AP42 Section:	4.12
Related:	14
Title:	Source test: Tire Retreading Source Evaluation Results Goodyear Tire & Rubber Company Jacksonville, FL Envisage Environmental September 1987

GOODYEAR TIRE & RUBBER

SOURCE EVALUATION RESULTS

PREPARED BY

Envisage Environmental Incorporated
P.O. Box 152 Richfield, Ohio 44286
Phone (216) 526-0990

30800501
Tire retreading - buffing machine

Sept 1987

Envisage Environmental Incorporated P.O. Box 152 Richfield, Ohio 44286
Phone (216) 526-0990

[redacted]

October 1, 1987

The Goodyear Tire & Rubber Company
1144 East Market Street
Akron, Ohio 44316-0001

The following report is the result of the USEPA Reference Methods 1-5 Particulate Emission Evaluation conducted on September 16, 1987. The test was conducted at the Goodyear Tire and Rubber Company, Truck Tire Center, 1475 Picketville Road, Jacksonville, Florida on the Retread Buffer Cyclone exhaust.

The results are true and accurate to the degree specified in the pertinent sections of the Federal Register, in force at the time of testing, concerning Source Sampling for Particulate Matter.

Looking forward to answering any questions you may have and assisting you in the future.

Respectfully submitted,

Tom E. Holder

Tom E. Holder
Environmental Engineer
ENVISAGE ENVIRONMENTAL INC.

87-1701

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Envisage Environmental Incorporated

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INTRODUCTION

Envisage Environmental Incorporated
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INTRODUCTION

Envisage Environmental Inc. conducted an E.P.A. Methods 1-5 Particulate Emission Evaluation at the Goodyear Tire and Rubber Company, Truck Tire Center, 1475 Picketville Road, Jacksonville, Florida on September 16, 1987. The testing was completed by Messrs. Tom Holder and Eric Wolfendale and consisted of three (3) test runs to establish the particulate emission rates. Three (3) test runs for particle size distribution utilizing Andersen Inc. cascade impactors were also performed. USEPA Reference Method 9, Visible Opacity Determinations were also conducted simultaneously with the three particulate test runs. The purpose of this test program was to ascertain compliance with EPA regulations.

A part of this facilities operation is the grinding (or buffing) of used truck tires as part of the retread operation. The amount of tread removed varies with each tire and a random selection was weighted prior to and after buffing. The buffer is equipped with a water spray to cool the tires and to facilitate particulate collection. The unit is equipped with a B&J Manufacturing Cyclone.

Included in this report are the particulate emission rates, particle size distribution and opacity readings from the three test runs and the various temperature, volumetric, and velocity measurements associated with these tests.

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DESCRIPTION OF PROGRAM

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DESCRIPTION OF PROGRAM

The tests were conducted in the horizontal extension leading to the atmosphere through three (3) sample ports. Four (4) sample points were utilized in each sample port making a total of twelve (12) sample points per test run. The sample was drawn for five (5) minutes at each sample point for a total test time of sixty (60) minutes per test run. A diagram of the sample point locations is included in this report.

The samples were withdrawn from the gas stream isokinetically with a two foot Pyrex lined probe. The probe was attached to a standard EPA Method Five Sample Train. The probe and filter compartment were heated and monitored throughout each test to ensure that no condensation formed prior to the impingers. An ice bath was used to ensure that the impinger exit gas temperature was maintained below seventy (70) degrees Fahrenheit.

Flue gas composition was determined by drawing an integrated air bag sample during each run and analyzed with a Hays Republic Model 621A "Orsat" Gas Analyzer. The average of these readings for each test run were used in calculating the emission rates.

Calibration of equipment used, to include the dry gas meter, orifice meter, and the "S" type pitot tube was conducted August 18, 1987. Calibration sheets are included in this report.

DESCRIPTION OF PROGRAM - con't

All analytical procedures were performed in accordance with the methods specified in the Federal Register, Title 40, Part 60, Volume 43, with amendments. During the laboratory analysis, a blank was performed on the residue left from the acetone and distilled water used in the evaluation. The acetone blank was recorded and incorporated into the results. The distilled water blank was less than could be measured on a 0.1 milligram analytical balance and therefore was considered to be zero.

A set of sample stack testing equations used for data reduction and analysis is included in this report for convenience and to aid in understanding the presented data. Incorporated figures are from the first test run conducted on this date at this facility.

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OPERATIONAL PARAMETERS

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OPERATIONAL PARAMETERS

Goodyear Tire & Rubber Company
1475 Picketville Road
Jacksonville, Florida

Run # 1

#	Tare	Final	Removed
1	NA	NA	NA
2	111	108	3
3	132	108	26
4	117	108	9
5	112.5	108	4.5
			42.5

Test results
0.073 lbs/hr

42.5 / 4 = 10.6 lbs/tire

Average for ~~5~~ 4 tires = 10.6
Total for 6? tires = 53 pounds - ?

~ 0.0015 lbs emitted / lb removed, assuming 50 lbs removed in same hour as sampling.
RR 2/13/02

Run # 2

1	NA	NA	Scrapped
2	90	74	16
3	71	60	11
4	71	61	10
5	82	67.5	15.5
6	75	57	18
7	104	89	15
8	103	88	15
			~~99.5~~ 100.5 for 7

Test results
0.163 lbs/hr

Average for 7 tires = 14.4
Total for 8? tires = 113.6 pounds
113.9

100.5 / 7 = 14.4 lbs/tire

~ 0.0016 lbs emitted / lb removed, assuming 100 lbs removed in same hour as sampling.
RR 2/13/02

Run # 3 - No tires weighed - 6 tires buffed

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TEST RESULTS
SUMMARY

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TEST RESULTS SUMMARY

Goodyear Tire & Rubber Company

1475 Picketville Road

Jacksonville, Florida

Retread Buffer Cyclone Exhaust

Particulate Emission Evaluation

Conducted - September 16, 1987

PARAMETER	Run # 1	Run # 2	Run # 3
Particulate Emissions			
Pounds/hour	0.073	0.163	0.120
Grains/dscf	0.0040	0.0088	0.0064
System Flow Rates			
Feet/second	47.98	49.38	50.31
ACFM	2,332	2,400	2,445
SCFM	2,132	2,165	2,183
Moisture Content			
Volume percent	1.96	2.26	2.55
Sample Location Temperature			
Degrees Fahrenheit	109	114	118

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SUMMARY

Goodyear Tire & Rubber Company
1475 Picketville Road
Jacksonville, Florida

Run # 1
Total Rubber Removed - 53 pounds
Emissions - 0.073 pounds/hour
Efficiency - 99.86% - this is not efficiency of just the cyclone

Run # 2
Total Rubber Removed - 113.6 pounds
Emissions - 0.163 pounds/hour
Efficiency - 99.86%

Run # 3
Average Rubber Removed Runs 1 & 2 - 83.3 pounds
Emissions - 0.120 pounds/hour
Efficiency - 99.86%

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TEST RESULTS DETAILED

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TEST RESULTS

Goodyear Tire & Rubber Company

Retread Buffer Cyclone Exhaust

Particulate Emission Test

DATE: September 16, 1987	Symbol	Units	RUN # 1	RUN # 2	RUN # 3
Time of Day			1110 1214	1340 1445	1540 1645
1 Gas Volume-dry,std.	Vmstd	cu. ft.	54.90	54.15	54.74
2 Condensate Vapor Vol.	Vwstd	cu. ft.	1.10	1.25	1.43
3 Gas Stream Moisture	Bws	vol.dec	0.0196	0.0226	0.0255
4 Mol.Wt-flue gas (dry)	Msd	lb/lb mo.	28.84	28.84	28.84
5 Mol.Wt-flue gas (wet)	Ms	lb/lb mo.	28.62	28.59	28.56
6 Flue Gas Velocity	Vs	ft/sec	47.98	49.38	50.31
7 Flue Gas Volume-Actual	ACFM	cu. ft.	2,332	2,400	2,445
8 Flue Gas Volume-Std.	SCFM	cu. ft.	2,132	2,165	2,183
9 Particulate Conc.	Cs				
- Probe		gr/scf	0.0022	0.0041	0.0027
- Filter		gr/scf	0.0018	0.0047	0.0037
- Impingers		gr/scf	0.0003	0.0011	0.0002
- Total *		gr/scf	0.0040	0.0088	0.0064
10 Emission Rate	E				
- Probe		lb/hr	0.040	0.077	0.051
- Filter		lb/hr	0.033	0.087	0.070
- Impingers		lb/hr	0.006	0.021	0.004
- Total *		lb/hr	0.079	0.163	0.120
11 Isokinetic Rate	I	%	102.0	99.0	99.3

* Totals DO NOT include impinger weights.

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PARTICLE SIZING DATA

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PARTICLE SIZE DISTRIBUTION
EMISSIONS SUMMARY

Goodyear Tire & Rubber Company
1475 Picketville Road
Jacksonville, Florida

Run # 1

Approximately 93% less than 10 microns

Therefore: Approximately 0.068 pounds/hour less than 10 microns.

Run # 2

Approximately 89% less than 10 microns

Therefore: Approximately 0.145 pounds/hour less than 10 microns.

Run # 3

Approximately 90% less than 10 microns

Therefore: Approximately 0.108 pounds/hour less than 10 microns.

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PARTICLE SIZING DATA

Goodyear Tire & Rubber Co.

