 3 FYRITE DATA

Client: HARRISON Radiator PN: 205.011 Date: 2/6/90
Source: BOILER 4 Site: OUTLET Run: 1
Operator: TB

	Oxygen (O2)	Carbon Dioxide (CO2)
Run 1	5.0	9.5
Run 2	4.5	9.5
Run 3	4.0	10.0
Average	4.5	9.7

HAYDEN
ENVIRONMENTAL GROUP, INC.

METHOD 3 FYRITE DATA

Client: HARRISON Radiator PN: 205.011 Date: 2/6/90
Source: BOILER 4 Site: OUTLET Run: 1
Operator: TB

	Oxygen (O2)	Carbon Dioxide (CO2)
Run 1	5.0	9.5
Run 2	4.5	9.5
Run 3	4.0	10.0
Average	4.5	9.7

HAYDEN
ENVIRONMENTAL GROUP, INC.

METHOD 7 NOx DATA

Client: HARRISON RADIATOR PN: 205.011 Date: 2-6-90
Source: OUTLET Site: BOILER 4 Run: 2
Operator: BL

	DATA \ RUN	2A	2B	2C	2D
SAMPLING DATA	DATE	2-6-90	2-6-90	2-6-90	2-6-90
	TIME	1110	1125	1140	1155
	FLASK I.D.	6H	11H	12H	13H
	FLASK VOL (Vf, mls)	2060	2065	2064	2062
	Pb (i) (mm Hg)	749.5	749.5	749.5	749.5
	VACUUM (mm Hg)	690	690	690	690
	ABSOLUTE PRESSURE (Pi, mm Hg)				
	TEMP. (Ti, °C)	10.2	9.8	18.1	13.9

	DATA \ RUN	2A	2B	2C	2D
RECOVERY DATA	DATE	2-9-90	2-9-90	2-9-90	2-9-90
	TIME	1443	1444	1500	1501
	Pb (f) (mm Hg)	740.5	740.5	740.5	740.5
	VACUUM (mm Hg)	0	0	0	0
	ABSOLUTE PRESSURE (Pf, mm Hg)				
	TEMP. (Tf, °C)	20.5	17.8	18.4	18.0
	SAMPLE VOL (Vsc, mls)	35	35	35	35

$$Vsg = (0.3858)\ (Vf - 25)\ [(Pf + [Tf + 273)] - [Pi + (Ti + 273)]]$$

HAYDEN ENVIRONMENTAL GROUP, INC.

METHOD 2 VELOCITY FIELD DATA

Client: HARRISON Radiator
PN: 205.011
Date: 2-6-90
Source: Boiler 4
Site: Outlet
Run: 2
Operators: TB, BS
Barometric Pressure (Pb): 749.5mm 29.51
Static Pressure (Pg): -0.13

Pitot Tube I.D.: 8A
Thermocouple I.D.: 8A
Pre-Test Leak Check: OK
Post-Test Leak Check: OK
Stack I.D.: 77"

METHOD 4 DATA

Wet Bulb Thermocouple I.D.:
Dry Bulb Thermocouple I.D.:
Tempertures (°F); Wet: Dry:

TRAVERSE POINT NUMBER	ΔP (" H20)	STACK TEMPERATURE (°F)	TRAVERSE POINT NUMBER	ΔP (" H20)	STACK TEMPERATURE (°F)
1	0.18	326	1	0.14	324
2	0.20	323	2	0.15	324
3	0.21	324	3	0.15	323
4	0.18	327	4	0.15	326
5	0.07	332	5	0.13	329
6	0.06	334	6	0.13	330
7	0.08	334	7	0.11	332
8	0.07	320	8	0.12	322

NOTES:
O2:
CO2:
Bws:
ΔP:
√ΔP: 0.3591
Ts: 327
Vs:
Qa:
Qstd:

SKETCH

HAYDEN ENVIRONMENTAL GROUP, INC.

EMISSION TESTING FIELD DATA

Client: Harrison Radiator
PN: 205.011
Date: 2-6-90
Source: Boiler 4
Site: Outlet
Sample Type: Moisture
Run: 2
Operators: TB, BS
Barometric Pressure (Pb):
Static Pressure (Pg):

Meter Box #: N-3
Sample Box #: 4
Filter #:
Probe Length/Type:
Stack Thermocouple #:
Oven Thermocouple #:
Impinger Thermocouple #: I-4
Pitot Tube #:
Stack I.D.: 77"
Record Data Every 10.0 Minutes

Meter ΔH@: 1.98
Meter Y Factor: 0.988
C Factor:
Reference ΔP:
Nozzle I.D.: — — — Avg.
Pre-Test Leak Rate: .001 cfm@ 10 "Hg
Post-Test Leak Rate: .001 cfm@ 7 "Hg
Pitot Tube Leak Check: Pre: — Post: —
Orsat Train Leak Check: Pre: — Post: —
Page 1 of 1

TRAVERSE POINT NUMBER	SAMPLING TIME (min)	CLOCK TIME (hr)	METER READING (cu ft)	VELOCITY PRESSURE ΔP ("H2O)	ORIFICE PRESSURE ΔH@ ("H2O)		TRAIN VACUUM ("Hg)	TEMPERATURES (°F)				
					DESIRED	ACTUAL		STACK	FILTER	PROBE	IMP	METER
	0	1110	105.561									
	10	1120	112.870			2.0	4				42	53
center of stack	20	1130	120.105			2.0	4				48	56
	30	1140	126.950			2.0	4				53	60
	40	1150	134.325			2.0	4				57	62
	50	1200	141.100			2.0	4				60	66
	60	1210	148.170			2.0	4				57	66
	60		42.609			2.0						60

HAYDEN

SAMPLE RECOVERY DATA

Client: HARRISON RADIATOR PN: 205.011 Date: 2-5-90

Source: OUTLET Site: BOILER 4 Run: 2

Sample Date: 2-6-90 Recovery Date: 2-6-90

FILTER NO.: M GLASSWARE SET NO.: 2 SAMPLE BOX NO.: 4

IMPINGER DATA

GRAVIMETRIC: ✓ VOLUMETRIC: _____

	#1	#2	#3	#4	#5	TOTAL
FINAL	610.2	566.7	432.6	542.0		
INITIAL	471.7	551.1	429.1	521.4		
NET	138.5	15.6	3.5	20.6		178.2

RECOVERED SAMPLE

DESCRIPTION OF PARTICULATE ON FILTER: NA

COLOR OF SILICA GEL: 30%

BY: BS

HAYDEN ENVIRONMENTAL GROUP, INC.

METHOD 3 FYRITE DATA

Client: HARRISON Radiator PN: 205 011 Date: 2-6-90
Source: Boiler 4 Site: outlet Run: 2
Operator: TB

	Oxygen (O2)	Carbon Dioxide (CO2)
Run 1	3.5	9.5
Run 2	3.0	9.5
Run 3	3.0	10.0
Average	3.2	9.7

HAYDEN ENVIRONMENTAL GROUP, INC.

METHOD 7 NOx DATA

Client: HARRISON RADIATOR PN: 205.011 Date: 2-6-90
Source: OUTLET Site: BOILER 4 Run: 3
Operator: BL

SAMPLING DATA

DATA \ RUN		3A	3B	3C	3D
DATE		2-6-90	2-6-90	2-6-90	2-6-90
TIME		1345	1400	1415	1430
FLASK I.D.		9H	10H	14H	~~15H~~ 16H
FLASK VOL (Vf, mls)		2004	1972	2057	~~2070~~ 2050
Pb (i) (mm Hg)		749.5	749.5	749.5	749.5
VACUUM (mm Hg)		690	690	690	690
ABSOLUTE PRESSURE (Pi, mm Hg)					
TEMP. (Ti, °C)		12.9	13.1	12.0	~~13.1~~ 12.6

RECOVERY DATA

DATA \ RUN		3A	3B	3C	3D
DATE		2-9-90	2-9-90	2-9-90	2-9-90
TIME		1508	1509	1515	1516
Pb (f) (mm Hg)		740.5	740.5	740.5	740.5
VACUUM (mm Hg)		0	0	0	0
ABSOLUTE PRESSURE (Pf, mm Hg)					
TEMP. (Tf, °C)		18.1	17.9	19.3	19.5
SAMPLE VOL (Vsc, mls)		35	35	35	35

$$Vsg = (0.3858)\,(Vf - 25)\,((Pf \div [Tf + 273]) - [Pi \div (Ti + 273)])$$

HAYDEN ENVIRONMENTAL GROUP, INC.

METHOD 2 VELOCITY FIELD DATA

Client: HARRISON Radiator
PN: 205.011
Date: 2-6-90
Source: Boiler 4
Site: Outlet
Run: 3
Operators: TB, BS
Barometric Pressure (Pb): 29.51
Static Pressure (Pg): -0.11

Pitot Tube I.D.: 8A
Thermocouple I.D.: 8A
Pre-Test Leak Check: OK
Post-Test Leak Check: OK
Stack I.D.: 77"

METHOD 4 DATA

Wet Bulb Thermocouple I.D.: NA
Dry Bulb Thermocouple I.D.: NA
Tempertures (°F); Wet: NA Dry: NA

TRAVERSE POINT NUMBER	ΔP (" H20)	STACK TEMPERATURE (°F)	TRAVERSE POINT NUMBER	ΔP (" H20)	STACK TEMPERATURE (°F)
1	0.20	321	1	0.12	324
2	0.21	323	2	0.14	325
3	0.20	326	3	0.15	325
4	0.18	327	4	0.16	324
5	0.08	329	5	0.17	325
6	0.08	330	6	0.15	325
7	0.08	326	7	0.15	326
8	0.07	320	8	0.14	326

NOTES:
O2:
CO2:
Bws:
ΔP:
√ΔP: 0.3724
Ts: 325
Vs:
Qa:
Qstd:

SKETCH

HAYDEN

EMISSION TESTING FIELD DATA

Client: HARRISON Radiator
PN: 205011
Date: 2-6-90
Source: Boiler 4
Site: outlet
Sample Type: MOISTURE
Run: 3
Operators: TB, BS
Barometric Pressure (Pb):
Static Pressure (Pg):

Meter Box #: N-3
Sample Box #: 3
Filter #:
Probe Length/Type:
Stack Thermocouple #:
Oven Thermocouple #:
Impinger Thermcouple #: I-3
Pitot Tube #:
Stack I.D.: 77"
Record Data Every 10.0 Minutes

Meter ΔH@: 1.89
Meter Y Factor: 0.988
C Factor:
Reference ΔP:
Nozzle I.D.: — — — Avg.
Pre-Test Leak Rate: .001 cfm@ 10 "Hg
Post-Test Leak Rate: .001 cfm@ 7 "Hg
Pitot Tube Leak Check: Pre: — Post: —
Orsat Train Leak Check: Pre: — Post: —
Page 1 of 1

TRAVERSE POINT NUMBER	SAMPLING TIME (min)	CLOCK TIME (hr)	METER READING (cu ft)	VELOCITY PRESSURE ΔP ("H2O)	ORIFICE PRESSURE ΔH@ ("H2O) DESIRED	ORIFICE PRESSURE ΔH@ ("H2O) ACTUAL	TRAIN VACUUM ("Hg)	TEMPERATURES (°F) STACK	FILTER	PROBE	IMP	METER
	0	1:45	148.290									
	10	1:55	155.750			2.0	5.0				50	55
	20	2:05	162.800			2.0	5.0				56	56
	30	2:15	170.235			2.0	5.0				52	59
	40	2:25	176.900			2.0	5.0				51	60
	50	2:35	183.950			2.0	5.0				51	61
	60	2:45	190.624			2.0	5.0				51	60
	60		42.334			2.0						58

HAYDEN GAS

SAMPLE RECOVERY DATA

Client: HARRISON RADIATOR PN: 205.001 Date: 7-6-90

Source: OUTLET Site: BOILER 4 Run: 3

Sample Date: 7-6-90 Recovery Date: 7-6-90

FILTER NO.: NA GLASSWARE SET NO.: 3 SAMPLE BOX NO.: 3

IMPINGER DATA

GRAVIMETRIC: ✓ VOLUMETRIC: _____

	#1	#2	#3	#4	#5	TOTAL
FINAL	760.5	646.5	456.4	628.8		
INITIAL	696.1	546.5	455.7	615.2		
NET	64.4	100.0	0.7	13.6		178.7

RECOVERED SAMPLE

DESCRIPTION OF PARTICULATE ON FILTER: NA

COLOR OF SILICA GEL: 70% BLUE

BY: BS

HAYDEN ENVIRONMENTAL GROUP, INC.

METHOD 3 FYRITE DATA

Client: Harrison Radiator PN: 205.011 Date: 2-6-90
Source: Boiler 4 Site: Outlet Run: 3
Operator: TB

	Oxygen (O2)	Carbon Dioxide (CO2)
Run 1	3.0	9.5
Run 2	3.0	9.5
Run 3	3.0	10.0
Average	3.0	9.7

HAYDEN
ENVIRONMENTAL GROUP, INC.

METHOD 7 NOx DATA

Client: HARRISON RADIATOR PN: 205.011 Date: 2-7-90
Source: OUTLET Site: BOILER 5 Run: 1
Operator: BS

	DATA \ RUN	1A	1B	1C	1D
SAMPLING DATA	DATE	2-7-90	2-7-90	2-7-90	2-7-90
	TIME	0910	0925	0940	0955
	FLASK I.D.	1P	2P	3P	4P
	FLASK VOL (Vf, mls)	2079	2090	2118	2069
	Pb (i) (mm Hg)	750.4	750.4	750.4	750.4
	VACUUM (mm Hg)	690	694	690	690
	ABSOLUTE PRESSURE (Pi, mm Hg)				
	TEMP. (Ti, °C)	10.3	9.8	10.2	10.2

	DATA \ RUN	1A	1B	1C	1D
RECOVERY DATA	DATE	2-7-90	2-9-90	2-9-90	2-9-90
	TIME	1250	1251	1258	1259
	Pb (f) (mm Hg)	740.5	740.5	740.5	740.5
	VACUUM (mm Hg)	0	22	0	0
	ABSOLUTE PRESSURE (Pf, mm Hg)				
	TEMP. (Tf, °C)	19.9	19.7	19.8	19.7
	SAMPLE VOL (Vsc, mls)	35	35	35	35

$$Vsg = (0.3858)\ (Vf - 25)\ \{(Pf \div [Tf + 273]) - [Pi \div (Ti + 273)]\}$$

HAYDEN ENVIRONMENTAL GROUP, INC.

METHOD 2 VELOCITY FIELD DATA

Client: HARRISON Radiator
PN: 205.011
Date: 2-7-90
Source: BOILER 5
Site: Outlet
Run: 1
Operators: TB, BS
Barometric Pressure (Pb): 29.54
Static Pressure (Pg): -0.08

Pitot Tube I.D.: 8A
Thermocouple I.D.: 8A
Pre-Test Leak Check: OK
Post-Test Leak Check: OK
Stack I.D.: 77"

METHOD 4 DATA
Wet Bulb Thermocouple I.D.:
Dry Bulb Thermocouple I.D.:
Tempertures (°F); Wet: Dry:

TRAVERSE POINT NUMBER	ΔP (" H20)	STACK TEMPERATURE (°F)	TRAVERSE POINT NUMBER	ΔP (" H20)	STACK TEMPERATURE (°F)
1	0.08	368	1	0.08	366
2	0.08	370	2	0.09	370
3	0.09	372	3	0.10	368
4	0.09	371	4	0.09	369
5	0.08	370	5	0.10	368
6	0.08	370	6	0.09	367
7	0.08	370	7	0.08	365
8	0.06	365	8	0.06	365

NOTES:
O2:
CO2:
Bws:
ΔP:
√ΔP: 0.2876
Ts: 368
Vs:
Qa:
Qstd:

SKETCH

HAYDEN ENVIRONMENTAL GROUP, INC.

