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Particulate Emissions Sampling
W. R. Grace Co., Dallas TX
April 2-4, 1990
Turner Engineering, Inc. Project W-2465-90

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TABLE OF CONTENTS

	Page
I. INTRODUCTION	1
II. SUMMARY	2
III. PROCEDURES	10
IV. APPENDICES	
A - CALCULATION SUMMARIES	11
B - ANALYTICAL SUMMARIES	69
C - FIELD DATA SHEETS	118
D - CALIBRATIONS	140

I. INTRODUCTION

A series of tests were performed on seven exhaust stacks at the W. R. Grace facility in Dallas, on April 2-4, 1990.

The purpose of this test series was to determine the exhaust emission rates of particulate in terms of lbs/hr.

Testing was performed following procedures detailed in Title 40: Code of Federal Regulations (40:CFR).

Testing was conducted by Joe Barrera, Jerry Salinas, Larry Miller, and Mark Peterson of Turner Engineering, Inc.

Sampling was performed over a seven hour period on each day of testing.

Submitted by:
Turner Engineering, Inc.

Joe Barrera @s

Joe A. Barrera
Project Manager

JB/os

II. SUMMARY

A series of tests were performed on seven exhaust stacks at the W. R. Grace facility in Dallas, TX on April 2-4, 1990.

Sampling was performed following procedures detailed in Title 40: Code of Federal Regulations.

Results of this test series are summarized in Tables 1 thru 7.

High particulate concentrations on the G-2 furnace exhaust are believed to be due to small chunks of debris coming out of the stack during sampling.

Oil was also detected on the G-1 and G-2 exhaust stacks and were analyzed by organic extraction with methylene chloride. These solutions were evaporated at room temperature and weighed. It should be noted this was not included with the particulates.

SUMMARY OF EMISSIONS TEST DATA

TABLE: 2

PLANT: W.R. Grace

LOCATION: G-1 Furnace Exhaust

OPERATOR: Larry Miller

TEST DATE:

4/2/90

4/2/90

4/2/90

REPETITION:

1

2

3

STACK GAS

Temperature, F	257.8	246.8	247.3
Velocity, fps	30.31	30.31	29.77
Volume Flow, acfm	5251	5247	5154
scfm	3764	3764	3728
scfh	225829	225868	223691
Moisture, %	1.836	3.252	2.380
CO2, %	0.0	0.0	1.0
O2, %	20.0	21.0	20.0

SAMPLE

Start Time, hrs:min	11:25am	12:50pm	2:10pm
Finish Time, hrs:min	12:27pm	1:55pm	3:15pm
Volume, scf	55.367	39.211	38.611
Isokinetic Ratio, %	94.26	96.21	95.66

PARTICULATE

Sample Weight, mg	147.6	59.74	90.80
Concentration, gr/scf	0.0411	0.0325	0.0363
Emissions, lbs/hr	1.328	0.759	1.160

CONDENSIBLES (Oil)

Sample Weight, mg	26.20	18.50	32.80
Emissions, lbs/hr	0.236	0.235	0.419

SUMMARY OF EMISSIONS TEST DATA

TABLE: 3

PLANT: W.R. Grace

LOCATION: G-2 Furnace Exhaust

OPERATOR: Mark Peterson

TEST DATE:

4/3/90

4/3/90

4/3/90

REPETITION:

1

2

3

STACK GAS

Temperature, F	181.8	189.3	195.9
Velocity, fps	31.84	31.53	29.73
Volume Flow, acfm	3567	3532	3330
scfm	2811	2718	2541
scfh	168646	163064	152463
Moisture, %	3.704	4.868	4.707
CO2, %	0.0	0.0	0.0
O2, %	19.5	19.0	19.5

SAMPLE

Start Time, hrs:min	9:15am	10:47am	12:15pm
Finish Time, hrs:min	10:18am	11:50am	1:17pm
Volume, scf	40.379	39.557	36.209
Isokinetic Ratio, %	105.3	106.7	104.5

PARTICULATE

Sample Weight, mg	218.3	51.95	26.52
Concentration, gr/scf	0.0836	0.0203	0.0113
Emissions, lbs/hr	2.010	0.472	0.246

CONDENSIBLES (Oil)

Sample Weight, mg	39.30	57.60	93.40
Emissions, lbs/hr	0.362	0.524	0.867

SUMMARY OF EMISSIONS TEST DATA

TABLE: 6

PLANT: W.R. Grace

LOCATION: D-18 Exhaust

OPERATOR: Larry Miller

TEST DATE:

REPETITION:

4/4/90
1

4/4/90
2

4/4/90
3

STACK GAS

Temperature, F	266.4	276.8	288.7
Velocity, fps	33.38	33.43	27.72
Volume Flow, acfm	5777	5788	4798
scfm	4016	4005	3188
scfh	240986	240277	191291
Moisture, %	3.873	2.957	5.310
CO2, %	0.5	0.5	0.5
O2, %	20.5	20.5	20.5

SAMPLE

Start Time, hrs:min	9:43am	11:08am	12:40pm
Finish Time, hrs:min	10:45am	12:10pm	1:44pm
Volume, scf	44.384	43.255	35.253
Isokinetic Ratio, %	102.1	99.80	102.1

PARTICULATE

Sample Weight, mg	22.92	29.52	25.05
Concentration, gr/scf	0.0080	0.0105	0.0110
Emissions, lbs/hr	0.274	0.362	0.300

Avg = 0.312 lbs/hr

III. PROCEDURES

The procedures for sampling followed Methods detailed in Title 40: Code of Federal Regulations. The following methods were used:

Method	Title
1	Sample and Velocity Traverses for Stationary Sources
2	Determination of Stack Gas Velocity and Volumetric Flow Rate (Type S Pitot)
3	Gas Analysis for CO ₂ , O ₂ , Excess Air, and Dry Molecular Weight
4	Determination of Moisture Content in Stack Gases
5	Determination of Particulate Emissions from Stationary Sources

Three one hour repetitions were performed on each source.

CO₂ and O₂ concentration was determined using Fyrite analyzers.

APPENDIX A

W.R. Grace
B-1 Furnace Exhaust
4/2/90
Repetition # 1

SAMPLE VOLUME, STANDARD CUBIC FEET

$$((H/13.6) / TM) * Y * VM * 17.64 = 55.36676$$

VOLUME OF WATER VAPOR, STANDARD CUBIC FEET

$$VLC * 0.04707 = 1.03554$$

FRACTIONAL MOISTURE CONTENT

$$VWSTD / (VMSTD + VWSTD) = 1.835989E-02$$

PARTICULATE CONCENTRATION, GR/SCF DB

$$(MN/VMSTD) * 0.01543 = 4.114536E-02$$

PARTICULATE CONCENTRATION, LBS/SCF DB

$$(MN/VMSTD) * 2.205E-06 = 5.879813E-06$$

MOLECULAR WEIGHT OF STACK GAS, DRY BASIS

$$(CO2 * .44) + (O2 * .32) + ((N2 + CO) * .28) = 28.8$$

MOLECULAR WEIGHT OF STACK GAS, WET BASIS

$$(MD * (1 - BWS)) + (18 * BWS) = 28.60171$$

STACK PRESSURE, INCHES OF MERCURY

$$SP / 13.6) + PBAR = 29.70662$$

STACK GAS VELOCITY, FPS

$$SQR(((TS + 460) / MS) / PS)) * CP * DP * 85.49 = 30.33568$$

STACK GAS VOLUME, ACFM

$$* AS * 60 = 5251.106$$

STACK GAS VOLUME, SCFH

$$((528 * PBAR) / (TS + 460) / 29.92)) * AS * V * (1 - BWS) * 3600 = 225829$$

PARTICULATE EMISSIONS, LBS/HR

$$S * QS = 1.327832$$

ISOKINETIC RATIO, %

$$((VMSTD / 17.64) + (.002669 * VLC)) / AN / V / PS / T * (TS + 460) * 1.667 = 94.25538$$

W.R. Grace
S-1 Furnace Exhaust
4/2/90
Repetition # 1

PRESSURE DROP ACROSS ORIFICE, H = 3.025
METER CO-EFFICIENT, Y = .98101
METER TEMPERATURE, TM = 97.67
BAROMETRIC PRESSURE, PBAR = 29.7
GAS METER VOLUME, VM = 59.629
LIQUID COLLECTED, VLC = 22
PARTICULATE SAMPLE WEIGHT, MN = 147.64
STATIC PRESSURE, SP = 9.000001E-02
STACK TEMPERATURE, TS = 257.8
PITOT CO-EFFICIENT, CP = .84
SQUARE ROOT OF DELTA P, DP = .4596
AREA OF STACK, AS = 2.885
TEST DURATION, T = 60
AREA OF NOZZLE, AN = 7.507146E-04
CO2 % = 0
O2 % = 20
CO % = 0

W.R. Grace
3-1 Furnace Exhaust
4/2/90
Repetition # 2

SAMPLE VOLUME, STANDARD CUBIC FEET

$$V((H/13.6) / TM) * Y * VM * 17.64 = 39.21074$$

VOLUME OF WATER VAPOR, STANDARD CUBIC FEET

$$VLC * 0.04707 = 1.31796$$

FRACTIONAL MOISTURE CONTENT

$$VWSTD / (VMSTD + VWSTD) = 3.251918E-02$$

PARTICULATE CONCENTRATION, GR/SCF DB

$$(MN/VMSTD) * 0.01543 = 2.350856E-02$$

PARTICULATE CONCENTRATION, LBS/SCF DB

$$(MN/VMSTD) * 2.205E-06 = 3.359455E-06$$

MOLECULAR WEIGHT OF STACK GAS, DRY BASIS

$$(CO2 * .44) + (O2 * .32) + ((N2 + CO) * .28) = 28.94$$

MOLECULAR WEIGHT OF STACK GAS, WET BASIS

$$(MD * (1 - BWS)) + (18 * BWS) = 28.48749$$

STACK PRESSURE, INCHES OF MERCURY

$$SP / 13.6) + PBAR = 29.70735$$

STACK GAS VELOCITY, FPS

$$SOR(((TS + 460) / MS) / PS)) * CP * DP * 85.49 = 30.3132$$

STACK GAS VOLUME, ACFM

$$* AS * 60 = 5247.214$$

STACK GAS VOLUME, SCFH

$$((528 * PBAR) / (TS + 460) / 29.92)) * AS * V * (1 - BWS) * 3600 = 225868$$

PARTICULATE EMISSIONS, LBS/HR

$$S * QS = .7587931$$

ISO KINETIC RATIO, %

$$((VMSTD / 17.64) + (.002669 * VLC)) / AN / V / PS / T * (TS + 460) * 1.667 = 96.20746$$

N.R. Grace
S-1 Furnace Exhaust
4/2/90
Repetition # 2

PRESSURE DROP ACROSS ORIFICE, H = 1.525
METER CO-EFFICIENT, Y = .98101
METER TEMPERATURE, TM = 103.4
BAROMETRIC PRESSURE, PBAR = 29.7
GAS METER VOLUME, VM = 42.821
LIQUID COLLECTED, VLC = 28
PARTICULATE SAMPLE WEIGHT, MN = 59.74
STATIC PRESSURE, SP = .1
STACK TEMPERATURE, TS = 246.8
PITOT CO-EFFICIENT, CP = .84
SQUARE ROOT OF DELTA P, DP = .4619
AREA OF STACK, AS = 2.885
TEST DURATION, T = 60
AREA OF NOZZLE, AN = 5.207676E-04
CO2 % = 0
O2 % = 21
CO % = 0