Jacksonville, Florida

Retread Buffer Cyclone Exhaust

Run # 1

Conducted:	September 16, 1987
Temperature (F):	109.1
Sample Rate (cu.ft/min):	0.58
Sample Time (minutes):	5.8

Stage	Tare (g)	Final (g)	Net (g)	% in Size Range	Cumulative % Less Than Size Range	Effectve cut Diameter	Size Range (u)
0	0.1963	0.1963	0.0000	0.0	100.0	12.5	> or = 12.5
1	0.1533	0.1540	0.0007	9.0	91.0	7.8	7.8 - 12.5
2	0.1370	0.1370	0.0000	0.0	91.0	5.3	5.3 - 7.8
3	0.1525	0.1529	0.0004	5.1	85.9	3.6	3.6 - 5.3
4	0,1634	0.1642	0.0008	10.3	75.6	2.3	2.3 - 3.6
5	0.1502	0.1513	0.0011	14.1	61.5	1.2	1.2 - 2.3
6	0.1642	0.1652	0.0010	12.8	48.7	0.71	0.71 - 1.2
7	0.1497	0.1512	0.0015	19.2	29.5	0.48	0.48 - 0.71
Back -up	0.2181	0.2204	0.0023	29.5	0	0	0 - 0.48
Total			0.0078				

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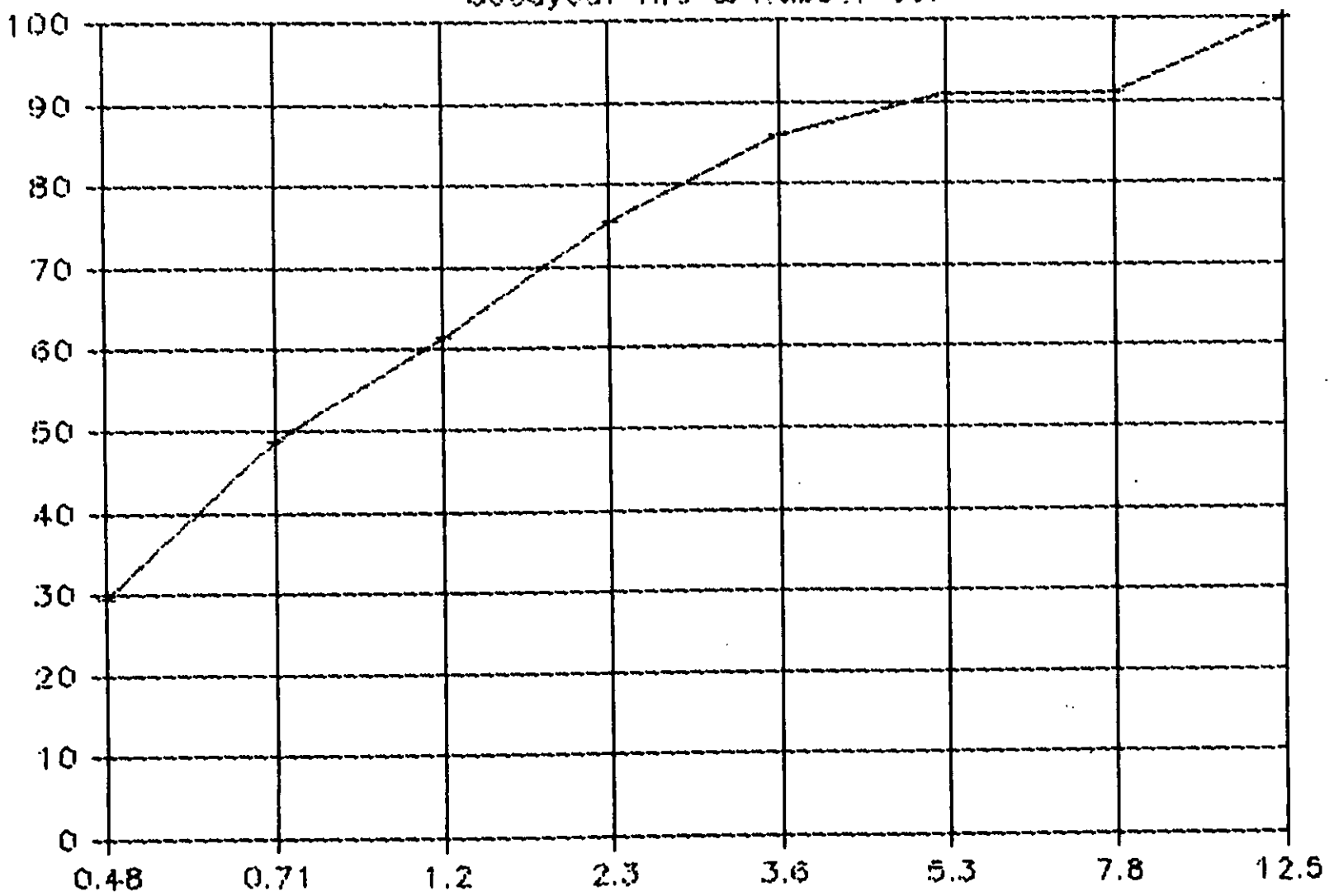
Run # 1

Particle Size Distribution

Goodyear Tire & Rubber Co.



+ September 16, 1987

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PARTICLE SIZING DATA

Goodyear Tire & Rubber Co.

Jacksonville, Florida

Retread Buffer Cyclone Exhuast

Run # 2

Conducted:	September 16, 1987
Temperature (F):	114.3
Sample Rate (cu.ft/min):	0.57
Sample Time (minutes):	19.0

Stage	Tare (g)	Final (g)	Net (g)	% in Size Range	Cumulative % Less Than Size Range	Effectve cut Diameter	Size Range (u)
0	0.1609	0.1621	0.0012	10.6	89.4	12.5	> or = 12.5
1	0.1255	0.1256	0.0001	0.9	88.5	7.6	7.6 - 12.5
2	0.1603	0.1610	0.0007	6.2	82.3	5.3	5.3 - 7.6
3	0.1535	0.1540	0.0005	4.4	77.9	3.6	3.6 - 5.3
4	0.1575	0.1583	0.0008	7.1	70.8	2.3	2.3 - 3.6
5	0.1534	0.1540	0.0006	5.3	65.5	1.2	1.2 - 2.3
6	0.1584	0.1592	0.0008	7.1	58.4	0.71	0.71 - 1.2
7	0.1535	0.1545	0.0010	8.8	49.6	0.48	0.48 - 0.71
Back -up	0.2177	0.2233	0.0056	49.6	0	0	0 - 0.48
Total			0.0113				

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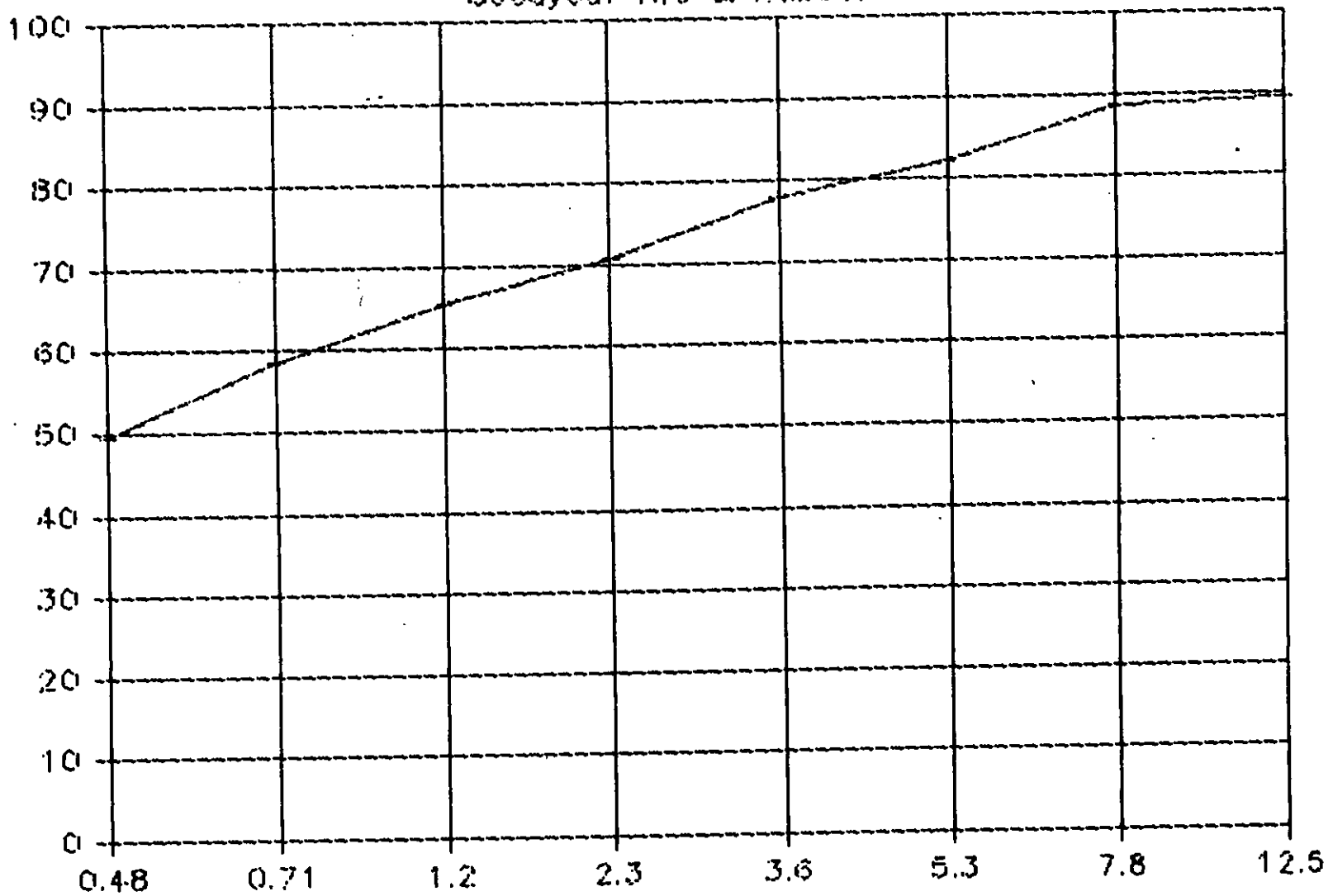
Run # 2

Particle Size Distribution

Goodyear Tire & Rubber Co.



September 16, 1987

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PARTICLE SIZING DATA

Goodyear Tire & Rubber Co.