EMISSION TESTING FIELD DATA

Client: HARRISON Radiator
PN: 205.011
Date: 1-7-90
Source: Boiler 5
Site: outlet
Sample Type: moisture
Run: 1
Operators: JB, BS
Barometric Pressure (Pb):
Static Pressure (Pg):

Meter Box #: N-3
Sample Box #: 3
Filter #:
Probe Length/Type:
Stack Thermocouple #:
Oven Thermocouple #:
Impinger Thermocouple #: I-3
Pitot Tube #:
Stack I.D.: 77"
Record Data Every 10.0 Minutes

Meter ΔH@: 1.98
Meter Y Factor: 0.988
C Factor:
Reference ΔP:
Nozzle I.D.: — — — Avg.
Pre-Test Leak Rate: .001 cfm@ 10 "Hg
Post-Test Leak Rate: .002 cfm@ 7 "Hg
Pitot Tube Leak Check: Pre: — Post: —
Orsat Train Leak Check: Pre: OK Post: OK
Page 1 of 1

TRAVERSE POINT NUMBER	SAMPLING TIME (min)	CLOCK TIME (hr)	METER READING (cu ft)	VELOCITY PRESSURE ΔP ("H2O)	ORIFICE PRESSURE ΔH@ ("H2O) DESIRED	ORIFICE PRESSURE ΔH@ ("H2O) ACTUAL	TRAIN VACUUM ("Hg)	TEMPERATURES (°F) STACK	FILTER	PROBE	IMP	METER
	0	0910	190.774									
	10	0920	198.125			2	4				43	50
	20	0930	205.395			2	4				50	53
	30	0940	212.800			2	4				57	56
	40	0950	219.905			2	4				60	59
	50	1000	226.990			2	4				60	61
	60	1010	234.333			2	4				62	61
	60		43.559			2						57

[redacted] OIL TELEDYNE O_2 = 5.0 %

SAMPLE RECOVERY DATA

Client: HARRISON RADIATOR PN: 205.011 Date: 2-6-90
Source: OUTLET Site: BOILER 5 Run: 1
Sample Date: 2-7-90 Recovery Date: 2-7-90

FILTER NO.: NA GLASSWARE SET NO.: 6 SAMPLE BOX NO.: 3

IMPINGER DATA

GRAVIMETRIC: _____ VOLUMETRIC: _____

	#1	#2	#3	#4	#5	TOTAL
FINAL	665.4	468.3	438.9	1014.5		
INITIAL	560.9	466.5	436.5	983.6		
NET	104.5	1.8	2.4	30.9		139.6

RECOVERED SAMPLE

DESCRIPTION OF PARTICULATE ON FILTER: NA
COLOR OF SILICA GEL: 10% BLUE

BY: BS

HAYDEN ENVIRONMENTAL CORPORATION

METHOD 3 ORSAT DATA

Client: HARRISON Radiator PN: 205.011 Date: 2-7-90
Source: Boiler 5 Site: outlet Run: 1
Operator: TB

		Carbon Dioxide (CO2)	Oxygen (O2) (1)	Carbon Monoxide (CO) (2)	Nitrogen (N2) (3)
Run 1	Actual %	10.0	12.2		
	Net %	10.0	2.2		
Run 2	Actual %	10.1	12.2		
	Net %	10.1	2.1		
Run 3	Actual %	10.0	12.2		
	Net %	10.0	2.2		
Average		10.0	2.2		

$$Fo = \frac{20.9\% - \%O2}{\%CO2}$$

$$Fo = \frac{20.9\% - (\quad)}{(\quad)}$$

Fo = _____

Expected Fo Value = _____

(1) Net is Actual O2 reading minus the Actual CO2 reading.

(2) Net is Actual CO reading minus the Actual O2 reading.

(3) Net is 100 minus the Actual CO reading.

HAYDEN ENVIRONMENTAL GROUP, INC.

METHOD 7 NOx DATA

Client: HARRISON RADIATOR PN: 205.011 Date: 2-7-90
Source: OUTLET Site: BOILER 5 Run: 2
Operator: BS

SAMPLING DATA	RUN / DATA	2A	2B	2C	2D
DATE		2-7-90	2-7-90	2-7-90	2-7-90
TIME		1035	1050	1105	1120
FLASK I.D.		5P	6P	7P	8P
FLASK VOL (Vf, mls)		2047	2071	2093	2044
Pb (i) (mm Hg)		750.4	750.4	750.4	750.4
VACUUM (mm Hg)		694	690	690	690
ABSOLUTE PRESSURE (Pi, mm Hg)					
TEMP. (Ti, °C)		8.9	9.7	11.0	12.1

RECOVERY DATA	RUN / DATA	2A	2B	2C	2D
DATE		2-9-90	2-9-90	2-9-90	2-9-90
TIME		1315	1316	1325	1325
Pb (f) (mm Hg)		740.5	740.5	740.5	740.5
VACUUM (mm Hg)		14	112	16	0
ABSOLUTE PRESSURE (Pf, mm Hg)					
TEMP. (Tf, °C)		19.5	19.4	19.4	19.4
SAMPLE VOL (Vsc, mls)		35	35	35	35

$$Vsg = (0.3858)\ (Vf - 25)\ ((Pf \div [Tf + 273)] - [Pi \div (Ti + 273)])$$

HAYDEN ENVIRONMENTAL GROUP, INC.

METHOD 2 VELOCITY FIELD DATA

Client: HARRISON Radiator
PN: 205.011
Date: 2-7-90
Source: Boiler 5 OIL
Site: Outlet
Run: 2
Operators: TB, BS
Barometric Pressure (Pb): 750.4 mm 29.54
Static Pressure (Pg): -0.08

Pitot Tube I.D.: 8A
Thermocouple I.D.: 8A
Pre-Test Leak Check: OK
Post-Test Leak Check: OK
Stack I.D.: 77"

METHOD 4 DATA

Wet Bulb Thermocouple I.D.:
Dry Bulb Thermocouple I.D.:
Tempertures (°F); Wet: Dry:

TRAVERSE POINT NUMBER	ΔP (" H20)	STACK TEMPERATURE (°F)	TRAVERSE POINT NUMBER	ΔP (" H20)	STACK TEMPERATURE (°F)
1	0.08	348	1	0.09	360
2	0.09	350	2	0.09	361
3	0.09	354	3	0.10	363
4	0.08	357	4	0.10	368
5	0.08	370	5	0.09	372
6	0.07	376	6	0.08	374
7	0.07	378	7	0.07	373
8	0.06	378	8	0.06	374

NOTES:
O2:
CO2:
Bws:
ΔP:
√ΔP: 0.2842
Ts: 366
Vs:
Qa:
Qstd:

SKETCH

HAYDEN ENVIRONMENTAL GROUP INC.

EMISSION TESTING FIELD DATA

Client: HARRISON Radiator
PN: 205.011
Date: 2-7-90
Source: Boiler 5 (OIL)
Site: outlet
Sample Type: moisture
Run: 2
Operators: TB, BS
Barometric Pressure (Pb):
Static Pressure (Pg):

Meter Box #: N-3
Sample Box #: 4
Filter #:
Probe Length/Type:
Stack Thermocouple #:
Oven Thermocouple #:
Impinger Thermcouple #: I-4
Pitot Tube #:
Stack I.D.:
Record Data Every 10.0 Minutes

Meter ΔH@: 1.98
Meter Y Factor: 0.988
C Factor:
Reference ΔP:
Nozzle I.D.: — — — Avg.
Pre-Test Leak Rate: .009 cfm@ 10 "Hg
Post-Test Leak Rate: .005 cfm@ 7 "Hg
Pitot Tube Leak Check: Pre: — Post: —
Orsat Train Leak Check: Pre: ✓ Post: ✓
Page 1 of 1

TRAVERSE POINT NUMBER	SAMPLING TIME (min)	CLOCK TIME (hr)	METER READING (cu ft)	VELOCITY PRESSURE ΔP ("H2O)	ORIFICE PRESSURE ΔH@ ("H2O) DESIRED	ORIFICE PRESSURE ΔH@ ("H2O) ACTUAL	TRAIN VACUUM ("Hg)	TEMPERATURES (°F) STACK	FILTER	PROBE	IMP	METER
	0	1035	234.532			2	4				46	57
	10	1045	242.280			2	4				49	62
center	20	1055	249.300			2	4				57	65
of stack	30	1105	256.335			2	4				58	66
	40	1115	263.725			2	4				58	67
	50	1125	270.470			2	4				56	67
	60	1135	277.379			2	4					
												64
	60		42.847			2						

Teledyne O_2 = 5.1

HAYDEN

SAMPLE RECOVERY DATA

Client: HARRISON RADIATOR PN: 205.011 Date: 2-6-90

Source: OUTLET Site: BOILER 5 Run: 2

Sample Date: 2-7-90 Recovery Date: 2-7-90

FILTER NO.: NA GLASSWARE SET NO.: 4 SAMPLE BOX NO.: 4

IMPINGER DATA

GRAVIMETRIC: _____ VOLUMETRIC: _____

	#1	#2	#3	#4	#5	TOTAL
FINAL	560.0	542.6	436.9	563.0		
INITIAL	470.4	539.1	432.7	532.4		
NET	89.6	3.5	4.2	30.6		127.9

RECOVERED SAMPLE

DESCRIPTION OF PARTICULATE ON FILTER: NA

COLOR OF SILICA GEL: 50% BLUE

BY: BS

HAYDEN ENVIRONMENTAL GROUP, INC.

METHOD 3 ORSAT DATA

Client: HARRISON Radiator PN: 205.011 Date: 2-7-90
Source: Boiler 5 Site: Outlet Run: 2
Operator: TB

		Carbon Dioxide (CO2)	Oxygen (1) (O2)	Carbon (2) Monoxide (CO)	Nitrogen (3) (N2)
Run 1	Actual %	10.8	13.2		
	Net %	10.8	2.4		
Run 2	Actual %	10.6	12.8		
	Net %	10.6	2.2		
Run 3	Actual %	10.8	13.0		
	Net %	10.8	2.2		
Average		10.7	2.3		

$$Fo = \frac{20.9\% - \%O2}{\%CO2}$$

$$Fo = \frac{20.9\% - (\quad)}{(\quad)}$$

Fo = _____

Expected Fo Value = _____

(1) Net is Actual O2 reading minus the Actual CO2 reading.

(2) Net is Actual CO reading minus the Actual O2 reading.

(3) Net is 100 minus the Actual CO reading.

HAYDEN ENVIRONMENTAL GROUP, INC.

METHOD 7 NOx DATA

Client: HARRISON RADIATOR PN: 205.011 Date: 2-7-90
Source: OUTLET Site: BOILER 5 Run: 3
Operator: BS

SAMPLING DATA

DATA \ RUN		3A	3B	3C	3D
DATE		2-7-90	2-7-90	2-7-90	2-7-90
TIME		1300	1315	1330	1345
FLASK I.D.		9P	10P	~~11P~~ 12P	13P
FLASK VOL (Vf, mls)		2032	2063	~~2049~~ 2086	2048
Pb (i) (mm Hg)		750.4	750.4	750.4	750.4
VACUUM (mm Hg)		690	690	690	690
ABSOLUTE PRESSURE (Pi, mm Hg)					
TEMP. (Ti, °C)		12.0	11.3	~~11.3~~ 10.3	10.7

RECOVERY DATA

DATA \ RUN		3A	3B	3C	3D
DATE		2-9-90	2-9-90	2-9-90	2-9-90
TIME		1336	1337	1344	1345
Pb (f) (mm Hg)		740.5	740.5	740.5	740.5
VACUUM (mm Hg)		48	110	0	0
ABSOLUTE PRESSURE (Pf, mm Hg)					
TEMP. (Tf, °C)		20.2	19.8	23.2	20.6
SAMPLE VOL (Vsc, mls)		35	35	35	35

$$Vsg = (0.3858)\ (Vf - 25)\ [(Pf \div [Tf + 273)] - [Pi \div (Ti + 273)]]$$

HAYDEN ENVIRONMENTAL GROUP, INC.

METHOD 2 VELOCITY FIELD DATA

Client: HARRISON Radiator
PN: 205 011
Date: Boiler 5 2-7-90
Source: Outlet
Site:
Run: 3
Operators: TB, BS
Barometric Pressure (Pb): 29.54
Static Pressure (Pg): -0.08

Pitot Tube I.D.: 8A
Thermocouple I.D.: 8A
Pre-Test Leak Check: OK
Post-Test Leak Check: OK
Stack I.D.: 72"

METHOD 4 DATA
Wet Bulb Thermocouple I.D.:
Dry Bulb Thermocouple I.D.:
Tempertures (°F): Wet: Dry:

TRAVERSE POINT NUMBER	ΔP (" H20)	STACK TEMPERATURE (°F)	TRAVERSE POINT NUMBER	ΔP (" H20)	STACK TEMPERATURE (°F)
1	0.09	371	1	0.08	367
2	0.09	371	2	0.09	367
3	0.09	372	3	0.10	368
4	0.09	371	4	0.10	367
5	0.08	370	5	0.09	368
6	0.08	370	6	0.09	367
7	0.08	370	7	0.08	366
8	0.06	363	8	0.07	363

NOTES:
O2:
CO2:
Bws:
ΔP:
√ΔP: 0.2910
Ts: 368
Vs:
Qa:
Qstd:

SKETCH

HAYDEN ENVIRONMENTAL GROUP INC.

EMISSION TESTING FIELD DATA

Client: HARRISON Radiator
PN: 205.011
Date: 1-7-90
Source: Boiler 5 Oil
Site: Outlet
Sample Type: moisture
Run: 3
Operators: TB, RS
Barometric Pressure (Pb):
Static Pressure (Pg):

Meter Box #: N-3
Sample Box #: 3
Filter #:
Probe Length/Type:
Stack Thermocouple #:
Oven Thermocouple #:
Impinger Thermcouple #: I-3
Pitot Tube #:
Stack I.D.: 77"
Record Data Every 10.0 Minutes

Meter ΔH@: 1.98
Meter Y Factor: 0.988
C Factor:
Reference ΔP:
Nozzle I.D.: — — — Avg.
Pre-Test Leak Rate: .002 cfm@ 10 "Hg
Post-Test Leak Rate: .001 cfm@ 10 "Hg
Pitot Tube Leak Check: Pre: — Post: —
Orsat Train Leak Check: Pre: ✓ Post: ✓
Page 1 of 1

TRAVERSE POINT NUMBER	SAMPLING TIME (min)	CLOCK TIME (hr)	METER READING (cu ft)	VELOCITY PRESSURE ΔP ("H2O)	ORIFICE PRESSURE ΔH@ ("H2O) DESIRED	ORIFICE PRESSURE ΔH@ ("H2O) ACTUAL	TRAIN VACUUM ("Hg)	TEMPERATURES (°F) STACK	FILTER	PROBE	IMP	METER
	0	0100	277.458									
	10	0110	284.900			2	5				38	63
	20	0120	292.100			2	5				43	68
	30	0130	299.835			2	5				44	70
	40	0140	306.780			2	5				45	67
	50	0150	314.215			2	5				44	67
	60	0200	321.653			2	5				45	66
	60		44.195			2						67

Center of stack

Teledyne O_2 = 5.2 %

[redacted]

SAMPLE RECOVERY DATA

Client: HARRISON RADIATOR PN: 205.011 Date: 2-7-90

Source: OUTLET Site: BOILER 5 Run: 3

Sample Date: 2-7-90 Recovery Date: 2-7-90

FILTER NO.: NA GLASSWARE SET NO.: 7 SAMPLE BOX NO.: 3

IMPINGER DATA

GRAVIMETRIC: ✓ VOLUMETRIC: _____

	#1	#2	#3	#4	#5	TOTAL
FINAL	762.5	471.0	442.2	1022.2		
INITIAL	665.4	468.3	438.9	991.4		
NET	97.1	2.7	3.3	30.8		133.9

RECOVERED SAMPLE

DESCRIPTION OF PARTICULATE ON FILTER: NA

COLOR OF SILICA GEL: 70% BLUE

BY: BS

HAYDEN ENVIRONMENTAL GROUP, INC.

METHOD 3 ORSAT DATA

Client: HARRISON Radiator PN: 205.011 Date: 2-7-90
Source: Boiler 5 Site: Outlet Run: 3
Operator: TB

		Carbon Dioxide (CO2)	Oxygen (O2) (1)	Carbon Monoxide (CO) (2)	Nitrogen (N2) (3)
Run 1	Actual %	10.2	12.2		
	Net %	10.2	2.0		
Run 2	Actual %	10.6	13.0		
	Net %	10.6	2.4		
Run 3	Actual %	10.4	12.6		
	Net %	10.4	2.2		
Average		10.4	2.2		

$$Fo = \frac{20.9\% - \%O2}{\%CO2}$$

$$Fo = \frac{20.9\% - (\quad)}{(\quad)}$$

Fo = _____

Expected Fo Value = _____

(1) Net is Actual O2 reading minus the Actual CO2 reading.

(2) Net is Actual CO reading minus the Actual O2 reading.

(3) Net is 100 minus the Actual CO reading.

HAYDEN ENVIRONMENTAL GROUP, INC.

LABORATORY ANALYSIS REPORT

Mr. Bob Kerr
HARRISON RADIATOR
P.O. Box 824
Dayton, OH 45401

Page 1
Report Date : 02/21/90
HEG Task # : 90020146
HEG P/N, Acct: 205.011

P.O. Number:

Date Received: 02/09/90

HEG Sample # : 9003211
Sample ID : HARRISON RADIATOR, Boiler 3, Run 2B,
: Flask 21P
Sample Date : 02/09/90 Sample Priority : Normal

Parameter	Units	Results / Comments
Nitrogen Oxide	ug	64

HEG Sample # : 9003212
Sample ID : Boiler 4, Run 3B, Flask 10H
Sample Date : 02/09/90 Sample Priority : Normal

Parameter	Units	Results / Comments
Nitrogen Oxide	ug	38

HEG Sample # : 9003213
Sample ID : Boiler 4, Run 1B, Flask 2H
Sample Date : 02/09/90 Sample Priority : Normal

Parameter	Units	Results / Comments
Nitrogen Oxide	ug	58

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ENVIRONMENTAL GROUP, INC.