J.R. Grace
B-1 Furnace Exhaust
4/2/90
Repetition # 3

SAMPLE VOLUME, STANDARD CUBIC FEET
 $((H/13.6) / TM) * Y * VM * 17.64 = 38.61101$

VOLUME OF WATER VAPOR, STANDARD CUBIC FEET
 $VLC * 0.04707 = .9414$

FRACTIONAL MOISTURE CONTENT
 $WSTD / (VMSTD + VWSTD) = 2.380133E-02$

PARTICULATE CONCENTRATION, GR/SCF DB
 $(MN/VMSTD) * 0.01543 = 3.628613E-02$

PARTICULATE CONCENTRATION, LBS/SCF DB
 $(MN/VMSTD) * 2.205E-06 = 5.185413E-06$

MOLECULAR WEIGHT OF STACK GAS, DRY BASIS
 $(CO2 * .44) + (O2 * .32) + ((N2 + CO) * .28) = 28.96$

MOLECULAR WEIGHT OF STACK GAS, WET BASIS
 $(MD * (1 - BWS)) + (18 * BWS) = 28.69914$

STACK PRESSURE, INCHES OF MERCURY
 $SP / 13.6 + PBAR = 29.70662$

STACK GAS VELOCITY, FPS
 $SQR(((TS + 460) / MS) / PS)) * CP * DP * 85.49 = 29.77403$

STACK GAS VOLUME, ACFM
 $* AS * 60 = 5153.885$

STACK GAS VOLUME, SCFH
 $((528 * PBAR) / (TS + 460) / 29.92)) * AS * V * (1 - BWS) * 3600 = 223691.4$

PARTICULATE EMISSIONS, LBS/HR
 $PS * QS = 1.159932$

ISOKINETIC RATIO, %
 $(VMSTD/17.64) + (.002669 * VLC)) / AN * V / PS * T * (TS + 460) * 1.667 = 95.65992$

W.R. Grace
6-1 Furnace Exhaust
4/2/90
Repetition # 3

PRESSURE DROP ACROSS ORIFICE, H = 1.52
METER CO-EFFICIENT, Y = .98101
METER TEMPERATURE, TM = 103.9
BAROMETRIC PRESSURE, PBAR = 29.7
GAS METER VOLUME, VM = 42.204
LIQUID COLLECTED, VLC = 20
PARTICULATE SAMPLE WEIGHT, MN = 90.8
STATIC PRESSURE, SP = 9.000001E-02
STACK TEMPERATURE, TS = 247.3
PITOT CO-EFFICIENT, CP = .84
SQUARE ROOT OF DELTA P, DP = .4552
AREA OF STACK, AS = 2.885
TEST DURATION, T = 60
AREA OF NOZZLE, AN = 5.207676E-04
O2 % = 1
H2 % = 20
CO % = 0

W.R. Grace
3-1 Furnace Exhaust (Oil)
4/2/90
Repetition # 1

SAMPLE VOLUME, STANDARD CUBIC FEET
 $((H/13.6) / TM) * Y * VM * 17.64 = 55.36676$

VOLUME OF WATER VAPOR, STANDARD CUBIC FEET
 $VLC * 0.04707 = 1.03554$

FRACTIONAL MOISTURE CONTENT
 $VWSTD / (VMSTD + VWSTD) = 1.835989E-02$

PARTICULATE CONCENTRATION, GR/SCF DB
 $(MN/VMSTD) * 0.01543 = 7.301601E-03$

PARTICULATE CONCENTRATION, LBS/SCF DB
 $(MN/VMSTD) * 2.205E-06 = 1.043424E-06$

MOLECULAR WEIGHT OF STACK GAS, DRY BASIS
 $CO2 * .44 + (O2 * .32) + ((N2 + CO) * .28) = 28.9$

MOLECULAR WEIGHT OF STACK GAS, WET BASIS
 $MD * (1 - BWS) + (18 * BWS) = 28.60171$

STACK PRESSURE, INCHES OF MERCURY
 $SP / 13.6 + PBAR = 29.70662$

STACK GAS VELOCITY, FPS
 $SQR(((TS + 460) / MS) / PS)) * CP * DP * 85.49 = 30.33568$

STACK GAS VOLUME, ACFM
 $V * AS * 60 = 5251.106$

STACK GAS VOLUME, SCFH
 $((528 * PBAR) / (TS + 460) / 29.92) * AS * V * (1 - BWS) * 3600 = 225829$

PARTICULATE EMISSIONS, LBS/HR
 $PS * QS = .2356354$

SOOT KINETIC RATIO, %
 $((VMSTD / 17.64) + (.002669 * VLC)) / AN * V * PS * T * (TS + 460) * 1.667 = 94.25538$

N.R. Grace
S-1 Furnace Exhaust (Oil)
4/2/90
Repetition # 1

PRESSURE DROP ACROSS ORIFICE, H = 3.025
METER CO-EFFICIENT, Y = .98101
METER TEMPERATURE, TM = 97.67
BAROMETRIC PRESSURE, PBAR = 29.7
GAS METER VOLUME, VM = 59.629
LIQUID COLLECTED, VLC = 22
PARTICULATE SAMPLE WEIGHT, MN = 26.2
STATIC PRESSURE, SP = 9.000001E-02
STACK TEMPERATURE, TS = 257.8
PITOT CO-EFFICIENT, CP = .84
SQUARE ROOT OF DELTA P, DP = .4596
AREA OF STACK, AS = 2.885
TEST DURATION, T = 60
AREA OF NOZZLE, AN = 7.507146E-04
SO2 % = 0
O2 % = 20
CO % = 0

N.R. Grace
B-1 Furnace Exhaust (Oil)
4/2/90
Repetition # 2

SAMPLE VOLUME, STANDARD CUBIC FEET
 $((H/13.6) / TM) * Y * VM * 17.64 = 39.21074$

VOLUME OF WATER VAPOR, STANDARD CUBIC FEET
 $VLC * 0.04707 = 1.31796$

FRACTIONAL MOISTURE CONTENT
 $WSTD / (VMSTD + VWSTD) = 3.251918E-02$

PARTICULATE CONCENTRATION, GR/SCF DB
 $(MN/VMSTD) * 0.01543 = 7.280021E-03$

PARTICULATE CONCENTRATION, LBS/SCF DB
 $(MN/VMSTD) * 2.205E-06 = 1.04034E-06$

MOLECULAR WEIGHT OF STACK GAS, DRY BASIS
 $(CO2 * .44) + (O2 * .32) + ((N2 + CO) * .28) = 28.84$

MOLECULAR WEIGHT OF STACK GAS, WET BASIS
 $MD * (1 - BWS) + (18 * BWS) = 28.48749$

STACK PRESSURE, INCHES OF MERCURY
 $SP / 13.6 + PBAR = 29.70735$

STACK GAS VELOCITY, FPS
 $SQR(((TS + 460) / MS) / PS)) * CP * DP * 85.49 = 30.3132$

STACK GAS VOLUME, ACFM
 $* AS * 60 = 5247.214$

STACK GAS VOLUME, SCFH
 $((528 * PBAR) / (TS + 460) / 29.92) * AS * V * (1 - BWS) * 3600 = 225868$

PARTICULATE EMISSIONS, LBS/HR
 $PS * OS = .2349794$

ISOKINETIC RATIO, %
 $(VMSTD/17.64) + (.002669 * VLC) / (AN/V/PS/T * (TS + 460) * 1.667 = 96.20746$

J.R. Grace
3-1 Furnace Exhaust (Oil)
4/2/90
Repetition # 2

PRESSURE DROP ACROSS ORIFICE, H = 1.525
METER CO-EFFICIENT, Y = .98101
METER TEMPERATURE, TM = 103.4
BAROMETRIC PRESSURE, PBAR = 29.7
GAS METER VOLUME, VM = 42.821
LIQUID COLLECTED, VLC = 28
PARTICULATE SAMPLE WEIGHT, MN = 18.5
STATIC PRESSURE, SP = .1
STACK TEMPERATURE, TS = 246.8
PITOT CO-EFFICIENT, CP = .94
SQUARE ROOT OF DELTA P, DP = .4619
AREA OF STACK, AS = 2.885
TEST DURATION, T = 60
AREA OF NOZZLE, AN = 5.207676E-04
CO2 % = 0
O2 % = 21
CO % = 0

J.R. Grace
B-1 Furnace Exhaust (Oil)
4/2/90
Repetition # 3

SAMPLE VOLUME, STANDARD CUBIC FEET
 $V((H/13.6) / TM) * Y * VM * 17.64 = 38.61101$

VOLUME OF WATER VAPOR, STANDARD CUBIC FEET
 $VLC * 0.04707 = .9414$

FRACTIONAL MOISTURE CONTENT
 $VWSTD / (VMSTD + VWSTD) = 2.380133E-02$

PARTICULATE CONCENTRATION, GR/SCF DB
 $(MN/VMSTD) * 0.01543 = 1.310776E-02$

PARTICULATE CONCENTRATION, LBS/SCF DB
 $(MN/VMSTD) * 2.205E-06 = 1.873145E-06$

MOLECULAR WEIGHT OF STACK GAS, DRY BASIS
 $(CO2 * .44) + (O2 * .32) + ((N2 + CO) * .28) = 28.96$

MOLECULAR WEIGHT OF STACK GAS, WET BASIS
 $MD * (1 - BWS) + (18 * BWS) = 28.69914$

STACK PRESSURE, INCHES OF MERCURY
 $SP / 13.6 + PBAR = 29.70662$

STACK GAS VELOCITY, FPS
 $SQR(((TS + 460) / MS) / PS)) * CF * DP * 85.49 = 29.77403$

STACK GAS VOLUME, ACFM
 $* AS * 60 = 5153.885$

STACK GAS VOLUME, SCFH
 $((528 * PBAR) / (TS + 460) / 29.92) * AS * V * (1 - BWS) * 3600 = 223691.4$

PARTICULATE EMISSIONS, LBS/HR
 $PS * QS = .4190063$

ISO KINETIC RATIO, %
 $(VMSTD / 17.64) + (.002669 * VLC) / AN * V / PS * T * (TS + 460) * 1.667 = 75.65992$

J.R. Grace
-1 Furnace Exhaust (Oil)
/2/90
petition # 3

RESSURE DROP ACROSS ORIFICE, H = 1.52
ETER CO-EFFICIENT, Y = .98101
ETER TEMPERATURE, TM = 103.9
AROMETRIC PRESSURE, PBAR = 29.7
AS METER VOLUME, VM = 42.204
IQUID COLLECTED, VLC = 20
ARTICULATE SAMPLE WEIGHT, MN = 32.8
TATIC PRESSURE, SP = 9.000001E-02
TACK TEMPERATURE, TS = 247.3
ITQT CO-EFFICIENT, CP = .84
QUARE ROOT OF DELTA P, DP = .4552
REA OF STACK, AS = 2.885
EST DURATION, T = 60
FEA OF NOZZLE, AN = 5.207676E-04
C % = 1
% = 20
% = 0

W.R. Grace
G-2 Furnace Exhaust
4/3/90
Repetition # 1

SAMPLE VOLUME, STANDARD CUBIC FEET
 $((H/13.6) / TM) * Y * VM * 17.64 = 40.37899$

VOLUME OF WATER VAPOR, STANDARD CUBIC FEET
 $VLC * 0.04707 = 1.55331$

FRACTIONAL MOISTURE CONTENT
 $VWSTD / (VMSTD + VWSTD) = 3.704328E-02$

PARTICULATE CONCENTRATION, GR/SCF DB
 $(MN/VMSTD) * 0.01543 = 8.341885E-02$

PARTICULATE CONCENTRATION, LBS/SCF DB
 $MN/VMSTD) * 2.205^{-06} = 1.192084E-05$

MOLECULAR WEIGHT OF STACK GAS, DRY BASIS
 $O_2 * .44) + (O_2 * .32) + ((N_2 + CO) * .28) = 28.78$

MOLECULAR WEIGHT OF STACK GAS, WET BASIS
 $MD * (1 - BWS)) + (18 * BWS) = 28.38068$

STACK PRESSURE, INCHES OF MERCURY
 $SP / 13.6) + PBAR = 29.77324$

STACK GAS VELOCITY, FPS
 $SQR(((TS + 460) / MS) / PS)) * CP * DP * 85.49 = 31.84324$

STACK GAS VOLUME, ACFM
 $V * AS * 60 = 3567.079$

STACK GAS VOLUME, SCFH
 $((528 * PBAR) / (TS + 460) / 29.92)) * AS * V * (1 - BWS) * 3600 = 168646.1$

PARTICULATE EMISSIONS, LBS/HR
 $CS * QS = 2.010403$

ISOKINETIC RATIO, %
 $((VMSTD / 17.64) + (.002669 * VLC)) / AN / V / PS / T * (TS + 460) * 1.667 = 105.3075$

V.R. Grace
3-2 Furnace Exhaust
1/3/90
Repetition # 1

PRESSURE DROP ACROSS ORIFICE, H = 1.453
METER CO-EFFICIENT, Y = .98101
METER TEMPERATURE, TM = 82.83
BAROMETRIC PRESSURE, PBAR = 29.76
GAS METER VOLUME, VM = 42.409
LIQUID COLLECTED, VLC = 33
PARTICULATE SAMPLE WEIGHT, MN = 218.3
STATIC PRESSURE, SP = .18
STACK TEMPERATURE, TS = 181.8
PITOT CO-EFFICIENT, CP = .84
SQUARE ROOT OF DELTA P, DP = .5088001
AREA OF STACK, AS = 1.867
TEST DURATION, T = 60
AREA OF NOZZLE, AN = 4.245565E-04
% = 0
% = 19.5
% = 0