Jacksonville, Florida

Retread Buffer Cyclone Exhuast

Run # 3

Conducted:	September 16, 1987
Temperature (F):	118.3
Sample Rate (cu.ft/min):	0.58
Sample Time (minutes):	60.0

Stage	Tare (g)	Final (g)	Net (g)	% in Size Range	Cumulative % Less Than Size Range	Effectve cut Diameter	Size Range (u)
0	0.1618	0.1627	0.0009	5.2	94.8	12.5	> or = 12.5
1	0.1517	0.1532	0.0015	8.7	86.0	7.8	7.8 - 12.5
2	0.1602	0.1610	0.0008	4.7	81.4	5.3	5.3 - 7.8
3	0.1516	0.1520	0.0004	2.3	79.1	3.6	3.6 - 5.3
4	0.1606	0.1606	0.0000	0.0	79.1	2.3	2.3 - 3.6
5	0.1504	0.1506	0.0002	1.2	77.9	1.2	1.2 - 2.3
6	0.1616	0.1621	0.0005	2.9	75.0	0.71	0.71 - 1.2
7	0.1521	0.1522	0.0001	0.6	74.4	0.48	0.48 - 0.71
Back -up	0.2134	0.2262	0.0128	74.4	0	0	0 - 0.48
Total			0.0172				

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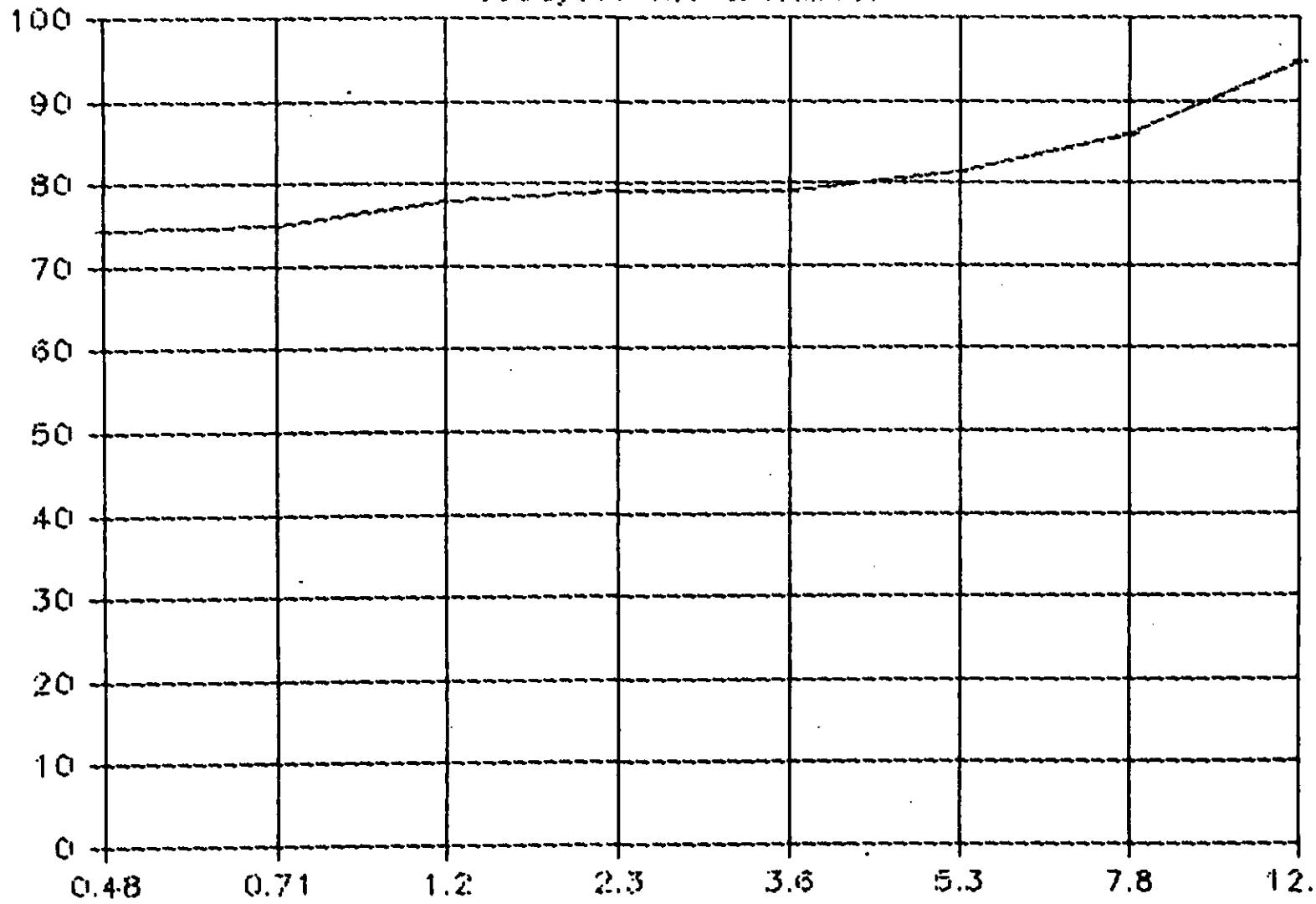
Run # 3

Particle Size Distribution

Goodyear Tire & Rubber Co.



+ September 16, 1987

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VISIBLE EMISSIONS

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Name of Company Goodyear Re Tread

Address

Owner, Manager or Agent

Observation Point Parking Lot, East South of Stack

Observation Began 11:10A M Ended 12:14 PM: Date 9-16-87

Distance from stack 70' feet. Observer EAW

Run #1

SEC / MIN	0	15	30	45	PLUME COLOR	SEC / MIN	0	15	30	45	PLUME COLOR
00	0	0	0	0	—	30	5	0	0	5	light
01	0	0	0	0	—	31	0	0	5	5	light
02	0	0	0	0	—	32	0	0	0	0	—
03	0	0	0	0	—	33	0	0	0	0	—
04	0	0	0	0	—	34	0	0	0	0	—
05	0	0	0	0	—	35	0	0	0	0	—
06	0	0	0	0	—	36	0	0	0	0	—
07	0	0	0	0	—	37	0	0	0	0	—
08	0	0	0	0	—	38	0	0	0	0	—
09	0	0	0	0	—	39	0	5	0	0	light
10	0	0	0	0	—	40	0	0	0	0	—
11	0	5	5	0	light	41	0	0	0	0	—
12	0	0	0	0	—	42	0	0	0	0	—
13	0	0	0	0	—	43	0	0	0	0	—
14	0	0	5	0	light	44	0	0	0	0	—
15	0	0	0	5	light	45	0	0	0	0	—
16	0	0	0	0	—	46	0	0	0	0	—
17	0	0	0	0	—	47	0	0	0	0	—
18	0	0	0	0	—	48	0	5	0	0	light
19	0	0	0	0	—	49	0	0	0	0	—
20	0	0	0	0	—	50	0	0	0	0	—
21	0	0	0	0	—	51	0	0	0	0	—
22	0	0	0	0	—	52	0	0	0	0	—
23	0	0	0	0	—	53	0	0	0	0	—
24	0	0	0	5	light	54	0	0	0	0	—
25	0	5	0	0	light	55	0	0	5	0	light
26	0	0	0	10	light	56	0	0	0	0	—
27	5	0	0	5	light	57	0	0	0	0	—
28	15	5	10	0	light	58	0	0	0	0	—
29	0	15	5	10	light	59	0	0	0	0	—

Stack Description Rectangular, metal

Source Description Cyclone Tread Grinder

Sky Condition Clear / Partly Cloud

Wind Speed 0/5 MPH

Wind Direction 0 - NE SW

Plume Background Sky

SUMMARY OF READING	
Opacity (Percent)	Minutes Observed
0 - 20%	60
25 - 60%	—
65 - 100%	—
Minutes in Excess of Limitations	

Was Uncombined Water Present? ☐ Yes ☒ No

Remarks and/or Explanation about wei plume:

Sky = blue, clear

6 Minute Averages

1	0.0	6	0.8
2	0.4	7	0.2
3	0.2	8	0.0
4	0.0	9	0.2
5	3.8	10	0.2

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Name of Company Goodyear PaTrend 24

Address

Owner, Manager or Agent

Observation Point Parking Lot ~~North~~ West ~~South~~ of stack

Observation Began 1340 M Ended 1440 M: Date 9-16-87

Distance from stack 70' feet. Observer ~~EMW~~ JA

Run #2

SEC / MIN	0	15	30	45	PLUME COLOR	SEC / MIN	0	15	30	45	PLUME COLOR
00	5	5	0	0	White	30	0	0	5	0	White
01	0	0	0	0	-	31	0	5	0	0	"
02	0	0	0	0	-	32	0	0	0	5	"
03	0	0	0	0	-	33	5	0	0	0	"
04	0	0	0	0	-	34	0	0	0	0	-
05	0	0	0	5	White	35	0	0	0	0	-
06	5	0	0	0	-	36	0	0	0	0	-
07	0	5	0	0	White	37	0	0	0	0	-
08	0	0	0	0	-	38	0	0	0	0	-
09	0	0	0	0	-	39	0	0	0	0	-
10	0	0	0	0	-	40	0	0	0	0	-
11	0	0	0	0	-	41	0	0	0	0	-
12	0	0	0	0	-	42	0	0	0	0	-
13	0	0	0	0	-	43	0	0	0	0	-
14	0	0	0	0	-	44	0	0	0	0	-
15	0	0	0	0	-	45	0	0	0	0	-
16	0	0	0	0	-	46	0	0	0	0	-
17	0	0	0	0	-	47	0	0	0	0	-
18	0	0	0	0	-	48	0	0	0	0	-
19	0	0	0	5	White	49	0	0	0	0	-
20	0	0	0	0	-	50	0	0	0	0	-
21	0	0	0	0	-	51	0	0	0	0	-
22	0	0	0	0	-	52	0	0	0	0	-
23	0	0	0	0	-	53	0	0	0	0	-
24	0	0	0	0	-	54	0	0	0	0	-
25	0	0	0	0	-	55	0	0	0	0	-
26	0	0	0	0	-	56	5	5	0	0	White
27	0	0	0	0	-	57	0	0	0	0	-
28	0	0	0	0	-	58	0	0	0	0	
29	0	0	0	0		59	0	0	0	0	

Stack Description Metal, Rectangular

Source Description Trend Grinder Cyclone

Sky Condition Clear / Partly Cloudy

Wind Speed 0-5 MPH

Wind Direction ~~SW~~ NW

Plume Background Sky

SUMMARY OF READING	
Opacity (Percent)	Minutes Observed
0 - 20%	60
25 - 60%	
65 - 100%	
Minutes in Excess of Limitations	

Was Uncombined Water Present? ☐ Yes ☒ No

Remarks and/or Explanation about w plume:

6 Minute Averages

1	0.6	6	0.8
2	0.4	7	0.0
3	0.0	8	0.0
4	0.2	9	0.0
5	0.0	10	0.4

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Name of Company Goodyear Truck Tire Cent

Address 1475 Pickerville Rd Jacksonville Fla

Owner, Manager or Agent

Observation Point Parking Lot West North of Stack

Observation Began 15:40 M Ended 16:40 M: Date 9-16-87

Distance from stack 20' feet. Observer EAW

Run #3

SEC / MIN	0	15	30	45	PLUME COLOR	SEC / MIN	0	15	30	45	PLUME COLOR
00	0	0	0	0	—	30	0	0	0	0	—
01	0	0	0	0	—	31	0	0	0	0	—
02	0	0	0	0	—	32	0	0	0	0	—
03	0	0	0	0	—	33	0	0	0	0	—
04	0	0	0	0	—	34	0	0	0	0	—
05	0	0	0	0	—	35	0	5	0	0	light
06	5	0	0	0	light	36	5	5	0	0	light
07	5	5	0	0	light	37	0	0	0	0	—
08	0	0	0	0	—	38	0	0	0	0	—
09	0	0	0	0	—	39	0	0	0	0	—
10	0	0	0	0	—	40	0	0	0	0	—
11	0	0	0	0	—	41	0	0	0	0	—
12	0	0	0	0	—	42	0	0	0	0	—
13	0	0	0	0	—	43	0	5	0	0	light
14	0	0	0	5	light	44	0	0	5	0	light
15	0	0	0	0	—	45	5	0	0	0	light
16	0	0	5	5	light	46	0	0	5	0	light
17	0	5	0	0	light	47	0	0	0	0	—
18	0	0	0	0	—	48	0	0	0	0	—
19	0	0	0	0	—	49	0	0	0	0	—
20	0	0	0	0	—	50	0	0	0	0	—
21	0	0	0	0	—	51	0	0	0	0	—
22	0	0	0	0	—	52	0	0	0	0	—
23	0	0	0	0	—	53	0	5	0	0	light
24	0	0	5	0	light	54	0	0	0	0	—
25	0	0	0	0	—	55	0	0	5	0	light
26	0	5	0	0	light	56	0	5	0	0	light
27	0	0	0	0	—	57	0	0	0	5	light
28	0	0	0	0	—	58	0	0	0	0	—
29	0	0	0	0	—	59	0	0	0	0	—

Stack Description Metal Rectangular

Source Description ReTread Cyclone

Sky Condition Clear/P.C.