LABORATORY ANALYSIS REPORT

Mr. Bob Kerr
HARRISON RADIATOR
P.O. Box 824
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Report Date : 02/21/90
HEG Task # : 90020146
HEG P/N, Acct: 205.011

==========

HEG Sample # : 9003214
Sample ID : Boiler 3, Run 3D, Flask 30P
Sample Date : 02/09/90 Sample Priority : Normal

Parameter	Units	Results /	Comments
Nitrogen Oxide	ug	150	

==========

HEG Sample # : 9003215
Sample ID : Boiler 3, Run 1B, Flask 17P
Sample Date : 02/09/90 Sample Priority : Normal

Parameter	Units	Results /	Comments
Nitrogen Oxide	ug	70	

==========

HEG Sample # : 9003216
Sample ID : Boiler 3, Run 1C, Flask 18P
Sample Date : 02/09/90 Sample Priority : Normal

Parameter	Units	Results /	Comments
Nitrogen Oxide	ug	70	

==========

HEG Sample # : 9003217
Sample ID : Boiler 5, Run 2C, Flask 7P
Sample Date : 02/09/90 Sample Priority : Normal

Parameter	Units	Results /	Comments
Nitrogen Oxide	ug	48	

LABORATORY ANALYSIS REPORT

Mr. Bob Kerr
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Dayton, OH 45401

Report Date : 02/21/90
HEG Task # : 90020146
HEG P/N, Acct: 205.011

==========

HEG Sample # : 9003218
Sample ID : Boiler 3, Run 1A, Flask 16P
Sample Date : 02/09/90 Sample Priority : Normal

Parameter	Units	Results / Comments
Nitrogen Oxide	ug	52

==========

HEG Sample # : 9003219
Sample ID : Boiler 4, Run 3C, Flask 14H
Sample Date : 02/09/90 Sample Priority : Normal

Parameter	Units	Results / Comments
Nitrogen Oxide	ug	67

==========

HEG Sample # : 9003220
Sample ID : Boiler 5, Run 3B, Flask 10P
Sample Date : 02/09/90 Sample Priority : Normal

Parameter	Units	Results / Comments
Nitrogen Oxide	ug	27

==========

HEG Sample # : 9003221
Sample ID : Boiler 5, Run 3D, Flask 13P
Sample Date : 02/09/90 Sample Priority : Normal

Parameter	Units	Results / Comments
Nitrogen Oxide	ug	45

LABORATORY ANALYSIS REPORT

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Report Date : 02/21/90
HEG Task # : 90020146
HEG P/N, Acct: 205.011

==========

HEG Sample # : 9003222
Sample ID : Boiler 4, Run 1C, Flask 3H
Sample Date : 02/09/90 Sample Priority : Normal

Parameter	Units	Results / Comments
Nitrogen Oxide	ug	69

==========

HEG Sample # : 9003223
Sample ID : Boiler 5, Run 1C, Flask 3P
Sample Date : 02/09/90 Sample Priority : Normal

Parameter	Units	Results / Comments
Nitrogen Oxide	ug	30

==========

HEG Sample # : 9003224
Sample ID : Boiler 5, Run 2A, Flask 5P
Sample Date : 02/09/90 Sample Priority : Normal

Parameter	Units	Results / Comments
Nitrogen Oxide	ug	43

==========

HEG Sample # : 9003225
Sample ID : Boiler 3, Run 10, Flask 19P
Sample Date : 02/09/90 Sample Priority : Normal

Parameter	Units	Results / Comments
Nitrogen Oxide	ug	72

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LABORATORY ANALYSIS REPORT

Mr. Bob Kerr
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Page 5
Report Date : 02/21/90
HEG Task # : 90020146
HEG P/N, Acct: 205.011

==========

HEG Sample # : 9003226
Sample ID : Boiler 5, Run 1A, Flask 1P
Sample Date : 02/09/90 Sample Priority : Normal

Parameter	Units	Results	/ Comments
Nitrogen Oxide	ug	50	

==========

HEG Sample # : 9003227
Sample ID : Boiler 4, Run 12D, Flask 13H
Sample Date : 02/09/90 Sample Priority : Normal

Parameter	Units	Results	/ Comments
Nitrogen Oxide	ug	65	

==========

HEG Sample # : 9003228
Sample ID : Boiler 4, Run 2B, Flask 11H
Sample Date : 02/09/90 Sample Priority : Normal

Parameter	Units	Results	/ Comments
Nitrogen Oxide	ug	63	

==========

HEG Sample # : 9003229
Sample ID : Boiler 5, Run 3C, Flask 12P
Sample Date : 02/09/90 Sample Priority : Normal

Parameter	Units	Results	/ Comments
Nitrogen Oxide	ug	45	

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LABORATORY ANALYSIS REPORT

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Dayton, OH 45401

Page 6
Report Date : 02/21/90
HEG Task # : 90020146
HEG P/N, Acct: 205.011

==========

HEG Sample # : 9003230
Sample ID : Boiler 4, Run 2A, Flask 6H
Sample Date : 02/09/90 Sample Priority : Normal

Parameter	Units	Results	/ Comments
Nitrogen Oxide	ug	63	

==========

HEG Sample # : 9003231
Sample ID : Boiler 4, Run 3A, Flask 9H
Sample Date : 02/09/90 Sample Priority : Normal

Parameter	Units	Results	/ Comments
Nitrogen Oxide	ug	68	

==========

HEG Sample # : 9003232
Sample ID : Boiler 3, Run 2C, Flask 22P
Sample Date : 02/09/90 Sample Priority : Normal

Parameter	Units	Results	/ Comments
Nitrogen Oxide	ug	75	

==========

HEG Sample # : 9003233
Sample ID : Boiler 3, Run 3C, Flask 29P
Sample Date : 02/09/90 Sample Priority : Normal

Parameter	Units	Results	/ Comments
Nitrogen Oxide	ug	110	

LABORATORY ANALYSIS REPORT

Mr. Bob Kerr
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P.O. Box 824
Dayton, OH 45401

Page 7
Report Date : 02/21/90
HEG Task # : 90020146
HEG P/N, Acct: 205.011

==========

HEG Sample # : 9003234
Sample ID : Boiler 5, Run 3A, Flask 9P
Sample Date : 02/09/90 Sample Priority : Normal

Parameter	Units	Results	/	Comments
Nitrogen Oxide	ug	43		

==========

HEG Sample # : 9003235
Sample ID : Boiler 5, Run 2B, Flask 6P
Sample Date : 02/09/90 Sample Priority : Normal

Parameter	Units	Results	/	Comments
Nitrogen Oxide	ug	33		

==========

HEG Sample # : 9003236
Sample ID : Boiler 5, Run 2D, Flask 8P
Sample Date : 02/09/90 Sample Priority : Normal

Parameter	Units	Results	/	Comments
Nitrogen Oxide	ug	34		

==========

HEG Sample # : 9003237
Sample ID : Blank
Sample Date : 02/09/90 Sample Priority : Normal

Parameter	Units	Results	/	Comments
Nitrogen Oxide	ug	< 25		

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LABORATORY ANALYSIS REPORT

Mr. Bob Kerr
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Dayton, OH 45401

Page 8
Report Date : 02/21/90
HEG Task # : 90020146
HEG P/N, Acct: 205.011

==========

HEG Sample # : 9003238
Sample ID : Boiler 3, Run 2D, Flask 25P
Sample Date : 02/09/90 Sample Priority : Normal

Parameter	Units	Results	/ Comments
Nitrogen Oxide	ug	72	

==========

HEG Sample # : 9003239
Sample ID : Boiler 3, Run 3A, Flask 27P
Sample Date : 02/09/90 Sample Priority : Normal

Parameter	Units	Results	/ Comments
Nitrogen Oxide	ug	110	

==========

HEG Sample # : 9003240
Sample ID : Boiler 4, Run 3D, Flask 16H
Sample Date : 02/09/90 Sample Priority : Normal

Parameter	Units	Results	/ Comments
Nitrogen Oxide	ug	59	

==========

HEG Sample # : 9003241
Sample ID : Boiler 4, Run 2C, Flask 12H
Sample Date : 02/09/90 Sample Priority : Normal

Parameter	Units	Results	/ Comments
Nitrogen Oxide	ug	58	

LABORATORY ANALYSIS REPORT

Mr. Bob Kerr
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Dayton, OH 45401

Report Date : 02/21/90
HEG Task # : 90020146
HEG P/N, Acct: 205.011

==========

HEG Sample # : 9003242
Sample ID : Boiler 3, Run 2A, Flask 20P
Sample Date : 02/09/90 Sample Priority : Normal

Parameter	Units	Results	/ Comments
Nitrogen Oxide	ug	130	

==========

HEG Sample # : 9003243
Sample ID : Boiler 4, Run 1A, Flask 1H
Sample Date : 02/09/90 Sample Priority : Normal

Parameter	Units	Results	/ Comments
Nitrogen Oxide	ug	57	

==========

HEG Sample # : 9003244
Sample ID : Boiler 5, Run 1D, Flask 4P
Sample Date : 02/09/90 Sample Priority : Normal

Parameter	Units	Results	/ Comments
Nitrogen Oxide	ug	29	

==========

HEG Sample # : 9003245
Sample ID : Boiler 4, Run 1D, Flask 4H
Sample Date : 02/09/90 Sample Priority : Normal

Parameter	Units	Results	/ Comments
Nitrogen Oxide	ug	69	

LABORATORY ANALYSIS REPORT

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P.O. Box 824
Dayton, OH 45401

Page 10
Report Date : 02/21/90
HEG Task # : 90020146
HEG P/N, Acct: 205.011

HEG Sample # : 9003246
Sample ID : Boiler 5, Run 1B, Flask 2P
Sample Date : 02/09/90 Sample Priority : Normal

Parameter	Units	Results / Comments
Nitrogen Oxide	ug	44

HEG Sample # : 9003247
Sample ID : Boiler 3, Run 3B, Flask 28P
Sample Date : 02/09/90 Sample Priority : Normal

Parameter	Units	Results / Comments
Nitrogen Oxide	ug	96

HEG Sample # : 9003248
Sample ID : EPA VIAL
Sample Date : Not Specified Sample Priority : Normal

Parameter	Units	Results / Comments
Nitrogen Oxide	mg/dscm	346

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NOMENCLATURE AND DIMENSIONS

An	=	area of sampling nozzle, ft^2
As	=	cross-sectional area of stack, ft^2
Bws	=	proportion by volume of water vapor in gas stream, dimensionless
CER	=	condensible particulate emission rate, lb/hr
CCs1	=	concentration of condensible particulate in stack gas, grains/dscf
CCs2	=	concentration of condensible particulate in stack gas, lb/dscf
CO	=	percent carbon monoxide in stack gas by volume, dry basis, %
CO2	=	percent carbon dioxide in stack gas by volume, dry basis, %
Cp	=	pitot tube coefficient, dimensionless
Cs1	=	concentration of filterable particulate in stack gas, grains/dscf
Cs2	=	concentration of filterable particulate in stack gas, grains/dscf
Cs3	=	concentration of filterable particulate in stack gas, grains/acf
dia	=	diameter of stack at measurement site, inches
ER	=	filterable particulate emission rate, lb/hr
ΔH	=	average pressure drop across orifice, inches H_2O
%I	=	percent isokinetic sampling rate
Lp	=	post test leak rate, ft^3
L	=	length of sampling site cross section, in.
Md	=	molecular weight of stack gas, dry basis, lb/lb-mole
Mnc	=	weight of condensible particulate, mg
Mnf	=	weight of filterable particulate, mg
Ms	=	molecular weight of stack gas, stack conditions, lb/lb-mole

NOMENCLATURE AND DIMENSIONS (CON'T)

N_2	=	percent nitrogen in stack gas by volume, dry basis, %
O_2	=	percent oxygen in stack gas by volume, dry basis, %
Δp	=	average velocity head of stack gas, inches H_2O
$\sqrt{\Delta p}$	=	average square root of velocity head of stack gas, inches H_2O
Pb	=	barometric pressure, inches Hg
Ps	=	absolute stack gas pressure, inches Hg
PW	=	prosses charging rate, lb/hr
Qa	=	volumetric flow rate of stack gas, stack conditions, acfm
Qstd	=	volumetric flow rate of stack gas, standard conditions, dscfm
ø	=	elapsed time of test, minutes
Tm	=	average temperature of dry gas meter, °F
Ts	=	average stack temperature, °F
Vlc	=	mass of water collected in impingers, g
Vm	=	volume of gas sampled measured by dry gas meter, ft^3
V_{mc}	=	volume of gas sampled corrected for leak rate, ft^3
Vmstd	=	metered volume corrected to dry standard conditions, ft^3
Vs	=	stack gas velocity, fps
W	=	width of sampling site cross section, in.
Y	=	dry gas meter calibration factor, dimensionless

Note: Standard Conditions = 68 °F and 29.92 inches Hg.

EXAMPLE CALCULATIONS

1. LEAKAGE CORRECTION FOR VOLUME METERED

$V_{mc} = \mathbf{V_m} - (\mathbf{L_p} - 0.02)(\mathbf{\emptyset})$

$V_{mc} =$ ft^3

2. VOLUME METERED, STANDARD CONDITIONS (68°F, 29.92 in. Hg)

$$V_{mstd} = 17.64\,(\mathbf{V_{mc}})(\mathbf{Y})\,\frac{(\mathbf{P_b}) + (\Delta H/13.6)}{(\mathbf{T_m} + 460)}$$

$V_{mstd} =$ dscf

3. VOLUME WATER VAPOR COLLECTED, STANDARD CONDITIONS

$V_{wstd} = 0.04707\,(\mathbf{V_{lc}})$

$V_{wstd} =$ scf

4. PORPORTION OF WATER VAPOR, BY VOLUME

$$B_{ws} = \frac{\mathbf{V_{wstd}}}{(\mathbf{V_{wstd}}) + (\mathbf{V_{mstd}})}$$

$B_{ws} =$

5. DRY MOLECULAR WEIGHT OF STACK GAS

$M_d = 0.44\,(\mathbf{CO_2}) + 0.32\,(\mathbf{O_2}) + 0.28\,(\mathbf{N_2} + \mathbf{CO})$

$M_d =$ lb/lb - mole

6. MOLECULAR WEIGHT OF STACK GAS, STACK CONDITIONS

$M_s = \mathbf{M_d}\,(1 - \mathbf{B_{ws}}) + 18\,(\mathbf{B_{ws}})$

$M_s =$ lb/lb - mole

7. STACK GAS VELOCITY, AVERAGE

$$V_s = 85.49\,(\mathbf{C_p})\,(\sqrt{\Delta p})\,\sqrt{\frac{(\mathbf{T_s} + 460)}{(\mathbf{P_s})(\mathbf{M_s})}}$$

$V_s =$ fps

8. VOLUMETRIC FLOW RATE, ACTUAL CONDITIONS

$Q_a = 60\,(\mathbf{V_s})(5.454\text{ E }-03)(\mathbf{dia})^2$

$Q_a =$ acfm

9. VOLUMETRIC FLOW RATE, DRY STANDARD CONDITIONS

$$Q_{std} = 17.64\,(\mathbf{Q_s})(1 - \mathbf{B_{ws}})\,\frac{(\mathbf{P_s})}{(\mathbf{T_s} + 460)}$$

$Q_{std} =$ dscfm

CALCULATIONS

CLIENT: HARRISON RADIATOR **DATE: 2/8/90** **RUN:B3-R1**

1. **LEAKAGE CORRECTION FOR VOLUME METERED**

$V_{mc} = 43.104 - (0.02 - 0.02)(60)$

$V_{mc} = 43.104\ ft^3$

2. **VOLUME METERED, STANDARD CONDITIONS (68°F, 29.92 IN. Hg)**

$V_{mstd} = 17.64\,(43.104)(0.967)\dfrac{(29.39)+(2.00/13.6)}{(50+460)}$

$V_{mstd} = 42.583$ dscf

3. **VOLUME WATER VAPOR COLLECTED, STANDARD CONDITIONS**

$V_{wstd} = 0.04707\,(187.0)$

$V_{wstd} = 8.802$ scf

4. **PROPORTION OF WATER VAPOR, BY VOLUME**

$B_{ws} = \dfrac{8.802}{(8.802)+(42.583)}$

$B_{ws} = 0.171$

5. **DRY MOLECULAR WEIGHT OF STACK GAS**

$M_d = 0.44\,(7.5) + 0.32\,(1.9) + 0.28\,(90.60)$

$M_d = 29.28$ lb/lb - mole

6. **MOLECULAR WEIGHT OF STACK GAS, STACK CONDITIONS**

$M_s = 29.28\,(1 - 0.171) + 18\,(0.171)$

$M_s = 27.34$ lb/lb - mole

7. **STACK GAS VELOCITY, AVERAGE**

$V_s = 85.49\,(0.84)\,(0.577)\sqrt{\dfrac{(312+460)}{(29.37)(27.34)}}$

$V_s = 40.6$ fps

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CALCULATIONS (CONT.)