R. Grace
-2 Furnace Exhaust
/3/90
petition # 2

AMPLE VOLUME, STANDARD CUBIC FEET
 $((H/13.6) / TM) * Y * VM * 17.64 = 39.55688$

OLUME OF WATER VAPOR, STANDARD CUBIC FEET
 $LC * 0.04707 = 2.02401$

RACTIONAL MOISTURE CONTENT
 $WSTD / (VMSTD + VWSTD) = 4.867645E-02$

ARTICULATE CONCENTRATION, GR/SCF DB
 $MN/VMSTD) * 0.01543 = .0202642$

ARTICULATE CONCENTRATION, LBS/SCF DB
 $/VMSTD) * 2.205^{-06} = 2.895824E-06$

ECULAR WEIGHT OF STACK GAS, DRY BASIS
 $2 * .44) + (O2 * .32) + ((N2 + CO) * .28) = 28.76$

ECULAR WEIGHT OF STACK GAS, WET BASIS
 $* (1 - BWS)) + (18 * BWS) = 28.23624$

CK PRESSURE, INCHES OF MERCURY
 $/ 13.6) + PBAR = 29.77324$

CK GAS VELOCITY, FPS
 $R(((TS + 460) / MS) / PS)) * CP * DP * 85.49 = 31.52995$

ACK GAS VOLUME, ACFM
 $* AS * 60 = 3531.985$

STACK GAS VOLUME, SCFH
 $((528*PBAR)/(TS+460)/29.92)) * AS * V * (1-BWS) * 3600 = 163064$

PARTICULATE EMISSIONS, LBS/HR
 $PS * QS = .4722047$

ISOKINETIC RATIO, %
 $((VMSTD/17.64) + (.002669*VLC))/AN/V/PS/T*(TS+460)*1.667 = 106.6953$

R. Grace
2 Furnace Exhaust
3/90
petition # 2

RESSURE DROP ACROSS ORIFICE, H = 1.43
TER CO-EFFICIENT, Y = .98101
TER TEMPERATURE, TM = 83.21
ROMETRIC PRESSURE, PBAR = 29.76
S METER VOLUME, VM = 41.577
QUID COLLECTED, VLC = 43
ARTICULATE SAMPLE WEIGHT, MN = 51.95
ATIC PRESSURE, SP = .18
ACK TEMPERATURE, TS = 189.3
TOT CO-EFFICIENT, CP = .84
QUARE ROOT OF DELTA P, DP = .4996
EA OF STACK, AS = 1.867
T DURATION, T = 60
OF NOZZLE, AN = 4.245565E-04
% = 0
= 19
= 0

.R. Grace
-2 Furnace Exhaust
/3/90
petition # 3

AMPLE VOLUME, STANDARD CUBIC FEET
 $((H/13.6) / TM) * Y * VM * 17.64 = 36.20882$

OLUME OF WATER VAPOR, STANDARD CUBIC FEET
 $LC * 0.04707 = 1.78866$

ACTIONAL MOISTURE CONTENT
 $TD / (VMSTD + VWSTD) = 4.707312E-02$

ICULATE CONCENTRATION, GR/SCF DB
 $VMSTD) * 0.01543 = 1.130121E-02$

ICULATE CONCENTRATION, LBS/SCF DB
 $VMSTD) * 2.205^{-06} = 1.614982E-06$

ULAR WEIGHT OF STACK GAS, DRY BASIS
 $* .44) + (O2 * .32) + ((N2 + CO) * .28) = 28.78$

ULAR WEIGHT OF STACK GAS, WET BASIS
 $(1 - BWS)) + (18 * BWS) = 28.27255$

PRESSURE, INCHES OF MERCURY
 $13.6) + PBAR = 29.77324$

K GAS VELOCITY, FPS
 $((TS + 460) / MS) / PS)) * CP * DP * 85.49 = 29.72971$

I GAS VOLUME, ACFM
 $AS * 60 = 3330.323$

K GAS VOLUME, SCFH
 $.28 * PBAR) / ((TS + 460) / 29.92)) * AS * V * (1 - BWS) * 3600 = 152463.1$

TICULATE EMISSIONS, LBS/HR
 $* QS = .2462252$

SOKINETIC RATIO, %
 $(VMSTD/17.64) + (.002669 * VLC)) / AN / V / PS / T * (TS + 460) * 1.667 = 104.4554$

.R. Grace
-2 Furnace Exhaust
/3/90
petition # 3

RESSURE DROP ACROSS ORIFICE, H = 1.231
ETER CO-EFFICIENT, Y = .98101
ETER TEMPERATURE, TM = 97.71
AROMETRIC PRESSURE, PBAR = 29.76
AS METER VOLUME, VM = 39.093
IQUID COLLECTED, VLC = 38
ARTICULATE SAMPLE WEIGHT, MN = 26.52
TATIC PRESSURE, SP = .18
TACK TEMPERATURE, TS = 195.9
ITOT CO-EFFICIENT, CP = .84
QUARE ROOT OF DELTA P, DP = .469
REA OF STACK, AS = 1.867
EST DURATION, T = 60
REA OF NOZZLE, AN = 4.245565E-04
O2 % = 0
2 % = 19.5
O % = 0

W.R. Grace
3-2 Furnace Exhaust (Oil)
4/3/90
Repetition # 1

SAMPLE VOLUME, STANDARD CUBIC FEET
 $((H/13.6) / TM) * Y * VM * 17.64 = 40.37899$

VOLUME OF WATER VAPOR, STANDARD CUBIC FEET
 $VLC * 0.04707 = 1.55331$

FRACTIONAL MOISTURE CONTENT
 $VWSTD / (VMSTD + VWSTD) = 3.704328E-02$

PARTICULATE CONCENTRATION, GR/SCF DB
 $(MN/VMSTD) * 0.01543 = 1.501769E-02$

PARTICULATE CONCENTRATION, LBS/SCF DB
 $(MN/VMSTD) * 2.205E-06 = 2.146079E-06$

MOLECULAR WEIGHT OF STACK GAS, DRY BASIS
 $(CO2 * .44) + (O2 * .32) + ((N2 + CO) * .28) = 28.78$

MOLECULAR WEIGHT OF STACK GAS, WET BASIS
 $MD * (1 - BWS) + (18 * BWS) = 28.38068$

STACK PRESSURE, INCHES OF MERCURY
 $(SP / 13.6) + PBAR = 29.77324$

STACK GAS VELOCITY, FPS
 $(SQR(((TS + 460) / MS) / PS)) * CP * DP * 85.49 = 31.84324$

STACK GAS VOLUME, ACFM
 $V * AS * 60 = 3567.079$

STACK GAS VOLUME, SCFH
 $((528 * PBAR) / (TS + 460) / 29.92) * AS * V * (1 - BWS) * 3600 = 168646.1$

PARTICULATE EMISSIONS, LBS/HR
 $CS * QS = .3619278$

ISOKINETIC RATIO, %
 $((VMSTD / 17.64) + (.002669 * VLC)) / AN / V / PS / T * (TS + 460) * 1.667 = 105.3075$

W.R. Grace
3-2 Furnace Exhaust (Oil)
4/3/90
Repetition # 1

PRESSURE DROP ACROSS ORIFICE, H = 1.453
METER CO-EFFICIENT, Y = .98101
METER TEMPERATURE, TM = 82.83
BAROMETRIC PRESSURE, PBAR = 29.76
GAS METER VOLUME, VM = 42.409
LIQUID COLLECTED, VLC = 33
PARTICULATE SAMPLE WEIGHT, MN = 39.3
STATIC PRESSURE, SP = .18
STACK TEMPERATURE, TS = 181.8
PITOT CO-EFFICIENT, CP = .84
SQUARE ROOT OF DELTA P, DP = .5088001
AREA OF STACK, AS = 1.867
TEST DURATION, T = 60
AREA OF NOZZLE, AN = 4.245565E-04
CO2 % = 0
O2 % = 19.5
CO % = 0

W.R. Grace
3-2 Furnace Exhaust (Oil)
4/3/90
Repetition # 2

SAMPLE VOLUME, STANDARD CUBIC FEET
 $((H/13.6) / TM) * Y * VM * 17.64 = 39.55688$

VOLUME OF WATER VAPOR, STANDARD CUBIC FEET
 $VLC * 0.04707 = 2.02401$

FRACTIONAL MOISTURE CONTENT
 $VMSTD / (VMSTD + VWSTD) = 4.867645E-02$

PARTICULATE CONCENTRATION, GR/SCF DB
 $(MN/VMSTD) * 0.01543 = .0224681$

PARTICULATE CONCENTRATION, LBS/SCF DB
 $(MN/VMSTD) * 2.205E-06 = 3.210769E-06$

MOLECULAR WEIGHT OF STACK GAS, DRY BASIS
 $(CO2 * .44) + (O2 * .32) + ((N2 + CO) * .28) = 28.76$

MOLECULAR WEIGHT OF STACK GAS, WET BASIS
 $(MD * (1 - BWS)) + (18 * BWS) = 28.23624$

STACK PRESSURE, INCHES OF MERCURY
 $(SP / 13.6) + PBAR = 29.77324$

STACK GAS VELOCITY, FPS
 $(SQR(((TS + 460) / MS) / PS)) * CP * DP * 85.49 = 31.52995$

STACK GAS VOLUME, ACFM
 $V * AS * 60 = 3531.985$

STACK GAS VOLUME, SCFH
 $((528 * PBAR) / (TS + 460) / 29.92) * AS * V * (1 - BWS) * 3600 = 163064$

PARTICULATE EMISSIONS, LBS/HR
 $CS * QS = .523561$

SOOT KINETIC RATIO, %
 $((VMSTD / 17.64) + (.002669 * VLC)) / AN / V / PS / T * (TS + 460) * 1.667 = 106.6953$

R. Grace
2 Furnace Exhaust (Oil)
3/90
petition # 2

PRESSURE DROP ACROSS ORIFICE, H = 1.43
WATER CO-EFFICIENT, Y = .98101
WATER TEMPERATURE, TM = 83.21
BAROMETRIC PRESSURE, PBAR = 29.76
WATER METER VOLUME, VM = 41.577
LIQUID COLLECTED, VLC = 43
ARTICULATE SAMPLE WEIGHT, MN = 57.6
STATIC PRESSURE, SP = .18
STACK TEMPERATURE, TS = 189.3
WATER CO-EFFICIENT, CP = .84
SQUARE ROOT OF DELTA P, DP = .4996
AREA OF STACK, AS = 1.867
TEST DURATION, T = 60
AREA OF NOZZLE, AN = 4.245565E-04
O2 % = 0
CO % = 19
H2 % = 0

race
rnace (oil)
tion # 3

E VOLUME, STANDARD CUBIC FEET
 $13.6) / TM) * Y * VM * 17.64 = 36.20882$

E OF WATER VAPOR, STANDARD CUBIC FEET
 $0.04707 = 1.78866$

IONAL MOISTURE CONTENT
 $) / (VMSTD + VWSTD) = 4.707312E-02$

ICULATE CONCENTRATION, GR/SCF DB
 $VMSTD) * 0.01543 = 3.980141E-02$

ICULATE CONCENTRATION, LBS/SCF DB
 $VMSTD) * 2.205^{-06} = 5.687759E-06$

ECULAR WEIGHT OF STACK GAS, DRY BASIS
 $2 * .44) + (O2 * .32) + ((N2 + CO) * .28) = 28.78$

ECULAR WEIGHT OF STACK GAS, WET BASIS
 $* (1 - BWS)) + (18 * BWS) = 28.27255$

CK PRESSURE, INCHES OF MERCURY
 $/ 13.6) + PBAR = 29.77324$

CK GAS VELOCITY, FPS
 $IR(((TS + 460) / MS) / PS)) * CP * DP * 85.49 = 29.72971$

ACK GAS VOLUME, ACFM
 $* AS * 60 = 3330.323$

ACK GAS VOLUME, SCFH
 $(528*PBAR)/(TS+460)/29.92)) * AS * V * (1-BWS) * 3600 = 152463.1$

RTICULATE EMISSIONS, LBS/HR
 $* QS = .8671732$

OKINETIC RATIO, %
 $(VMSTD/17.64) + (.002669*VLC)) / AN / V / PS / T * (TS+460) * 1.667 = 104.4554$

J.R. Grace
-2 Furnace (oil)
/3/90
petition # 3

RESSURE DROP ACROSS ORIFICE, H = 1.231
ETER CO-EFFICIENT, Y = .98101
ETER TEMPERATURE, TM = 97.71
AROMETRIC PRESSURE, PBAR = 29.76
AS METER VOLUME, VM = 39.093
IQUID COLLECTED, VLC = 38
ARTICULATE SAMPLE WEIGHT, MN = 93.4
TATIC PRESSURE, SP = .18
TACK TEMPERATURE, TS = 195.9
ITOT CO-EFFICIENT, CP = .84
SQUARE ROOT OF DELTA P, DP = .469
AREA OF STACK, AS = 1.867
EST DURATION, T = 60
AREA OF NOZZLE, AN = 4.245565E-04
O2 % = 0
O2 % = 19.5
CO % = 0