Wind Speed ~~0-5~~ MPH 0-10

Wind Direction ~~Southerly~~ Easterly

Plume Background sky w/clouds

SUMMARY OF READING	
Opacity (Percent)	Minutes Observed
0 - 20%	60
25 - 60%	
65 - 100%	
Minutes in Excess of Limitations	

Was Uncombined Water Present? ☐ Yes ☒ No

Remarks and/or Explanation about wet plume:

sky/background = clouds

6 Minute Averages

1	0.0	6	0.2
2	0.6	7	0.4
3	0.8	8	0.8
4	0.0	9	0.2
5	0.4	10	0.6

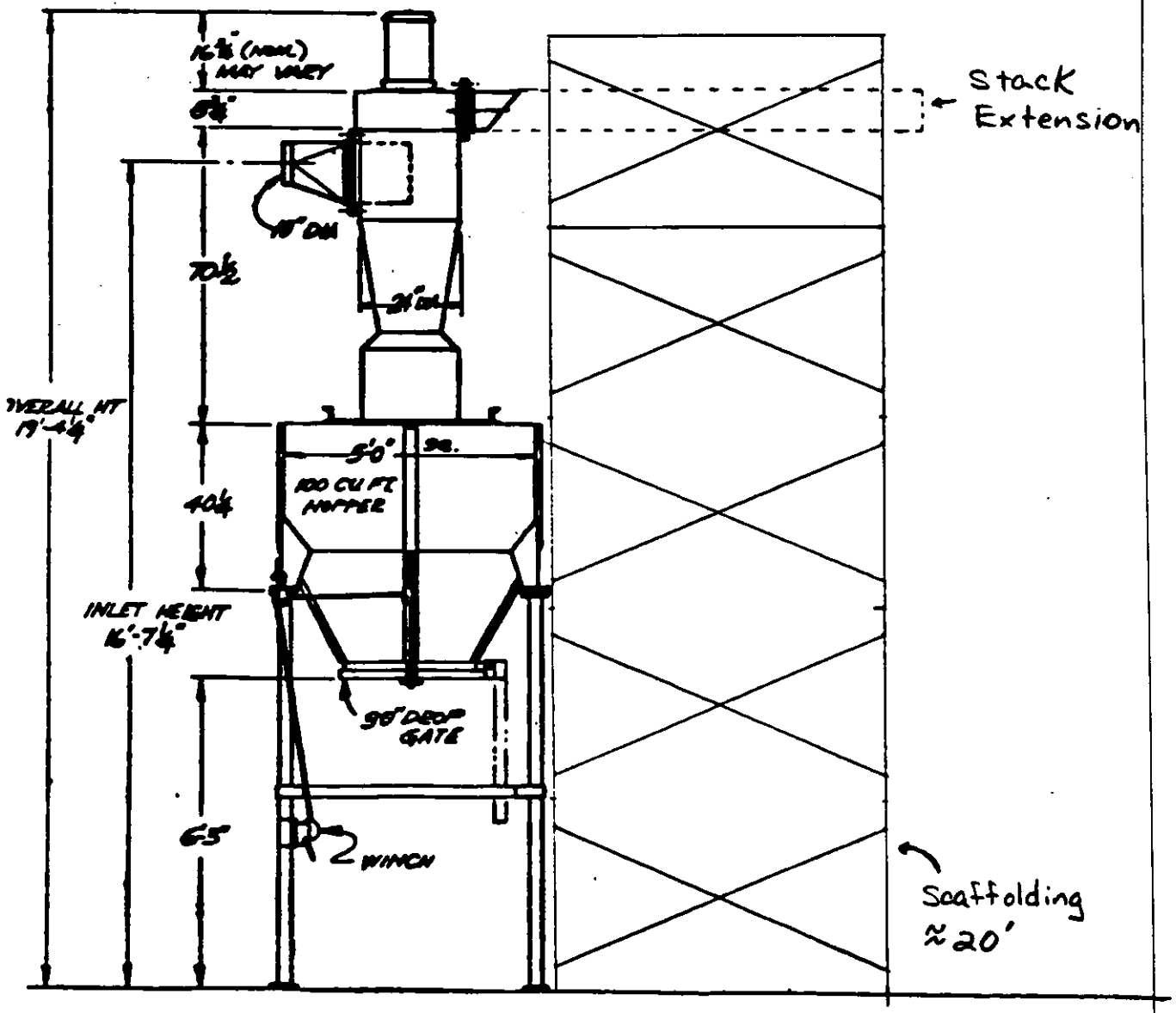
SAMPLE POINT LOCATION DIAGRAM

Envisage Environmental Incorporated
P.O. Box 152 Richfield, Ohio 44286
Phone (216) 526-0990

SAMPLING LOCATION

Goodyear Tire & Rubber Company
Jacksonville, Florida

Retread Buffer Cyclone Exhaust



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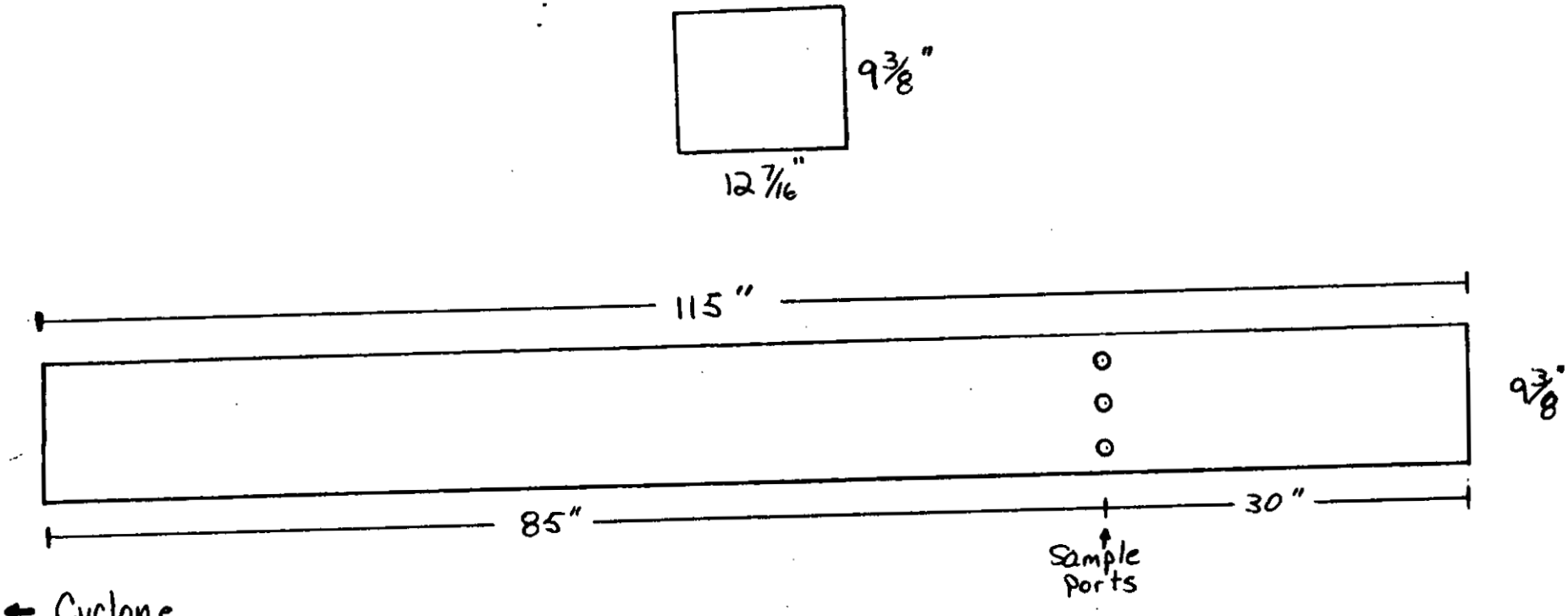
Stack Extension