CLIENT: HARRISON RADIATOR **DATE: 2/8/90** **RUN:B3-R1**

8. **VOLUMETRIC FLOW RATE, ACTUAL CONDITIONS, ACFM**

$Qa = 60\,(\,40.6\,)(\,5.454\text{ E -03})(\,73.000\,)^2$

$Qa = 70{,}801$ acfm

9. **VOLUMETRIC FLOW RATE, DRY STANDARD CONDITIONS, DSCFM**

$$Qstd = 17.64\,(70{,}801\,)(\,1 - 0.171\,)\,\frac{(\,29.37\,)}{(\,312 + 460\,)}$$

$Qstd = 39{,}374$ dscfm

CALCULATIONS

CLIENT: HARRISON RADIATOR **DATE: 2/8/90** **RUN:B3-R2**

1. **LEAKAGE CORRECTION FOR VOLUME METERED**

   $V_{mc} = 41.177 - (0.02 - 0.02)(60)$

   $V_{mc} = 41.177\ ft^3$

2. **VOLUME METERED, STANDARD CONDITIONS (68°F, 29.92 IN. Hg)**

   $V_{mstd} = 17.64\,(41.177)(0.967)\dfrac{(29.39)+(2.00/13.6)}{(56+460)}$

   $V_{mstd} = 40.207$ dscf

3. **VOLUME WATER VAPOR COLLECTED, STANDARD CONDITIONS**

   $V_{wstd} = 0.04707\,(178.1)$

   $V_{wstd} = 8.383$ scf

4. **PROPORTION OF WATER VAPOR, BY VOLUME**

   $B_{ws} = \dfrac{8.383}{(8.383)+(40.207)}$

   $B_{ws} = 0.173$

5. **DRY MOLECULAR WEIGHT OF STACK GAS**

   $M_d = 0.44\,(8.8) + 0.32\,(2.7) + 0.28\,(88.50)$

   $M_d = 29.52$ lb/lb - mole

6. **MOLECULAR WEIGHT OF STACK GAS, STACK CONDITIONS**

   $M_s = 29.52\,(1 - 0.173) + 18\,(0.173)$

   $M_s = 27.53$ lb/lb - mole

7. **STACK GAS VELOCITY, AVERAGE**

   $V_s = 85.49\,(0.84)\,(0.547)\sqrt{\dfrac{(326+460)}{(29.37)(27.53)}}$

   $V_s = 38.7$ fps

CALCULATIONS (CONT.)

CLIENT: HARRISON RADIATOR **DATE: 2/8/90** **RUN:B3-R2**

8. VOLUMETRIC FLOW RATE, ACTUAL CONDITIONS, ACFM

$Q_a = 60\,(38.7)(5.454\text{ E-}03)(73.000)^2$

$Q_a = 67{,}487$ acfm

9. VOLUMETRIC FLOW RATE, DRY STANDARD CONDITIONS, DSCFM

$$Q_{std} = 17.64\,(67{,}487)(1 - 0.173)\,\frac{(29.37)}{(326 + 460)}$$

$Q_{std} = 36{,}808$ dscfm

CALCULATIONS

CLIENT: HARRISON RADIATOR **DATE: 2/8/90** **RUN:B3-R3**

1. LEAKAGE CORRECTION FOR VOLUME METERED

$V_{mc} = 42.449 - (0.02 - 0.02)(60)$

$V_{mc} = 42.449\ ft^3$

2. VOLUME METERED, STANDARD CONDITIONS (68°F, 29.92 IN. Hg)

$V_{mstd} = 17.64\,(42.449)(0.967)\ \dfrac{(29.39)+(2.00/13.6)}{(63+460)}$

$V_{mstd} = 40.894$ dscf

3. VOLUME WATER VAPOR COLLECTED, STANDARD CONDITIONS

$V_{wstd} = 0.04707\,(180.9)$

$V_{wstd} = 8.515$ scf

4. PROPORTION OF WATER VAPOR, BY VOLUME

$B_{ws} = \dfrac{8.515}{(8.515)+(40.894)}$

$B_{ws} = 0.172$

5. DRY MOLECULAR WEIGHT OF STACK GAS

$M_d = 0.44\,(8.5) + 0.32\,(2.1) + 0.28\,(89.40)$

$M_d = 29.44$ lb/lb - mole

6. MOLECULAR WEIGHT OF STACK GAS, STACK CONDITIONS

$M_s = 29.44\,(1 - 0.172) + 18\,(0.172)$

$M_s = 27.47$ lb/lb - mole

7. STACK GAS VELOCITY, AVERAGE

$V_s = 85.49\,(0.84)\,(0.575)\ \sqrt{\dfrac{(329+460)}{(29.37)(27.47)}}$

$V_s = 40.8$ fps

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CALCULATIONS (CONT.)

CLIENT: HARRISON RADIATOR **DATE: 2/8/90** **RUN:B3-R3**

8. VOLUMETRIC FLOW RATE, ACTUAL CONDITIONS, ACFM

$Qa = 60\,(\,\mathbf{40.8}\,)(\,5.454\text{ E }-03)(\,\mathbf{73.000}\,)^2$

$Qa = \mathbf{71,150}$ acfm

9. VOLUMETRIC FLOW RATE, DRY STANDARD CONDITIONS, DSCFM

$$Qstd = 17.64\,(\mathbf{71,150})(\,1 - \mathbf{0.172}\,)\,\frac{(\,\mathbf{29.37}\,)}{(\,\mathbf{329} + 460\,)}$$

$Qstd = \mathbf{38,667}$ dscfm

CALCULATIONS

CLIENT: HARRISON RADIATOR **DATE: 2/6/90** **RUN: B4-R1**

1. LEAKAGE CORRECTION FOR VOLUME METERED

$V_{mc} = 41.966 - (0.02 - 0.02)(60)$

$V_{mc} = 41.966\ ft^3$

2. VOLUME METERED, STANDARD CONDITIONS (68°F, 29.92 IN. Hg)

$$V_{mstd} = 17.64\ (41.966)\ (0.967)\ \frac{(29.51) + (2.00 / 13.6)}{(50 + 460)}$$

$V_{mstd} = 41.628$ dscf

3. VOLUME WATER VAPOR COLLECTED, STANDARD CONDITIONS

$V_{wstd} = 0.04707\ (176.0)$

$V_{wstd} = 8.284$ scf

4. PROPORTION OF WATER VAPOR, BY VOLUME

$$B_{ws} = \frac{8.284}{(8.284) + (41.628)}$$

$B_{ws} = 0.166$

5. DRY MOLECULAR WEIGHT OF STACK GAS

$M_d = 0.44\ (9.7) + 0.32\ (4.5) + 0.28\ (85.80)$

$M_d = 29.73$ lb/lb - mole

6. MOLECULAR WEIGHT OF STACK GAS, STACK CONDITIONS

$M_s = 29.73\ (1 - 0.166) + 18\ (0.166)$

$M_s = 27.78$ lb/lb - mole

7. STACK GAS VELOCITY, AVERAGE

$$V_s = 85.49\ (0.84)\ (0.300)\ \sqrt{\frac{(370 + 460)}{(29.50)(27.78)}}$$

$V_s = 21.7$ fps

CALCULATIONS (CON'T)

RUN # B4-R1

8. **VOLUMETRIC FLOW RATE, ACTUAL CONDITIONS, ACFM**

$Q_a = 60\ (21.7)\ (5.454\ E\text{-}03)\ (77.000)^2$

$Q_a = 42{,}102$ acfm

9. **VOLUMETRIC FLOW RATE, DRY STANDARD CONDITIONS, DSCFM**

$Q_{std} = 17.64\ (42{,}102)\ (1 - 0.166)\ \left[\frac{(29.50)}{(370 + 460)}\right]$

$Q_{std} = 22{,}015$ dscfm

CALCULATIONS

CLIENT: HARRISON RADIATOR **DATE: 2/6/90** **RUN: B4-R2**

1. LEAKAGE CORRECTION FOR VOLUME METERED

$V_{mc} = 42.609 - (0.02 - 0.02)(60)$

$V_{mc} = 42.609\ ft^3$

2. VOLUME METERED, STANDARD CONDITIONS (68°F, 29.92 IN. Hg)

$$V_{mstd} = 17.64\ (42.609)\ (0.967)\ \frac{(29.51) + (2.00 / 13.6)}{(60 + 460)}$$

$V_{mstd} = 41.453$ dscf

3. VOLUME WATER VAPOR COLLECTED, STANDARD CONDITIONS

$V_{wstd} = 0.04707\ (178.2)$

$V_{wstd} = 8.388$ scf

4. PROPORTION OF WATER VAPOR, BY VOLUME

$$B_{ws} = \frac{8.388}{(8.388) + (41.453)}$$

$B_{ws} = 0.168$

5. DRY MOLECULAR WEIGHT OF STACK GAS

$M_d = 0.44\ (9.7) + 0.32\ (3.2) + 0.28\ (87.10)$

$M_d = 29.68$ lb/lb - mole

6. MOLECULAR WEIGHT OF STACK GAS, STACK CONDITIONS

$M_s = 29.68\ (1 - 0.168) + 18\ (0.168)$

$M_s = 27.72$ lb/lb - mole

7. STACK GAS VELOCITY, AVERAGE

$$V_s = 85.49\ (0.84)\ (0.359)\ \sqrt{\frac{(327 + 460)}{(29.50)(27.72)}}$$

$V_s = 25.3$ fps

CALCULATIONS (CON'T)

RUN # B4-R2

8. VOLUMETRIC FLOW RATE, ACTUAL CONDITIONS, ACFM

$Q_a = 60\ (\mathbf{25.3})\ (5.454\ E\text{-}03)\ (\mathbf{77.000})^2$

$Q_a = \mathbf{49{,}087}$ acfm

9. VOLUMETRIC FLOW RATE, DRY STANDARD CONDITIONS, DSCFM

$Qstd = 17.64\ (\mathbf{49{,}087})\ (1 - \mathbf{0.168})\ \left[\frac{(\mathbf{29.50})}{(\mathbf{327} + 460)}\right]$

$Qstd = \mathbf{27{,}004}$ dscfm

CALCULATIONS

CLIENT: HARRISON RADIATOR **DATE: 2/6/90** **RUN: B4-R3**

1. LEAKAGE CORRECTION FOR VOLUME METERED

$V_{mc} = 42.334 - (0.02 - 0.02)(60)$

$V_{mc} = 42.334\ ft^3$

2. VOLUME METERED, STANDARD CONDITIONS (68°F, 29.92 IN. Hg)

$$V_{mstd} = 17.64\ (42.334)\ (0.967)\ \frac{(29.51) + (2.00 / 13.6)}{(58 + 460)}$$

$V_{mstd} = 41.344$ dscf

3. VOLUME WATER VAPOR COLLECTED, STANDARD CONDITIONS

$V_{wstd} = 0.04707\ (178.7)$

$V_{wstd} = 8.411$ scf

4. PROPORTION OF WATER VAPOR, BY VOLUME

$$B_{ws} = \frac{8.411}{(8.411) + (41.344)}$$

$B_{ws} = 0.169$

5. DRY MOLECULAR WEIGHT OF STACK GAS

$M_d = 0.44\ (9.7) + 0.32\ (3.0) + 0.28\ (87.30)$

$M_d = 29.67$ lb/lb - mole

6. MOLECULAR WEIGHT OF STACK GAS, STACK CONDITIONS

$M_s = 29.67\ (1 - 0.169) + 18\ (0.169)$

$M_s = 27.70$ lb/lb - mole

7. STACK GAS VELOCITY, AVERAGE

$$V_s = 85.49\ (0.84)\ (0.371)\ \sqrt{\frac{(325 + 460)}{(29.50)(27.70)}}$$

$V_s = 26.1$ fps

CALCULATIONS (CON'T)

RUN # B4-R3

8. **VOLUMETRIC FLOW RATE, ACTUAL CONDITIONS, ACFM**

$Q_a = 60\,(\mathbf{26.1})\,(5.454\text{ E -03})\,(\mathbf{77.000})^2$

$Q_a = \mathbf{50{,}639}$ acfm

9. **VOLUMETRIC FLOW RATE, DRY STANDARD CONDITIONS, DSCFM**

$Q_{std} = 17.64\ (\mathbf{50{,}639})\,(1 - \mathbf{0.169})\left[\dfrac{(\mathbf{29.50})}{(\mathbf{325} + 460)}\right]$

$Q_{std} = \mathbf{27{,}896}$ dscfm

CALCULATIONS (CON'T)

RUN # B4-R3

8. **VOLUMETRIC FLOW RATE, ACTUAL CONDITIONS, ACFM**

$Q_a = 60\,(26.1)\,(5.454\text{ E-}03)\,(77.000)^2$

$Q_a = 50{,}639$ acfm

9. **VOLUMETRIC FLOW RATE, DRY STANDARD CONDITIONS, DSCFM**

$Q_{std} = 17.64\ (50{,}639)\,(1 - 0.169)\left[\frac{(29.50)}{(325 + 460)}\right]$

$Q_{std} = 27{,}896$ dscfm

CALCULATIONS

CLIENT: HARRISON RADIATOR **DATE: 2/7/90** **RUN:B5-R1**

1. **LEAKAGE CORRECTION FOR VOLUME METERED**

$V_{mc} = 43.559 - (0.02 - 0.02)(60)$

$V_{mc} = 43.559\ ft^3$

2. **VOLUME METERED, STANDARD CONDITIONS (68°F, 29.92 IN. Hg)**

$V_{mstd} = 17.64\,(43.559)(0.967)\,\dfrac{(29.54)+(2.00/13.6)}{(57+460)}$

$V_{mstd} = 42.666$ dscf

3. **VOLUME WATER VAPOR COLLECTED, STANDARD CONDITIONS**

$V_{wstd} = 0.04707\,(139.6)$

$V_{wstd} = 6.571$ scf

4. **PROPORTION OF WATER VAPOR, BY VOLUME**

$B_{ws} = \dfrac{6.571}{(6.571)+(42.666)}$

$B_{ws} = 0.133$

5. **DRY MOLECULAR WEIGHT OF STACK GAS**

$M_d = 0.44\,(10.0) + 0.32\,(2.2) + 0.28\,(87.80)$

$M_d = 29.69$ lb/lb - mole

6. **MOLECULAR WEIGHT OF STACK GAS, STACK CONDITIONS**

$M_s = 29.69\,(1 - 0.133) + 18\,(0.133)$

$M_s = 28.13$ lb/lb - mole

7. **STACK GAS VELOCITY, AVERAGE**

$V_s = 85.49\,(0.84)\,(0.288)\,\sqrt{\dfrac{(368+460)}{(29.53)(28.13)}}$

$V_s = 20.6$ fps

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CALCULATIONS (CONT.)

CLIENT: HARRISON RADIATOR **DATE: 2/7/90** **RUN:B5-R1**

8. VOLUMETRIC FLOW RATE, ACTUAL CONDITIONS, ACFM

$Q_a = 60\ (\mathbf{20.6})(5.454\ E\text{-}03)(\mathbf{77.000})^2$

$Q_a = \mathbf{39,968}$ acfm

9. VOLUMETRIC FLOW RATE, DRY STANDARD CONDITIONS, DSCFM

$Q_{std} = 17.64\ (\mathbf{39,968})(1 - \mathbf{0.133})\ \dfrac{(\mathbf{29.53})}{(\mathbf{368} + 460)}$

$Q_{std} = \mathbf{21,792}$ dscfm

CALCULATIONS

CLIENT: HARRISON RADIATOR **DATE: 2/7/90** **RUN:B5-R2**

1. LEAKAGE CORRECTION FOR VOLUME METERED

$V_{mc} = 42.847 - (0.02 - 0.02)(60)$

$V_{mc} = 42.847\ ft^3$

2. VOLUME METERED, STANDARD CONDITIONS (68°F, 29.92 IN. Hg)

$$V_{mstd} = 17.64\,(42.847)(0.967)\,\frac{(29.54)+(2.00/13.6)}{(64+460)}$$

$V_{mstd} = 41.408$ dscf

3. VOLUME WATER VAPOR COLLECTED, STANDARD CONDITIONS

$V_{wstd} = 0.04707\,(127.9)$

$V_{wstd} = 6.020$ scf

4. PROPORTION OF WATER VAPOR, BY VOLUME

$$B_{ws} = \frac{6.020}{(6.020)+(41.408)}$$

$B_{ws} = 0.127$

5. DRY MOLECULAR WEIGHT OF STACK GAS

$M_d = 0.44\,(10.7) + 0.32\,(2.3) + 0.28\,(87.00)$

$M_d = 29.80$ lb/lb - mole

6. MOLECULAR WEIGHT OF STACK GAS, STACK CONDITIONS

$M_s = 29.80\,(1 - 0.127) + 18\,(0.127)$

$M_s = 28.31$ lb/lb - mole

7. STACK GAS VELOCITY, AVERAGE

$$V_s = 85.49\,(0.84)\,(0.284)\,\sqrt{\frac{(366+460)}{(29.53)(28.31)}}$$

$V_s = 20.3$ fps

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CALCULATIONS (CONT.)