A.R. Grace
0-18 Exhaust
4/4/90
Repetition # 1

SAMPLE VOLUME, STANDARD CUBIC FEET
 $K((H/13.6) / TM) * Y * VM * 17.64 = 44.38425$

VOLUME OF WATER VAPOR, STANDARD CUBIC FEET
 $VLC * 0.04707 = 1.78866$

FRACTIONAL MOISTURE CONTENT
 $VWSTD / (VMSTD + VWSTD) = .0387383$

PARTICULATE CONCENTRATION, GR/SCF DB
 $(MN/VMSTD) * 0.01543 = 7.968043E-03$

PARTICULATE CONCENTRATION, LBS/SCF DB
 $(MN/VMSTD) * 2.205E-06 = 1.138661E-06$

MOLECULAR WEIGHT OF STACK GAS, DRY BASIS
 $(CO2 * .44) + (O2 * .32) + ((N2 + CO) * .28) = 28.9$

MOLECULAR WEIGHT OF STACK GAS, WET BASIS
 $MD * (1 - BWS) + (18 * BWS) = 28.47775$

STACK PRESSURE, INCHES OF MERCURY
 $SP / 13.6 + PBAR = 29.7825$

STACK GAS VELOCITY, FPS
 $SQR(((TS + 460) / MS) / PS)) * CP * DP * 85.49 = 33.37535$

STACK GAS VOLUME, ACFM
 $* AS * 60 = 5777.273$

STACK GAS VOLUME, SCFH
 $((528 * PBAR) / (TS + 460) / 29.92)) * AS * V * (1 - BWS) * 3600 = 240985.6$

PARTICULATE EMISSIONS, LBS/HR
 $CS * QS = .2744008$

ISOKINETIC RATIO, %
 $((VMSTD/17.64) + (.002669 * VLC)) / AN / V / PS / T * (TS + 460) * 1.667 = 102.0521$

R. Grace
18 Exhaust
4/90
petition # 1

PRESSURE DROP ACROSS ORIFICE, H = 1.788
TER CO-EFFICIENT, Y = 1.00127
TER TEMPERATURE, TM = 97.71
ROMETRIC PRESSURE, PBAR = 29.77
S METER VOLUME, VM = 46.87
QUID COLLECTED, VLC = 38
RTICULATE SAMPLE WEIGHT, MN = 22.92
TATIC PRESSURE, SP = .17
ACK TEMPERATURE, TS = 266.4
TOT CO-EFFICIENT, CP = .84
QUARE ROOT OF DELTA P, DP = .5022
REA OF STACK, AS = 2.885
EST DURATION, T = 60
REA OF NOZZLE, AN = 5.207676E-04
02 % = .5
2 % = 20.5
0 % = 0

W.R. Grace
D-18 Exhaust
4/4/90
Repetition # 2

SAMPLE VOLUME, STANDARD CUBIC FEET
 $((H/13.6) / TM) * Y * VM * 17.64 = 43.25479$

VOLUME OF WATER VAPOR, STANDARD CUBIC FEET
 $VLC * 0.04707 = 1.31796$

FRACTIONAL MOISTURE CONTENT
 $VWSTD / (VMSTD + VWSTD) = 2.956874E-02$

PARTICULATE CONCENTRATION, GR/SCF DB
 $(MN/VMSTD) * 0.01543 = 1.053048E-02$

PARTICULATE CONCENTRATION, LBS/SCF DB
 $(MN/VMSTD) * 2.205E-06 = 1.504842E-06$

MOLECULAR WEIGHT OF STACK GAS, DRY BASIS
 $CO2 * .44) + (O2 * .32) + ((N2 + CO) * .28) = 28.9$

MOLECULAR WEIGHT OF STACK GAS, WET BASIS
 $MD * (1 - BWS)) + (18 * BWS) = 28.5777$

STACK PRESSURE, INCHES OF MERCURY
 $SP / 13.6) + PBAR = 29.78177$

STACK GAS VELOCITY, FPS
 $SQR(((TS + 460) / MS) / PS)) * CP * DP * 85.49 = 33.43473$

STACK GAS VOLUME, ACFM
 $V * AS * 60 = 5787.552$

STACK GAS VOLUME, SCFH
 $((528 * PBAR) / (TS + 460) / 29.92)) * AS * V * (1 - BWS) * 3600 = 240277.2$

PARTICULATE EMISSIONS, LBS/HR
 $CS * QS = .361579$

ISOKINETIC RATIO, %
 $((VMSTD / 17.64) + (.002669 * VLC)) / AN / V / PS / T * (TS + 460) * 1.667 = 99.75063$

.R. Grace
-18 Exhaust
/4/90
petition # 2

RESSURE DROP ACROSS ORIFICE, H = 1.771
ETER CO-EFFICIENT, Y = 1.00127
ETER TEMPERATURE, TM = 110.1
AROMETRIC PRESSURE, PBAR = 29.77
AS METER VOLUME, VM = 46.694
IQUID COLLECTED, VLC = 28
ARTICULATE SAMPLE WEIGHT, MN = 29.52
STATIC PRESSURE, SP = .16
STACK TEMPERATURE, TS = 276.8
PITOT CO-EFFICIENT, CP = .84
SQUARE ROOT OF DELTA P, DP = .5004
AREA OF STACK, AS = 2.885
EST DURATION, T = 60
AREA OF NOZZLE, AN = 5.207676E-04
O2 % = .5
O2 % = 20.5
O % = 0

J.R. Grace
D-18 Exhaust
4/4/90
Repetition # 3

SAMPLE VOLUME, STANDARD CUBIC FEET
 $((H/13.6) / TM) * Y * VM * 17.64 = 35.25305$

VOLUME OF WATER VAPOR, STANDARD CUBIC FEET
 $VLC * 0.04707 = 1.97694$

FRACTIONAL MOISTURE CONTENT
 $VWSTD / (VMSTD + VWSTD) = 5.310075E-02$

PARTICULATE CONCENTRATION, GR/SCF DB
 $(MN/VMSTD) * 0.01543 = .0109642$

PARTICULATE CONCENTRATION, LBS/SCF DB
 $(MN/VMSTD) * 2.205E-06 = 1.566822E-06$

MOLECULAR WEIGHT OF STACK GAS, DRY BASIS
 $(CO2 * .44) + (O2 * .32) + ((N2 + CO) * .28) = 28.9$

MOLECULAR WEIGHT OF STACK GAS, WET BASIS
 $(MD * (1 - BWS)) + (18 * BWS) = 28.3212$

STACK PRESSURE, INCHES OF MERCURY
 $(SP / 13.6) + PBAR = 29.77956$

STACK GAS VELOCITY, FPS
 $SQR(((TS + 460) / MS) / PS)) * CF * DP * 85.49 = 27.7204$

STACK GAS VOLUME, ACFM
 $V * AS * 60 = 4798.401$

STACK GAS VOLUME, SCFH
 $((528 * PBAR) / (TS + 460) / 29.92) * AS * V * (1 - BWS) * 3600 = 191291.2$

PARTICULATE EMISSIONS, LBS/HR
 $CS * QS = .2997193$

ISOKINETIC RATIO, %
 $((VMSTD/17.64) + (.002669 * VLC)) / AN / V / PS / T * (TS + 460) * 1.667 = 102.1246$

W.R. Grace
D-18 Exhaust
4/4/90
Repetition # 3

PRESSURE DROP ACROSS ORIFICE, H = 1.188
METER CO-EFFICIENT, Y = 1.00127
METER TEMPERATURE, TM = 111.9
BAROMETRIC PRESSURE, PBAR = 29.77
GAS METER VOLUME, VM = 38.231
LIQUID COLLECTED, VLC = 42
PARTICULATE SAMPLE WEIGHT, MN = 25.05
STATIC PRESSURE, SP = .13
STACK TEMPERATURE, TS = 288.7
PITOT CO-EFFICIENT, CP = .84
SQUARE ROOT OF DELTA P, DP = .4097
AREA OF STACK, AS = 2.985
TEST DURATION, T = 60
AREA OF NOZZLE, AN = 5.207676E-04
O2 % = .5
O2 % = 20.5
CO % = 0

APPENDIX B

BLANK ANALYTICAL DATA FORM (Acetone)

PLANT: Grace

SAMPLE LOCATION: _____

LIQUID LEVEL MARKED? ✓

BLANK VOLUME (Va): 100 mls

DATE OF WEIGHING 4-5-90 GROSS WEIGHT 94.1125

DATE OF WEIGHING _____ GROSS WEIGHT _____

AVERAGE GROSS WEIGHT _____

TARE WEIGHT 94.1127

WEIGHT OF BLANK (Ma) 0

$$Ca = \frac{Ma}{Va Pa} = \frac{0}{100 \times 1} = 0 \text{ mg/g}$$

Note: In no case should a blank residue greater than 0.01 mg/g or 0.001% of the blank weight be subtracted from the sample weight.

PARTICULATE ANALYTICAL DATA FORM

Company: Graco Run Number: R1 PW & Filter

Location: Monokate Exhaust Density(Pa.) 0.781

Date: 4-2-90

Liquid Level Marked? ✓

Blank Concentration(Ca) 0

Rinse Volume(Vaw) 200 mls

Residue in Rinse(Wa)=Ca*Vaw*Pa 0

Date of Weighing 4-7-90 Gross Wt. 114.8670 gm

Date of Weighing _____ Gross Wt. _____

Average Gross Wt. _____

Less Blank Residue(Wa) 0

Tare Wt. 114.8438 gm

Weight of Particulate in Rinse 23.2 mg.

Date of Weighing 4/8/90 Gross Filter Wt. 458.54 mg.

Date of Weighing _____ Gross Filter Wt. _____

Average Gross Wt. _____

Filter Tare Wt. 457.33 mg.

Weight of Particulate on Filter 1.21 mg.

Total Weight of Particulate 24.41 mg.

PARTICULATE ANALYTICAL DATA FORM

Company: CRACC Run Number: R1 PW + Filter

Location: G-1 FURNACE EXHAUST Density(Pa.) 0.781

Date: 4-2-90

Liquid Level Marked? ✓

Blank Concentration(Ca) 0

Rinse Volume(Vaw) 215

Residue in Rinse(Wa)=Ca*Vaw*Pa 0

Date of Weighing 4-7-90 Gross Wt. 105.2469 gm

Date of Weighing _____ Gross Wt. _____

Average Gross Wt. _____

Less Blank Residue(Wa) 0

Tare Wt. 105.1402 gm

Weight of Particulate in Rinse 106.7 mg

Date of Weighing 4/8/90 Gross Filter Wt. 460.98 mg

Date of Weighing _____ Gross Filter Wt. _____

Average Gross Wt. _____

Filter Tare Wt. 456.54 mg

Weight of Particulate on Filter 4.44 mg

Total Weight of Particulate 111.14 mg

PARTICULATE ANALYTICAL DATA FORM

Company: Grac Run Number: 22 PW + Filter

Location: G-1 Furnace Exhaust Density(Pa.) 0.781

Date: 4-2-90

Liquid Level Marked? ✓

Blank Concentration(Ca) 0

Rinse Volume(Vaw) 220mls

Residue in Rinse(Wa)=Ca*Vaw*Pa 0

Date of Weighing 4-7-90 Gross Wt. 97.4896 gm.