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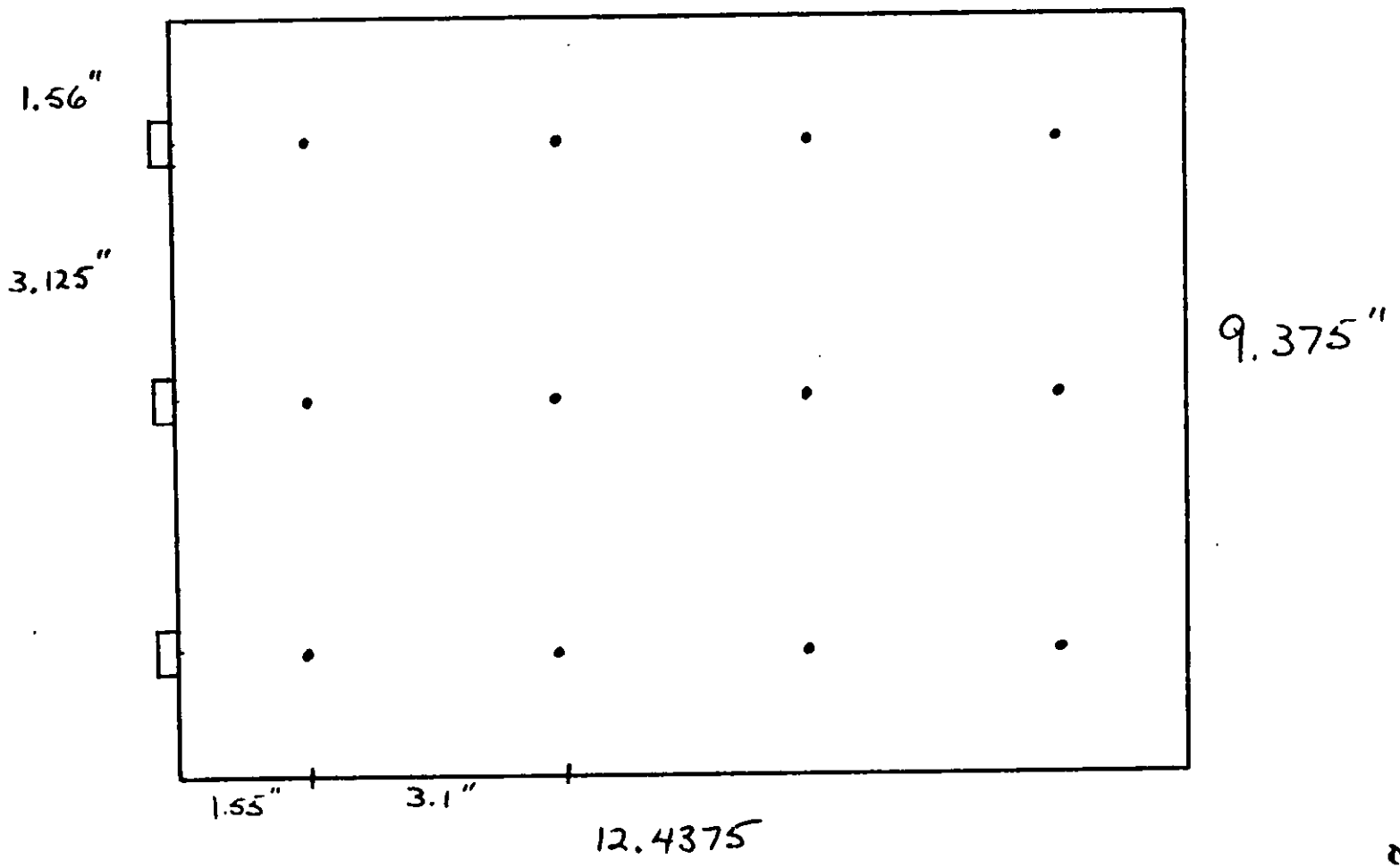
SAMPLE POINT LOCATION

Goodyear Tire & Rubber Company

Jacksonville, Florida

Retread Buffer Cyclone Exhaust



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SAMPLING TRAIN DIAGRAM

Envisage Environmental Incorporated
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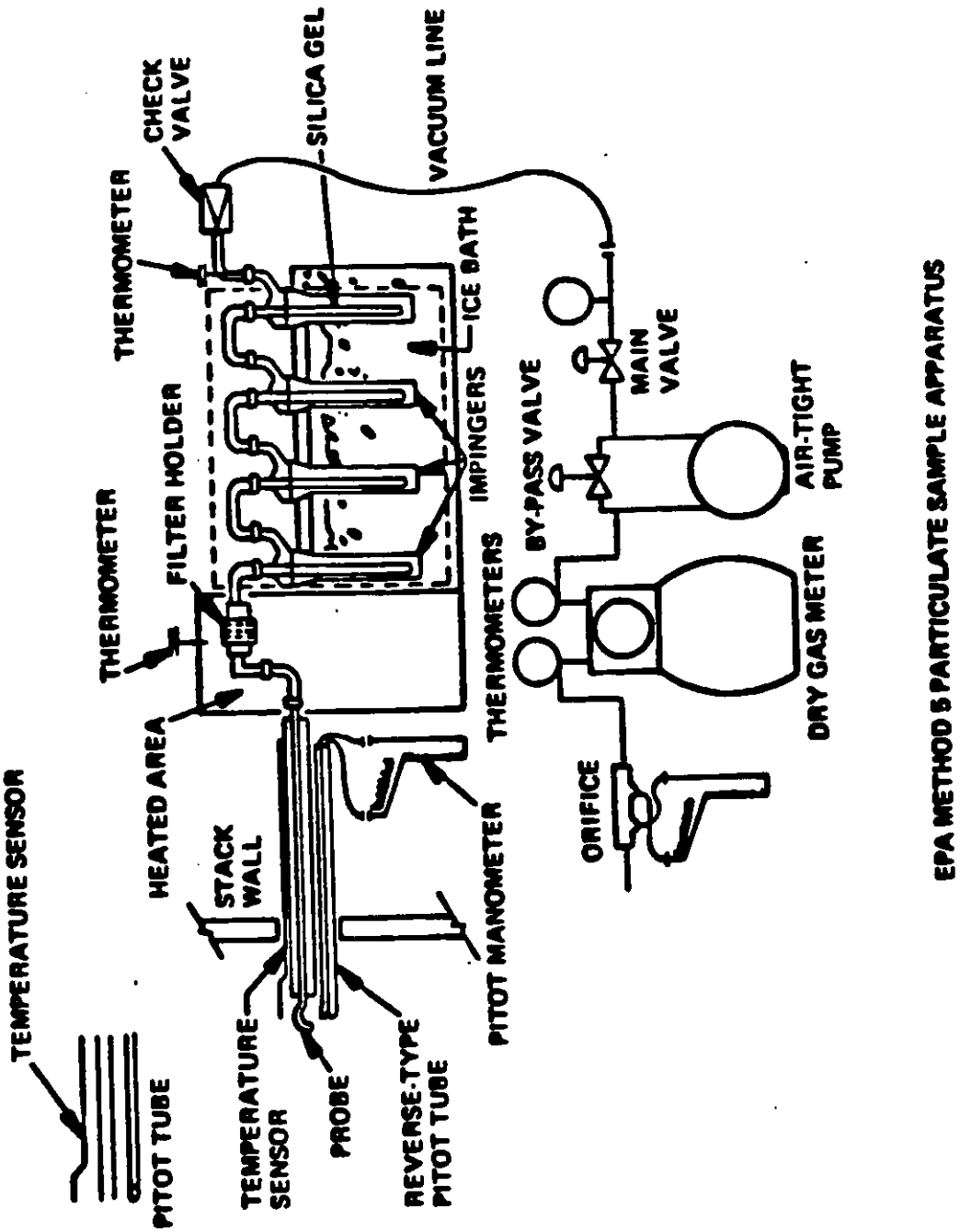
Phone (216) 526-0990



EPA METHOD 5 PARTICULATE SAMPLE APPARATUS

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Phone (216) 526-0990

STACK TESTING

EQUIPMENT SPECIFICATIONS

Envisage Environmental Incorporated
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Phone (216) 526-0990

Control Unit (Meter box)	Equipment designation
Envisage Environmental Inc. (E.E.I.)	Control Unit #'s MB-01 & 02
Anderaen Samplers	Control Unit # MB-03
Resanufactured R.A.C.	Control Unit #'s MB-04 - 08

Sample Box	
E.E.I.	SB-01, 02 & 05 - 07
Resanufactured R.A.C.	SB-03 & 04
E.E.I. (special design)	SB-08 - 11

Impingers - per sample train (each set changed for each test run)

E.E.I.	2 Modified Smith-Greenburg type
E.E.I.	2 Smith-Greenburg type

Probes	Length	Lining types
PRI	2 foot	Pyrex
E.E.I.	3 foot	SS, Pyrex, Quartz, Teflon
E.E.I.	5 foot	SS, Pyrex, Quartz, Teflon
E.E.I.	3 foot	SS, Pyrex, Teflon
E.E.I.	7 foot	SS, Pyrex, Teflon
E.E.I.	10 foot	SS, Pyrex, Teflon
E.E.I.	12 foot	Pyrex, Teflon
E.E.I.	15 foot	SS, Pyrex, Teflon
E.E.I.	24 foot	SS, Teflon

Temperature Sensors	Equipment designation - Type
Omega Engineering (K type thermocouple)	PY-01 & 02
Thermo Electric (K type thermocouple)	PY-03 - 08
Fisher Scientific	Mercury Thermometer
Fisher Scientific	Bimetalic Thermometer

Pressure Gages	Type
Dwyer Incline Manometer	Oil, 0 - 0.25 inch water
Dwyer Incline Manometer	Oil, 0 - 10 inch water
Dwyer Magnehelic	Magnetic/Mechanical 0 - 1 inch water
Dwyer Magnehelic	Magnetic/Mechanical 0 - 10 inch water
Dwyer "U" Tube Manometer	Mercury, 36 inch
Dwyer "U" Tube Manometer	Water, 72 inch
Dwyer Microtector (Micro-manometer)	Water, 0 - 1 inch water

Chemicals & Reagents	
Water	Deionized/distilled
Isopropanol	Reagent grade (80 % solution for sampling)
Hydrogen Peroxide	Reagent grade (3 % solution for sampling)
Acetone	Reagent grade (0.001 % residue)
Silica Gel	6 - 16 mesh
Stopcock Grease	Acetone-insoluble & Heat stable

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LABORATORY SECTION

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Phone (216) 526-0990

LABORATORY SUMMARY SHEET

Goodyear Tire & Rubber Company

Retread Buffer Cyclone Exhaust

Particulate Emission Test

DATE: September 16, 1987	Symbol	Units	RUN # 1	RUN # 2	RUN # 3
1 Sampling Time	t	minutes	60.0	60.0	60.0
2 Barometric Pressure	Pb	in. Hg	30.05	30.02	30.00
3 Static Pressure	Pg	in. H2O	0.26	0.28	0.26
Stack Pressure	Ps	in. Hg	30.07	30.04	30.02
4 Gas Meter Volume	Vm	cu. ft.	59.62	59.57	60.57
5 Stack Area	A	sq. ft.	0.81	0.81	0.81
6 Nozzle Diameter	Dn	dec. in.	0.25	0.25	0.25
7 Meter Temperature		degrees F	119.8	126.9	130.0
	Tm	degrees R	579.8	586.9	590.0
8 Stack Temperature		degrees F	109.1	114.3	118.3
	Ts	degrees R	569.1	574.3	578.3
9 Velocity Head	^P	in. H2O	0.812	0.831	0.843
10 Orifice Pressure	^H	in. H2O	2.75	2.89	2.93
11 Carbon dioxide	CO2	%	0.0	0.0	0.0
12 Oxygen	O2	%	20.9	20.9	20.9
13 Carbon monoxide	CO	%	0.0	0.0	0.0
14 Nitrogen	N2	%	79.1	79.1	79.1
15 Pitot Coefficient	Cp		0.85	0.85	0.85
16 Water Collected	Vlc	ml	23.3	26.6	30.4
Sample Weight:	Mn				
17 - Probe		g	0.0077	0.0145	0.0096
18 - Filter		g	0.0065	0.0164	0.0132
19 - Impingers		g	0.0011	0.0039	0.0007