CLIENT: HARRISON RADIATOR **DATE: 2/7/90** **RUN:B5-R2**

8. VOLUMETRIC FLOW RATE, ACTUAL CONDITIONS, ACFM

$Q_a = 60\,(\mathbf{20.3})(5.454\text{ E }-03)(\mathbf{77.000})^2$

$Q_a = \mathbf{39{,}386}$ acfm

9. VOLUMETRIC FLOW RATE, DRY STANDARD CONDITIONS, DSCFM

$Q_{std} = 17.64\,(\mathbf{39{,}386})(1 - \mathbf{0.127})\,\dfrac{(\mathbf{29.53})}{(\mathbf{366} + 460)}$

$Q_{std} = \mathbf{21{,}689}$ dscfm

CALCULATIONS

CLIENT: HARRISON RADIATOR **DATE: 2/7/90** **RUN:B5-R3**

1. LEAKAGE CORRECTION FOR VOLUME METERED

$V_{mc} = 44.195 - (0.02 - 0.02)(60)$

$V_{mc} = 44.195\ ft^3$

2. VOLUME METERED, STANDARD CONDITIONS (68°F, 29.92 IN. Hg)

$$V_{mstd} = 17.64\,(44.195)(0.967)\,\frac{(29.54)+(2.00/13.6)}{(67+460)}$$

$V_{mstd} = 42.467$ dscf

3. VOLUME WATER VAPOR COLLECTED, STANDARD CONDITIONS

$V_{wstd} = 0.04707\,(133.9)$

$V_{wstd} = 6.303$ scf

4. PROPORTION OF WATER VAPOR, BY VOLUME

$$B_{ws} = \frac{6.303}{(6.303)+(42.467)}$$

$B_{ws} = 0.129$

5. DRY MOLECULAR WEIGHT OF STACK GAS

$M_d = 0.44\,(10.4) + 0.32\,(2.2) + 0.28\,(87.40)$

$M_d = 29.75$ lb/lb - mole

6. MOLECULAR WEIGHT OF STACK GAS, STACK CONDITIONS

$M_s = 29.75\,(1 - 0.129) + 18\,(0.129)$

$M_s = 28.23$ lb/lb - mole

7. STACK GAS VELOCITY, AVERAGE

$$V_s = 85.49\,(0.84)\,(0.291)\,\sqrt{\frac{(368+460)}{(29.53)(28.23)}}$$

$V_s = 20.8$ fps

CALCULATIONS (CONT.)

CLIENT: HARRISON RADIATOR **DATE: 2/7/90** **RUN:B5-R3**

8. VOLUMETRIC FLOW RATE, ACTUAL CONDITIONS, ACFM

$Q_a = 60\,(\mathbf{20.8})(5.454\text{ E-}03)(\mathbf{77.000})^2$

$Q_a = \mathbf{40{,}356}$ acfm

9. VOLUMETRIC FLOW RATE, DRY STANDARD CONDITIONS, DSCFM

$Q_{std} = 17.64\,(\mathbf{40{,}356})(1 - \mathbf{0.129})\,\dfrac{(\mathbf{29.53})}{(\mathbf{368} + 460)}$

$Q_{std} = \mathbf{22{,}111}$ dscfm

METHOD 7 NOMENCLATURE

C	=	concentration of NO_x in stack gas, lb/dscf
C1	=	concentration of NO_x in stack gas, ppm
D	=	density of #2 heating oil, lb/Gal
ER	=	mass emission rate of NO_x, lb/hr
ER1	=	mass emission rate of NO_x, lb/MM Btu (GAS)
ER2	=	mass emission rate of NO_x, lb/MM Btu (OIL)
F_g	=	feed rate, gas, KSCF/Hr
F_o	=	feed rate, oil, Gal/Hr
HV_g	=	heat value of natural gas, Btu/SCF
HV_o	=	heat value of #2 heating oil, Btu/lb
m	=	mass of NO_x as NO_2 in sample, μg
P_f	=	final absolute pressure of flask, mm Hg
P_i	=	initial absolute pressure of flask, mm Hg
Qstd	=	volumetric flow rate of stack gas, dscfm
T_f	=	final temperature of flask, °C
T_i	=	initial temperature of flask, °C
V_f	=	calibrated volume of flask and valve, ml
V_{sc}	=	sample volume at standard conditions, ml

NO_X EMISSION CALCULATIONS

1. SAMPLE VOLUME, ml

V_{sc} = (0.3858) * (Vf -25) * ((Pf / (Tf + 273)) - (Pi / (Ti + 273)))

V_{sc} = ml

2. NOX CONCENTRATION IN SAMPLE, lb-NOX/dscf

C = 6.243 E-05 * (m / V_{sc})

C = lb-NOX/dscf

3. NOX CONCENTRATION IN SAMPLE, ppm

C_1 = ((0.5245 * m) / V_{sc}) * 1000

C_1 = ppm

4. MASS EMISSION RATE, lb-NOX/hr

ER = C * Q_{std} * 60

ER = lb-NOX/hr

5. MASS EMISSION RATE, lb-NOX/MM Btu (GAS)

ER_1 = (ER) / [(F_g) X (1000) X (HV_g) / (1,000,000)]

ER_1 = lb- NOX/ MM Btu

6. MASS EMISSION RATE, lb-NOX/MM Btu (OIL)

ER_2 = (ER) / [(F_o) X (D) X (HV_o) / (1,000,000)]

ER_2 = lb- NOX/ MM Btu

METHOD 7A DETERMINATION OF NITROGEN OXIDE EMISSIONS

CALCULATIONS

CLIENT: **HARRISON RADIATOR** RUN: **B3-R1A** DATE: **2/8/90**

1. SAMPLE VOLUME, ml

V_{sc} = (0.3858) X [(2137) - (25)] X {[(722.5) + (16.8 + 273)] - [(56.5) + (8.3 + 273)]}

V_{sc} = **1868** ml

2. NO_x CONCENTRATION IN SAMPLE, lb-NO_x/dscf

C = 6.243 E-05 X [(52) + (1868)]

C = **1.74E-06** lb-NO_x/dscf

3. NO_x CONCENTRATION IN SAMPLE, ppm

C_1 = {[(0.5245) X (52)] + (1868)} X 1000

C_1 = **14.6** ppm

4. MASS EMISSION RATE, lb-NO_x/hr

ER = (1.74E-06) X (39374) X (60)

ER = 4.1 lb-NO_x/hr

5. MASS EMISSION RATE, lb-NO_x/MM Btu (GAS)

ER_1 = (4.1) / [(229.35) X (1000) X (1022) / (1,000,000)]

ER_1 = **1.75E-02** lb-NO_x/MM Btu

METHOD 7A DETERMINATION OF NITROGEN OXIDE EMISSIONS

CALCULATIONS

CLIENT: **HARRISON RADIATOR** RUN: **B3-R1B** DATE: **2/8/90**

1. SAMPLE VOLUME, ml

V_{sc} = (0.3858) X [(**2075**) - (25)] X {[(**634.5**) + (**15.3** + 273)] - [(**56.5**) + (**9.1** + 273)]}

V_{sc} = **1582** ml

2. NO_x CONCENTRATION IN SAMPLE, lb-NO_x/dscf

C = 6.243 E-05 X [(**70**) + (**1582**)]

C = **2.76E-06** lb-NO_x/dscf

3. NO_x CONCENTRATION IN SAMPLE, ppm

C_1 = {[(0.5245) X (**70**)] + (**1582**)} X 1000

C_1 = **23.2** ppm

4. MASS EMISSION RATE, lb-NO_x/hr

ER = (**2.76E-06**) X (**39374**) X (60)

ER = **6.5** lb-NO_x/hr

5. MASS EMISSION RATE, lb-NO_x/MM Btu (GAS)

ER_1 = (**6.5**) / [(**229.35**) X (1000) X (1022) / (1,000,000)]

ER_1 = **2.78E-02** lb-NO_x/MM Btu

METHOD 7A DETERMINATION OF NITROGEN OXIDE EMISSIONS

CALCULATIONS

CLIENT: **HARRISON RADIATOR** RUN: **B3-R1C** DATE: **2/8/90**

1. SAMPLE VOLUME, ml

V_{sc} = (0.3858) X [(**2116**) - (25)] X {[(**686.5**) + (**19.5** + 273)] - [(**56.5**) + (**9.3** + 273)]}

V_{sc} = **1732** ml

2. NO_x CONCENTRATION IN SAMPLE, lb-NO_x/dscf

C = 6.243 E-05 X [(**70**) + (**1732**)]

C = **2.52E-06** lb-NO_x/dscf

3. NO_x CONCENTRATION IN SAMPLE, ppm

C_1 = {[(0.5245) X (**70**)] + (**1732**)} X 1000

C_1 = 21.2 ppm

4. MASS EMISSION RATE, lb-NO_x/hr

ER = (**2.52E-06**) X (**39374**) X (60)

ER = **6.0** lb-NO_x/hr

5. MASS EMISSION RATE, lb-NO_x/MM Btu (GAS)

ER_1 = (**6.0**) / [(**229.35**) X (1000) X (**1022**) / (1,000,000)]

ER_1 = **2.54E-02** lb-NO_x/MM Btu

METHOD 7A DETERMINATION OF NITROGEN OXIDE EMISSIONS

CALCULATIONS

CLIENT: **HARRISON RADIATOR** RUN: **B3-R1D** DATE: **2/8/90**

1. SAMPLE VOLUME, ml

V_{sc} = (0.3858) X [(2196) - (25)] X {[(718.5) + (20.5 + 273)] - [(56.5) + (12.7 + 273)]}

V_{sc} = **1885** ml

2. NO_x CONCENTRATION IN SAMPLE, lb-NO_x/dscf

C = 6.243 E-05 X [(72) + (1885)]

C = **2.38E-06** lb-NO_x/dscf

3. NO_x CONCENTRATION IN SAMPLE, ppm

C_1 = {[(0.5245) X (72)] + (1885)} X 1000

C_1 = **20.0** ppm

4. MASS EMISSION RATE, lb-NO_x/hr

ER = (2.38E-06) X (38374) X (60)

ER = **5.6** lb-NO_x/hr

5. MASS EMISSION RATE, lb-NO_x/MM Btu (GAS)

ER_1 = (5.6) / [(229.35) X (1000) X (1022) / (1,000,000)]

ER_1 = **2.40E-02** lb-NO_x/MM Btu

METHOD 7A DETERMINATION OF NITROGEN OXIDE EMISSIONS

CALCULATIONS

CLIENT: **HARRISON RADIATOR** RUN: **B3-R2A** DATE: **2/8/90**

1. SAMPLE VOLUME, ml

V_{sc} = (0.3858) X [(2110) - (25)] X {[(740.5) + (18.6 + 273)] - [(56.5) + (15.6 + 273)]}

V_{sc} = **1885** ml

2. NO_x CONCENTRATION IN SAMPLE, lb-NO_x/dscf

C = 6.243 E-05 X [(130) + (1885)]

C = **4.30E-06** lb-NO_x/dscf

3. NO_x CONCENTRATION IN SAMPLE, ppm

C_1 = {[(0.5245) X (130)] + (1885)} X 1000

C_1 = **36.2** ppm

4. MASS EMISSION RATE, lb-NO_x/hr

ER = (4.30E-06) X (36808) X (60)

ER = **9.5** lb-NO_x/hr

5. MASS EMISSION RATE, lb-NO_x/MM Btu (GAS)

ER_1 = (9.5) / [(229.09) X (1000) X (1022) / (1,000,000)]

ER_1 = **4.06E-02** lb-NO_x/MM Btu

HAYDEN ENVIRONMENTAL GROUP, INC.

METHOD 7A DETERMINATION OF NITROGEN OXIDE EMISSIONS

CALCULATIONS

CLIENT: **HARRISON RADIATOR** RUN: **B3-R2B** DATE: **2/8/90**

1. SAMPLE VOLUME, ml

V_{sc} = (0.3858) X [(2064) - (25)] X {[(740.5) + (18.7 + 273)] - [(56.5) + (15 + 273)]}

V_{sc} = **1843** ml

2. NO_x CONCENTRATION IN SAMPLE, lb-NO_x/dscf

C = 6.243 E-05 X [(64) + (1843)]

C = **2.17E-06** lb-NO_x/dscf

3. NO_x CONCENTRATION IN SAMPLE, ppm

C_1 = {[(0.5245) X (64)] + (1843)} X 1000

C_1 = **18.2** ppm

4. MASS EMISSION RATE, lb-NO_x/hr

ER = (2.17E-06) X (36808) X (60)

ER = **4.8** lb-NO_x/hr

5. MASS EMISSION RATE, lb-NO_x/MM Btu (GAS)

ER_1 = (4.8) / [(229.09) X (1000) X (1022) / (1,000,000)]

ER_1 = **2.05E-02** lb-NO_x/MM Btu

HAYDEN ENVIRONMENTAL GROUP, INC.

METHOD 7A DETERMINATION OF NITROGEN OXIDE EMISSIONS

CALCULATIONS

CLIENT: **HARRISON RADIATOR** RUN: **B3-R2C** DATE: **2/8/90**

1. SAMPLE VOLUME, ml

V_{sc} = (0.3858) X [(**2124**) - (25)] X {[(**740.5**) + (**18.6** + 273)] - [(**56.5**) + (**15.1** + 273)]}

V_{sc} = **1898** ml

2. NO_x CONCENTRATION IN SAMPLE, lb-NO_x/dscf

C = 6.243 E-05 X [(**75**) + (**1898**)]

C = **2.47E-06** lb-NO_x/dscf

3. NO_x CONCENTRATION IN SAMPLE, ppm

C_1 = {[(0.5245) X (**75**)] + (**1898**)} X 1000

C_1 = **20.7** ppm

4. MASS EMISSION RATE, lb-NO_x/hr

ER = (**2.47E-06**) X (**36808**) X (60)

ER = **5.4** lb-NO_x/hr

5. MASS EMISSION RATE, lb-NO_x/MM Btu (GAS)

ER_1 = (**5.4**) / [(**229.09**) X (1000) X (**1022**) / (1,000,000)]

ER_1 = **2.33E-02** lb-NO_x/MM Btu

METHOD 7A DETERMINATION OF NITROGEN OXIDE EMISSIONS

CALCULATIONS

CLIENT: **HARRISON RADIATOR** RUN: **B3-R2D** DATE: **2/8/90**

1. SAMPLE VOLUME, ml

V_{sc} = (0.3858) X [(2120) - (25)] X {[(732.5) + (18.8 + 273)] - [(56.5) + (14.5 + 273)]}

V_{sc} = **1871** ml

2. NO_x CONCENTRATION IN SAMPLE, lb-NO_x/dscf

C = 6.243 E-05 X [(72) + (1871)]

C = **2.40E-06** lb-NO_x/dscf

3. NO_x CONCENTRATION IN SAMPLE, ppm

C_1 = {[(0.5245) X (72)] + (1871)] X 1000

C_1 = **20.2** ppm

4. MASS EMISSION RATE, lb-NO_x/hr

ER = (2.40E-06) X (36808) X (60)

ER = **5.3** lb-NO_x/hr

5. MASS EMISSION RATE, lb-NO_x/MM Btu (GAS)

ER_1 = (5.3) / [(229.09) X (1000) X (1022) / (1,000,000)]

ER_1 = **2.27E-02** lb-NO_x/MM Btu

HAYDEN
ENVIRONMENTAL GROUP, INC

METHOD 7A DETERMINATION OF NITROGEN OXIDE EMISSIONS

CALCULATIONS

CLIENT: **HARRISON RADIATOR** RUN: **B3-R3A** DATE: **2/8/90**

1. SAMPLE VOLUME, ml

V_{sc} = (0.3858) X [(2097) - (25)] X {[(702.5) + (17.1 + 273)] - [(56.5) + (15.8 + 273)]}

V_{sc} = **1779** ml

2. NO_x CONCENTRATION IN SAMPLE, lb-NO_x/dscf

C = 6.243 E-05 X [(110) + (1779)]

C = **3.86E-06** lb-NO_x/dscf

3. NO_x CONCENTRATION IN SAMPLE, ppm

C_1 = {[(0.5245) X (110)] + (1779)} X 1000

C_1 = **32.4** ppm

4. MASS EMISSION RATE, lb-NO_x/hr

ER = (3.86E-06) X (38667) X (60)

ER = **9.0** lb-NO_x/hr

5. MASS EMISSION RATE, lb-NO_x/MM Btu (GAS)

ER_1 = (9.0) / [(229.38) X (1000) X (1022) / (1,000,000)]

ER_1 = **3.82E-02** lb-NO_x/MM Btu

HAYDEN ENVIRONMENTAL GROUP, INC.