Date of Weighing _____ Gross Wt. _____

Average Gross Wt. _____

Less Blank Residue(Wa) _____

Tare Wt. 97.4542 gm.

Weight of Particulate in Rinse 35.4 mg.

Date of Weighing 4/8/90 Gross Filter Wt. 458.02 mg.

Date of Weighing _____ Gross Filter Wt. _____

Average Gross Wt. _____

Filter Tare Wt. 452.18 mg.

Weight of Particulate on Filter 5.84 mg.

Total Weight of Particulate 41.24mg

PARTICULATE ANALYTICAL DATA FORM

Company: GRACO Run Number: R3 PW & Filter

Location: G-1 Furnace Exhaust Density(Pa.) 0.781

Date: 4-2-90

Liquid Level Marked? ✓

Blank Concentration(Ca) 0

Rinse Volume(Vaw) 212 mls

Residue in Rinse(Wa)=Ca*Vaw*Pa 0

Date of Weighing 4-2-90 Gross Wt. 97.4236 gm.

Date of Weighing _____ Gross Wt. _____

Average Gross Wt. _____

Less Blank Residue(Wa) _____

Tare Wt. 97.3786 gm.

Weight of Particulate in Rinse 45 mg.

Date of Weighing 4/8/90 Gross Filter Wt. 468.48 mg.

Date of Weighing _____ Gross Filter Wt. _____

Average Gross Wt. _____

Filter Tare Wt. 448.48 mg.

Weight of Particulate on Filter 20.0 mg.

Total Weight of Particulate 65 mg.

PARTICULATE ANALYTICAL DATA FORM

Company: Grac Run Number: R1 Imps

Location: G-1 Furnace Exhaust Density(Pa.) _____

Date: 4-2-90

Liquid Level Marked? _____

Blank Concentration(Ca) _____

Rinse Volume(Vaw) _____

Residue in Rinse(Wa) = $Ca \times Vaw \times Pa$ _____

Date of Weighing 4-7-90 Gross Wt. 96.0391 gm.

Date of Weighing _____ Gross Wt. _____

Average Gross Wt. _____

Less Blank Residue(Wa) _____

Tare Wt. 96.0026 gm.

Weight of Particulate in Rinse _____

Date of Weighing _____ Gross Filter Wt. _____

Date of Weighing _____ Gross Filter Wt. _____

Average Gross Wt. _____

Filter Tare Wt. _____

Weight of Particulate on Filter _____

Total Weight of Particulate 36.5 mg.

PARTICULATE ANALYTICAL DATA FORM

Company: Grace Run Number: R2 Imps

Location: G-1 Furnace Exhaust Density(Pa.) _____

Date: 4-2-90

Liquid Level Marked? _____

Blank Concentration(Ca) _____

Rinse Volume(Vaw) _____

Residue in Rinse(Wa) = $Ca * Vaw * Pa$ _____

Date of Weighing 4-7-90 Gross Wt. 98.7077 gm.

Date of Weighing _____ Gross Wt. _____

Average Gross Wt. _____

Less Blank Residue(Wa) _____

Tare Wt. 78.6892 gm

Weight of Particulate in Rinse _____

Date of Weighing _____ Gross Filter Wt. _____

Date of Weighing _____ Gross Filter Wt. _____

Average Gross Wt. _____

Filter Tare Wt. _____

Weight of Particulate on Filter _____

Total Weight of Particulate 18.5 mg.

PARTICULATE ANALYTICAL DATA FORM

Company: Grac Run Number: R3 Tmp 5

Location: G-1 Furnace Exhaust Density(Pa.) _____

Date: 4-2-90

Liquid Level Marked? _____

Blank Concentration(Ca) _____

Rinse Volume(Vaw) _____

Residue in Rinse(Wa)=Ca*Vaw*Pa _____

Date of Weighing 4-7-90 Gross Wt. 105.3095

Date of Weighing _____ Gross Wt. _____

Average Gross Wt. _____

Less Blank Residue(Wa) _____

Tare Wt. 105.2837

Weight of Particulate in Rinse _____

Date of Weighing _____ Gross Filter Wt. _____

Date of Weighing _____ Gross Filter Wt. _____

Average Gross Wt. _____

Filter Tare Wt. _____

Weight of Particulate on Filter _____

Total Weight of Particulate 25.8 mg

PARTICULATE ANALYTICAL DATA FORM

Company: Grace Run Number: R1 Imps Oil

Location: 6-1 FURNACE EXHAUST Density(Pa.) _____

Date: 4-2-90

Liquid Level Marked? _____

Blank Concentration(Ca) _____

Rinse Volume(Vaw) _____

Residue in Rinse(Wa) = $Ca \times Vaw \times Pa$ _____

Date of Weighing 4-7-90 Gross Wt. 105.4059 gm.

Date of Weighing _____ Gross Wt. _____

Average Gross Wt. _____

Less Blank Residue(Wa) _____

Tare Wt. 105.3797 gm.

Weight of Particulate in Rinse _____

Date of Weighing _____ Gross Filter Wt. _____

Date of Weighing _____ Gross Filter Wt. _____

Average Gross Wt. _____

Filter Tare Wt. _____

Weight of Particulate on Filter _____

Total Weight of Particulate 26.2 mg.

PARTICULATE ANALYTICAL DATA FORM

Company: Grace Run Number: R2 Imps 0.1

Location: G-1 Furnace Exhaust Density(Pa.) _____

Date: 4-2-90

Liquid Level Marked? _____

Blank Concentration(Ca) _____

Rinse Volume(Vaw) _____

Residue in Rinse(Wa) = $Ca \times Vaw \times Pa$ _____

Date of Weighing 4-7-90 Gross Wt. 99.2599 gm.

Date of Weighing _____ Gross Wt. _____

Average Gross Wt. _____

Less Blank Residue(Wa) _____

Tare Wt. 99.2414 gm.

Weight of Particulate in Rinse _____

Date of Weighing _____ Gross Filter Wt. _____

Date of Weighing _____ Gross Filter Wt. _____

Average Gross Wt. _____

Filter Tare Wt. _____

Weight of Particulate on Filter _____

Total Weight of Particulate 18.5 mg.

PARTICULATE ANALYTICAL DATA FORM

Company: Grac Run Number: R3 Imps Oil

Location: 6-1 FVH9C1 Density(Pa.) _____

Date: 4-3-90

Liquid Level Marked? _____

Blank Concentration(Ca) _____

Rinse Volume(Vaw) _____

Residue in Rinse(Wa)=Ca*Vaw*Pa _____

Date of Weighing 4-7-90 Gross Wt. 101.2682 gm.

Date of Weighing _____ Gross Wt. _____

Average Gross Wt. _____

Less Blank Residue(Wa) _____

Tare Wt. 101.8354 gm.

Weight of Particulate in Rinse _____

Date of Weighing _____ Gross Filter Wt. _____

Date of Weighing _____ Gross Filter Wt. _____

Average Gross Wt. _____

Filter Tare Wt. _____

Weight of Particulate on Filter _____

Total Weight of Particulate 32.8 mg

PARTICULATE ANALYTICAL DATA FORM

Company: 610CP Run Number: 121 PW & Filter

Location: 6-2 Furnace Exhaust Density(Pa.) 0.781

Date: 4-3-90

Liquid Level Marked? ✓

Blank Concentration(Ca) 0

Rinse Volume(Vaw) 226 ml

Residue in Rinse(Wa)=Ca*Vaw*Pa 0

Date of Weighing _____ Gross Wt. _____

Date of Weighing 4/7/90 Gross Wt. 103.5176 gm

Average Gross Wt. _____

Less Blank Residue(Wa) _____

Tare Wt. 103.3138 gm.

Weight of Particulate in Rinse 203.8 mg.

Date of Weighing 4/2/90 Gross Filter Wt. 448.76 mg.

Date of Weighing _____ Gross Filter Wt. _____

Average Gross Wt. _____

Filter Tare Wt. 448.78 mg.

Weight of Particulate on Filter 0

Total Weight of Particulate 203.8 mg.

PARTICULATE ANALYTICAL DATA FORM

Company: Grace Run Number: RZ PW & Filter

Location: G-2 Furnace Exhaust Density(Pa.) 0.781

Date: 4-3-90

Liquid Level Marked? ✓

Blank Concentration(Ca) 0

Rinse Volume(Vaw) 238 ml's

Residue in Rinse(Wa)=Ca*Vaw*Pa 0

Date of Weighing 4-7-90 Gross Wt. 100.8634 gm

Date of Weighing _____ Gross Wt. _____

Average Gross Wt. _____

Less Blank Residue(Wa) 0

Tare Wt. 100.8260 gm

Weight of Particulate in Rinse 37.4 mg

Date of Weighing 4/6/90 Gross Filter Wt. 458.75 mg

Date of Weighing _____ Gross Filter Wt. _____

Average Gross Wt. _____

Filter Tare Wt. 457.70 mg

Weight of Particulate on Filter 1.05 mg

Total Weight of Particulate 38.45 mg

PARTICULATE ANALYTICAL DATA FORM

Company: GROCC Run Number: R3 PW & Filter

Location: G-2 Furnace Exhaust Density(Pa.) 0.781

Date: 4-3-90

Liquid Level Marked? ✓

Blank Concentration(Ca) 0

Rinse Volume(Vaw) 230 ml's

Residue in Rinse(Wa)=Ca*Vaw*Pa 0

Date of Weighing 4-7-90 Gross Wt. 96.5307 gm.

Date of Weighing _____ Gross Wt. _____

Average Gross Wt. _____

Less Blank Residue(Wa) 0

Tare Wt. 96.5153 gm

Weight of Particulate in Rinse 15.4 mg.

Date of Weighing 4/8/90 Gross Filter Wt. 456.92 mg.

Date of Weighing _____ Gross Filter Wt. _____

Average Gross Wt. _____

Filter Tare Wt. 456.20 mg.

Weight of Particulate on Filter .72 mg

Total Weight of Particulate 16.12 mg

PARTICULATE ANALYTICAL DATA FORM

Company: Graco Run Number: R1 Imps

Location: 6-2 FURNACE EXHAUST Density(Pa.) _____

Date: 4-3-90

Liquid Level Marked? _____

Blank Concentration(Ca) _____

Rinse Volume(Vaw) _____

Residue in Rinse(Wa)=Ca*Vaw*Pa _____

Date of Weighing 4-7-90 Gross Wt. 104.7267 gm.

Date of Weighing _____ Gross Wt. _____

Average Gross Wt. _____

Less Blank Residue(Wa) _____

Tare Wt. 104.7122 gm.

Weight of Particulate in Rinse _____

Date of Weighing _____ Gross Filter Wt. _____

Date of Weighing _____ Gross Filter Wt. _____

Average Gross Wt. _____

Filter Tare Wt. _____

Weight of Particulate on Filter _____

Total Weight of Particulate 14.5 mg

PARTICULATE ANALYTICAL DATA FORM

Company: Crane Run Number: R2 Imps

Location: G-2 Furnace Exhaust Density(Pa.) _____

Date: 4-3-90

Liquid Level Marked? _____

Blank Concentration(Ca) _____

Rinse Volume(Vaw) _____

Residue in Rinse(Wa) = $Ca \times Vaw \times Pa$ _____

Date of Weighing 4-7-90 Gross Wt. 99.6102 gm

Date of Weighing _____ Gross Wt. _____

Average Gross Wt. _____

Less Blank Residue(Wa) _____

Tare Wt. 99.5967 gm

Weight of Particulate in Rinse _____

Date of Weighing _____ Gross Filter Wt. _____

Date of Weighing _____ Gross Filter Wt. _____

Average Gross Wt. _____

Filter Tare Wt. _____

Weight of Particulate on Filter _____

Total Weight of Particulate 13.5 mg

PARTICULATE ANALYTICAL DATA FORM

Company: Graco Run Number: R3 Imps

Location: G-2 Furnace Exhaust Density (Pa.) _____

Date: 4-3-90

Liquid Level Marked? _____

Blank Concentration (Ca) _____

Rinse Volume (Vaw) _____

Residue in Rinse (Wa) = $Ca \times Vaw \times Pa$ _____

Date of Weighing 4-7-90 Gross Wt. 106.7521 gm.