PLANT	Goodyear
DATE	September 16, 1987
RUN NO.	1
CASE NO.	9

CONTAINER NUMBER	WEIGHT OF PARTICULATE COLLECTED			
	FINAL WEIGHT	TARE WEIGHT	WEIGHT GAIN	
230	0.6267	0.6202	0.0065 ✓	FILTER
2	128.5023	128.5012	0.0011 ✓	IMPINGERS
11	101.4567	101.4490	0.0077 ✓	PROBE *
			0.0153	

* Corrected for Acetone Blank

VOLUME OF LIQUID WATER COLLECTED				
	IMPINGER VOLUME (ml)	SILICA GEL WEIGHT (g)		
FINAL	215	239.3		
INITIAL	200	231.0		
NET LIQUID COLLECTED	15	8.3		
TOTAL NET VOLUME	23.3 ✓	g*	ml	

* Convert weight of water to volume by dividing weight increase by density of water:

$$\frac{\text{Increase g}}{(1\ \text{g/ml})} = \text{Volume Water, ml}$$

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PLANT Goodyear

DATE September 16, 1987

RUN NO. 2

CASE NO. 10

CONTAINER NUMBER	WEIGHT OF PARTICULATE COLLECTED			
	FINAL WEIGHT	TARE WEIGHT	WEIGHT GAIN	
256	0.6305	0.6141	0.0164 ✓	FILTER
709	127.6693	127.6654	0.0039 ✓	IMPINGERS
12	104.2819	104.2674	0.0145 ✓	PROBE *
			0.0348	

* Corrected for Acetone Blank

VOLUME OF LIQUID WATER COLLECTED			
	IMPINGER VOLUME (ml)	SILICA GEL WEIGHT (g)	
FINAL	220	237.6	
INITIAL	200	231.0	
NET LIQUID COLLECTED	20	6.6	
TOTAL NET VOLUME	26.6 ✓	g*	ml

* Convert weight of water to volume by dividing weight increase by density of water:

$$\frac{\text{Increase g}}{(1\ \text{g/ml})} = \text{Volume Water, ml}$$

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PLANT Goodyear

DATE September 16, 1987

RUN NO. 3

CASE NO. 11

CONTAINER NUMBER	WEIGHT OF PARTICULATE COLLECTED			
	FINAL WEIGHT	TARE WEIGHT	WEIGHT GAIN	
259	0.6236	0.6104	0.0132 ✓	FILTER
20	131.1614	131.1607	0.0007 ✓	IMPINGERS
13	98.5126	98.5030	0.0096 ✓	PROBE *
			0.0235	

* Corrected for Acetone Blank

VOLUME OF LIQUID WATER COLLECTED			
	IMPINGER VOLUME (ml)	SILICA GEL WEIGHT (g)	
FINAL	221	240.4	
INITIAL	200	231.0	
NET LIQUID COLLECTED	21	9.4	
TOTAL NET VOLUME	30.4 ✓	g*	ml

* Convert weight of water to volume by dividing weight increase by density of water:

$$\frac{\text{Increase g}}{(1\ \text{g/ml})} = \text{Volume Water, ml}$$

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ORSAT DATA

Plant Goodyear Jacksonville
Date September 16, 1987
Sampling Time 60 min
Sampling Location Cyclone Exhaust
Sample Type Integrated Bag
Analytical Method Orsat
Ambient Temperature 80's
Operator RW

Run #1

TEST / GAS	1		2		3		Average Net Volume
	Actual Reading	Net	Actual Reading	Net	Actual Reading	Net	
CO_2		0		0		0	0
O_2 (net is actual - CO2 reading)	20.9	20.9	20.9	20.9	20.9	20.9	20.9
CO (net is actual - O2 reading)							0
N_2 (net is 100 - CO reading)							79.1

Comments:

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Phone (216) 526-0990

ORSAT DATA

Plant Goodyear Jacksonville
Date September 16, 1987
Sampling Time 60 min
Sampling Location Cyclone Exhaust
Sample Type Integrated Bag
Analytical Method Orsat
Ambient Temperature 80's
Operator RW

Run #2

TEST / GAS	1		2		3		Average Net Volume
	Actual Reading	Net	Actual Reading	Net	Actual Reading	Net	
CO_2		0		0		0	0
O_2 (net is actual - CO2 reading)		20.8		20.9		20.9	20.9
CO (net is actual - O2 reading)							0
N_2 (net is 100 - CO reading)							79.1

Comments:

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ORSAT DATA

Plant Goodyear Jacksonville
Date September 16, 1987
Sampling Time 60 min
Sampling Location Cyclone Exhaust
Sample Type 6 Integrated Bag
Analytical Method Orsat
Ambient Temperature 80's
Operator EW

Run #3

TEST / GAS	1		2		3		Average Net Volume
	Actual Reading	Net	Actual Reading	Net	Actual Reading	Net	
CO_2		0		0		0	0
O_2 (net is actual - CO2 reading)		20.9		20.9		20.9	20.9
CO (net is actual - O2 reading)							0
N_2 (net is 100 - CO reading)							79.1

Comments:

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CALIBRATION SECTION

Envisage
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P.O. Box 152 Richfield, Ohio 44286
Phone (216) 526-0990

METER BOX CALIBRATION

Meter Box Number: MB - 04

Calibration Date: August 18, 1987

$$Y = \frac{V_t \; P_b \; (T_m + 460)}{V_m \left[P_b + \frac{\Delta H}{13.6} \right] (T + 460)}$$

$$\Delta H_@ = \frac{0.0317 \; \Delta H}{P_b \; (Tm + 460)} \left[\frac{(T_t + 460) \; t}{V_t} \right]$$

Delta H (ΔH)	in. H20	0.5	1.0	3.0	5.0	7.0
Pres.Barometer (P_b)	in. Hg	29.99	29.99	29.99	29.99	29.99
Vol.Meter Box (V_m)	cu. ft.	3.960	5.615	9.751	12.659	14.895
Vol.Test Meter(V_t)	cu. ft.	3.911	5.500	9.515	12.150	14.355
Temp. Meter Box (T_m)	°F	79.6	84.5	91.3	96.9	100.5
	°R	539.6	544.5	551.3	556.9	560.5
Temp. Test Meter (T_t)	°F	74.0	74.0	74.0	74.0	74.0
	°R	534.0	534.0	534.0	534.0	534.0
Time (t)	minutes	10.0	10.0	10.0	10.0	10.0
METER FACTOR (Y)		0.997	0.996	1.000	0.989	0.995
- Average				1.00	.9954	
METER COEFFICIENT ($\Delta H_@$)		1.826	1.830	1.812	1.833	1.827
- Average				1.83		

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"S" TYPE PITOT TUBE CALIBRATION

"S" Type Pitot Tube (Probe) # 09 2 foot Probe

Calibration Date: August 17, 1987

$$C_p = C_{std} \sqrt{\frac{\Delta P_{std}}{\Delta P_p}}$$ (EPA Equation 2-2)

where:

C_p = Coefficient of Type S pitot tube, dimensionless

C_{std} = Coefficient of Standard Pitot Tube (0.99), dimensionless

ΔP_{std} = Velocity head measured by standard pitot tube, inches H_2O

ΔP_p = Velocity head measured by Type S pitot tube, inches H_2O

	ΔP_{std}	ΔP_p	C_p
Side A	0.26	0.34	0.866
Side B	0.26	0.35	0.853
Side A	0.34	0.46	0.851
Side B	0.34	0.46	0.851
Side A	0.62	0.84	0.851
Side B	0.62	0.84	0.851

Average - 0.85

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NOZZLE DIAMETER CALIBRATION

I.D. of nozzles are checked periodically by inside micrometer on at least 12 different diameters. If deviation exceeds +0.001" on an average or 0.002" maximum, nozzle is reworked. Sharpening occurs after each test.

CALIBRATION FREQUENCY

The frequency of calibration is dictated by the Federal Register, Volume 42, Number 160, August 18, 1977. The regulations state that you must "use methods and equipment which have been approved by the Administrator to calibrate the orifice meter, pitot tube, dry gas meter, and probe heater. Recalibrate after each test".

The methods of calibration are determined from "Maintenance, Calibration, and Operation of Isokinetic Source Sampling Equipment," published by the U.S. EPA Office of Air Program Publications APTD-0576. Per the above listed regulations, the equipment was checked after the stack test and the values of Y, Cp (Test) and nozzle diameter had not appreciably changed from the acceptable tolerances.

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FIELD DATA SHEETS

Envisage Environmental Incorporated
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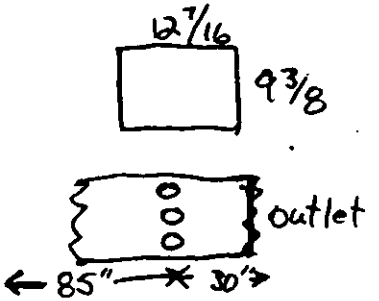
Phone (216) 526-0990

FIELD DATA

PLANT Goodyear Jacksonville
DATE Sept 16, 1987
SAMPLING LOCATION Retread Grinder
SAMPLE TYPE EPA Methods 1-5
OPERATOR TH, EW
AMBIENT TEMPERATURE 90's
BAROMETRIC PRESSURE
STATIC PRESSURE + .26
HEATER BOX SETTING 248



PROBE LENGTH & TYPE 2' Pyrex #9
NOZZLE I.D. 0.25
ASSUMED MOISTURE % 1
METER BOX NUMBER And 04
METER ΔH @ 1.83
C FACTOR 1.05
PITOT CORRECTION FACTOR
PRE-TEST LEAK CHECK 0 CFM @ 15 "Hg
POST-TEST LEAK CHECK ≤.01 CFM @ 9 "Hg

SCHEMATIC OF TRAVERSE POINT LAYOUT Pitot tuber #2 0@7"
#4 0@6.5"