METHOD 7A DETERMINATION OF NITROGEN OXIDE EMISSIONS

CALCULATIONS

CLIENT: **HARRISON RADIATOR** RUN: **B3-R3B** DATE: **2/8/90**

1. SAMPLE VOLUME, ml

V_{sc} = (0.3858) X [(2037) - (25)] X {[(740.5) + (17.4 + 273)] - [(56.5) + (15.1 + 273)]}

V_{sc} = **1827** ml

2. NO_x CONCENTRATION IN SAMPLE, lb-NO_x/dscf

C = 6.243 E-05 X [(96) + (1827)]

C = **3.28E-06** lb-NO_x/dscf

3. NO_x CONCENTRATION IN SAMPLE, ppm

C_1 = {[(0.5245) X (96)] + (1827)} X 1000

C_1 = **27.6** ppm

4. MASS EMISSION RATE, lb-NO_x/hr

ER = (3.28E-06) X (38667) X (60)

ER = **7.6** lb-NO_x/hr

5. MASS EMISSION RATE, lb-NO_x/MM Btu (GAS)

ER_1 = (7.6) / [(229.38) X (1000) X (1022) / (1,000,000)]

ER_1 = **3.25E-02** lb-NO_x/MM Btu

HAYDEN ENVIRONMENTAL GROUP, INC.

METHOD 7A DETERMINATION OF NITROGEN OXIDE EMISSIONS

CALCULATIONS

CLIENT: **HARRISON RADIATOR** RUN: **B3-R3C** DATE: **2/8/90**

1. SAMPLE VOLUME, ml

V_{sc} = (0.3858) X [(2117) - (25)] X [[(730.5) + (17.7 + 273)] - [(56.5) + (16.1 + 273)]]

V_{sc} = **1870** ml

2. NO_x CONCENTRATION IN SAMPLE, lb-NO_x/dscf

C = 6.243 E-05 X [(110) + (1870)]

C = **3.67E-06** lb-NO_x/dscf

3. NO_x CONCENTRATION IN SAMPLE, ppm

C_1 = [[(0.5245) X (110)] + (1870)] X 1000

C_1 = **30.8** ppm

4. MASS EMISSION RATE, lb-NO_x/hr

ER = (3.67E-06) X (38667) X (60)

ER = **8.5** lb-NO_x/hr

5. MASS EMISSION RATE, lb-NO_x/MM Btu (GAS)

ER_1 = (8.5) / [(229.38) X (1000) X (1022) / (1,000,000)]

ER_1 = **3.63E-02** lb-NO_x/MM Btu

METHOD 7A DETERMINATION OF NITROGEN OXIDE EMISSIONS

CALCULATIONS

CLIENT: **HARRISON RADIATOR** RUN: **B3-R3D** DATE: **2/8/90**

1. SAMPLE VOLUME, ml

V_{sc} = (0.3858) X [(2118) - (25)] X {[(740.5) + (17.6 + 273)] - [(56.5) + (17 + 273)]}

V_{sc} = **1900** ml

2. NO_x CONCENTRATION IN SAMPLE, lb-NO_x/dscf

C = 6.243 E-05 X [(150) + (1900)]

C = **4.93E-06** lb-NO_x/dscf

3. NO_x CONCENTRATION IN SAMPLE, ppm

C_1 = {[(0.5245) X (150)] + (1900)} X 1000

C_1 = **41.4** ppm

4. MASS EMISSION RATE, lb-NO_x/hr

ER = (4.93E-06) X (38667) X (60)

ER = **11.4** lb-NO_x/hr

5. MASS EMISSION RATE, lb-NO_x/MM Btu (GAS)

ER_1 = (11.4) / [(229.38) X (1000) X (1022) / (1,000,000)]

ER_1 = **4.88E-02** lb-NO_x/MM Btu

HAYDEN ENVIRONMENTAL GROUP, INC.

METHOD 7A DETERMINATION OF NITROGEN OXIDE EMISSIONS

CALCULATIONS

CLIENT: **HARRISON RADIATOR** RUN: **B4-R1A** DATE: **2/6/90**

1. SAMPLE VOLUME, ml

V_{sc} = (0.3858) X [(2073) - (25)] X {[(740.5) + (19.9 + 273)] - [(59.5) + (9.3 + 273)]}

V_{sc} = **1831** ml

2. NO_x CONCENTRATION IN SAMPLE, lb-NO_x/dscf

C = 6.243 E-05 X [(57) + (1831)]

C = **1.94E-06** lb-NO_x/dscf

3. NO_x CONCENTRATION IN SAMPLE, ppm

C_1 = {[(0.5245) X (57)] + (1831)} X 1000

C_1 = **16.3** ppm

4. MASS EMISSION RATE, lb-NO_x/hr

ER = (1.94E-06) X (22015) X (60)

ER = **2.6** lb-NO_x/hr

5. MASS EMISSION RATE, lb-NO_x/MM Btu (GAS)

ER_1 = (2.6) / [(124.2) X (1000) X (1022) / (1,000,000)]

ER_1 = **2.02E-02** lb-NO_x/MM Btu

HAYDEN ENVIRONMENTAL GROUP, INC.

METHOD 7A DETERMINATION OF NITROGEN OXIDE EMISSIONS

CALCULATIONS

CLIENT: **HARRISON RADIATOR** RUN: **B4-R1B** DATE: **2/6/90**

1. SAMPLE VOLUME, ml

V_{sc} = (0.3858) X [(2042) - (25)] X {[(740.5) + (20 + 273)] - [(59.5) + (11.1 + 273)]}

V_{sc} = **1804** ml

2. NO_x CONCENTRATION IN SAMPLE, lb-NO_x/dscf

C = 6.243 E-05 X [(58) + (1804)]

C = **2.01E-06** lb-NO_x/dscf

3. NO_x CONCENTRATION IN SAMPLE, ppm

C_1 = {[(0.5245) X (58)] + (1804)} X 1000

C_1 = **16.9** ppm

4. MASS EMISSION RATE, lb-NO_x/hr

ER = (2.01E-06) X (22015) X (60)

ER = **2.7** lb-NO_x/hr

5. MASS EMISSION RATE, lb-NO_x/MM Btu (GAS)

ER_1 = (2.7) / [(124.2) X (1000) X (1022) / (1,000,000)]

ER_1 = **2.09E-02** lb-NO_x/MM Btu

METHOD 7A DETERMINATION OF NITROGEN OXIDE EMISSIONS

CALCULATIONS

CLIENT: **HARRISON RADIATOR** RUN: **B4-R1C** DATE: **2/6/90**

1. SAMPLE VOLUME, ml

V_{sc} = (0.3858) X [(2090) - (25)] X {[(740.5) + (19.2 + 273)] - [(59.5) + (10.9 + 273)]}

V_{sc} = **1852** ml

2. NO_x CONCENTRATION IN SAMPLE, lb-NO_x/dscf

C = 6.243 E-05 X [(69) ÷ (1852)]

C = **2.33E-06** lb-NO_x/dscf

3. NO_x CONCENTRATION IN SAMPLE, ppm

C_1 = {[(0.5245) X (69)] ÷ (1852)} X 1000

C_1 = **19.5** ppm

4. MASS EMISSION RATE, lb-NO_x/hr

ER = (2.33E-06) X (22015) X (60)

ER = **3.1** lb-NO_x/hr

5. MASS EMISSION RATE, lb-NO_x/MM Btu (GAS)

ER_1 = (3.1) / [(124.2) X (1000) X (1022) / (1,000,000)]

ER_1 = **2.42E-02** lb-NO_x/MM Btu

METHOD 7A DETERMINATION OF NITROGEN OXIDE EMISSIONS

CALCULATIONS

CLIENT: HARRISON RADIATOR RUN: B4-R1D DATE: 2/6/90

1. SAMPLE VOLUME, ml

V_{sc} = (0.3858) X [(2042) - (25)] X {[(740.5) + (19.5 + 273)] - [(59.5) + (10.6 + 273)]}

V_{sc} = **1807** ml

2. NO_x CONCENTRATION IN SAMPLE, lb-NO_x/dscf

C = 6.243 E-05 X [(69) + (1807)]

C = **2.38E-06** lb-NO_x/dscf

3. NO_x CONCENTRATION IN SAMPLE, ppm

C_1 = {[(0.5245) X (69)] + (1807)} X 1000

C_1 = **20.0** ppm

4. MASS EMISSION RATE, lb-NO_x/hr

ER = (2.38E-06) X (22015) X (60)

ER = **3.1** lb-NO_x/hr

5. MASS EMISSION RATE, lb-NO_x/MM Btu (GAS)

ER_1 = (3.1) / [(124.2) X (1000) X (1022) / (1,000,000)]

ER_1 = **2.48E-02** lb-NO_x/MM Btu

METHOD 7A DETERMINATION OF NITROGEN OXIDE EMISSIONS

CALCULATIONS

CLIENT: **HARRISON RADIATOR** RUN: **B4-R2A** DATE: **2/6/90**

1. SAMPLE VOLUME, ml

V_{sc} = (0.3858) X [(2060) - (25)] X {[(740.5) + (20.5 + 273)] - [(59.5) + (10.2 + 273)]}

V_{sc} = **1816** ml

2. NO_x CONCENTRATION IN SAMPLE, lb-NO_x/dscf

C = 6.243 E-05 X [(63) + (1816)]

C = **2.17E-06** lb-NO_x/dscf

3. NO_x CONCENTRATION IN SAMPLE, ppm

C_1 = {[(0.5245) X (63)] + (1816)} X 1000

C_1 = **18.2** *ppm*

4. MASS EMISSION RATE, lb-NO_x/hr

ER = (2.17E-06) X (27004) X (60)

ER = **3.5** lb-NO_x/hr

5. MASS EMISSION RATE, lb-NO_x/MM Btu (GAS)

ER_1 = (3.5) / {(125.6) X (1000) X (1022) / (1,000,000)}

ER_1 = **2.73E-02** lb-NO_x/MM Btu

HAYDEN
ENVIRONMENTAL GROUP, INC.

METHOD 7A DETERMINATION OF NITROGEN OXIDE EMISSIONS

CALCULATIONS

CLIENT: **HARRISON RADIATOR** RUN: **B4-R2B** DATE: **2/8/90**

1. SAMPLE VOLUME, ml

V_{sc} = (0.3858) X [(**2065**) - (25)] X {[(**740.5**) + (**17.8** + 273)] - [(**59.5**) + (**9.8** + 273)]}

V_{sc} = **1839** ml

2. NO_x CONCENTRATION IN SAMPLE, lb-NO_x/dscf

C = 6.243 E-05 X [(**63**) + (**1839**)]

C = **2.14E-06** lb-NO_x/dscf

3. NO_x CONCENTRATION IN SAMPLE, ppm

C_1 = {[(0.5245) X (**63**)] + (**1839**)} X 1000

C_1 = **18.0** ppm

4. MASS EMISSION RATE, lb-NO_x/hr

ER = (**2.14E-06**) X (**27004**) X (60)

ER = **3.5** lb-NO_x/hr

5. MASS EMISSION RATE, lb-NO_x/MM Btu (GAS)

ER_1 = (**3.5**) / [(**125.6**) X (1000) X (**1022**) / (1,000,000)]

ER_1 = **2.70E-02** lb-NO_x/MM Btu

HAYDEN ENVIRONMENTAL GROUP INC.

METHOD 7A DETERMINATION OF NITROGEN OXIDE EMISSIONS

CALCULATIONS

CLIENT: **HARRISON RADIATOR** RUN: **B4-R2C** DATE: **2/6/90**

1. SAMPLE VOLUME, ml

V_{sc} = (0.3858) X [(2064) - (25)] X [[(740.5) + (18.4 + 273)] - [(59.5) + (18.1 + 273)]]

V_{sc} = **1838** ml

2. NO_x CONCENTRATION IN SAMPLE, lb-NO_x/dscf

C = 6.243 E-05 X [(58) + (1838)]

C = **1.97E-06** lb-NO_x/dscf

3. NO_x CONCENTRATION IN SAMPLE, ppm

C_1 = [[(0.5245) X (58)] + (1838)] X 1000

C_1 = **16.5** ppm

4. MASS EMISSION RATE, lb-NO_x/hr

ER = (1.97E-06) X (27004) X (60)

ER = **3.2** lb-NO_x/hr

5. MASS EMISSION RATE, lb-NO_x/MM Btu (GAS)

ER_1 = (3.2) / [(125.6) X (1000) X (1022) / (1,000,000)]

ER_1 = **2.49E-02** lb-NO_x/MM Btu

METHOD 7A DETERMINATION OF NITROGEN OXIDE EMISSIONS

CALCULATIONS

CLIENT: **HARRISON RADIATOR** RUN: **B4-R2D** DATE: **2/6/90**

1. SAMPLE VOLUME, ml

V_{sc} = (0.3858) X [(2062) - (25)] X [[(740.5) + (18 + 273)] - [(59.5) + (13.9 + 273)]]

V_{sc} = 1837 ml

2. NO_x CONCENTRATION IN SAMPLE, lb-NO_x/dscf

C = 6.243 E-05 X [(65) + (1837)]

C = **2.21E-06** lb-NO_x/dscf

3. NO_x CONCENTRATION IN SAMPLE, ppm

C_1 = [[(0.5245) X (65)] + (1837)] X 1000

C_1 = 18.6 ppm

4. MASS EMISSION RATE, lb-NO_x/hr

ER = (2.21E-06) X (27004) X (60)

ER = 3.6 lb-NO_x/hr

5. MASS EMISSION RATE, lb-NO_x/MM Btu (GAS)

ER_1 = (3.6) / [(125.6) X (1000) X (1022) / (1,000,000)]

ER_1 = **2.79E-02** lb-NO_x/MM Btu

HAYDEN
ENVIRONMENTAL GROUP, INC.

METHOD 7A DETERMINATION OF NITROGEN OXIDE EMISSIONS

CALCULATIONS

CLIENT: **HARRISON RADIATOR** RUN: **B4-R3A** DATE: **2/6/90**

1. SAMPLE VOLUME, ml

V_{sc} = (0.3858) X [(2004) - (25)] X {[(740.5) + (18.1 + 273)] - [(59.5) + (12.9 + 273)]}

V_{sc} = **1783** ml

2. NO_x CONCENTRATION IN SAMPLE, lb-NO_x/dscf

C = 6.243 E-05 X [(68) + (1783)]

C = **2.38E-06** lb-NO_x/dscf

3. NO_x CONCENTRATION IN SAMPLE, ppm

C_1 = {[(0.5245) X (68)] + (1783)} X 1000

C_1 = **20.0** ppm

4. MASS EMISSION RATE, lb-NO_x/hr

ER = (2.38E-06) X (27896) X (60)

ER = **4.0** lb-NO_x/hr

5. MASS EMISSION RATE, lb-NO_x/MM Btu (GAS)

ER_1 = (4.0) / [(125.4) X (1000) X (1022) / (1,000,000)]

ER_1 = **3.11E-02** lb-NO_x/MM Btu

HAYDEN ENVIRONMENTAL GROUP, INC.

METHOD 7A DETERMINATION OF NITROGEN OXIDE EMISSIONS

CALCULATIONS

CLIENT: **HARRISON RADIATOR** RUN: **B4-R3B** DATE: **2/6/90**

1. SAMPLE VOLUME, ml

V_{sc} = (0.3858) X [(1972) - (25)] X {[(740.5) + (17.9 + 273)] - [(59.5) + (13.1 + 273)]}

V_{sc} = **1756** ml

2. NO_x CONCENTRATION IN SAMPLE, lb-NO_x/dscf

C = 6.243 E-05 X [(38) + (1756)]

C = **1.35E-06** lb-NO_x/dscf

3. NO_x CONCENTRATION IN SAMPLE, ppm

C_1 = {[(0.5245) X (38)] + (1756)} X 1000

C_1 = **11.4** ppm

4. MASS EMISSION RATE, lb-NO_x/hr

ER = (1.35E-06) X (27896) X (60)

ER = **2.3** lb-NO_x/hr

5. MASS EMISSION RATE, lb-NO_x/MM Btu (GAS)

ER_1 = (2.3) / [(125.4) X (1000) X (1022) / (1,000,000)]

ER_1 = **1.76E-02** lb-NO_x/MM Btu

HAYDEN ENVIRONMENTAL GROUP, INC.