Date of Weighing _____ Gross Wt. _____

Average Gross Wt. _____

Less Blank Residue (Wa) _____

Tare Wt. 106.7417 gm.

Weight of Particulate in Rinse _____

Date of Weighing _____ Gross Filter Wt. _____

Date of Weighing _____ Gross Filter Wt. _____

Average Gross Wt. _____

Filter Tare Wt. _____

Weight of Particulate on Filter _____

Total Weight of Particulate 10.4 mg.

PARTICULATE ANALYTICAL DATA FORM

Company: Grac Run Number: 21 Imps 0.1

Location: 6-2 Furnace Exhaust Density(Pa.) _____

Date: 4-3-90

Liquid Level Marked? _____

Blank Concentration(Ca) _____

Rinse Volume(Vaw) _____

Residue in Rinse(Wa)=Ca*Vaw*Pa _____

Date of Weighing 4-7-90 Gross Wt. 95.4346 gm

Date of Weighing _____ Gross Wt. _____

Average Gross Wt. _____

Less Blank Residue(Wa) _____

Tare Wt. 95.3953 gm

Weight of Particulate in Rinse _____

Date of Weighing _____ Gross Filter Wt. _____

Date of Weighing _____ Gross Filter Wt. _____

Average Gross Wt. _____

; Filter Tare Wt. _____

Weight of Particulate on Filter _____

Total Weight of Particulate 39.3mg

PARTICULATE ANALYTICAL DATA FORM

Company: Grace Run Number: R2 Imps 011

Location: 6-2 FURNACE EXHAUST Density (Pa.) _____

Date: 4-3-90

Liquid Level Marked? _____

Blank Concentration (Ca) _____

Rinse Volume (Vaw) _____

Residue in Rinse (Wa) = $Ca \times Vaw \times Pa$ _____

Date of Weighing 4-5-90 Gross Wt. 106.6086 gm

Date of Weighing _____ Gross Wt. _____

Average Gross Wt. _____

Less Blank Residue (Wa) _____

Tare Wt. 106.5510 gm

Weight of Particulate in Rinse _____

Date of Weighing _____ Gross Filter Wt. _____

Date of Weighing _____ Gross Filter Wt. _____

Average Gross Wt. _____

Filter Tare Wt. _____

Weight of Particulate on Filter _____

Total Weight of Particulate 57.6 mg.

PARTICULATE ANALYTICAL DATA FORM

Company: Grac Run Number: R1 PW & Filter
Location: D-18 Exhaust Density(Pa.) 0.781
Date: 4-4-90
Liquid Level Marked? ✓

Blank Concentration(Ca) 0

Rinse Volume(Vaw) 226mls

Residue in Rinse(Wa)=Ca*Vaw*Pa 0

Date of Weighing 4-7-90 Gross Wt. 99.0108 gm.

Date of Weighing _____ Gross Wt. _____

Average Gross Wt. _____

Less Blank Residue(Wa) 0

Tare Wt. 98.9982 gm.

Weight of Particulate in Rinse 12.6mg

Date of Weighing 4/8/90 Gross Filter Wt. 456.14 mg.

Date of Weighing _____ Gross Filter Wt. _____

Average Gross Wt. _____

Filter Tare Wt. 455.52 mg.

Weight of Particulate on Filter .62 mg.

Total Weight of Particulate 13.22 mg.

PARTICULATE ANALYTICAL DATA FORM

Company: GVACP Run Number: R2 PW & Filter

Location: D-18 Exhaust Density(Pa.) 0.781

Date: 4-4-90

Liquid Level Marked? ✓

Blank Concentration(Ca) 0

Rinse Volume(Vaw) 222 ml

Residue in Rinse(Wa)=Ca*Vaw*Pa 0

Date of Weighing 4-5-90 Gross Wt. 95.3868 gm.

Date of Weighing _____ Gross Wt. _____

Average Gross Wt. _____

Less Blank Residue(Wa) 0

Tare Wt. 95.3657 gm.

Weight of Particulate in Rinse 21.1 mg

Date of Weighing 4/8/90 Gross Filter Wt. 455.62 mg.

Date of Weighing _____ Gross Filter Wt. _____

Average Gross Wt. _____

Filter Tare Wt. 453.70 mg.

Weight of Particulate on Filter 1.92 mg

Total Weight of Particulate 23.02 mg

PARTICULATE ANALYTICAL DATA FORM

Company: Gracc Run Number: 123 PW & Filter
Location: D-18 Exhaust Density(Pa.) 0.781
Date: 4-4-90

Liquid Level Marked? ✓

Blank Concentration(Ca) 0

Rinse Volume(Vaw) 234mls

Residue in Rinse(Wa)=Ca*Vaw*Pa 0

Date of Weighing 4-7-90 Gross Wt. 105.9677 gm.

Date of Weighing _____ Gross Wt. _____

Average Gross Wt. _____

Less Blank Residue(Wa) 0

Tare Wt. 105.9542 gm.

Weight of Particulate in Rinse 13.5 mg.

Date of Weighing 4/8/90 Gross Filter Wt. 459.13 mg.

Date of Weighing _____ Gross Filter Wt. _____

Average Gross Wt. _____

Filter Tare Wt. 457.68 mg.

Weight of Particulate on Filter 1.45 mg.

Total Weight of Particulate 14.95 mg.

PARTICULATE ANALYTICAL DATA FORM

Company: Grac Run Number: R' Imps

Location: D-18 Exhaust Density(Pa.) _____

Date: 4-4-90

Liquid Level Marked? _____

Blank Concentration(Ca) _____

Rinse Volume(Vaw) _____

Residue in Rinse(Wa)=Ca*Vaw*Pa _____

Date of Weighing 4-7-90 Gross Wt. 105.4482 gm.

Date of Weighing _____ Gross Wt. _____

Average Gross Wt. _____

Less Blank Residue(Wa) _____

Tare Wt. 105.4385 gm

Weight of Particulate in Rinse 9.7 mg

Date of Weighing _____ Gross Filter Wt. _____

Date of Weighing _____ Gross Filter Wt. _____

Average Gross Wt. _____

Filter Tare Wt. _____

Weight of Particulate on Filter _____

Total Weight of Particulate 9.7 mg.

PARTICULATE ANALYTICAL DATA FORM

Company: Grall Run Number: 12 Imps
Location: D-18 Exhaust Density(Pa.) _____
Date: 4-4-90

Liquid Level Marked? _____

Blank Concentration(Ca) _____

Rinse Volume(Vaw) _____

Residue in Rinse(Wa)=Ca*Vaw*Pa _____

Date of Weighing 4-5-90 Gross Wt. 104.9778 gm.

Date of Weighing _____ Gross Wt. _____

Average Gross Wt. _____

Less Blank Residue(Wa) _____

Tare Wt. 104.9713 gm.

Weight of Particulate in Rinse _____

Date of Weighing _____ Gross Filter Wt. _____

Date of Weighing _____ Gross Filter Wt. _____

Average Gross Wt. _____

Filter Tare Wt. _____

Weight of Particulate on Filter _____

Total Weight of Particulate 6.5mg.

PARTICULATE ANALYTICAL DATA FORM

Company: Grace Run Number: 3 Imps

Location: D-18 Exhaust Density(Pa.) _____

Date: 4/4/90

Liquid Level Marked? _____

Blank Concentration(Ca) _____

Rinse Volume(Vaw) _____

Residue in Rinse(Wa) = $Ca \times Vaw \times Pa$ _____

Date of Weighing 4/7/90 Gross Wt. 101.4604 gm

Date of Weighing _____ Gross Wt. _____

Average Gross Wt. _____

Less Blank Residue(Wa) _____

Tare Wt. 101.4503 gm.

Weight of Particulate in Rinse _____

Date of Weighing _____ Gross Filter Wt. _____

Date of Weighing _____ Gross Filter Wt. _____

Average Gross Wt. _____

Filter Tare Wt. _____

Weight of Particulate on Filter _____

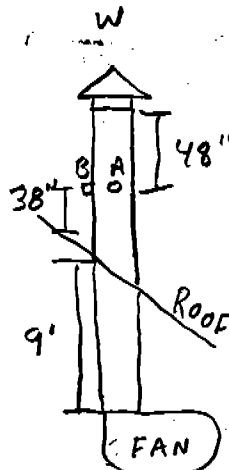
Total Weight of Particulate 10.1 mg

APPENDIX C

PARTICULATE FIELD DATA

PLANT: WR
DATE: 4/2/90
REPETITION: 1

LOCATION: G-1 Furnace Ex S
OPERATOR: LAM
STACK #:
SAMPLE BOX #: 5
METER BOX #: 2
AMBIENT TEMPERATURE: 76
BAROMETRIC PRESSURE: 29.7
ASSUMED MOISTURE: 5%
PROBE LENGTH: 5"
NOZZLE IDAMETER: .371, .373, .369
STACK DIAMETER: ~~23.1~~ 22.885
METER H : 1.6395
C FACTOR: .84
METER CO-EFFICIENT: .98101



IMPINGERS

<u>Initial</u>	<u>Final</u>
#1: 100 mls H_2O	112
#2: 100 mls H_2O	103
#3: —	
#4: 200 gm. SG	207
#5: —	22

COMMENTS

$$\frac{CO_2}{O}$$

FILTER TARE: .45654

PRE-TEST LEAK CHECK

Meter: 0.09 cu. ft. / 5 in. HG
Pitots: ✓ 5.1 in. H2O
✓ 3.9

POST-TEST LEAK CHECK

Meter: 0.009 cu.ft. 10 in. HG
Pitots: ✓ in. H2O
✓

[illegible]

$$T_m = 103.7$$

in. H2O

[illegible]

PARTICULATE FIELD DATA

PLANT: *Grass*
DATE: 4-2-90
REPETITION: 3

LOCATION: G. 1 Furnace Ex

OPERATOR: LM

STACK #: —

SAMPLE BOX #: 5

METER BOX #: 2

AMBIENT TEMPERATURE: 79

BAROMETRIC PRESSURE: 29.7

ASSUMED MOISTURE: 5 %

PROBE LENGTH: 5' 208 (.309) (.0005208)

NOZZLE IDAMETER: 309, 310,

STACK DIAMETER: 23"

METER H : 1.6395

C FACTOR: .84

METER CO-EFFICIENT: 98/01

FILTER TARE: .44248

PRE-TEST LEAK CHECK

Meter: 0.009 cu. ft. 15 in. HG

Pitots: ✓ in. H2O

IMPINGERS

Initial

Final

#1: 100 m/s H_2O 108

#2: 100 ml 42° 104

#3:

#4: 200 gms 5.6. 208

#5:

$$\begin{array}{r} 208 \\ \hline 20 \end{array}$$

COMMENTS

 O_2 CO_2 z_c

/

POST-TEST LEAK CHECK

Meter: 0.006 cu.ft. 7

Pitots: in. H2O

[illegible]

721-2564
100

A hand-drawn diagram of a vertical structure, possibly a chimney or tower. The structure is labeled 'W' at the top. It has a conical roof. A vertical dimension of 37" is marked on the right side. A horizontal dimension of 36" is marked on the left side. A diagonal dimension of 1.38' is marked across the middle. A vertical dimension of 9' is marked on the left side. A label 'B A O' is near the top. A label 'R 20 F' is near the diagonal dimension. A label 'FAN' is at the bottom, enclosed in a circle.



IMPINGERS

Initial

#1: 100 H₂O

#2: 100 Hz

#3: 56

#4: 2009

#5:

Final

127.