READ AND RECORD ALL DATA EVERY 5 MINUTES

Cyclonic Flow CK 0° at all points

PAGE 1 OF

Run #1
Nose #9

TRAVERSE POINT NUMBER	ELAPSED SAMPLING TIME min.	GAS METER READING	VELOCITY HEAD		ORIFICE PRESSURE DIFFERENTIAL	STACK TEMPERATURE	GAS METER TEMPERATURE		PUMP VACUUM	FILTER HOLDER TEMP.	IMPINGER TEMP.
							INLET	OUTLET			
1	0/1110	186.00	.72	.849	3.00	106	95	90	3.0	265	<10
2	5	191.10	.71	.843	2.95	106	116	91	3.0		
3	10	196.00	.71	.843	2.95	107	126	94	3.0	264	
4	15	200.95	.66	.812	2.75	108	134	97	3.0		
1	20	205.92	.67	.819	2.80	107	134	100	3.0	234	
2	25	210.85	.71	.843	2.95	110	142	103	3.0		
3	30	215.90	.70	.837	2.95	113	146	106	3.0	246	
4	35	221.00	.65	.806	2.70	110	148	109	3.0		
1	40	226.00	.55	.742	2.30	110	140	111	3.0	252	
2	45	230.45	.56	.748	2.32	110	149	112	3.0		
3	50	235.50	.71	.843	2.95	112	152	113	3.0	250	
4	55	239.95	.58	.762	2.40	110	153	113	3.0		
	60/1214	245.62									
		59.62		.812 ✓	2.75 ✓	109.1 ✓	119.	8 ✓			
1	0	246.50	.66	.812	.88	109.1	107	103			
	3	248.20	.66	.812	.88	109.1	120	103			
	3 min 45 sec	248.60	.66	.812	.88	109.1	111	102			
	5	249.30	.66	.812	.88	109.1	118	102			
	5 min 45 sec	249.75									
							108	3			

P2 #1
Series A
4-7-87

4-7

PLANT Goodyear Truck Tire Center DATE 9-16-87 LEAK CHECK 0 CFM@ 17" "Hg PAGE 2 OF

Run #2
Case #10

S.P. +.28

TRAVERSE POINT NUMBER	ELAPSED SAMPLING TIME min.	GAS METER READING	VELOCITY HEAD		ORIFICE PRESSURE DIFFERENTIAL	STACK TEMPERATURE	GAS METER TEMPERATURE		PUMP VACUUM	FILTER HOLDER TEMP.	IMPINGER TEMP.
							INLET	OUTLET			
1	0 /15:40	280.81	.68	.825	2.85	113	113	100	4.0	229	60
2	5	285.90	.60	.775	2.60	113	133	102	3.5	238	
3	10	260.67	.59	.768	2.50	112	140	104	3.5	240	
4	15	265.37	.58	.762	2.45	112	147	106	3.5	250	
1	20	270.30	.68	.825	2.85	113	139	109	4.0	265	
2	25	275.15	.67	.819	2.80	113	143	111	4.0	262	
3	30	280.00	.82	.906	3.30	115	152	112	4.0	269	
4	35	285.30	.65	.806	2.70	114	153	115	4.0	267	
1	40	290.40	.79	.889	3.20	117	145	115	4.0	257	
2	45	295.55	.71	.843	2.90	114	153	116	3.0	255	
3	50	301.10	.77	.877	3.15	117	156	117	4.0	255	
4	55	305.60	.77	.877	3.15	118	156	117	4.0	257	
	60/14:45	310.38									
		59.57 ✓		.831 ✓	~~2.89~~	114.3 ✓		126.9			
		~~62.549~~			2.89 ✓			127.1			
	0 /15:06	310.45	.66	.812	.88	114.3	117	112			
	5	313.27	.66	.812	.88	114.3	132	110			
	10	316.12	.66	.812	.88	114.3	138	110			
	15	318.90	.66	.812	.85	114.3	141	111			
STOP	20 /15:25	321.15	~~.66~~	~~.812~~	~~.88~~	~~114.3~~					
19 min	25		~~.66~~	~~.812~~	~~.88~~	~~114.3~~					
	30										
		10.7									

P2
Run #2

Series "E"

PLANT Goodyear Jacksonville DATE 9-16-87 LEAK CHECK 0 CFM@ 15 "Hg PAGE 3 OF _____

TRAVERSE POINT NUMBER	ELAPSED SAMPLING TIME min.	GAS METER READING	VELOCITY HEAD		ORIFICE PRESSURE DIFFERENTIAL	STACK TEMPERATURE	GAS METER TEMPERATURE		PUMP VACUUM	FILTER HOLDER TEMP.	IMPINGER TEMP.
							INLET	OUTLET			
Run #3 Case #11											
1	0/1540	321.25	.74	.860	3.00	120	131	111	3.0	256	<70
2	5	325.90	.74	.860	3.00	116	143	109	3.0		
3	10	331.10	.77	.878	3.20	121	146	110	3.5	245	
4	15	336.40	.68	.825	2.80	117	149	111	3.0		
1	20	342.60	.76	.872	3.15	117	146	112	3.5	237	
2	25	346.30	.76	.872	3.15	118	150	113	3.5		
3	30	351.60	.68	.825	2.80	121	151	113	3.2	230	
4	35	357.10	.82	.906	3.40	119	153	114	4.0		
1	40	362.40	.64	.800	2.65	115	145	114	3.0	225	
2	45	367.00	.64	.800	2.65	121	151	114	3.0		
3	50	372.00	.58	.762	2.40	116	152	114	3.0	231	
4	55	376.40	.74	.860	3.00	118	153	115	3.5		
	60/1645	381.82					1770	1350 ✓			
		60.57 ✓		.843 ✓	2.93 ✓	1183 ✓	130.0 ✓				
		63.599									
SP +.26											
						IN	Out				
P2#3 Series H	0/1655	382.40	.71	.843	.93	134	108				
	5	385.50	.71	.843	.93	135	108				
	10	388.30	.71	.843	.93	140	108				
	15	391.40	.71	.843	.93	141	109				
	20	394.20	.71	.843	.93	142	108				
	25	397.10	.71	.843	.93	142	109				
	30	399.50	.71	.843	.93	142	109				
	35	402.00	.71	.843	.93	143	110				
	40	405.30	.71	.843	.93	143	110				
	45	407.70	.71	.843	.93	143	110				
	50	410.70	.71	.843	.93	145	110				
	55	413.60	.71	.843	.93	144	110				
	60/1755	416.42									
						125.1					

EMISSIONS SAMPLING

NOMENCLATURE

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PARTICULATE SAMPLING NOMENCLATURE

A = Cross sectional area of stack or duct, ft^2.

A_n = Cross sectional area of nozzle, ft^2.

B_{ws} = Water vapor in gas stream, proportion by volume.

C = Monograph correction factor, dimensionless.

C_p = Pitot tube coefficient, dimensionless.

C_s = Concentration of particulate matter in gas stream, dry basis-corrected to standard conditions, gr/dscf.

D_n = Nominal diameter of probe nozzle tip, inches.

E = Particulate Emission Rate, lb/hr.

ΔH = Average pressure differential across orifice, in. H_2O.

$\Delta H_@$ = Orifice meter calibration factor, in. H_2O.

I = Percent of Isokinetic sampling, %.

K_p = Pitot tube constant, $85.49 \left[\frac{ft}{sec}\right]\left[\frac{(lb/lb\text{-}mole)(in.Hg)}{(°R)(in.H_2O)}\right]$

M_d = Molecular weight of gas, dry basis, lb/lb-mole.

M_n = Total amount of particulate matter collected, g.

M_s = Molecular weight of gas, wet basis, lb/lb-mole.

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Particulate Sampling Nomenclature - continued

M_w = Molecular weight of water, 18 lb/lb-mole.

P_{bar} = Barometric Pressure, in. Hg.

P_g = Pressure differential from gas stream to atmosphere, (static pressure) in.H_2O.

P_s = Absolute gas stream pressure, (P_{bar} + P_g/13.6) in.Hg.

P_{std} = Absolute pressure at standard conditions, 29.92 in. Hg.

P_w = Density of water, 0.0022 lb/ml.

ΔP_{avg} = Average of the square roots of the velocity head readings, ($\sum \sqrt{\Delta p}$) (in.H_2O).

Q = Volumetric flow rate at gas stream conditions, A.C.F.M.

Q_{sd} = Dry volumetric gas flow rate corrected to standard conditions, S.C.F.M.

R = Ideal gas constant, 21.85 in. Hg-ft^3/ ^oR-lb-mole.

t = Total sampling time, minutes.

T_m = Average dry gas meter temperature, ^oR.

T_s = Average absolute gas stream temperature, ^oR.

T_{std} = Standard absolute temperature, 528^o Rankine.

V_{lc} = Volume of water collected in impingers & silica gel, ml.

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Particulate Sampling Nomenclature - continued

V_m = Volume of gas sample measured at meter box (meter conditions), ft^3.

$V_{m(std)}$ = Volume of gas sample measured at meter box (corrected to standard conditions), ft^3.

V_s = Average gas stream velocity, ft/sec.

$V_{w(std)}$ = Volume of water vapor in gas sample (standard conditions) ft^3.

13.6 = Specific gravity of mercury (Hg).

% CO_2 = Percent by volume of CO_2 in gas stream (dry basis).

% O_2 = Percent by volume of O_2 in gas stream (dry basis).

% CO = Percent by volume of CO in gas stream (dry basis).

% N_2 = Percent by volume of N_2 in gas stream (dry basis).

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EMISSION SAMPLING

CALCULATIONS

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1) Volume of dry gas sampled through meter box at standard conditions,

$$V_{m(std)} = V_m \left[\frac{T_{std}}{T_m} \right] \left[\frac{P_b + \frac{\Delta H}{13.6}}{P_{std}} \right]$$

(EPA Equation 5-1)

Where:

$V_{m(std)}$ = Volume of gas sample measured at meter box (corrected to standard conditions), ft^3.

V_m = Volume of gas sample measured at meter box (meter conditions), ft^3.

T_{std} = Standard absolute temperature, 528° Rankine.

T_m = Average dry gas meter temperature, $^\circ R$.

P_{bar} = Barometric Pressure, in. Hg.

ΔH = Average pressure differential across orifice, in. H_2O.

13.6 = Specific gravity of mercury (Hg).

P_{std} = Absolute pressure at standard conditions, 29.92 in. Hg.

Example: Run 1

V_m = 59.62 ft^3

T_m = 579.8 $^\circ R$

ΔH = 2.75 in. H_2O

P_{bar} = 30.05 in. Hg

$$V_{m(std)} = 59.62 \left[\frac{528.0}{579.8} \right] \left[\frac{30.05 + \frac{2.75}{13.6}}{29.92} \right]$$

$$= 59.62 \quad (0.9106) \quad (1.0111)$$

$$= \frac{54.90}{57.645} \; ft^3$$

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2) Volume of water vapor collected at standard conditions,

$$V_{w(std)} = V_{lc} \left[\frac{P_w}{M_w} \right] \left[\frac{(R)(T_{std})}{P_{std}} \right]$$

(EPA Equation 5-2)

Where:

$V_{w(std)}$ = Volume of water vapor in gas sample (standard conditions) ft^3.