METHOD 7A DETERMINATION OF NITROGEN OXIDE EMISSIONS

CALCULATIONS

CLIENT: **HARRISON RADIATOR** RUN: **B4-R3C** DATE: **2/6/90**

1. SAMPLE VOLUME, ml

V_{sc} = (0.3858) X [(2057) - (25)] X {[(740.5) + (19.3 + 273)] - [(59.5) + (12 + 273)]}

V_{sc} = **1822** ml

2. NO_x CONCENTRATION IN SAMPLE, lb-NO_x/dscf

C = 6.243 E-05 X [(67) + (1822)]

C = **2.30E-06** lb-NO_x/dscf

3. NO_x CONCENTRATION IN SAMPLE, ppm

C_1 = {[(0.5245) X (67)] + (1822)} X 1000

C_1 = **19.3** ppm

4. MASS EMISSION RATE, lb-NO_x/hr

ER = (2.30E-06) X (27896) X (60)

ER = **3.8** lb-NO_x/hr

5. MASS EMISSION RATE, lb-NO_x/MM Btu (GAS)

ER_1 = (3.8) / [(125.4) X (1000) X (1022) / (1,000,000)]

ER_1 = **3.00E-02** lb-NO_x/MM Btu

METHOD 7A DETERMINATION OF NITROGEN OXIDE EMISSIONS

CALCULATIONS

CLIENT: **HARRISON RADIATOR** RUN: **B4-R3D** DATE: **2/6/90**

1. SAMPLE VOLUME, ml

V_{sc} = (0.3858) X [(2050) - (25)] X {[(740.5) + (19.5 + 273)] - [(59.5) + (12.6 + 273)]}

V_{sc} = **1815** ml

2. NO_x CONCENTRATION IN SAMPLE, lb-NO_x/dscf

C = 6.243 E-05 X [(59) + (1815)]

C = **2.03E-06** lb-NO_x/dscf

3. NO_x CONCENTRATION IN SAMPLE, ppm

C_1 = {[(0.5245) X (59)] + (1815)} X 1000

C_1 = **17.0** ppm

4. MASS EMISSION RATE, lb-NO_x/hr

ER = (2.03E-06) X (27896) X (60)

ER = **3.4** lb-NO_x/hr

5. MASS EMISSION RATE, lb-NO_x/MM Btu (GAS)

ER_1 = (3.4) / [(125.4) X (1000) X (1022) / (1,000,000)]

ER_1 = **2.65E-02** lb-NO_x/MM Btu

METHOD 7A DETERMINATION OF NITROGEN OXIDE EMISSIONS

CALCULATIONS

CLIENT: **HARRISON RADIATOR** RUN: **B5-R1A** DATE: **2/7/90**

1. SAMPLE VOLUME, ml

V_{sc} = (0.3858) X [(2079) - (25)] X {[(740.5) + (19.9 + 273)] - [(60.4) + (10.3 + 273)]}

V_{sc} = **1834** ml

2. NO_x CONCENTRATION IN SAMPLE, lb-NO_x/dscf

C = 6.243 E-05 X [(50) + (1834)]

C = **1.70E-06** lb-NO_x/dscf

3. NO_x CONCENTRATION IN SAMPLE, ppm

C_1 = {[(0.5245) X (50)] ÷ (1834)} X 1000

C_1 = **14.3** ppm

4. MASS EMISSION RATE, lb-NO_x/hr

ER = (1.70E-06) X (21792) X (60)

ER = **2.2** lb-NO_x/hr

5. MASS EMISSION RATE, lb-NO_x/MM Btu (OIL)

ER_2 = (2.2) / [(853.53) X (7.296) X (19500) / (1,000,000)]

ER_2 = **1.83E-02** lb-NO_x/MM Btu

METHOD 7A DETERMINATION OF NITROGEN OXIDE EMISSIONS

CALCULATIONS

CLIENT: HARRISON RADIATOR RUN: B5-R1B DATE: 2/7/90

1. SAMPLE VOLUME, ml

V_{sc} = (0.3858) X [(2090) - (25)] X [[(718.5) + (19.7 + 273)] - [(60.4) + (9.8 + 273)]]

V_{sc} = 1785 ml

2. NO_x CONCENTRATION IN SAMPLE, lb-NO_x/dscf

C = 6.243 E-05 X [(44) + (1785)]

C = 1.54E-06 lb-NO_x/dscf

3. NO_x CONCENTRATION IN SAMPLE, ppm

C_1 = [[(0.5245) X (44)] + (1785)] X 1000

C_1 = 12.9 ppm

4. MASS EMISSION RATE, lb-NO_x/hr

ER = (1.54E-06) X (21792) X (60)

ER = 2.0 lb-NO_x/hr

5. MASS EMISSION RATE, lb-NO_x/MM Btu (OIL)

ER_2 = (2.0) / [(853.53) X (7.296) X (19500) / (1,000,000)]

ER_2 = 1.66E-02 lb-NO_x/MM Btu

HAYDEN ENVIRONMENTAL GROUP, INC.

METHOD 7A DETERMINATION OF NITROGEN OXIDE EMISSIONS

CALCULATIONS

CLIENT: **HARRISON RADIATOR** RUN: **B5-R1C** DATE: **2/7/90**

1. SAMPLE VOLUME, ml

V_{sc} = (0.3858) X [(2118) - (25)] X [[(740.5) + (19.8 + 273)] - [(60.4) + (10.2 + 273)]]

V_{sc} = **1870** ml

2. NO_x CONCENTRATION IN SAMPLE, lb-NO_x/dscf

C = 6.243 E-05 X [(30) + (1870)]

C = **1.00E-06** lb-NO_x/dscf

3. NO_x CONCENTRATION IN SAMPLE, ppm

C_1 = [[(0.5245) X (30)] + (1870)] X 1000

C_1 = **8.4** ppm

4. MASS EMISSION RATE, lb-NO_x/hr

ER = (1.00E-06) X (21792) X (60)

ER = **1.3** lb-NO_x/hr

5. MASS EMISSION RATE, lb-NO_x/MM Btu (OIL)

ER_2 = (1.3) / [(853.53) X (7.296) X (19500) / (1,000,000)]

ER_2 = **1.08E-02** lb-NO_x/MM Btu

METHOD 7A DETERMINATION OF NITROGEN OXIDE EMISSIONS

CALCULATIONS

CLIENT: HARRISON RADIATOR RUN: B5-R1D DATE: 2/7/90

1. SAMPLE VOLUME, ml

V_{sc} = (0.3858) X [(2069) - (25)] X [[(740.5) + (19.7 + 273)] - [(60.4) + (10.2 + 273)]]

V_{sc} = 1827 ml

2. NO_x CONCENTRATION IN SAMPLE, lb-NO_x/dscf

C = 6.243 E-05 X [(29) + (1827)]

C = 9.91E-07 lb-NO_x/dscf

3. NO_x CONCENTRATION IN SAMPLE, ppm

C_1 = {[(0.5245) X (29)] + (1827)} X 1000

C_1 = 8.3 ppm

4. MASS EMISSION RATE, lb-NO_x/hr

ER = (9.91E-07) X (21792) X (60)

ER = 1.3 lb-NO_x/hr

5. MASS EMISSION RATE, lb-NO_x/MM Btu (OIL)

ER_2 = (1.3) / [(853.53) X (7.296) X (19500) / (1,000,000)]

ER_2 = 1.07E-02 lb-NO_x/MM Btu

HAYDEN
ENVIRONMENTAL GROUP, INC.

METHOD 7A DETERMINATION OF NITROGEN OXIDE EMISSIONS

CALCULATIONS

CLIENT: HARRISON RADIATOR RUN: B5-R2A DATE: 2/7/90

1. SAMPLE VOLUME, ml

V_{sc} = (0.3858) X [(2047) - (25)] X {[(726.5) + (19.5 + 273)] - [(60.4) + (8.9 + 273)]}

V_{sc} = 1770 ml

2. NO_x CONCENTRATION IN SAMPLE, lb-NO_x/dscf

C = 6.243 E-05 X [(43) + (1770)]

C = 1.52E-06 lb-NO_x/dscf

3. NO_x CONCENTRATION IN SAMPLE, ppm

C_1 = {[(0.5245) X (43)] + (1770)} X 1000

C_1 = 12.7 ppm

4. MASS EMISSION RATE, lb-NO_x/hr

ER = (1.52E-06) X (21689) X (60)

ER = 2.0 lb-NO_x/hr

5. MASS EMISSION RATE, lb-NO_x/MM Btu (OIL)

ER_2 = (2.0) / [(854.61) X (7.296) X (19500) / (1,000,000)]

ER_2 = 1.62E-02 lb-NO_x/MM Btu

HAYDEN ENVIRONMENTAL GROUP, INC.

METHOD 7A DETERMINATION OF NITROGEN OXIDE EMISSIONS

CALCULATIONS

CLIENT: **HARRISON RADIATOR** RUN: **B5-R2B** DATE: **2/7/90**

1. SAMPLE VOLUME, ml

V_{sc} = (0.3858) X [(2071) - (25)] X {[(628.5) + (19.4 + 273)] - [(60.4) + (9.7 + 273)]}

V_{sc} = **1528** ml

2. NO_x CONCENTRATION IN SAMPLE, lb-NO_x/dscf

C = 6.243 E-05 X [(33) + (1528)]

C = **1.35E-06** lb-NO_x/dscf

3. NO_x CONCENTRATION IN SAMPLE, ppm

C_1 = {[(0.5245) X (33)] + (1528)} X 1000

C_1 = **11.3** ppm

4. MASS EMISSION RATE, lb-NO_x/hr

ER = (1.35E-06) X (21689) X (60)

ER = **1.8** lb-NO_x/hr

5. MASS EMISSION RATE, lb-NO_x/MM Btu (OIL)

ER_2 = (1.8) / [(854.61) X (7.296) X (19500) / (1,000,000)]

ER_2 = **1.44E-02** lb-NO_x/MM Btu

METHOD 7A DETERMINATION OF NITROGEN OXIDE EMISSIONS

CALCULATIONS

CLIENT: **HARRISON RADIATOR** RUN: **B5-R2C** DATE: **2/7/90**

1. SAMPLE VOLUME, ml

V_{sc} = (0.3858) X [(2093) - (25)] X {[(724.5) + (19.4 + 273)] - [(60.4) + (11 + 273)]}

V_{sc} = **1807** ml

2. NO_x CONCENTRATION IN SAMPLE, lb-NO_x/dscf

C = 6.243 E-05 X [(48) + (1807)]

C = **1.66E-06** lb-NO_x/dscf

3. NO_x CONCENTRATION IN SAMPLE, ppm

C_1 = {[(0.5245) X (48)] + (1807)} X 1000

C_1 = **13.9** ppm

4. MASS EMISSION RATE, lb-NO_x/hr

ER = (1.66E-06) X (21689) X (60)

ER = **2.2** lb-NO_x/hr

5. MASS EMISSION RATE, lb-NO_x/MM Btu (OIL)

ER_2 = (2.2) / [(854.61) X (7.296) X (19500) / (1,000,000)]

ER_2 = **1.77E-02** lb-NO_x/MM Btu

METHOD 7A DETERMINATION OF NITROGEN OXIDE EMISSIONS

CALCULATIONS

CLIENT: **HARRISON RADIATOR** RUN: **B5-R2D** DATE: **2/7/90**

1. SAMPLE VOLUME, ml

V_{sc} = (0.3858) X [(2044) - (25)] X [[(740.5) + (19.4 + 273)] - [(60.4) + (12.1 + 273)]]

V_{sc} = **1808** ml

2. NO_x CONCENTRATION IN SAMPLE, lb-NO_x/dscf

C = 6.243 E-05 X [(34) + (1808)]

C = **1.17E-06** lb-NO_x/dscf

3. NO_x CONCENTRATION IN SAMPLE, ppm

C_1 = [[(0.5245) X (34)] + (1808)] X 1000

C_1 = **9.9** ppm

4. MASS EMISSION RATE, lb-NO_x/hr

ER = (1.17E-06) X (21689) X (60)

ER = **1.5** lb-NO_x/hr

5. MASS EMISSION RATE, lb-NO_x/MM Btu (OIL)

ER_2 = (1.5) / [(854.61) X (7.296) X (19500) / (1,000,000)]

ER_2 = **1.26E-02** lb-NO_x/MM Btu

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METHOD 7A DETERMINATION OF NITROGEN OXIDE EMISSIONS

CALCULATIONS

CLIENT: **HARRISON RADIATOR** RUN: **B5-R3A** DATE: **2/7/90**

1. SAMPLE VOLUME, ml

Vsc = (0.3858) X [(2032) - (25)] X [[(692.5) + (20.2 + 273)] - [(60.4) + (12 + 273)]]

Vsc = **1665** ml

2. NO_x CONCENTRATION IN SAMPLE, lb-NO_x/dscf

C = 6.243 E-05 X [(43) + (1665)]

C = **1.61E-06** lb-NO_x/dscf

3. NO_x CONCENTRATION IN SAMPLE, ppm

C_1 = [[(0.5245) X (43)] + (1665)] X 1000

C_1 = **13.5** ppm

4. MASS EMISSION RATE, lb-NO_x/hr

ER = (1.61E-06) X (22111) X (60)

ER = **2.1** lb-NO_x/hr

5. MASS EMISSION RATE, lb-NO_x/MM Btu (OIL)

ER_2 = (2.1) / [(840.3) X (7.296) X (19500) / (1,000,000)]

ER_2 = **1.79E-02** lb-NO_x/MM Btu

METHOD 7A DETERMINATION OF NITROGEN OXIDE EMISSIONS

CALCULATIONS

CLIENT: HARRISON RADIATOR RUN: B5-R3B DATE: 2/7/90

1. SAMPLE VOLUME, ml

V_{sc} = (0.3858) X [(2063) - (25)] X [[(630.5) + (19.8 + 273)] - [(60.4) + (11.3 + 273)]]

V_{sc} = 1526 ml

2. NO_x CONCENTRATION IN SAMPLE, lb-NO_x/dscf

C = 6.243 E-05 X [(27) + (1526)]

C = 1.10E-06 lb-NO_x/dscf

3. NO_x CONCENTRATION IN SAMPLE, ppm

C_1 = [[(0.5245) X (27)] + (1526)] X 1000

C_1 = 9.3 ppm

4. MASS EMISSION RATE, lb-NO_x/hr

ER = (1.10E-06) X (22111) X (60)

ER = 1.5 lb-NO_x/hr

5. MASS EMISSION RATE, lb-NO_x/MM Btu (OIL)

ER_2 = (1.5) / [(840.3) X (7.296) X (19500) / (1,000,000)]

ER_2 = 1.23E-02 lb-NO_x/MM Btu

METHOD 7A DETERMINATION OF NITROGEN OXIDE EMISSIONS

CALCULATIONS

CLIENT: HARRISON RADIATOR RUN: B5-R3C DATE: 2/7/90

1. SAMPLE VOLUME, ml

V_{sc} = (0.3858) X [(2081) - (25)] X [[(740.5) + (23.2 + 273)] - [(60.4) + (10.3 + 273)]]

V_{sc} = 1814 ml

2. NO_x CONCENTRATION IN SAMPLE, lb-NO_x/dscf

C = 6.243 E-05 X [(45) + (1814)]

C = 1.55E-06 lb-NO_x/dscf

3. NO_x CONCENTRATION IN SAMPLE, ppm

C_1 = [[(0.5245) X (45)] + (1814)] X 1000

C_1 = 13.0 ppm

4. MASS EMISSION RATE, lb-NO_x/hr

ER = (1.55E-06) X (22111) X (60)

ER = 2.1 lb-NO_x/hr

5. MASS EMISSION RATE, lb-NO_x/MM Btu (OIL)

ER_2 = (2.1) / [(840.3) X (7.296) X (19500) / (1,000,000)]

ER_2 = 1.72E-02 lb-NO_x/MM Btu

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METHOD 7A DETERMINATION OF NITROGEN OXIDE EMISSIONS

CALCULATIONS

CLIENT: **HARRISON RADIATOR** RUN: **B5-R3D** DATE: **2/7/90**

1. SAMPLE VOLUME, ml

V_{sc} = (0.3858) X [(2048) - (25)] X {[(740.5) + (20.6 + 273)] - [(60.4) + (10.7 + 273)]}

V_{sc} = **1802** ml

2. NO_x CONCENTRATION IN SAMPLE, lb-NO_x/dscf

C = 6.243 E-05 X [(45) + (1802)]

C = **1.56E-06** lb-NO_x/dscf

3. NO_x CONCENTRATION IN SAMPLE, ppm

C_1 = {[(0.5245) X (45)] + (1802)} X 1000

C_1 = **13.1** ppm

4. MASS EMISSION RATE, lb-NO_x/hr

ER = (1.56E-06) X (22111) X (60)

ER = **2.1** lb-NO_x/hr

5. MASS EMISSION RATE, lb-NO_x/MM Btu (OIL)

ER_2 = (2.1) / [(840.3) X (7.296) X (19500) / (1,000,000)]

ER_2 = **1.73E-02** lb-NO_x/MM Btu

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QUALITY ASSURANCE PROCEDURES AND RESULTS

The sampling equipment used in this test series has been calibrated in accordance with procedures outlined in the USEPA Reference Methods for stationary source sampling and also in the Quality Assurance Handbook for Air Pollution Measurement Systems. All pertinent calibration data for the equipment used in this test series are included in this Appendix. The following calibration procedures are employed:

a. Probe-tips (Nozzles)
Probe-tips are inspected before use to detect damage or irregularities. If the nozzle shows signs of damage, it is repaired and measured before use. The nozzle diameter is determined in the field by measuring three diameters with a precision micrometer. The average of the three measurements is the nozzle diameter.

b. Pitot Tubes
The S-type pitot tubes are built to the design specifications cited in Reference Method 2 and are assigned a coefficient of 0.84. Standard pitot tubes are supplied from the manufacturer with a coefficient of 0.99. The pitot tubes, connecting lines, and manometers are leak-checked in the field before and after each test run.

c. Thermocouples
Thermocouples are calibrated upon receipt and annually thereafter. The thermocouples are calibrated at 32°F, ambient temperature, 212°F, and approximately 450°F.

d. Orsat Analyzer
The Orsat analyzer is calibrated before each use with standard gases in the expected range of oxygen and carbon dioxide in the sample gas. Orsat reagents are changed when analysis indicates slow adsorption, lack of agreement between runs, or when the calibration standards cannot be accurately measured.