104

2079

33

5 COMMENTS

$$\frac{CO_2}{0\%}$$
$$\frac{0.2}{19.5\%}$$

POST-TEST LEAK CHECK

Meter: 0.004 cu. ft. 8

Pitots: ✓

in. H2O

D
A

B

70. 7.69

LOCATION: GZ Furnace ex
OPERATOR: MB

IMPINGERS

Initial

Final

#1: 100 H₂O
#2: 100 H₂O
#3: —
#4: 200 g 56g
#5:

130
205

$$\begin{array}{r} 205 \\ \hline 43 \end{array}$$

COMMENTS

$$\frac{CO_2}{O}$$
$$\frac{02}{19}$$

PRE-TEST LEAK CHECK

Meter: 0.008 cu. ft. 15 in. HG
Pitots: ✓ in. H2O

POST-TEST LEAK CHECK

Meter: 0.004 cu.ft. 6 in. HG
Pitots: ✓ in. H2O

126

1

LOCATION: G-2 Furnace 2 ✓
 OPERATOR: MP
 STACK #:
 SAMPLE BOX #: 3
 METER BOX #: 2
 AMBIENT TEMPERATURE: 75
 BAROMETRIC PRESSURE: 29.76
 ASSUMED MOISTURE: 1%
 PROBE LENGTH: 4
 NOZZLE IDAMETER: 1/4
 STACK DIAMETER: 18.5
 METER H : 1.625
 C FACTOR: .84
 METER CO-EFFICIENT: .98101

#1: 100 H₂O
#2: 100 H₂O
#3:
#4: 200 g SL
#5:

124
105

$$\begin{array}{r} 208 \\ \hline 38 \end{array}$$
$$\frac{CO_2}{D}$$
$$\frac{0.2}{19.5}$$

Meter: 6.07 cu. ft. 15
Pitots: 1

in. HG
in. H2O

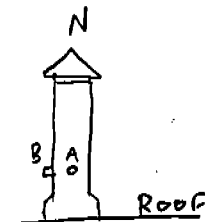
Pitots: 1

5 in. HG
in. H2O

127

PARTICULATE FIELD DATA

PLANT: Grace
DATE: 4-4-90
REPETITION: 1



LOCATION: D-18 EX
OPERATOR: LM
STACK #:
SAMPLE BOX #:
METER BOX #: V
AMBIENT TEMPERATURE: 75°
BAROMETRIC PRESSURE: 29.77
ASSUMED MOISTURE:
PROBE LENGTH: 5'
NOZZLE IDAMETER: .310, .300, .304(.309) (.0005208)
STACK DIAMETER: 23" (2.865 Sq Ft)
METER H: 1.63469
C FACTOR: .84
METER CO-EFFICIENT: 1.00127

IMPINGERS

Initial	Final
#1: 100 m/s 1/20	118 m/s
#2: 100 m/s 1/20	108 m/s
#3:	
#4: 200 g/m 1.6	212 g/m
#5:	38

COMMENTS

O ₂	CO ₂
20.5	.5

FILTER TARE: .45552

PRE-TEST LEAK CHECK

Meter: 0.016 cu. ft. / 5 in. HG
Pitots: ✓ in. H2O

POST-TEST LEAK CHECK

Meter: 0.00 / cu. ft. / 0 in. HG
Pitots: ✓ in. H2O

P #	θ	STATIC PRES.	Ts °F	ΔP	√ΔP	ΔH	Vm FT.3	Tm INLET	Tm OUTLET	OVEN TEMP	IMP OUTLET TEMP	VACUUR (IN Hg)
A 1	9:43	4.17	244	.15		1.1	303.015	82	75	245	50	3
2			253	.20		1.4	04.5	88	77	249	50	5
3	9:48		264	.24		1.7	06.3	91	78	247	50	5
4			266	.25		1.8	08.2	95	80	243	50	6
5	9:53		268	.26		1.9	10.1	97	82	249	50	6
6			268	.27		1.9	12.1	99	83	244	50	6
7	9:58		269	.29		2.0	14.1	110	85	247	50	6
8			270	.29		2.0	16.2	102	87	249	50	6
9	10:03		269	.28		2.0	18.3	104	87	248	50	6
10			269	.28		2.0	20.4	105	90	247	50	6
11	10:08		268	.27		1.9	22.4	106	91	250	50	6
12			265	.23		1.6	24.4	107	92	249	50	5
B 1	10:15		256	.15		1.1	26.3	102	94	250	50	4
2			266	.24		1.7	27.9	107	92	251	50	5
3	10:20		271	.25		1.8	29.8	109	92	250	50	6
4			254	.26		1.8	31.7	110	94	247	50	6
5	10:25		265	.26		1.8	33.7	113	96	250	50	6
6			265	.27		1.9	35.7	112	97	251	50	6
7	10:30		275	.28		2.0	37.7	113	96	249	50	6
8			275	.29		2.0	39.7	113	99	246	50	6
9	10:35		275	.27		1.9	41.8	114	100	247	50	6
10			275	.28		2.0	43.9	115	99	250	50	6
11	10:40		273	.27		1.9	45.9	115	101	247	50	6
12			270	.25		1.8	47.9	117	107	246	50	6
	10:45						549.865				50	
AV		4.17	266.4		.5022	1.788	46.87	97.71				

PARTICULATE FIELD DATA

PLANT: Gravel
DATE: 4-4-90
REPETITION: 2

LOCATION: 10-18 EX

OPERATOR: LM

STACK #:

SAMPLE BOX #: 1

METER BOX #: 4

AMBIENT TEMPERATURE: 75°

BAROMETRIC PRESSURE: 29.77

ASSUMED MOISTURE:

PROBE LENGTH: 5'

NOZZLE IDAMETER: (.309), (.0005208)

STACK DIAMETER: 23"

METER H : 163469

C FACTOR: .84

METER CO-EFFICIENT: 1.00127

IMPINGERS

	<u>Initial</u>	<u>Final</u>
#1: 100 m/s H ₂ O		114 m/s
#2: 100 m/s H ₂ O		108
#3:		
#4: 200 gms S.G.		206 gm
#5:		28

COMMENTS

O ₂	CO ₂
20.5	0.5

FILTER TARE: 45370

PRE-TEST LEAK CHECK

Meter: 0.015 cu. ft. 15" in. HG
Pitots: ✓ in. H₂O

POST-TEST LEAK CHECK

Meter: 0.011 cu. ft. 10" in. HG
Pitots: ✓ in. H₂O

P #	Θ	STATIC PRES.	Ts °F	ΔP	√ΔP	ΔH	Vm FT.3	Tm INLET	Tm OUTLET	OVEN TEMP	IMP OUTLET TEMP	VACUUM (IN Hg)
A 1	11:08	4.16	271	.25		1.8	350.141	102	98	247	50	6
2			275	.27		1.9	52.1	108	98	249	50	6
3	11:13		276	.27		1.9	54.1	110	99	248	50	6
4			278	.27		1.9	56.1	112	99	251	50	6
5	11:18		278	.28		2.0	58.1	113	100	250	50	6
6			277	.27		1.9	60.2	114	98	249	50	6
7	11:23		278	.26		1.8	62.2	115	100	247	50	5
8			278	.25		1.8	64.2	116	101	249	50	5
9	11:28		279	.25		1.8	66.2	117	101	248	50	5
10			277	.22		1.5	68.1	118	102	252	50	4
11	11:33		274	.20		1.4	69.9	119	103	251	50	4
12			255	.14		1.0	71.7	119	104	249	50	3
B 1	11:40		277	.27		1.9	73.1	114	103	250	50	5
2			281	.29		2.0	75.1	118	104	248	50	6
3	11:45		281	.30		2.1	77.2	119	104	249	50	6
4			285	.30		2.1	79.4	120	104	251	50	6
5	11:50		283	.30		2.1	81.5	121	105	249	50	6
6			284	.30		2.1	83.6	122	106	247	50	6
7	11:55		284	.28		2.0	85.7	122	107	251	50	6
8			284	.26		1.8	87.8	122	107	249	50	6
9	12:00		282	.26		1.8	89.9	123	107	247	50	6
10			280	.23		1.6	91.8	123	108	249	50	5
11	12:05		274	.19		1.3	93.6	123	109	250	50	4
12			255	.15		1.0	95.3	123	108	248	50	3
	12:10						396.835				50	
AV		4.16	276.8		.5004	1.77125	46.694	110.1				

PARTICULATE FIELD DATA

PLANT: Grace
DATE: 4-4-90
REPETITION: 3

LOCATION: D-18 Ex
OPERATOR: LM
STACK #:
SAMPLE BOX #: 1
METER BOX #: 4
AMBIENT TEMPERATURE: 80°
BAROMETRIC PRESSURE: 29.77
ASSUMED MOISTURE:
PROBE LENGTH: 5'
NOZZLE IDAMETER: (.309), (.0005208)
STACK DIAMETER: 23"
METER H: 1.6346'
C FACTOR: .24
METER CO-EFFICIENT: 1.00127

FILTER TARE: .45768

PRE-TEST LEAK CHECK

Meter: 0.002 cu. ft. 15 in. HG
Pitots: in. H2O

IMPINGERS

	Initial	Final
#1: 100 mlr H ₂ O	130	109
#2: 100 mlr H ₂ O		
#3:		
#4: 200 gm S.C.	208 gm	
#5:	42	

COMMENTS

CO₂ 20.5
CO₂ .5

POST-TEST LEAK CHECK

Meter: 0.002 cu. ft. 10 in. HG
Pitots: in. H2O

P	θ	STATIC PRES.	Ts °F	ΔP	√ΔP	ΔH	Vm FT.3	Tm INLET	Tm OUTLET	OVEN TEMP	IMP OUTLET TEMP	VACUUM (IN Hg)
1	12:40	7.13	278	.27		1.9	397.100	105	101	249	50	8
2			281	.19		1.3	99.1	110	101	248	50	6
3	12:45		284	.18		1.2	100.8	113	100	250	50	5
4			287	.18		1.3	02.5	115	102	250	50	5
5	12:50		291	.19		1.3	04.1	118	102	250	50	5
6			288	.19		1.3	05.8	118	96	249	50	5
7	12:55		283	.18		1.3	07.5	114	92	251	50	5
8			289	.17		1.2	09.2	116	101	247	50	5
9	1:00		291	.17		1.2	10.8	117	103	249	50	5
10			289	.16		1.1	12.4	120	106	251	50	5
11	1:05		281	.13		.9	13.9	122	107	250	50	4
12			277	.13		.9	15.3	124	107	247	50	4
13	1:14		288	.17		1.2	16.7	116	108	252	50	5
2			293	.18		1.3	18.3	120	108	249	50	5
3	1:19		295	.17		1.2	20.0	123	108	249	50	4
4			297	.18		1.3	21.4	122	108	250	50	4
5	1:24		297	.17		1.2	23.2	122	108	248	50	5
6			298	.17		1.2	24.8	122	106	249	50	5
7	1:29		298	.17		1.2	26.4	123	108	251	50	5
8			297	.16		1.1	28.0	122	109	247	50	5
9	1:34		297	.17		1.2	29.6	123	107	248	50	5
10			294	.15		1.1	31.2	124	108	250	50	5
11	1:39		286	.13		.9	32.7	125	107	248	50	4
12			269	.10		.7	34.1	126	107		50	
	1:44						435.33				50	
AV		7.13	288.7	.4097	136	1.188	38.231	111.9				

APPENDIX D

METER BOX CALIBRATION SUMMARY

METER BOX #2

3/22/90

BAROMETRIC PRESSURE = 29.91

DELTA H = .5 VW = 5 TW = 67

VD = 5.106 TD = 70 TIME = 11.685 TEST METER Y = .983

METER BOX Y = .966884212

METER BOX H = 1.51661602

DELTA H = 1 VW = 5 TW = 67.5

VD = 5.104 TD = 75 TIME = 8.613 TEST METER Y = .984

METER BOX Y = .975257761

METER BOX H = 1.63569709

DELTA H = 1.5 VW = 10 TW = 68

VD = 10.24 TD = 78.5 TIME = 14.196 TEST METER Y = .9843

METER BOX Y = .976744072

METER BOX H = 1.65862508

DELTA H = 2 VW = 10 TW = 68.5

VD = 10.246 TD = 82.75 TIME = 12.41 TEST METER Y = .9845

METER BOX Y = .981942669

METER BOX H = 1.67998947

DELTA H = 3 VW = 10 TW = 68.75

VD = 10.198 TD = 85.25 TIME = 10.101 TEST METER Y = .985

METER BOX Y = .988724553

METER BOX H = 1.66340473

DELTA H = 4 VW = 10 TW = 69.5

VD = 10.117 TD = 86.75 TIME = 8.798 TEST METER Y = .986

METER BOX Y = .996348069

METER BOX H = 1.68272789

AVERAGE Y = .981016893

AVERAGE H = 1.63951005

Meter Box Calibration

Dry Gas Meter #: 2
 Calibrated by: J.S
 Date: 3-22-90
 Barometric Pressure:

Orifice ΔH	Test Meter Volume V_w	Dry Gas Meter Volume V_d	Temperature				Time θ	γ	ΔH_0
			Test Meter. T_w	Dry Gas Meter					
				Inlet T_{di}	Outlet T_{do}	Ave T_d			
.5	5.000	5.106	67	67/79	66/68	70	11.685	.9830	
1.0	5.000	5.104	67.5	71/87	70/72	75	8.613	.9840	
1.5	10.000	10.24	68	76/89	73/76	78.5	14.196	.9843	
2.0	10.000	10.246	68.5	81/94	77/79	82.75	12.41	.9845	
3.0	10.000	10.198	68.75	86/96	79/80	85.25	10.161	.9850	
4.0	10.000	10.117	69.5	87/99	80/81	86.75	8.798	.9860	

$$\gamma = \frac{V_w P_{\text{bar}} (T_d + 460)}{V_d (P_{\text{bar}} + \frac{\Delta H}{13.6}) (T_w + 460)}$$

$$\Delta H_0 = \frac{0.0317 \Delta H}{P_{\text{bar}} (T_d + 460)} \left[\frac{(T_w + 460) \theta}{V_w} \right]^2$$

P_{bar} = Barometric Pressure

DRY GAS METER # : 2

DATE : 3-22-90

ΔH	V_w	T_w	V_D	T_{DT}	T_{DO}	ATD	G
.5 (5 ft ³)	831.000	67 / 66	329.931	67	66		
	826.060	68 / 67	324.825	79	69		
	5.000	67	5.106		→	70	11.6
1.0 (5 ft ³)	836.000	68 / 67	335.035	71	70		
	831.000	68 / 67	329.931	87	72		
	5.000	67.5	5.104		→	75	8.613
1.5 (10 ft ³)	846.000	68 / 67	345.275	76	73		
	836.000	69 / 68	335.035	89	76		
	10.000	68	10.24		→	78.5	14.196
2.0 (10 ft ³)	856.000	69 / 68	355.521	81	77		
	846.000	69 / 68	345.275	94	79		
	10.000	68.5	10.246		→	82.75	12.41
3.0 (10 ft ³)	866.000	69 / 68	365.719	86	79		
	856.000	70 / 68	355.521	96	80		
	10.000	68.75	10.198		→	85.25	10.101
4.0 (10 ft ³)	876.000	70 / 69	375.836	87	80		
	866.000	70 / 69	365.719	99	81		
	10.000	69.5	10.117		→	86.75	8.798

POST METER BOX CALIBRATION SUMMARY

METER BOX # 2

4/9/90

BAROMETRIC PRESSURE = 29.78

DELTA H 1 VW = 10 TW = 63

VD = 10.117 TD = 68.5 TIME = 17.422 TEST METER Y = .984

METER BOX Y = .9804279

METER BOX H = 1.672203

DELTA H 1 VW = 10 TW = 63

VD = 10.191 TD = 75 TIME = 17.203 TEST METER Y = .984

METER BOX Y = .9852794

METER BOX H = 1.610618

DELTA H 1 VW = 10 TW = 63

VD = 10.254 TD = 78.25 TIME = 17.293 TEST METER Y = .984

METER BOX Y = .9851744

METER BOX H = 1.617687

AVERAGE Y = .9836272

AVERAGE H = 1.633503

Post-Test
Meter Box Calibration

Dry Gas Meter #: 2

Calibrated by: J. Barrera

Date: 4/9/90

Barometric Pressure: 29.78

Orifice ΔH	Test Meter Volume V_w	Dry Gas Meter Volume V_d	Temperature				Time θ	γ	$\Delta H@$
			Test Meter T_w	Dry Gas Meter					
				Inlet T_{di}	Outlet T_{do}	Ave T_d			
1.0	10.0	10.117	63	62/83	62/67	68.5	17.422	.9804	1.672
1.0	10.0	10.191	63	71/88	69/72	75.0	17.203	.9853	1.611
1.0	10.0	10.254	63	76/89	73/75	78.25	17.293	.9852	1.618

$$\gamma = \frac{V_w P_{\text{bar}} (T_d + 460)}{V_d (P_{\text{bar}} + \frac{\Delta H}{13.6}) (T_w + 460)}$$

$$\Delta H@ = \frac{0.0317 \Delta H}{P_{\text{bar}} (T_d + 460)} \left[\frac{(T_w + 460) \theta}{V_w} \right]^2$$

P_{bar} = Barometric Pressure

DRY GAS METER # : 2

DATE : 4/9/90

P_{bar} = 29.78

ΔH	V_w	T_w	V_D	T_{DT}	T_{DO}	ΔT_D	G
1.0 (10ft ³)	71.000	63/63	819.033	62	62		
	61.000	63/63	808.916	83	67		
	10.000	63	10.117			68.5	17.422
1.0 (10.4ft ³)	81.000	63/63	829.224	71	69		
	71.000	63/63	819.033	88	72		
	10.000	63	10.191			75.0	17.203
1.0 (10.4ft ³)	91.000	63/63	839.478	76	73		
	81.000	63/63	829.224	89	75		
	10.000	63	10.254			78.25	17.293

METER BOX CALIBRATION SUMMARY

METER BOX #4

3/20/90

BAROMETRIC PRESSURE = 30.17

DELTA H = .5 VW = 5 TW = 60.5

VD = 5.035 TD = 68 TIME = 13.253 TEST METER Y = .983

METER BOX Y = .989027423

METER BOX H = 1.8938688

DELTA H = 1 VW = 5 TW = 62

VD = 5.052 TD = 75.25 TIME = 8.563 TEST METER Y = .984

METER BOX Y = .996163838

METER BOX H = 1.56884545

DELTA H = 1.5 VW = 10 TW = 63.5

VD = 10.137 TD = 79.25 TIME = 14.252 TEST METER Y = .9843

METER BOX Y = .996367517

METER BOX H = 1.62693445

DELTA H = 2 VW = 10 TW = 64.5

VD = 10.156 TD = 83.25 TIME = 12.27 TEST METER Y = .9845

METER BOX Y = .999161093

METER BOX H = 1.60211735

DELTA H = 3 VW = 10 TW = 65

VD = 10.062 TD = 85.5 TIME = 9.717 TEST METER Y = .985

METER BOX Y = 1.00977258

METER BOX H = 1.56635315

DELTA H = 4 VW = 10 TW = 65.5

VD = 10.009 TD = 87.75 TIME = 8.553 TEST METER Y = .986

METER BOX Y = 1.01691019

METER BOX H = 1.5500437

AVERAGE Y = 1.00126711

AVERAGE H = 1.63469382

Meter Box Calibration

Dry Gas Meter #: 4
 Calibrated by: L. Miller
 Date: 3-20-90
 Barometric Pressure: 30.17

Orifice ΔH	Test Meter Volume V_w	Dry Gas Meter Volume V_d	Temperature				Time θ	γ	$\Delta H @$
			Test Meter. T_w	Dry Gas Meter					
				Inlet T_{di}	Outlet T_{do}	Ave T_d			
.5	5.0	5.035	60.5	65/81	62/64	68	13.253	.9530	
1.0	5.0	5.052	62	78/87	67/69	75.25	8.563	.9840	
1.5	10.0	10.137	63.5	85/83	70/74	79.25	14.252	.9843	
2.0	10.0	10.156	64.5	88/93	76/76	83.25	12.27	.9845	
3.0	10.0	10.062	65	87/99	78/78	85.5	9.917	.9850	
4.0	10.0	10.009	65.5	94/99	78/80	87.75	9.553	.9860	

$$\gamma = \frac{V_w P_{bar} (T_d + 460)}{V_d (P_{bar} + \frac{\Delta H}{13.6}) (T_w + 460)}$$

$$\Delta H @ = \frac{0.0317 \Delta H}{P_{bar} (T_d + 460)} \left[\frac{(T_w + 460) \theta}{V_w} \right]^2$$

P_{bar} = Barometric Pressure

DATE : 3-20-90

ΔH	VW	TW		VD	TDT	TDO	ATD	Σ
5 (5 ft ³)	708.000	60	60	34.035	65	62		
	703.000	62	60	29.0	81	64		
	5.000	60.5		5.035		68	13.253	
10 (5 ft ³)	713.000	62	60	39.087	78	67		
	708.000	66	60	34.035	87	69		
	5.000	62		5.052		75.25	8.563	
1.5 (10 ft ³)	723.000	66	60	49.224	85	70		
	713.000	66	62	39.087	88	74		
	10.000	63.5		10.137		79.25	14.252	
1 (10 ft ³)	733.000	66	62	59.380	88	76		
	723.000	68	62	49.224	93	76		
	10.000	64.5		10.156		83.25	12.27	
3.0 (10 ft ³)	743.000	68	62	69.442	87	78		
	733.000	68	62	59.380	99	78		
	10.000	65		10.062		85.5	9.917	
10 (10 ft ³)	753.000	68	62	79.451	94	78		
	743.000	68	64	69.442	99	80		
	10.000	65.5		10.009		87.75	8.553	

POST METER BOX CALIBRATION SUMMARY

METER BOX # 4

4/13/90

BAROMETRIC PRESSURE = 29.82

DELTA H 1 VW = 10 TW = 66.5

VD = 9.787 TD = 74.75 TIME = 17.253 TEST METER Y = .984

METER BOX Y = 1.018658

METER BOX H = 1.640313

DELTA H 1 VW = 10 TW = 66.75

VD = 9.953 TD = 83.75 TIME = 16.953 TEST METER Y = .984

METER BOX Y = 1.018043

METER BOX H = 1.55903

DELTA H 1 VW = 10 TW = 67

VD = 10.017 TD = 87.75 TIME = 16.882 TEST METER Y = .984

METER BOX Y = 1.018497

METER BOX H = 1.536167

AVERAGE Y = 1.018399

AVERAGE H = 1.578503

Post-Test
Meter Box Calibration

Dry Gas Meter #: 4

Calibrated by: J. Barrera

Date: 4/13/90

Barometric Pressure: 29.82

Orifice ΔH	Test Meter Volume V_w	Dry Gas Meter Volume V_d	Temperature				Time θ	γ	$\Delta H@$
			Test Meter T_w	Dry Gas Meter					
				Inlet T_{di}	Outlet T_{do}	Ave T_d			
1.0	10.0	9.787	66.5	67 92	67 73	74.75	17.253	1.0187	1.640
1.0	10.0	9.953	66.75	80 99	75 81	83.75	16.953	1.0180	1.559
1.0	10.0	10.017	67.0	85 102	80 84	87.75	16.882	1.0185	1.536

$$\gamma = \frac{V_w P_{\text{bar}} (T_d + 460)}{V_d (P_{\text{bar}} + \frac{\Delta H}{13.6}) (T_w + 460)}$$

$$\Delta H@ = \frac{0.0317 \Delta H}{P_{\text{bar}} (T_d + 460)} \left[\frac{(T_w + 460) \theta}{V_w} \right]^2$$

P_{bar} = Barometric Pressure

DRY GAS METER # : 4

DATE : 4/13/90

Pbar = 29.82

ΔH	V_w	T_w	V_D	T_{DT}	T_{DO}	ΔT_D	G
1.0 (10 ft ³)	198.100	67/66	572.863	67	67		
	188.100	67/66	563.076	92	73		
	10.000	66.5	9.787			74.75	17.253
1.0 (10 ft ³)	208.100	67/66	582.816	80	75		
	198.100	67/66	572.863	99	81		
	10.100	66.75	9.953			83.75	16.953
1.0 (10 ft ³)	218.100	68/66	592.833	85	80		
	208.100	68/66	582.816	102	84		
	10.000	67.0	10.017			87.75	16.882