V_{lc} = Volume of water collected in impingers & silica gel, ml.

P_w = Density of water, 0.0022 lb/ml.

M_w = Molecular weight of water, 18 lb/lb-mole.

R = Ideal gas constant, 21.83 in. Hg-ft^3 / ^oR-lb-mole.

T_{std} = Standard absolute temperature, 528 ^{o} Rankine.

P_{std} = Absolute pressure at standard conditions, 29.92 in. Hg.

Example: Run 1

V_{lc} = 23.3 ml

$$V_{w(std)} = 23.3 \left[\frac{0.0022}{18.0} \right] \left[\frac{(21.83)(528.0)}{29.92} \right]$$

= 1.10 ft^3

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3) Moisture content of gas stream,

$$B_{ws} = \frac{V_{w(std)}}{V_{m(std)} + V_{w(std)}}$$

(EPA Equation 5-3)

Where:

B_{ws} = Water vapor in gas stream, proportion by volume.

$V_{w(std)}$ = Volume of water vapor in gas sample (standard conditions) ft^3.

$V_{m(std)}$ = Volume of gas sample measured at meter box (corrected to standard conditions), ft^3.

Example: Run 1

$V_{w(std)}$ = 1.10 ft^3

$V_{m(std)}$ = 54.90 ft^3

$$B_{ws} = \frac{1.10}{54.90 + 1.10}$$

$$= \underline{0.0196}$$

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4) Dry Molecular Weight of gas in gas stream,

$$M_d = 0.440 (\%CO_2) + 0.320 (\%O_2) + 0.280 (\%N_2 + \%CO)$$

(EPA Equation 3-2)

Where:

M_d = Molecular weight of gas, dry basis, lb/lb-mole.

0.440 = Molecular weight of CO_2 divided by 100.

0.320 = Molecular weight of O_2 divided by 100.

0.280 = Molecular weight of N_2 or CO (same for both compounds) divided by 100.

$\% CO_2$ = Percent by volume of CO_2 in gas stream (dry basis).

$\% O_2$ = Percent by volume of O_2 in gas stream (dry basis).

% CO = Percent by volume of CO in gas stream (dry basis).

$\% N_2$ = Percent by volume of N_2 in gas stream (dry basis).

Example: Run 1

$\% CO_2$ = 0.0

$\% O_2$ = 20.9

% CO = 0.0

$\% N_2$ = 79.1

$M_d = 0.440 (0.0) + 0.320 (20.9) + 0.280 (79.1)$

$= 0.000 + 6.688 + 22.148$

$= 28.84$ lb/lb-mole

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5) Molecular Weight of gas in gas stream,

$$M_s = M_d (1 - B_{ws}) + M_w (B_{ws})$$

(EPA Equation 2-5)

Where:

M_s = Molecular weight of gas, wet basis, lb/lb-mole.

M_d = Molecular weight of gas, dry basis, lb/lb-mole.

B_{ws} = Water vapor in gas stream, proportion by volume.

M_w = Molecular weight of water, 18 lb/lb-mole.

Example: Run 1

M_d = 28.84 lb/lb-mole

B_{ws} = 0.0196

M_s = 28.84 (1 - 0.0196) + 18 (0.0196)

= 28.271 + 0.353

= 28.62 lb/lb-mole

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6) Average Gas Stream Velocity,

$$V_s = K_p C_p \Delta P_{avg} \sqrt{\frac{T_s}{P_s M_s}}$$

(EPA Equation 2-9)

Where:

V_s = Average gas stream velocity, ft/sec.

K_p = Pitot tube constant, 85.49 $\left[\frac{ft}{sec}\left(\frac{(lb/lb\text{-}mole)(in.Hg)}{(^oR)(in.H_2O)}\right)^{1/2}\right]$

C_p = Pitot tube coefficient, dimensionless.

ΔP_{avg} = Average of the square roots of the velocity head readings, $(\sqrt{\Delta p})$ $(in.H_2O)$.

T_s = Average absolute gas stream temperature, ^oR.

P_s = Absolute gas stream pressure, $(P_{bar} + P_g/13.6)$ in.Hg.

P_{bar} = Barometric Pressure, in. Hg.

P_g = Pressure differential from gas stream to atmosphere, (static pressure) $in.H_2O$.

M_s = Molecular weight of gas, wet basis, lb/lb-mole.

Example: Run 1

C_p = 0.85

ΔP_{avg} = 0.812 $in.H_2O^{1/2}$

T_s = 569.1 ^oR

P_s = $P_{bar} + P_g/13.6$ = 30.05 + 0.26 /13.6 = 30.07 in.Hg

M_s = 28.62 lb/lb-mole

$$V_s = (85.49)(0.85)(0.812)\sqrt{\frac{569.1}{(30.07)(28.62)}}$$

= 47.98 ft/sec

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7) Volumetric Flow Rate at Gas Stream Conditions,

$$Q = A \times V_s \times 60$$

Where:

Q = Volumetric flow rate at gas stream conditions, A.C.F.M.

A = Cross sectional area of stack or duct, ft^2.

V_s = Average gas stream velocity, ft/sec.

60 = Conversion factor from seconds to minutes.

Example: Run 1

A = 0.81 ft^2

V_s = 47.98 ft/sec

Q = (0.81) (47.98) 60

= 2,332 ACFM

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8) Volumetric Flow Rate at Standard Conditions,

$$Q_{sd} = 60 \left(1 - B_{ws} \right) V_s A \left[\frac{T_{std}}{T_s} \right] \left[\frac{P_s}{P_{std}} \right]$$

(EPA Equation 2-10)

Where:

Q_{sd} = Dry volumetric gas flow rate corrected to standard conditions, S.C.F.M.

60 = Conversion factor from seconds to minutes.

B_{ws} = Water vapor in gas stream, proportion by volume.

V_s = Average gas stream velocity, ft/sec.

A = Cross sectional area of stack or duct, ft^2.

T_{std} = Standard absolute temperature, 528 ^{o} Rankine.

T_s = Average absolute gas stream temperature, ^{o}R.

P_s = Absolute gas stream pressure, $(P_{bar} + P_g/13.6)$ in.Hg.

P_{bar} = Barometric Pressure, in. Hg.

P_g = Pressure differential from gas stream to atmosphere, (static pressure) in.H_2O.

P_{std} = Absolute pressure at standard conditions, 29.92 in. Hg.

Example: Run 1

B_{ws} = 0.0196

V_s = 47.98 ft/sec

A = 0.81 ft^2

T_s = 569.1 ^{o}R

$P_s = P_{bar} + P_g/13.6 = 30.05 + 0.26/13.6 = 30.07$ in.Hg

$$Q_{sd} = 60 \left(1 - 0.0196 \right) \left(47.98 \right) \left(0.81 \right) \left[\frac{528.0}{569.1} \right] \left[\frac{30.07}{29.92} \right]$$

= 2,132 SCFM

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9) Gas Stream Particulate Concentration,

$$C_s = 15.43 \text{ gr./g} \left[\frac{M_n}{V_{m(std)}} \right]$$

(EPA Equation 5-6)

Where:

C_s = Concentration of particulate matter in gas stream, dry basis-corrected to standard conditions, gr/dscf.

M_n = Total amount of particulate matter collected in probe wash and on filter, g.

$V_{m(std)}$ = Volume of gas sample measured at meter box (corrected to standard conditions), ft^3.

Example: Run 1

		(probe)		(filter)		
M_n	=	0.0077	•	0.0065	=	0.0142 g

$V_{m(std)}$ = 54.90 ft^3

$$C_s = 15.43 \left[\frac{0.0142}{54.90} \right]$$

= 0.0040 gr/dscf

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10) Particulate Emission Rate,

$$E = Q_{sd} \, C_s \left[\frac{1 \text{ pound}}{7000 \text{ grains}} \right] \left[\frac{60 \text{ minutes}}{1 \text{ hour}} \right]$$

Where:

E = Particulate Emission Rate, lb/hr.

Q_{sd} = Dry volumetric gas flow rate corrected to standard conditions, S.C.F.M.

C_s = Concentration of particulate matter in gas stream, dry basis-corrected to standard conditions, gr/dscf.

Example: Run 1

Q_{sd} = 2,132 ft^3

C_s = 0.0040 gr/dscf

$$E = (2,132) (0.0040) \left[\frac{60}{7000} \right]$$

$$= 0.07 \text{ lb/hr}$$

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ii) Percent of Isokinetic Sampling,

$$I = \frac{100\ T_s \left[K_3\ V_{lc} + \left[\frac{V_m}{T_m} \right] \left[P_{bar} + \frac{\Delta H}{13.6} \right] \right]}{60\ A_n\ V_s\ P_s\ t}$$

(EPA Equation 5-7)

Where:

I = Percent of Isokinetic sampling, %.

T_s = Average absolute gas stream temperature, ^{o}R.

K_3 = Constant, 0.002669 in.Hg-ft^3/ml-^{o}R.

V_{lc} = Volume of water collected in impingers & silica gel, ml.

V_m = Gas sample volume measured at meter box (meter conditions), ft^3.

T_m = Average dry gas meter temperature, ^{o}R.

P_{bar} = Barometric Pressure, in. Hg.

ΔH = Average pressure differential across orifice, in. H_2O.

t = Total sampling time, minutes.

V_s = Average gas stream velocity, ft/sec.

P_s = Absolute gas stream pressure, in.Hg.

D_n = Nominal diameter of probe nozzle tip, inches.

A_n = Cross sectional area of nozzle, ft^2.

Example: Run 1

T_s	=	569.1	^{o}R	ΔH	=	2.75	in.H_2O
V_{lc}	=	23.3	ml	t	=	60.0	min.
V_m	=	59.62	ft^3	V_s	=	47.98	ft/sec
T_m	=	579.8	^{o}R	P_s	=	30.07	in.Hg
A_n	=	0.0003408	ft^2	P_{bar}	=	30.05	in.Hg

$$I = \frac{569.1\ (\ 100\ ) \left[0.002669\ (\ 23.3\ ) + \left[\frac{59.62}{579.8} \right] \left[30.05 + \frac{0.26}{13.6} \right] \right]}{60\ (0.0003408\ )\ (\ 47.98\ )\ (\ 30.07\ )\ (\ 60.0\ )}$$

$$= \frac{102.0}{} \ \%$$

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