e. Fyrite Analyzers
The Fyrite analyzers are leak-checked on-site and the reagents are replenished as needed.

f. Method 5 Control Consoles
The dry gas meter and the orifice in the Method 5 control consoles are calibrated at six (6) points from 0 to 4 inches of mercury. The dry gas meter coefficient (y-factor) and the orifice constant ($\Delta H@$) are established from this calibration. The dry gas meter is calibrated after each test series to confirm the y-factor has not changed more than plus or minus 5%. The lower of the pre-test and post-test y-factors is used in all sample volume calculations. PCS participates in the USEPA Method 5 Dry Gas Meter Inter-Laboratory Performance Audit.

g. Barometers
The aneroid field barometers are calibrated with a stationary mercury column barometer prior to each use. The reference barometer is permanently mounted in the PCS laboratory.

h. SO_x and NO_x Analysis
PCS participates in the EPA Inter-Laboratory Performance Audits for SO_2 and NO_2. PCS uses recommended reagent grades and procedures as published in the Reference Methods for analysis of these pollutants. The details of our laboratory Quality Assurance plan are not included here.

i. NO_x Flasks

The NO_x flasks and stopcocks are engraved with an identification number upon receipt. Each flask and stopcock is calibrated by filling the flask and matching stopcock with deionized water. The water is then poured into a Class A graduated cylinder to determine the volume. The procedure is repeated three times to determine the average volume of the flask. The final volume is engraved into the flask.

j. Method 25 Sample Collection Tanks

The Method 25 tanks are assigned an identification number upon receipt from the manufacturer. The tanks are cleaned with an acid rinse, a deionized water rinse, an acetone rinse, and finally a deionized water rinse. After the initial cleaning, each tank is filled with deionized water and then emptied into a Class A graduated cylinder. This procedure is repeated three times. The average of the three measurements is the tank volume. The tank volume and identification number are engraved into the tank. The sample tanks are cleaned prior to field use by heating the tanks to approximately 125°F and alternately pressurizing and evacuating the sample tanks with nitrogen. The pressurization/evacuation cycle is repeated three times. After the final evacuation cycle, the tanks are pressurized to 5 psi with nitrogen for shipment to the sampling site.

k. Method 25 Condensate Traps

The condensate traps are fabricated in-house from 316 stainless steel tubing and quartz wool packing material. Each trap is assigned an identification number upon construction. The traps are burned out prior to field use. The burnout date is noted on the trap identification tag. A trap must be burned out within 60 days of field use. Any trap that does not meet the 60 day criteria is rejected from field use until it has been burned out again.

l. Method 25 Flow Controllers

The rotameter in the flow controller is calibrated against a soap bubble meter. Each flow controller is calibrated at two points, approximately 50 cc/min and 90 cc/min. The rotameters are calibrated annually or when their performance indicates frequent calibration.

m. Test Gauges

PCS uses mechanical gauges to measure pre- and post-test vacuums as required for Method 7 and Method 25 tests. The test gauges are calibrated annually against a mercury manometer.

n. Method 25 Analyzer

The NMO analyzer is calibrated according to the requirements of Section 5.0 of the Reference Method. The pertinent data from the calibration of the analyzer is included in this Appendix.

METER CALIBRATION

NOMENCLATURE AND DIMENSIONS

Y_b	=	ratio of accuracy of the reference meter to the dry test meter, dimensionless
Y_r	=	ratio of accuracy of the primary standard to the reference meter, dimensionless
ΔH	=	pressure differential across the dry test meter orifice, inches of H2O
Ø	=	calibration period, minutes
P_b	=	barometric pressure, inches of Hg
P_s	=	pressure at the exit of the reference meter, inches of H2O
V_d	=	gas volume passing through the dry test meter, cubic feet
V_r	=	gas volume passing through the reference meter, cubic feet
T_d	=	temperature of the dry test meter, degrees Fahrenheit
T_r	=	temperature of the reference meter, degrees Fahrenheit
$P_{a(box)}$	=	$P_b + (\Delta H + 13.6)$ = absolute pressure of the dry test meter, inches of Hg
$P_{a(ref)}$	=	$P_b + (P_s + 13.6)$ = absolute pressure the reference meter, inches of Hg

METER POST-TEST CALIBRATION

Client: **HARRISON RADIATOR** P.N: **205.011** Date: **FEB. 26,1990**

Reference Meter: **979952** Y_r = **1.004** P_b = **29.65** "Hg

Meter Box: **N-3** Pre-test Y_b = **0.988** ΔH = **2.32**

Vacuum = **4** "Hg Ø = **10.0** minutes

Performed by: BRUCE SARVEN / Tom Bayer

RAW CALIBRATION DATA

RUN	P_s	V_r	T_r	V_d	T_d
1	-0.180	298.859	56	64.674	58
		306.688	56	72.773	59
2	-0.180	306.688	56	72.773	59
		314.470	56	80.824	58
3	-0.180	314.470	56	80.824	58
		322.224	56	88.883	58

$$Y = (Y_r) \left\{ \frac{(V_r) \times (T_d + 460) \times [P_b - (P_s \div 13.6)]}{(V_d) \times (T_r + 460) \times [P_b + (\Delta H \div 13.6)]} \right\}$$

CALCULATED CALIBRATION DATA

RUN	$V_{r(f-i)}$	aveT_r	$P_{a(ref)}$	$V_{d(f-i)}$	aveT_d	$P_{a(box)}$	Y
1	7.829	516	29.6368	8.099	518	29.8206	0.9683
2	7.782	516	29.6368	8.051	518	29.8206	0.9682
3	7.754	516	29.6368	8.059	518	29.8206	0.9638

AVERAGE POST-TEST Y_b 0.967

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THERMOCOUPLE CALIBRATION

THERMOCOUPLE I. D.: I-1 LENGTH: NA DATE: 2-1-90

CALIBRATED BY: Barry Hunter HB

REFERENCE THERMOMETER: NBS 90333

SOURCE	REFERENCE THERMOMETER TEMPERATURE °F	TEST THERMOCOUPLE TEMPERATURE °F	TEMPERATURE DIFFERENCE °F
Ambient AIR	70.0	69.0	1.0
ICE WATER	32.0	32.0	0

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THERMOCOUPLE CALIBRATION

THERMOCOUPLE I. D.: I-2 LENGTH: NA DATE: 2-1-90

CALIBRATED BY: BARRY HUNTER/TB

REFERENCE THERMOMETER: NBS 90333

SOURCE	REFERENCE THERMOMETER TEMPERATURE °F	TEST THERMOCOUPLE TEMPERATURE °F	TEMPERATURE DIFFERENCE °F
Ambient AIR	68.0	68.0	0
ICE WATER	32.0	32.0	0

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THERMOCOUPLE CALIBRATION

THERMOCOUPLE I. D.: I-3 LENGTH: NA DATE: 2-1-90

CALIBRATED BY: BARRY HUNTER

REFERENCE THERMOMETER: NBS 9D333

SOURCE	REFERENCE THERMOMETER TEMPERATURE °F	TEST THERMOCOUPLE TEMPERATURE °F	TEMPERATURE DIFFERENCE °F
Ambient AIR	68.0	68.0	0
ICE WATER	32.0	32.0	0

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THERMOCOUPLE CALIBRATION

THERMOCOUPLE I. D.: I-4 LENGTH: NA DATE: 2-1-90

CALIBRATED BY: BARRY HUNTER / TB

REFERENCE THERMOMETER: NBS 90333

SOURCE	REFERENCE THERMOMETER TEMPERATURE °F	TEST THERMOCOUPLE TEMPERATURE °F	TEMPERATURE DIFFERENCE °F
Ambient Air	67.0	67.0	0
Ice Water	32.0	32.0	0

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THERMOCOUPLE CALIBRATION

THERMOCOUPLE I. D.: 8A LENGTH: 8 ft DATE: 2-1-90

CALIBRATED BY: BARRY HUNTER/HB

REFERENCE THERMOMETER: NBS 9D333

SOURCE	REFERENCE THERMOMETER TEMPERATURE °F	TEST THERMOCOUPLE TEMPERATURE °F	TEMPERATURE DIFFERENCE °F
Ambient AIR	69.0	70.0	1
Boiling water	212.0	212.0	0
Ice water	32.0	31.0	1
Hot Silicone OIL	416.0	414.0	2

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LABORATORY ANALYSIS REPORT

Mr. Bob Kerr
HARRISON RADIATOR
P.O. Box 824
Dayton, OH 45401

Page 10
Report Date : 02/21/90
HEG Task # : 90020146
HEG P/N, Acct: 205.011

==========

HEG Sample # : 9003246
Sample ID : Boiler 5, Run 1B, Flask 2P
Sample Date : 02/09/90 Sample Priority : Normal

Parameter	Units	Results / Comments
Nitrogen Oxide	ug	44

==========

HEG Sample # : 9003247
Sample ID : Boiler 3, Run 3B, Flask 28P
Sample Date : 02/09/90 Sample Priority : Normal

Parameter	Units	Results / Comments
Nitrogen Oxide	ug	96

==========

HEG Sample # : 9003248
Sample ID : EPA VIAL
Sample Date : Not Specified Sample Priority : Normal

Parameter	Units	Results / Comments
Nitrogen Oxide	mg/dscm	346

HAYDEN
ENVIRONMENTAL GROUP, INC.

LABORATORY ANALYSIS REPORT

Mr. Bob Kerr
HARRISON RADIATOR
P.O. Box 824
Dayton, OH 45401

Report Date : 02/21/90
HEG Task # : 90020146
HEG P/N, Acct: 205.011

==========

HEG Sample # : 9003234
Sample ID : Boiler 5, Run 3A, Flask 9P
Sample Date : 02/09/90 Sample Priority : Normal

Parameter	Units	Results	/	Comments
Nitrogen Oxide	ug	43		

==========

HEG Sample # : 9003235
Sample ID : Boiler 5, Run 2B, Flask 6P
Sample Date : 02/09/90 Sample Priority : Normal

Parameter	Units	Results	/	Comments
Nitrogen Oxide	ug	33		

==========

HEG Sample # : 9003236
Sample ID : Boiler 5, Run 2D, Flask 8P
Sample Date : 02/09/90 Sample Priority : Normal

Parameter	Units	Results	/	Comments
Nitrogen Oxide	ug	34		

==========

HEG Sample # : 9003237
Sample ID : Blank
Sample Date : 02/09/90 Sample Priority : Normal

Parameter	Units	Results	/	Comments
Nitrogen Oxide	ug	< 25		

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APPENDIX K

OEPA STACK TEST REVIEW SUMMARY FORM

APPLICATION NUMBER 08571000030 B003

FACILITY NAME Harrison Radiator Div.

SOURCE DESCRIPTION (OR SCC CODE) Natural Gas Boiler

CONTROL EQUIPMENT None

DATE(S) OF TEST 2-8-90

FINAL TEST REPORT RECEIVED ON 3-23-90

POLLUTANT(S) TESTED NO_x

TEST METHOD 1, 2, 3, 4, 7a

TEST FIRM Hayden Environmental Group

EMISSION RATES*:

ACTUAL (lb(s)/hr) 0.0298 lb/mmBtu ALLOWABLE** 0.2 lb/mm Btu

OPERATING RATES*:

DURING TEST** 229.27 KSCF/Hr MAXIMUM** 229.38 KSCF/Hr

EMISSION FACTOR***

COMMENTS:

I HEREBY VERIFY THAT IN THE STACK
TEST REPORT HAS BEEN 2-18/90 MINED THAT
THE TEST PROCEDURES, NO_x testing
[X] AN ACCEPTABLE D TH THE APPROVED
TESTING METHODC B003-S
[ ] AN UNACCEPTABLE WITH THE
APPROVED TESTIN

3-28-90
DATE OF REVIEW

Jon Hietz
REVIEWED BY

* BASED ON 3 RUN AVERAGE

** SPECIFY APPLICABLE UNITS

***SPECIFY IN UNITS OF MASS/INPUT

APPENDIX K

OEPA STACK TEST REVIEW SUMMARY FORM

APPLICATION NUMBER 08-57100030 B005
FACILITY NAME Harrison Radiator Div.
SOURCE DESCRIPTION (OR SCC CODE)
No. 2 Fuel Oil Boiler
CONTROL EQUIPMENT None

DATE(S) OF TEST 2-7-90
FINAL TEST REPORT RECEIVED ON 3-23-90
POLLUTANT(S) TESTED NO_x
TEST METHOD Methods 1, 2, 3, 4, 7a
TEST FIRM Hayden Environmental Group
EMISSION RATES*:
ACTUAL (lb(s)/hr) 0.0152 lb/mm Btu ALLOWABLE** 0.3 lb/mm Btu
OPERATING RATES*:
DURING TEST** 849.48 Gal/Hr MAXIMUM** 854.61 Gal/Hr
EMISSION FACTOR***
COMMENTS:

I HEREBY VERIFY THAT THE INFORMATION CONTAINED WITHIN THE STACK TEST REPORT HAS BEEN REVIEWED AND IT HAS BEEN DETERMINED THAT THE TEST PROCEDURES, ANALYSES AND CALCULATIONS ARE:

[X] AN ACCEPTABLE DEMONSTRATION OF CONFORMANCE WITH THE APPROVED TESTING METHODOLOGY.

[ ] AN UNACCEPTABLE DEMONSTRATION OF CONFORMANCE WITH THE APPROVED TESTING METHODOLOGY.

3-28-90
DATE OF REVIEW

Jon Hilty
REVIEWED BY

* BASED ON 3 RUN AVERAGE
** SPECIFY APPLICABLE UNITS
*** SPECIFY IN UNITS OF MASS/INPUT

APPENDIX K

OEPA STACK TEST REVIEW SUMMARY FORM

APPLICATION NUMBER 0857100030 B004

FACILITY NAME Harrison Radiator Div.

SOURCE DESCRIPTION (OR SCC CODE) Natural Gas/Fuel Oil Boiler

CONTROL EQUIPMENT None

DATE(S) OF TEST 2-6-90

FINAL TEST REPORT RECEIVED ON 3-23-90

POLLUTANT(S) TESTED NOx

TEST METHOD 1, 2, 3, 4, 7a

TEST FIRM Hayden Environmental Group

EMISSION RATES*:

ACTUAL (lb(s)/hr) 0.0252 lb/mmBtu ALLOWABLE** 0.2 lb/mmBtu

OPERATING RATES*:

DURING TEST** 125.07 KSCF/Hr MAXIMUM** 125.6 KSCF/Hr

EMISSION FACTOR***

COMMENTS:

I HEREBY VERIFY THAT THE INFORMATION CONTAINED WITHIN THE STACK TEST REPORT HAS BEEN REVIEWED AND IT HAS BEEN DETERMINED THAT THE TEST PROCEDURES, ANALYSES AND CALCULATIONS ARE:

[X] AN ACCEPTABLE DEMONSTRATION OF CONFORMANCE WITH THE APPROVED TESTING METHODOLOGY.

[ ] AN UNACCEPTABLE DEMONSTRATION OF CONFORMANCE WITH THE APPROVED TESTING METHODOLOGY.

3-28-90
DATE OF REVIEW

Jon Hilty
REVIEWED BY

* BASED ON 3 RUN AVERAGE

** SPECIFY APPLICABLE UNITS

***SPECIFY IN UNITS OF MASS/INPUT

CONTACT REPORT- STACK TEST

FACILITY:	Harrison Radiator Div. 0857100030
FACILITY CONTACT:	William Stevens - Harrison Plant Engineer Daniel Inlow - Harrison Chief Powerhouse Engineer
RAPCA REP:	Robert Booher Jon Hilty

The purpose of this visit was to observe a stack test on Harrison Radiator's #4 natural gas/fuel oil boiler (B004). B004 is rated at 145 mm BTU with a maximum fuel usage rate of 142,000 ft. 3/hr for natural gas. It was operating at 90%.

The entire boiler system is computer controlled. All functions of the boiler can be monitored and manipulated from the control room console. Any aspect of the boiler can be tracked and recorded.

For the test:

O_2 trim - 2.1% aug.

fuel usage - 124,000 - 126,000 ft. 3/hr aug.

/rm

CONTACT REPORT

FACILITY: Harrison Radiator Div., GM
3600 Dryden Road
Dayton, Ohio
Premises no. 0857100030

FACILITY CONTACT: Ron Williams
Bob Kerr

RAPCA REP: Bonnie Shelton
Jon Hilty

DATE: 2/7/90

STACK TEST

On this date, testing was performed on source B005, boiler #5 for the pollutant, NOx as part of the three day testing of sources B003, B004 and B005. Source B005 utilized ~~the~~ no. 2 fuel oil as its ~~main~~ source of fuel.

Testing began at 9:10 a.m. The information gathered during the test is as follows.

Run #1	O_2 Trim
Start - 9:10	3.10
End - 10:10	No. 2 fuel oil (gal/hr) 853

Run #2	O_2 Trim
Start - 10:35	3.10
End - 11:35	No. 2 fuel oil (gal/hr) 857.90

(I left after run #2 was complete.)

BS/rm